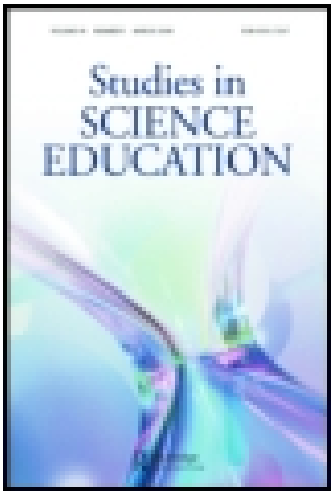

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Teaching and Learning Biology in Secondary Schools in Kenya

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Teaching and Learning Biology in Secondary Schools in Kenya

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INTRODUCTION

This paper presents two case studies of teaching and learning biology in 2 secondary schools in Kenya. The data were derived during a 3 year study (1982-1985) whose goal was to understand the nature of the teaching-learning process. A theoretical framework from interpretive research (Erickson, 1973, 1980 and 1986), was used, with data collection and analysis centred on exposing and clarifying teachers' and students' everyday meanings of their actions and events in the teaching-learning processes. Data were collected through participant and non-participant observation, interviews, self-reports by teachers and students and reflective discussion with teachers based on reviewing audio and video classroom lessons. The basic assumption was that participants assess the quality of the social environment in the school and classroom and, using their perspectives as individuals and as group members, devise short and long term strategies for participation in the teaching-learning process. Therefore, what is learnt and how it is learned may or may not be concordant with stated goals of teaching and learning biology.

The paper is divided into three sections. Section 1 presents two contrasting case studies of two teachers' perspectives regarding the quality of the social environment in which they worked and their evolved instructional strategies. Section 2 describes aspects of students' participation within teachers' overall instructional strategies. And Section 3 summarizes the observed modules of students' influences on the teaching-learning process with emphasis on the importance of the local school environment in determining how closely classroom practices adhere to stated goals of teaching and learning.

THE SCHOOLS

The data for two government maintained schools, National and Urbana, located in Kiambu and Nairobi Districts respectively, is discussed. National and Urbana were boarding and day schools respectively, and Table 1 shows some of their characteristics. [The school names and teacher names have been changed to maintain anonymity.]

Table 1: Some characteristics of the two schools

Name of School	*Total Student Intake*	*Level of Academic Achievement (Scale 0-10)*	*Student Gender*	*Number of Teachers*	*Library Books/ Student Ratio*
National	500	7	Female	38	14
Urbana	950	2	Female	55	8

GOALS OF TEACHING AND LEARNING

Biology was one of 14 subjects taught in the two secondary schools and teachers used syllabuses prescribed by the Ministry of Education which spelt out topics and their objectives all aspiring to the achievement of three main goals, namely:

1. Students should develop a scientific approach through practice of the scientific method and through learning and using various science process skills such as observation, hypothesising and drawing conclusions.
2. Students should develop and learn basic biological concepts.
3. Students should acquire certain attitudes such as rationality, a scientific approach to the solution of problems in their environment, confidence, co-operation with others in the solution of problems in the community, and ability to communicate biological knowledge.

These goals suggest that (a) teaching and learning biology should reflect its unique and special characteristics as a science; and (b) the content of biology and the intellectual and social attitudes modelled by teachers and acquired by students, should all fulfil the goals' prescriptions regarding attributes and skills of individuals who have learned biology. How well did observed teaching reflect attention to these goals?

SECTION 1

Influence of the Quality of the Environment on Teachers' Work

Many factors such as teacher qualification, teaching experience, grasp of content and availability of resources, influence the way teaching is conducted in

relationship to the above mentioned goals. In this study emphasis was centered on understanding how teachers' perspectives regarding the quality of their work environment influence the way they organise and conduct the teaching-learning process in relationship to these goals. It was assumed that:

1. A teacher's perceived authority in the school, and her assessment of students' intellectual abilities, influence the nature of the instructional strategies she uses and this may or may not be supportive of the overall goals for biology teaching and learning.
2. The processes by which the teacher and students construct and use various instructional and learning strategies are mutually adaptive and dependent on the total social environment in and outside the classroom.

The perspectives of teachers regarding the purpose of routines and management actions both in and outside biology lessons were solicited in order to assess what teachers regarded as important, and were, therefore, likely to translate into practices in the teaching-learning situation. A perspective is 'an ordered view of one's world — what is taken for granted about the attributes of various objects, events, and human nature' (Shibutani 1967). The teacher was viewed as an agent with an active and autonomous role shaped by her school and classroom experience (Clark and Yinger 1978a and b) where her practical knowledge specifies the intersection of what on the one hand, she values, thinks, believes and decides on, and on the other hand, what she actually does. It was assumed that what the teacher believes will affect how she behaves, and that such behaviour in turn, will give evidence of aspects of her belief.

Lydia's Perspectives

Although they had various elements of ambivalence, Lydia's total perspectives, like those of many of her 37 colleagues at National, were positive. The perspectives embodied three beliefs which might be expected to influence her instructional techniques, namely: the school environment as a decent place of work; the need for suitable instructional methods for biology as a science; and the high intellectual capabilities of her students. Lydia believed that school management recognised not only her individuality but also the fact that she was playing an important role in decision-making, teaching and general school management. She regarded management as supportive of decisions and actions in her various roles as teacher, as head of the biology department, as disciplinarian, as examiner and as judge of both students' behaviour and their academic achievement. Second, Lydia's perspectives, based on notions about the uniqueness of the individual, undergirded most of her interpretations of other people's actions and beliefs. Overall her assessment was liberal. For instance while she regarded the head of her school as 'tough and uncompromising', she appreciated not only the pragmatism of the head's actions and decisions as

beneficial to the school but also the head's eclectic consideration for individual teachers. Similarly, Lydia saw the importance and necessity for teachers, students and individuals in society to express their opinions. Third, Lydia's very positive conception of her students' abilities enabled her to set very high expectations for their work. And, although lately, Lydia had had doubts about students' performances, she did not regard students' failures as the result of inherent personal incapabilities but as due to a combination of various environmental factors such as: political interference in school work, lack of time to treat the mandated syllabuses to the required depth, and students' inattentiveness during learning due to developmental aspects of general adolescent behaviour. Finally, although Lydia's conception of biology as a discipline was not very articulate, it was, nevertheless, clear that she regarded her grasp of the subject matter and the methods of teaching it as excellent. Her conception of a suitable pedagogy had many facets such as availability of suitable resources, teacher and student commitment to the scientific method, and the need to assess students' learning frequently.

Lydia's Instructional Strategy

Lydia's instructional strategy was based on four factors inherent in her perspectives. First, Lydia believed that she had the mandate to organise the curriculum and her classroom activities according to her best judgement derived from her long experience of teaching biology. Second, Lydia believed that she knew the content authoritatively and that it had to be taught in an authoritative manner, which meant that she had to be the single most accurate resource, arbiter and purveyor of biology knowledge in the classroom. Third, Lydia saw the process of learning biology as consisting of the interrelated activities of: listening attentively; asking questions; undertaking practical work; and learning how to write accurately what students had heard or observed. Lastly, Lydia regarded lack of sufficient time as the most important resource constraining both her instructional procedures and students' learning so that its use was crucial for the individual and group. In actual implementation, Lydia's instructional strategy consisted of three main steps:

1. Introducing the lesson by asking checking questions.
2. Lecturing, assessing understanding, students' note-making, and monitoring students' work.
3. Students' practical work

Entry into Lessons

Lydia's classes began on time. Lateness was regarded by the school as a serious crime and was rarely committed without good reason. Lydia usually began a lesson by asking students 'checking questions' of two main types, which she said

served to assess learning progress, involve students in the lessons right from the start, mobilise in their minds the most recent information, and give her a point of entry into the lesson. For example,

1. Did we complete everything about food chains, so that we can do something about food webs?
2. Were you asked to make any food webs?
3. I remember, I left you to copy the food chains on the blackboard. Have you all completed that?
4. I don't know whether you have all this in your books. Do you?

The first two represent examples of questions which Lydia used to determine where the previous lesson had ended, while the last two were frequently used to assess how far students had progressed with written work from the previous lessons. Asking such questions and perusal of students' notebooks appeared to be crucial elements in Lydia's overall instructional strategy. Out of 78 periods observed, Lydia had begun 49 (62.8%) by asking checking questions, and in 32 (65.3%) of the 49 she had also examined students' notebooks.

Lydia prepared a loose and open-ended mental lesson plan rather than a paper plan. Two beliefs regarding the instructional process undergirded Lydia's apparent uncertainty in setting definite paper plans. First, since Lydia regarded theory and practical work as a continuum, she planned for both in every lesson and since all lessons were held in the laboratory, this enabled her to have either practical and/or theory episodes at any stage of a lesson. Second, Lydia did not believe that what she had prepared before a lesson should dictate what was actually done during the lesson. Rather, she depended on monitoring the progress of students' work in order to decide on the next major step.

Lecturing and Monitoring Students' Work

Lydia gave theory first as guidance to the related practical work. But in most lessons there would be practical episodes transiting into theory episodes and vice versa. Within an episode, Lydia would blend four activities, namely: verbal exposition, note-making by students, monitoring, and carrying out practical work by students.

Exposition of Substantive Content

After ascertaining an appropriate point of entry into the lesson, Lydia would introduce new concepts by definition, narration, description, and explanation. During exposition, lasting 5 to 15 minutes, Lydia demanded, insisted on and enforced the undivided attention of the class, forbidding students to write because: 'My belief is that if a student at this level is thinking what to write next, they won't pay sufficient attention to what you are saying; so that they will miss the next point and so on.' Usually Lydia conducted exposition with students'

involvement in constructing the lesson's conceptual content while, at the same time, attempting to evaluate students' understanding, particularly whenever students had had prior experience with a concept under discussion. However, assessment of understanding sometimes revealed gaps in students' knowledge, occasioning intellectual distress to Lydia. Lydia's distress at students' inability to respond correctly to what she regarded as simple questions should be seen in relation to three elements in her beliefs about her knowledge of biology, her evolved instructional strategy and her perspective of the intellectual abilities of her students.

First, Lydia believed that she knew biology well. Evidence of what Lydia meant by 'knowing well' can be gleaned from the fact that out of 78 lessons observed, Lydia had a 'paper' lesson plan on only 2 occasions. But this thorough knowledge made it difficult for Lydia to understand students' failure to grasp what she regarded as simple concepts. Lydia expected that when she delivered content in an authoritative, logical and sequential manner, students would learn that content in the same way. Second, Lydia believed that she had evolved an adequate instructional strategy where she 'knew' the most suitable sequence of presenting information. Lydia had a conception of her overall teaching strategy as capable of providing for all students' needs. She could not understand how students could fail to learn simple concepts under such an eloquent instructional strategy. Third, Lydia believed that all her students except one or two were bright and intelligent and, having set very high expectations for their achievement, she believed that they could do the work if they applied themselves sufficiently.

The Case of The 'Invisible' Endosperm

Lydia always attempted to resolve students' misunderstandings, at any point, before proceeding with the lesson. Whenever answers to a question were muddled, Lydia would first ask a simpler question. If the ensuing answer was also muddled or incorrect, Lydia would then ask progressively simpler questions until such questions became trivial. If the original confusion persisted, Lydia would select a certain point in content and launch a long-winded, but rational explanation, only to find, at the end, that the confusion had still not been clarified. At this point, Lydia once explained after such a lesson, 'I felt discouraged. I did not know what to do. I wanted to find someone to try to explain to the students — because I had failed. Because it now looked too difficult. I thought I had exhausted the possible examples.' An idea of the difficulties faced by Lydia and students in episodes of this nature is given by the events surrounding students' construction of a definition of the endosperm. During two lessons, Lydia had described the structure of mono-cotyledonous and di-cotyledonous plant seeds, as preparation for a practical study of the conditions necessary for germination. Lydia had stressed three points:

1. All seeds have at least one cotyledon in which food for germination is stored.
2. Some seeds have two cotyledons while other seeds have one cotyledon. A bean seed and a maize grain were observed as examples respectively.
3. Some seeds have endosperm which stores food for germination. A maize grain was observed as an example.

Introducing the third lesson, Lydia stated that she wanted to review the structure of seeds and asked students to name the structures which play a role in germination. The following exchange of questions and answers then ensued.

0.1. Mona: There is also the endosperm.
0.2. Lydia: What is its role?
0.3. Mona: It acts as a cotyledon in a seed.
0.4. Lydia: What do you mean? What is this acting? (with disbelief in tone)
0.5. Janet: The endosperm becomes the cotyledons when they are not there or when they are finished. (laughter from class)
0.6. Lydia: Now, now, what is an endosperm?
0.7. Muithera: It is a structure in a mono-cotyledonous seed which stores food.
0.8. Lydia: Really? Someone else? Yes, Joy?
0.9. Joy: It is a structure in a seed which stores food in the absence of a cotyledon.
10. Lydia: No! Sheila?
11. Sheila: It is the second cotyledon storing food in a mono-cotyledonous seed.
12. Anne: It is a structure that protects the stored food in a seed. (class laughter)
13. Lydia: No! No! Somebody, please!
14. Lilian: It is an invisible food storage organ which is located outside the cotyledonous seeds.
15. Mona: I know now. Once you have cotyledons, you can't have endosperm, because once you have endosperm you don't need cotyledons; like in maize, there is no cotyledon, but there is endosperm.
16. Lydia: But we said that all seeds, *all seeds* (much emphasis and desperation in tone) must have one or two cotyledons, to be called a seed.
17. Mona: Exactly. That is why the maize is not a seed. It is a grain. It has no cotyledons.

Students had, over only two weeks, accumulated a series of minor but significant misconceptions regarding the basic structure of seeds. Evidently, among this group of 40 bright students, no one was able to define an endosperm. Why? Lydia, like many other teachers of biology, had not either during exposition or practicals assisted students to visualize the relationship between structure, location and function. Instead, students had merely 'observed' the maize grain and made large and correct diagrams of the structures ostensibly located. Students had crushed the maize grain in order to test for the presence of starch. But Lydia had not assisted students to realise that the white substance in a maize grain was an *additional* quantity of food which, in a grain, is stored outside the seed but inside the pericarp, while in a seed, it is stored outside the cotyledons but inside the testa. Students' misconceptions had resulted from their failure to find a 'structure' which was or in which was the endosperm. Therefore, they had invented one.

Dealing with Students' Questions

Students usually want to pose questions during teaching and since Lydia believed

that it was important to exhaust all such questions before carrying on with the lesson, she would frequently be drawn into digressions, of varying magnitude, from the concepts under discussion, as was observed in 22 out of 78 lessons. In attempting to give each individual an opportunity, Lydia would answer those questions which she judged as relevant to the topic. But whenever a question was posed which Lydia judged as either irrelevant or marginally relevant to the topic, she would either attempt to answer it by showing its links, however extraneous they may be, to the topic under discussion or, more often, she would put the question on the floor. In this fashion, as various students attempted to find 'the answer', every succeeding response would lead to further digression and more questions, generating a wide array of differing opinions, hypotheses, pure conjecture, and a great deal of fun for students.

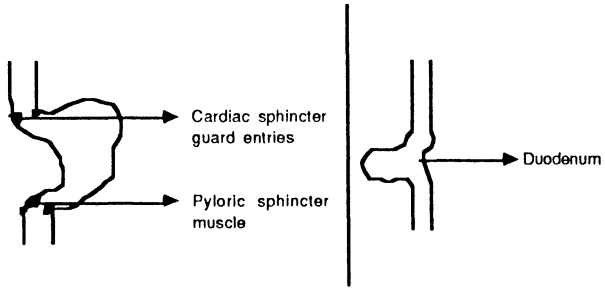
Students' Note-making and Teacher's Monitoring

Once Lydia had exhausted all questions, and if she was satisfied that she had corrected the various misconceptions, she would then allow students to make their own notes using the outline of points jotted on the blackboard. Lydia believed that note-making was a crucial component of learning biology and right from the first biology lesson, students were instructed to make their own notes. How useful were the outlines of notes on the blackboard, as both a consistent summary of Lydia's exposition and as a guide to note-making by individual students? Lydia did not use complete sentences in blackboard work; rather, she jotted down phrases, abbreviations, rough diagrams and arrows to indicate processes, reactions and relationships. Although the blackboard notes would be systematic, their appearance would be 'coded'. Sheila, a student, had once described Lydia's blackboard notes as, 'A mixture of English, Greek and some other language, which would throw (Lydia) into a fit, if a student used it in her assignments'. Lydia's students regarded much of the blackboard notes as abbreviations, and one reason for the large number of students' questions during Lydia's monitoring of note-making was to verify something on the board. Fig 1. shows Lydia's blackboard outline of a typical 15 minutes' verbal exposition for form 2 on *Digestion* which consisted of 5 checking questions and 5 students' responses followed by 12 minutes' uninterrupted exposition of new content.

The majority of students (20-22) used these notes with no apparent problem by simply incorporating the words in the outline in complete sentences. Notes composed in this manner were usually brief but accurate. Other students (12-15) negotiated the outline by constantly asking clarification from Lydia and by holding discussion among themselves. They, however, usually wrote long and accurate extracts covering 5 or 6 pages. Thus students were able to follow Lydia's long exposition and re-enact and reformulate correctly in their own words, its main components. Only two students failed to make accurate notes from this particular lesson segment.

Fig. 1: Teacher's Outline of Notes on Blackboard

Stomach
- thick wall
- muscular



digestion

--------> churned
--------> mixed
Juic [Juice]
--------> wall -------> glandular

Gastric Juice
--------> Enzymes
--------> Hydrochloric

Acid HCL
1. Kills bacteria, germs
2. Changes pH fr alkaline ------> acid
3. Coagulates
--------> Curd
--------> pepsin -------> requires acidic media
--------> protein
--------> peptones
--------> rennin
--------> casein
Coagulates
--------> acted by semi- liq [liquid]
--------> chime -------> duod [duodenum]
--------> chime

Lydia monitored note-making, going from student to student, reading the notes, pointing out omissions and consistently insisting on writing correct and complete grammatical sentences. She also used the tours to answer individual questions as long as students raised their hands. During these monitoring episodes, Lydia rarely looked at previous work, because she would have monitored its construction in earlier lessons. She spoke quietly to each student and always awarded ticks and, eventually, marks. During monitoring, Lydia would implement another technique basic to her instructional strategy, namely; allocating a definite number of minutes for note-making. But since Lydia believed that slow writers should be tolerated by constantly extending the time limits, she had problems balancing time needs among fast and slow writers. As a result, Lydia's lessons were characterised by a section of students who were fidgeting, dropping rulers, screeching chairs, shuffling pages in files and yawning. Lydia recognised these signs of boredom but she decided not to change her strategies because, 'When I start on something new, the students who have not finished will try to finish while I talk, and I am sure I will lose them'.

Lydia was observed to get upset if students whispered among each other during note-making. Lydia had commented: 'I hate whispering. It irritates me. When a student doesn't understand, instead of asking me, she whispers to her neighbour. My fear is that they may give each other wrong information and I won't know about it.' Lydia made a distinction between the work contexts during which students' talking was permitted. During practical work, talk was allowed since it implied that students were negotiating for space, resources and even strategies of approach and procedures. Such talk and discussion did not result in immediate written work. Whispering during note-making, however, was tantamount to seeking information from other students in order to write it down as a permanent record of what had been learnt. Lydia knew that classroom notes formed the backbone of the conceptual knowledge from which students would revise in later years. Therefore, notes had to be correct and if any student had doubts, Lydia was the authoritative resource and not other students.

Students' Practical Work

Lydia frequently incorporated setting-up-lab with monitoring the progress of students' work. If Lydia evaluated as unsatisfactory students' understanding or progress at note-making, she would continue to remedy these situations and abandon part of her mental lesson plan, including a proposed practical. If she, however, found students' progress in note-making up to her expectations, she would set lab in an incremental fashion, even for students who would eventually move back and forth between their locations and the teacher's bench while collecting what they required. Lydia always put the instructions for practical work on the blackboard and read them step by step with students. There was

always enough equipment for 8 to 10 groups of 5 or 4 students each. But Lydia did not have defined groups and sometimes as many as 15 groups would form, when Lydia's prescription had been 8. But once again Lydia's belief in individuality prevented her from curtailing multiple group proliferation. Since a group may have one, two, four or six students, practicals were characterised by a very high noise level and a lot of moving about, all of which appeared to be out of control. Yet these episodes of 'disorganized chaos' were quite structured and sometimes purposely encouraged by Lydia who kept a high level of control through various non-verbal and verbal cues. As long as Lydia judged, through her comprehensive monitoring system, that all students were doing work she made no attempt to intervene, precisely because the large number of groups also enabled her to keep track of individuals and their progress on various tasks.

Summary

Lydia's instructional strategy consisted of a cyclical reproduction of four major techniques, teacher verbal exposition and assessment of understanding; student note-making; teacher monitoring of work progress and setting up lab; and students' practical work. Practical work was normally followed by another episode of students' note-making. Throughout the instructional strategy, Lydia would strive whenever possible to implement techniques such as dealing exhaustively with each student's questions, monitoring individual work particularly note-making and practicals, and allowing the devolution of numerous groups during practical activity, in order to cater for students' individuality.

Charity's Perspectives and Practical Knowledge

As in the case of Lydia, the salient issues in Charity's perspective in Urbana which might be expected to influence her instructional techniques concerned three factors, namely: her conceptions of the school environment as inhuman and totally unsupportive of her work; her assessment of students as having low intellectual capabilities and, therefore, incapable of grasping properly the content of biology; and as a result, the need for her to evolve a suitable pedagogy concordant with students' limited capacities rather than the nature of biology as a science. Table 2 points out the main differences between Lydia and Charity's perspectives.

Charity translated these perspectives into an instructional strategy undergirded by two beliefs. First she had two categories of students in her class, the 'good who always did their work' and the 'lazy who never did their work' but unlike management which she regarded as lax in enforcing discipline, she was not going to let the bad students get away with their misbehaviour during her classes. Consequently Charity always established order among students before dealing with any sort of academic content, and if this order were interrupted during a

Table 2: Differences between Lydia and Charity's Perspectives

Factor	*Lydia*	*Charity*
Overall school perspective of nature of social and intellectual environment	Positive, and supported by consistent high achievement on public examinations and high social esteem by public	Negative, affirmed by low and sliding achievement on public examinations and low esteem by public
School management	Supportive of individual decisions in various key roles as teacher, manager, disciplinarian and judge of social and academic student performance	Unsupportive of individual and group decisions in key roles as teacher and disciplinarian and judge of students' academic and social performance
Movitation for student intellectual and social performance	Positive, and any negative elements apportioned to environmental rather inherent personal attributes	Negative and all negative elements apportioned to inherent personal, environmental and management attributes

lesson, she would re-establish it over and over again before continuing with the lesson. Second, she felt there was a limit to the extent to which students, good or lazy, could actually fully grasp the content of biology. Therefore, Charity regarded attempts to explain concepts to their logical conclusion as a waste of time. She, instead, gave students in full form what she knew they were expected to know. She had pointed out: 'With our students it does not matter how hard you explain. They won't understand. And, besides, they will not tell you if they have not understood. So you give them what you want them to learn. You will be lucky if they learn it in the way you gave it to them.' However because Charity was aware of the goals of biology, requiring that students should be exposed to practical work, not only did she have definite practical and non-practical lessons but she also evolved two somewhat different instructional strategies for the two types of lessons. Table 3 gives the main differences between the nature of steps characteristic of the two instructional strategies.

The duality in the overall instructional strategy was supported by various elements in Charity's perspectives about the quality of the working environment and her students' abilities. For instance, in a school environment where many teachers defined their role as simply 'being there', the most important role of many of Charity's activities such as checking whether or not students had completed assignments, constantly re-establishing order, publicly exposing individual students' social misbehaviours in relationship to their poor academic performance through repetitive public counselling, all undertaken during practical classes, was to fill time rather than to ensure that genuine instructional episodes would occur. As is evident from Table 3, the same activities were not

Table 3: Characteristics of Charity's Instructional Strategies

Step	*Practical Lessons*	*Non-Practical Lessons*
Entry into Lesson	Began late due to (a) interruption by school assembly, (b) student lateness and absenteeism, (c) inadequate seating arrangements; Characterised by time consuming procedures for setting up lab, settling class, using activities such as establishing order, inspecting students' note books in order to check and enforce the completion of assignments and previous class work, establish levels of readiness for learning, and counselling students	Begun on time and suffered no interruptions
Verbal Instruction	Instructions for practicals delivered verbally, no written record on blackboard; extended exposition of new concepts involving students' contributing to construction of content through difficult and time-consuming sense-making exercises; students' attempts to make their own notes as exposition progressed; titles of conventions for writing up practical work written on blackboard	Concepts described and a few questions given to assess understanding, followed by dictation of notes by teacher or copying of same from blackboard
Students' Work	Students devolve into their own groups, fewer than number stated by teacher, and they follow collated and reformulated procedures; materials and equipment for practical haphazardly assembled; students evolve various strategies in order to cater for incomplete instruction, but rarely ask for clarification from teacher; students devise various strategies to control the sequence and nature of activities; accurate and correct experimental data and results rarely obtained	Whole class work with full instructions and information from teacher. Very few questions from students
Teacher monitoring of student work	Implemented late and plagued by ill-timed, inconsistent and unworkable repairs to previous instruction regarding (a) size and number of groups, (b) procedural instructions, (c) substitution of specimen, reactants, even experiments and equipment; assessment of progress of current work combined with checking previous work and leading to prolonged and repetitive episodes of public categorisation and counselling of students who have defaulted on various exercises and social discipline, all resulting in students devising various strategies to reduce teaching time	Almost none
Integration of Knowledge	Attempts to get students to draw linkages between practical results and theory, through hypothesizing and inference drawing; usually unsatisfactory since few students obtained correct data and were as a result unable to make correct conclusions	Almost none

employed in the non-practical classes where Charity was critically concerned that students should get the 'correct' information by copying the teacher's notes either from the blackboard or through dictation.

Sometimes, during verbal exposition preceding practical work, Charity would approach some concepts by requiring students to use deduction in order to make sense out of definitions, descriptions and narratives and to answer questions evaluating understanding. But problems would arise because of three recurrent modes of students' cognition:

1. Students had problems recalling particular lessons and isolating the concepts that were relevant to the present lesson.
2. Students' experiential knowledge was so diverse and unequal, resulting in inability to isolate relevant knowledge.
3. Students were unable to develop a rule of thumb that would assist them to come up with relevant information, even within a single lesson.

Whenever Charity discovered either confusion or incomplete knowledge she would use any combination of 8 techniques to correct the situation, namely:

1. She would recount specific subsuming biological concepts taught previously and which related to the question at hand. Students had to assemble these concepts in a hierarchical manner and see 'the super-ordinate' concept that was the answer to a particular question. This techique rarely led to the correct answers because: (a) Charity recounted too many subsuming concepts, sometimes as many as 6, so that students either lost count or assumed that these were new concepts — since students would be busy writing them down; (b) Some students would 'fix' attention on one concept which to them sounded most relevant and would repeat it regardless of the original question.
2. She would analyse particular elements of the question's structure in the hope that students would see the type of information needed by understanding the structure of the question. In cases where this technique worked, students would see the 'logic of the question'. Where the technique did not work, students would fail to see such logic because: (a) Students would have forgotten what the original question was; (b) Charity would have rephrased the question in several formats in order to make its components clear; (c) The question would have become more complex than in its original form; and (d) The question would require a different answer than that solicited by the original question.
3. She would point to specific learning skills needed in order to work out the correct answer, but which she said were deficient among students. For instance, she might ask students: to use memory, imagination or common sense; to put the question in their own words; to identify what the question was asking for; and to recall similar questions students had answered during the first part of the lesson or during previous lessons.
4. She would introduce a discussion of the question in the context of its

application to wider contexts than originally stated. This would normally lead to a discussion of the 'functional application' of the concept and would, in most cases, result in answers that would not have been relevant to the original question. For instance, in an example of the question, 'What happens when wet grass is burnt?', discussion in the context of a country had led to another question: 'Why do people burn grass in various parts of Kenya?'. None of the answers to this second question lead directly to the required answer for the first question, namely, that 'wet grass loses water when it is burnt'.

5. She would revert to a re-definition of either the expected knowledge base of the class, thus, 'At this level you should know what happens in the process of evaporation' or the knowledge from other subject areas needed to learn biology, thus 'You should know this from your chemistry'.

6. She would enumerate the purposes of learning, such as: the use of knowledge once learned; the usefulness of memory and retention of simple facts; and why curricula were structured with levels of knowledge of increasing complexity.

7. She would counsel students about appropriate audience response in classroom situations as opposed to other situations such as homes, or churches. She might point to timesaving devices and the relationship of these to required school achievement and future life. Charity might also stress: the necessity for students to listen to teachers and students; the uselessness of whispering, talking and noise-making; the problems of coming late in lessons where students missed important content; and problems resulting from students' neglect of school work and wasting time in gossip.

8. Regardless of what combinations of instructional repairs she had used, she would, in the end, give the correct answer.

These techniques were usually in this order and it was rare for Charity to use only one of these repair techniques. On the average, she would use three in one sequence. She might repeat the same repair sequence six to eight times in a lesson, and it was quite frequent for her to use all 8 repair techniques in one long mega-repair sequence. Therefore, depending on the length of these repair sequences and the points of their insertion in the lesson cycle, a big part of a lesson may be eaten up thus leaving little time for students to undertake the assigned practical work.

Experimental Procedures and Monitoring work

Charity rarely had less than two sets of experimental procedures to give in one sitting, (the maximum observed was four) since textbook logic demanded that all experiments elucidating a specific biological concept should be performed in one sequence. Procedures for practical work were always given verbally but never written on the blackboard or dictated as notes to be copied by students. The

complexity of such an instructional technique to students, in the absence of a visible record of procedural instructions, can be judged from one experimental procedure given for an 80 minutes' lesson where in actual fact, four activities had to be performed in order to 'prove' the conditions under which the enzyme ptyalin digests starch, namely:

1. Experiment 1: To test sucrose and glucose solutions for the presence of simple sugar (control).
2. Experiment 2: To prepare a solution containing the enzyme ptyalin by using saliva extracted from the student's mouth.
3. Experiment 3: To investigate the effect of excess heating of ptyalin on its ability to digest sucrose.
4. Experiment 4: To investigate the suitable temperature and time needed for ptyalin to digest a solution of sucrose.

Each of 5 prescribed groups of 8 students had to work simultaneously with 10 test tubes, 2 water baths — each kept precisely at 37°C with one thermometer — a white tile with 20 fresh drops of iodine and a watch. Each group had to perform an iodine test 25 times and a Benedict's simple sugar test at least 6 times. The procedural instructions were verbally delivered and some steps demonstrated from the teacher's bench. How students applied themselves to this sort of exercise will be described shortly in Section 2. But it is evident that giving procedural instructions verbally inevitably resulted in incomplete instruction, where in almost all practical lessons, no single student would have a correct and systematic record of the procedural instructions for all tasks. Consequently the instructions followed would be collated by combining instructions jotted down in half sentences by various students in a group. Subsequently, whenever Charity began to monitor students' practical work, she would usually discover that: resources were insufficient; students were relying on inaccurate procedures; wrong observations were being made; and many students were not doing any work. Charity would, therefore, institute various instructional repairs depending on what she judged as the main constraints and whether or not she believed that the confusion was either shared throughout the class or was confined to the group of students which Charity regarded as lazy. If on the one hand, the confusion was widespread, the repair techniques would consist of calling the whole class to attention and amending the initial instructions regarding, for instance, the sharing of resources, the formation of groups, and the sequence of procedures. If on the other hand, Charity believed that the confusion was confined to lazy students, she would resort to public counselling which consisted of three main elements:

1. Identifying individual students and subjecting their notebooks to close scrutiny, looking for incomplete work and particularly practical exercises which might have inaccurate write-ups.

2. Raising the voice, using a sarcastic tone, flipping through students' notebooks noisily, waving the index finger in front of the student(s) concerned, and, sometimes, throwing the book across the desk to the owner.
3. Counselling the individual or a group of students loudly regarding various learning strategies that should give the student access to knowledge; soliciting from the student elements about the home, work habits and motivation for behaviour; and whether or not lazy behaviour was specific to biology learning or general to all learning; and seeking information from the whole class to repudiate the legitimacy of various claims made by the culprit(s) regarding crises such as loss of books in public transport vehicles, forgetting books at home and inability of parents to afford exercise books.

Consolidation and Integration of Lesson Content

Integrating knowledge consisted of drawing inferences from experimental or observational procedures, making inferences and conclusions and commenting on applications of various concepts to life experiences. Charity demanded from students the same strategies as during verbal exposition, that is, sense-making through deduction, now applied to 'students' collected data'. Charity tried to get students to draw inferences by using a model of inference-drawing which consisted of three steps:

1. Hypothesizing by using the title of the experiment.
2. Understanding the sequence of experimental actions, the experimental plot in spatial and temporal sequence, the biological logic underlying the working of the test in the experiment, and accounting for the cause-effect relationships.
3. Using the cause-effect relationships discovered, in order to make a conclusion in reference to the title of the experiment.

But each of these steps presented problems to students. For instance, proposing or generating hypotheses by using the title of the experiment was not done before, but after the experiment. Since the process of generating hypotheses from a whole class could only be haphazard, it was rare for students to understand why only a particular hypothesis, out of several generated by students, had been declared correct since there was no visible record of related hypotheses for reference and comparison. Having been given, rather than having arrived at a correct hypothesis, students had mentally to sketch out the plot of the experiment, particularly, the sequential steps, in space and time; the nature of specimen and substances used in the experiment; the role of each substance and specimen; and the final products at the end of the experiment. Students had difficulty differentiating between workings of various 'tests' and the experiment *per se* so that they could not talk about the final products meaningfully. The problems students faced in negotiating this instructional technique are illustrated

by the following brief description of the events leading to and transpiring during an 80 minute practical lesson in which students had to test 'dark' and 'light' leaves for starch, and were expected to draw inferences from the nature of the products, after using a somewhat complicated experimental plot.

1. The procedure for testing of starch was first introduced to students during the topic nutrition. The major emphasis then was on different types of foods — carbohydrates, protein and fats — as components of a balanced diet. Rice was boiled and then tested for starch using the iodine test. The reason for *boiling* the rice was not explained.

2. The second opportunity to test for the presence of starch came 2 weeks later. At this stage, it was pointed out that all green leaves photosynthesize and that starch, which can be found in green leaves, is the major product of this process. The iodine test was once again used. But the process of testing for starch in green leaves is preceded by three separate procedures which accomplish different purposes: The first process, dipping a leaf in boiling water, kills the living substance of the leaf. The second process, soaking the 'boiled' leaf in alcohol warmed in a water bath, removes chlorophyll, which would otherwise mask the blue-purple colour indicative of the presence of starch. The third process, dipping the leaf in cold water, softens the de-chlorophylled leaf. The purpose of these three procedures was not made clear to students.

3. During the lesson with 'dark and light' leaves, the topic concerned the conditions required for photosynthesis. It had already been stressed that 3 conditions — light, carbon dioxide and chlorophyll — were needed. (This in itself was confusing since the process requires two raw materials, water and carbon dioxide, and needs two conditions — light and chlorophyll). Two sets of leaves were provided; those kept in light, and those kept in the dark. Students were required to test each set of leaves in order to see which one had starch.

4. In carrying out the test, it became clear that students had not understood: why they should not boil the leaf directly, just as they had boiled the rice in a previous experiment; why they should not put the leaf in alcohol and heat the test tube directly and had, instead, to immerse the test tube containing alcohol in a water bath; whether there was a difference between alcohol, ethanol and ethyl alcohol; what would determine the length of time for keeping the leaf in alcohol; and why the leaf was dipped in cold water after 'boiling' it in alcohol. Furthermore, since it had been stressed that chlorophyll was one of the 'conditions' required in photosynthesis, it appeared to students contradictory to test a leaf for starch when it no longer had chlorophyll.

Due to the absence of an accurate set of procedural instructions for the experiment, the conceptual gaps in knowledge, and the ill-timed instructional repairs, students had botched up the experiments. Charity was aware of the problems occasioned by gaps in students' understanding of the purposes of

various parts of the 'test'. But she believed that it would severely reduce the time available for the teaching of biology if a teacher were to explain the chemistry involved. Ultimately, despite the fact that Charity used the same model on numerous occasions when inference-making was required, students failed to see the universal grids underlying the model as a convention for making inferences in all experimental situations.

Summary

The most curious characteristic of Charity's dual instructional strategy concerned on the one hand the absence of a visible record of instructions during practical work and, on the other hand, the giving in full form, during non-practical lessons, all notes and information on all concepts and practical work previously undertaken. In combination, these factors, however, reveal that Charity had derived much of her instructional strategy from her perspectives of management's laxity in dealing with students' discipline, her perceived knowledge of the kind of students she had, and what she believed about the purpose of the instructional process during teaching and learning biology. First, Charity's failure to dictate or give full notes for instructions for practical work was due to her belief that practical periods should be used almost entirely for practical activities. Secondly, Charity believed that in order to get students to pay attention they should be required to listen and make a record of the instructions for practical work by themselves. In contrast, during non-practical lessons her emphasis on giving students the correct facts and principles using a textbook logic and format served her other belief, namely that students were likely to have problems in understanding all biology. Consequently she insisted that students should reproduce somewhat mechanically the correct conventions for experimental write-ups, hypothesizing, and drawing inferences from titles of experiments, as well as getting the concepts correctly in dictated form.

Ultimately the occurrence and sequence of activities depended critically on Charity's insistence on personally imposing discipline in her class through monitoring work, categorization among students, and constantly resorting to public counselling. Unlike Lydia, Charity's instructional strategies did not usually evolve into a cyclical reproduction of the main components outlined above except for the re-establishment of order, because of two reasons. First, each component usually took a long time to implement and accomplish within the time available for either practical or non-practical lessons. Second, the main components of a lesson, for instance, settlement in class, students' practical work or verbal exposition, consisted of so many activities that such components may individually be regarded as a cycle.

SECTION 2

Students' Participation in the Teaching-Learning Process

The preceding discussion has illustrated how two teachers with different perspectives regarding the quality of the environment in which they worked and the kind of students they had in their classrooms had implemented radically different instructional strategies. It is reasonable to assume that students in each of the classes had to employ different participation strategies in order to make sense out of the instructional opportunities provided. In this section, students' participation strategies during learning biology in Lydia and Charity's classes are briefly reviewed.

Students' Learning Goals

Traditional descriptions of the teaching-learning process usually portray students as either passive recipients of information, content and directives from the teacher, or as active in terms of their carrying out various tasks, assigned to fulfil objectives designed by the teacher. In both cases, the teacher is seen as the dominant classroom actor, structuring both content and rules of behaviour for the students. More recent studies of how teachers and students live out their daily lives in school have, however, pointed to the fact that two types of activities exist in classrooms: formal events (labelled as instruction); and informal events which include all other events in which learning is a means of giving and obtaining information. Griffin (1977) suggests that conclusions about research results regarding instruction which do not take account of both formal and informal activities may be misleading. Green & Harker (1982) suggest that since students acquire knowledge of social and communicative strategies needed to gain access to the academic content of lessons simultaneously with the academic content, students must, therefore, be responsible for a substantial part of the structuring of classroom dialogue and events.

But some students' participation in classroom work is problematic and findings from studies which have attempted to understand the causes of problems that arise during the teaching-learning process, such that teachers find it difficult to teach and students are unable to learn, have suggested that some students, for various reasons, develop behaviours that result in opposition and resistance to being taught (Aronowitz & Giroux, 1985, p.72). The data from Charity's class seems to confirm this view while that in Lydia's class suggests that not all students consciously develop and act overtly through oppositional behaviours in their attempt to reach their own set goals through classroom experience. However, in both Charity and Lydia's class a more or less permanent group of students came to control a large proportion of classroom events, and, of course, the behaviour of the teachers and other students. In Lydia's class the group referred to as the

'Backbenchers' came to dominate participation in classroom dialogue, and, ultimately, brought about a certain kind of individual and group freedom and ease in the teaching-learning atmosphere which probably encouraged more understanding of biology by all students than would have otherwise been the case. In contrast, in Charity's class a group of students referred to as the 'Absentee group' used many of their unsocial and non-academic behaviours which were stressed by the teacher, namely, lateness, absenteeism, unreadiness for class, indiscipline and learning in overly large groups, in order to implement other behaviours and participation strategies disruptive of teaching and learning.

Students' Frames of Reference and Instructional Goals

Students' participation in the teaching-learning processes as observed in Charity and Lydia's classes was subsumed within three main findings in micro-ethnography research namely: (a) Mastering a set of rules for behaving, speaking, deciphering and interpreting constantly changing classroom social contexts is vital for survival in the classroom and for building meaningful learning experiences which attempt to achieve both the teacher's and students' goals (Smith, 1973); (b) Students' access to opportunity to participate in learning in group situations is guided by what McDermott (1977) has described as their ability to establish a working consensus to an event. Students have a shared sense of what is happening, the purposes of the event and the shared sense of the content and structure of the event. (Bloome 1984) (c) The classroom defines an ecological niche which must be adapted to by both teachers and students in order to construct meaningful learning experiences and the adaptive apparatus of many students and teachers is designed from contexts in and outside the classroom (Smith 1973).

Research using micro-ethnography has viewed the teaching and learning of academic content as embedded in and influenced by social processes since the social context in which an academic activity occurs affects the nature of the learning processes used and the nature of students' performance observed (Bloome & Green 1982). Thus students have a shared sense of what is happening. But Bloome cautions that 'sharedness' should not be equated with 'equally shared' or with 'similarly shared' since within interactional events, participants assume and are assigned roles within the event (Bloome 1984). Similarly, Green & Smith (1983) have considered learning as a cognitive, linguistic and social process where participants bring a frame of reference, that is, participants have a set of general expectations for what will occur. However, the specific rules or expectations for performance are signalled by the participants as they work together and build on each other's messages and behaviours in order to construct the activity and reach the instructional goal. Observations in both Charity and Lydia's classes showed that students in both classes not only had and shared

various frames of reference regarding the meaning of different activities in the teaching-learning process but also signalled between themselves the implementation of specific participation techniques and thereby achieved both academic and social goals. The discussion in section 1 has shown that different social and academic contexts were created and sustained in Lydia and Charity's classes. Obviously, the instructional strategies described were implemented in relationship to the students' evolving participation strategies. Therefore, subsequent discussion portrays how students' perspectives regarding their capacities and increasing understanding of the nature of the social context of the classroom and the academic demands made upon them were employed in constructing specific participation strategies.

'Backbenchers' as Pace-setters

During the first lessons in biology in Lydia's class of new secondary school recruits, it became clear that students who had attended urban primary schools tended to sit separately from students who had attended rural primary schools. While it was not possible to ascertain all the factors and processes that had brought about this pattern of sitting, three elements, namely location of primary schools attended, oral fluency in the English language, and differential material possessions would seem to have been important reference points in this initial self-grouping. It was also clear, from the nature of students' participation in the first of these lessons, that about 12 students sitting on the back benches — the backbenchers — all of whom had attended urban primary schools, and who had a very good command of spoken English in comparison to 8 and 20 students sitting on the front and midbenches, the frontbenchers and midbenchers respectively, were more vocal. The physical and social contexts which were constructed by the three categories became important reference points to students during learning, particularly in: assigning participation roles; defining characteristics of a working consensus; and in distributing learning opportunities among class members; and signalling the change of various activities and their pace.

Making Sense of Procedural Instructions

As pointed out in section 1, instructions for practical work were always written on the blackboard and 'gone over' by Lydia with the whole class. But front and backbenchers' in-group discussion regarding these procedures usually turned into debate and Lydia would be called in to arbitrate. In other words, students recognised and used Lydia as the final source of accurate information. Generally participation of students in practical work was characterized by four elements:

1. There was open competition between individuals and among the three main sitting groups for doing practical work.

2. The midbenchers tended to adhere strictly to the size of groups prescribed by the teacher while the front and backbenchers tended to want to work alone or in smaller groups than those prescribed by Lydia.
3. During practical work, the frontbenchers (8 students) and the midbenchers (20 students) and the backbenchers (12 students) would form at least 2, 3 and 6 groups respectively, so that it was usual to observe as many as 12 to 15 groups unless learning resources were so restricted as to make large groups an absolute necessity.
4. Even with proliferation of more groups during various practical tasks, the original sitting patterns remained a significant feature of student self re-organisation and re-assignment to groups.

Students' Strategies for Setting the Pace of Learning

The fluency in oral language skills of the backbenchers was a key factor in their claiming a disproportionate amount of Lydia's attention right from the beginning of their secondary school careers. First, backbenchers' oral fluency gave them sufficient confidence right from the first lesson, so that whenever they asked a question Lydia seemed to understand their problem. Second, unlike speakers from the front and midbenchers, backbenchers were always audible. Backbenchers' fluency coupled with their eagerness and competitiveness in carrying out tasks such as, moving about to collect specimens, setting up apparatus, observing, challenging one another, exchanging specimens, and setting up individual work stations, resulted in practical sessions that appeared and sounded chaotic with a high level of noise.

But backbenchers were not simply fluent in oral English, but also their accents were variously anglicized, conveying the impression to the front and midbenchers that the latters' accents were inappropriate for classroom communication. Consequently, backbenchers became a model for speech which others strove to emulate. But the front and midbenchers, took some time to 'learn' to anglicize their accents sufficiently, before they could feel confident enough to ask questions and take part in classroom dialogue and debate. By that time, the backbenchers had become so proficient in negotiating access to various aspects of classroom dialogue and activities that a permanent gap had been created between the three categories of students. As students became fully conversant with the school's rules concerning the teaching-learning process, they found that Lydia's instructional strategy, which was made up of giving a short exposition followed by assessing understanding through questions and then note-making, worked to the advantage of students with enough confidence to contribute to classroom debate in the following ways.

First, Lydia encouraged a certain amount of individualism and creativity among students so that her emphasis on giving a chance to students to ask

questions initially benefited mostly the backbenchers who were confident enough to ask questions and contribute to classroom dialogue. By the end of the first term, the backbenchers had established themselves as a dominant group of participants on whom Lydia relied to operationalize her goals. Second, Lydia regarded students' capacity to ask questions as a useful and logical way in which to gauge both students' participation in learning and their understanding of various concepts. She constantly encouraged those students who would provide data for her mental evaluation of the effectiveness of her instructional techniques. In the process, she provided plenty of opportunity to the backbenchers not only to practise asking and answering questions but also to learn Lydia's responses to students' various responses, reactions and interactions in such episodes. Third, as students became conversant with Lydia's expectations of them, and were able to 'read' the nuances in Lydia's reactions to their initiated contributions, Lydia's own instructional strategy worked to the advantage of the fluent and confident backbenchers at two levels.

(a) Students who were more fluent in the language skills were likely to get more out of the lecture exposition episodes than less fluent students. In turn, the fluent students tended to write more detailed notes than their less fluent colleagues. Lydia did not want to begin a new lesson episode or activity until she had given plenty of time to what she thought were slow writers to complete note-making. In actual fact, the fluent writers tended to ask more questions in order to have the outline of notes on the blackboard clarified by Lydia, and would then write longer texts than the rest of the class. While Lydia believed that she was waiting for slow writers she was, in fact, waiting for the more fluent students. Therefore, the fidgeting and boredom characteristic among the front and midbenchers were not observed among the backbenchers because the backbenchers always set the pace for the sequencing and changing of classroom activities.

(b) Backbenchers used their superior knowledge of the nuances of Lydia's reactions to students' participation structures in order to influence the nature of activity during some lessons. As earlier mentioned, Lydia did not set up practical work until she was satisfied that all students had understood previous concepts and completed note-making. By being able to control the pace of note-making, backbenchers effectively controlled the setting up of practical work and subsequent activities.

Micro-level Control of Content Delivery

A sense of other subtle but very effective strategies employed by the backbenchers in controlling classroom events can be gleaned from three recurrent elements in Lydia's lessons, namely; determining the pace of content delivery; signalling the sequence and implementation of some activities; and dominating class consensus.

Pacing Content Delivery

Backbenchers would use subtle mechanisms to influence the pace of delivering content by four related strategies. First, they might move the lesson forward; second, they might point out incomplete treatment of content; third, they might allow the teacher to give access to dialogue to other students in the classroom; and fourth, they might point out some disparity between class social expectations and actual procedure. Coupled with this covert control of dialogue was the role of class laughter. Most of the laughter which originated from the backbenchers and which was indicative of the relaxed classroom atmosphere was used to point to various disparities between what some students expected and what was seen to transpire. Class laughter was used for instance: to emphasize students' admission of 'intellectual defeat' by their inability to complete an answer; to underscore conceptual ambiguity in students' and the teacher's explanations; to re-affirm agreement or emphasize disagreement on answers; to ridicule unacceptable answers and explanations; to challenge Lydia's unclear opinions regarding students' responses and reactions; and to reprimand both teacher and students for misbehaviours such as wasting class time, using indecipherable abbreviations on the blackboard and making unexpected demands particularly in the use of time during note-making. Of course, there were incidences of laughter which were purely the result of humour. But this sort of laughter was more spontaneous, more widespread throughout the class and lasted longer than the control laughter which was more localized, more meditated, contrived and was extinct as soon as its purpose had been indicated and, in most cases, achieved.

Signalling Activity

Another subtle mechanism of control of both Lydia's pace of delivering content and the activities accompanying such delivery was observed to be implemented by the backbenchers whenever, somewhere during an 80 minutes' lesson, they realized that Lydia intended to use the whole period for exposition and students' note-making without any practical work. Whenever backbenchers got tired of writing, they would indicate to each other their feeling by 'palm breaking' gestures. Students would then implement an extremely effective control mechanism which utilized an ordinary classroom technique by which Lydia herself assessed not only students' participation in her lessons and their understanding of content, but also her own effectiveness as a good teacher. Students would ask questions, seeking as much information as possible from Lydia on various concepts, in order to keep Lydia and themselves talking, debating, and hypothesizing, so that, in the end, little time would be left for students' note-making. These would be mostly very good questions, often insightful and often requiring Lydia to go beyond what she had planned or to clarify content she had already hurriedly taught. Lydia would fall prey to

students' engineered techniques, digressing materially from her mental lesson plan; extending discussion to the whole group; throwing questions back and forth to the whole class; seeking as many interpretations of the same concept as possible; and giving alternative authoritative and conjectural explanations. The sum effect of these techniques would be decisive: there would be little or no note-making.

Dominating Class Consensus

A third strategy for controlling the pace of content delivery was to dominate class consensus. Backbenchers would always give very strong Yeses and Nos to Lydia's questions such as: Have you understood that? By dominating the class consensus, the backbenchers would determine, to a large extent, Lydia's point of entry into a new lesson and her pace of delivering content. Yet the backbenchers' consensus did not always reflect the true status of progress and knowledge in the whole class. This was partly the reason for the stark gaps in knowledge that Lydia frequently discovered whenever she attempted to assess students' understanding and progress in a systematic manner.

Backbenchers also used their domination of consensus in order to keep strict supervision over the staging of the signalling strategy. Whenever they sensed that the strategy had become unproductive, they would strive to abort it. For instance, if a student asked a question which backbenchers thought had already been asked and an adequate answer had been given, they would *Aah!..Aah!* the student who was constructing the question before she had completed it. Lydia would in fact, unintentionally, aid students' *Aah!..Aah!* by asking, 'Does everyone know that?', whereby the backbenchers would drown everyone else's response with a strong chorus of 'YES'. Similarly, whenever backbenchers thought that Lydia's answers and explanations to their questions had become trivial they would, once again, use their capacity to dominate class consensus to indicate their displeasure. For instance, during an episode in which Lydia had been diverted by students into a question session, and believing that students might not have understood what the various parts of a seed grow into during germination, Lydia had asked the following questions which, as the excerpt clearly shows, backbenchers subsequently chorused to insignificance, steering the lesson back to a students' engineered question session.

01. Lydia: What becomes of the cotyledons?
02. Chorus: They fall off.
03. Lydia: What becomes of the radicle?
04. Chorus: The root.
05. Lydia: And the plumule?
06. Chorus: The shoot
07. Lydia: What is a shoot?
08. Chorus: Oh – oh – oh – Now!
09. Lydia: No. No. I must ask. You don't seem to know these things.

10. Chorus: Yes. We know.
11. Lydia: You know?
12. Chorus: YES!

It was not clear why students had chosen these strategies but it is clear that they had selected strategies which fitted into the teacher's instructional strategy and would work more or less hand in hand with the teacher. But the significant factor was that these students liked to learn, and they generally understood that they were in class to learn, and were not really interested in curtailing information for learning. Students were simply interested in blending their own goals such as reducing the amount of writing as a physical activity which tired their hands, within the goals for teaching and learning biology.

Absentees as Pace-setters

In Charity's class several elements of students' participation in learning during practical lessons were described in section 1. The purpose here is to pull these elements together to show how students controlled some events in the classroom, in order to fulfil their own needs as well as learn a sort of biology. Students worked their strategies through the social and academic feaures in the teaching-learning process which were stressed by Charity, namely, students' lateness, absenteeism, unreadiness for class, indiscipline and learning in undefined groups, in order to influence the course of classroom events.

Absenteeism, Lateness and Resources

The most consistent way to categorise students in Charity's class would be whether or not a student was frequently absent. Of 40 students in the class, 27 (67.5%) had missed one or more of the 43 lessons observed. This high rate of absenteeism was coupled with a high level of lateness, sometimes intentionally perpetrated, mainly by students belonging to the 'absentee' group who also used their frequent absence from lessons to ignore assigned work and to shun their own responsibility in learning, by just copying notes from other students' notebooks and textbooks. The same students sometimes used as an excuse the shortage of resources such as laboratory chairs, effectively to disrupt class morale and interrupt lessons. It was obvious that while there were some students who wanted to learn, there were many who had learnt that 'searching for chairs' would waste a lot of class time, perpetuate a state of chaos at the beginning of lessons as students quarrelled with one another over 'stealing' chairs and the end result would be a reduction in the amount of time devoted to learning.

Student's Reformulation of Procedural Instructions

A more serious threat to students' learning, resulting in all manner of contradictions with regard to both teacher's and students' purposes in the

teaching-learning process, was the way in which instructions for practical work were reformulated by students. A comparison of the procedural instructions given by Charity and students' reformulation of these instructions i.e. the way in which they carried out the actual practical, showed that students did not usually understand the purpose of various tasks and steps in experiments. Students' inability to understand procedural instructions resulted partly from Charity's practice of giving instructions verbally without making an accurate record on the blackboard and partly from the practice of giving several experiments in one sitting. But students were unable to keep either a mental or a written record of accurate procedural instructions from simply listening to Charity's verbal exposition. Students, therefore, undertook the experiments as best as they could by combining and collating versions of instructions compiled by various students. Students in a group commonly employed two techniques to supplement their collated procedural instructions, namely inter-group negotiation and consultation of textbooks.

In the first instance, one student in a group would become what might be referred to as an 'inter-group negotiator'. This student would run back and forth between her group and other groups seeking information on what to do next, or how to do it. This phenomenon of inter-group negotiation, although quite common, especially where solutions being used were of different colours, rarely led to successful experiments, because the group giving advice to other students might not necessarily have the correct procedure. In the second instance, students would attempt to supplement their collated procedural instructions by looking up the relevant experimental procedure in a textbook. Problems would, however, arise because usually Charity would have substituted specimen and chemicals so that the procedure given in class would be slightly different from the textbook procedure. Unfortunately students would follow a combination of their collated procedures and those from the textbook and inevitably, 'things would refuse to work'. Generally, students' transformations of procedural instructions resulted in disastrous and meaningless results as illustrated by a comparison of the expected and students' procedures in an experiment on *The Action of Saliva on Starch.*

EXPECTED PROCEDURES AND RESULTS

Initial Test-tube And Content	*After 10 Minutes*	*After 30 Minutes*	
		Starch Test	*Simple Sugar Test*
A –starch B –saliva	A+B–starch+saliva	Negative	Positive
C –water D –starch	C+B–water+starch	Positive	Negative
E –saliva F –water	E+F–saliva+water	Negative	Negative

STUDENTS' TRANSFORMED PROCEDURES AND RESULTS

Initial Test-tube And Content	*After 25 Minutes*	*After 30-40 Minutes*	
		Starch Test	*Simple Sugar Test*
A –starch	A+D–starch+starch	Positive	Negative
B –saliva			
C –water	C+B–water+saliva	Positive	Negative
D –starch			
E –saliva	E+F–saliva+water	Positive	Negative
F –water			

The positive tests for starch obtained by mixing water and saliva were due to the fact that students used the same dropper to siphon all liquids without washing the dropper, thus contaminating all three test tubes. The procedures and results show that there was, in fact, no experiment. The processes by which students collated and transformed instructions were linked to two other factors in Charity's class. Charity did not assign students to permanent groups. As a result there was a large group of students — the mobile periphery — who moved from group to group during practical sessions. The 15 students who constituted this group were not observed carrying through a full practical exercise on their own, and their most consistent achievements during practical work were:

1. getting hold of some relevant artifact, equipment or specimen and making Charity believe that since students were holding on to something, they were actually doing useful work,
2. depriving students in legitimate and working groups of access to resources such as test tubes, microscope slides, thermometers, labels, specimens and even space, since these mobile students held on to their resources without actually making use of them,
3. copying from other students' notebooks, often lifting and perpetuating various errors and misconceptions and, generally, practising and encouraging poor learning habits,
4. creating confusion among legitimate and working groups by constantly feeding them with wrong or irrelevant information on procedural instructions and repairs.

At times, students from the 'mobile periphery' passed on useful procedural repairs to working groups. But in general, such information tended to be incomplete, irrelevant to the state of progress of a particular group's work and likely to force the group into unnecessary debate and confusion, with the attendant waste of time. Charity had categorized many members of the mobile periphery as lazy students who never did their work. In actual fact, the 'mobile periphery' was not really a group where membership never changed. During the

43 lessons observed, there were only 8 out of 40 students in the class who did not, at one time or other, contribute to the mobile periphery. There were 7 students who were almost always in the mobile periphery. The other 7-10 students making the full complement of 15, tended to acquire 'mobility' depending on the degree of convergence, during one lesson, of four main factors.

1. If Charity decided to combine the monitoring of the progress of the current practical work with checking on students' completion of a previous assignment or experiment, then students who had not made conclusions to that previous experiment would often be forced to abandon their working stations in order to seek out students who had made the conclusions, so as to copy these conclusions in their notebooks. By the time students accomplished the previous assignment, it would be too late to continue with the practical work so that many would not bother to return to their original stations, but would, instead, form a 'mobile periphery' to other working groups.
2. If the practical work involved either heating solutions or microscope work both of which many students feared.
3. If the procedural instructions for a particular experiment were too detailed so that few students had any sort of record of the procedures.
4. If friends with whom groups were normally composed were absent.

Other factors contributing to the creation of the 'mobile periphery' included, coming late and being re-admitted into the laboratory after being sent out for some time in order to complete homework. Generally, students had the perspective that Charity was very severe on students who attempted to do work but failed. This was why if a group realized, in the middle of an experiment, that none of the members had a record of procedural instructions for the remaining part of an experiment, it would simply abandon its work. This usually followed a monitoring exercise during which Charity would praise another group for its early success on an experiment. Other groups would subsequently either send inter-group negotiators to the successful group or one by one, they would quietly abandon their own experiment and join the successful group. This was never done en masse as students knew that this would result in reprimand. They would often continue with their own experiment as 'a show' but would, as soon as they had opportunity, wash their apparatus and if asked, they would claim that they had finished the experiment.

What was, perhaps, surprising was that students did not usually ask Charity to clarify procedural instructions, preferring, instead, to negotiate and transform procedural instructions among themselves until they had arrived at 'what the teacher has said'. Charity often stated during monitoring that students got wrong experimental results because they did not listen attentively. Students' failure to seek clarification from Charity was probably the result of their fear of being identified as 'those who do not listen'.

SECTION 3

Modules of Students' Influence on Teaching

How aware were students in Lydia and Charity's classes of the importance of their participatory techniques? Although backbenchers were aware of the strategies they had invented, they did not talk of these strategies in terms of either influencing or controlling classroom events. Students regarded their dialogue and various activities as simply participation. They indicated that their frequent laughter was caused by Lydia's 'funny' questions, comments and reactions, which students characterised as 'Too much'. Students pointed out that the purpose of the staged question sessions was to ensure that they got as much clarification as possible regarding various concepts before being asked to make notes.

The front and midbenchers however, saw both positive and negative elements in the roles played by the backbenchers in influencing the course of classroom events. A fluent frontbencher had characterized the backbenchers as show-offs but she had pointed out that Lydia usually encouraged backbenchers to show off explaining: 'The teacher does not explain the things you want; she asks students to explain.' A midbencher had, however, commented with reference to the backbenchers: 'Those girls read very much and they know what to ask, and I learn a lot from what they ask; because then the teacher can explain things she had forgotten to talk about before'. Therefore, the question sessions served not only some students' original purpose of curtailing students' note-making but also enhanced the effectiveness of the overall instructional strategy by forcing Lydia to clarify concepts and information which she had previously hurriedly taught.

Students in Charity's class were also aware of the influence of their participatory techniques in the teaching-learning process. Whenever students in Charity's class were asked to rate the degree of their participation in lessons and their satisfaction with the teaching-learning process, the majority indicated that they were quite satisfied. From what has been said earlier about the 'mobile periphery', one might have expected to find more students registering overall dissatisfaction with lessons. Certainly the fact that some students who often formed the 'mobile periphery' occasionally rated their participation in lessons as marginal was evidence that at least, they recognized that their milling around and pretensions to involvement in practical work did not constitute genuine participation. But why would a majority of students feel satisfied with the way they were learning biology when practical lessons appear to have been quite chaotic?

The answer seems to be in what students regarded as successful participation in each of the dual instructional strategies set up by Charity. On one hand the clear consistency of the activities which characterised non-practical lessons had

convinced students that 'real' learning occurred not when they practised various science process skills, but rather whenever the teacher 'gave' them notes to copy. Therefore, the non-practical lessons came to be regarded as incorporating serious and successful students' participation in learning where there was no noise, no shifting of places, no shuffling of book bags and certainly, no hiding or forgetting of notebooks.

On the other hand, activities in practical lessons were not only unpredictable from one lesson to another but also their varied fragmented tasks provided more opportunity for Charity and students to find fault with one another and thus encouraged the evolution of multiple definitions and meanings of what various groups of students could regard as either successful or unsuccessful participation. At the beginning of their secondary school careers, all students were generally attentive and eager to participate in practical work. But a number of factors external and internal to Charity's classroom processes had increasingly pushed both teacher and students into progressive disengagement from genuine learning. The most significant factors, as earlier pointed out, related to Charity's perspectives of the school as an inhumane environment in which to work; management as uncaring and oppressive; and students as incapable of grasping the content of biology. Alongside Charity's perspectives, students developed and solidified a number of beliefs about their own capabilities, biology as a subject, their teacher, and the key elements in the social environment of the classroom, all of which they used in defining their own roles in the teaching-learning situation.

One group of students who consistently attended practical lessons had initially defined successful participation in more or less the same terms as Charity. They did their work, attempted to complete their assignments, never came late, raised up hands to answer questions and participated in experimental work. But this group soon learnt that their status as 'those who always do their work' was precarious and subject to instability and reversal if it appeared to Charity that students were not working hard enough. It was observed that whenever there was only one experiment carried out, students in this group tended to do the tasks quite well. But normally, there would be more than one experiment and as earlier pointed out, practicals as the first lessons of the week were vulnerable to interruptions by school routines and students' lateness and absenteeism. Because Charity gave too many experiments to be completed in one sitting, those students who always attempted to do all of them correctly could not possibly undertake the exercise within the time available. And precisely because they lacked clear procedural instructions, the more serious students would discuss among themselves as to how best to proceed. But Charity would usually single these students out as noise-makers, attributing their failure to finish experiments to the noise they made during such discussions.

Another group of students had found it increasingly impossible to negotiate

incomplete instruction during practical lessons. They had indicated that their worst moments in a week occurred whenever 'things refused to work' during practical exercises. And indeed, many experiments did not work because of the transformations of experimental procedures applied by students as a result of the teacher's incomplete instruction. Consequently, this group installed a parallel 'formal' instructional strategy in order to thwart Charity's goals. And as long as they were convinced that this goal had been achieved, they regarded as successful their participation in lessons. Their strategy was to reduce their accountability for practical work by simply hanging around and pretending to be involved throughout the lesson without incurring serious reprimand from the teacher.

Charity's modes of organising practical work on a basis of undefined individual and group participation was an added bonus to those students who either feared experimentation or purposely dodged class work since all they had to do was to get hold of one relevant specimen or equipment, and spend the rest of the lesson going from group to group as a 'mobile periphery'. Since students knew that groups were undefined, they could always claim that they belonged to a group. And since there were no official group leaders, no group could deny access to or identification with an individual student, unless the student seriously disrupted the group's work, something which was observed to happen only once during the 43 lessons. The group of students which felt that biology was too tough, 'too much science' or those who thought that Charity 'over taught' by giving too much material, strove, albeit unconsciously and haphazardly, to reduce biology teaching to their desired level. Students somehow failed to realise that they could have reduced the toughness of biology by either asking Charity to simplify content or by asking questions for clarification. They viewed these avenues of reducing toughness as inaccessible. This may well have been the result of their tendency to underestimate their own ability as learners which was in turn a result of the teachers' constant public underestimation of students' intellectual abilities, so that students could not feel confident enough to challenge Charity on academic grounds. Students, therefore, used the one avenue of reducing 'academic' toughness and 'over teaching' open to them, namely, reducing the amount of time for learning during practical lessons.

Students had learnt that Charity was irritated by interruptions by students' lateness, unreadiness, noise and whispering and that she would be upset whenever experimental write-ups were not done or if a student did not have the right books. Therefore, the absentee group consistently repeated these actions and constantly created and re-enacted 'crises' such as coming late, moving from room to room looking for chairs, forgetting books at home, and claiming inability to buy new books or pencils, and effectively controlled the teacher's division of time between social control and academic learning. The more Charity conducted social counselling for different members of this group, the less time she would

have left to teach and do academic work. Since Charity believed that without these sessions of public counselling the whole class would not work, the cycle was self-perpetuating even though Charity always stated that, 'It is always the same girls'.

However, these participation patterns encouraged a great deal of intimacy within the two broad groups of students which Charity categorised. Exercise books were often seen being exchanged and discussions held among different class members regardless of group. The 'absentee' group came to be regarded as something of a 'hero' by the whole class because they were said to be able to 'manage' Charity by getting her upset, and by forcing her to waste learning time by counselling students who only found such exercises something to laugh about during and after class. Obviously, these participation patterns failed to inculcate individual responsibility for learning and in the final analysis, no group in Charity's class was a winner and because of this, the whole class was extremely cohesive. Those students who strove to work hard knew that Charity would frequently put them into the group of 'those who never do their work'. Those students who knew that they belonged to the group 'that never did their work' saw no way of moving out of this group, and having concluded that there was nothing left to gain or lose, they simply carried on wasting as much class time as possible.

A crucial irony in Charity's dual instructional strategy was that the physical environment, time schedules and techniques pertaining to non practical lessons contributed materially to undermining the procedures, conduct, activities and students' modes of participating and learning during the practical lessons. Non-practical lessons were held in the middle of an afternoon session, in the classroom so that there were no 'settling problems' of lateness or lack of chairs. Moreover, during these lessons, Charity gave only verbal instruction with emphasis on either dictating notes covering the experimental procedures, observations and conclusions of previous experiments or a lecture on a new topic with blackboard notes or handouts. The consistent 'giving' of notes had led students to expect that if they did not get information, procedures or indeed, results during practical lessons, Charity would, during a follow-up non-practical lesson, 'give' them everything. Therefore students knew that if Charity found incomplete work from practical lessons, the worst that could happen to students would be public counselling and what they referred to as abuse. Since Charity would not require students to repeat practicals and since she would ultimately dictate the 'correct' information during non-practical lessons, students saw no need to pay much attention during practical lessons.

DISCUSSION AND SUMMARY

At the beginning of this paper, it was asserted that perspectives of teachers and students influenced instructional processes. In the foregoing three sections data have been presented which has attempted to trace how perspectives by two

teachers, regarding the quality of their working environment, their authority within the totality of school management, and the capabilities of students as learners, were translated into tangible actions in the overall instructional strategy in the classroom. It was evident that in each case, the teacher's beliefs formed the critical reference points in structuring classroom work and in implementing avenues for students' individual and group participation in the teaching-learning process.

Lydia's class was made up of students some of whom had very fluent oral skills and were quite confident of themselves at the beginning of the year, while the rest were less fluent, less confident and unsure as to how to chart out independent ways of constructing meanings out of their classroom experience. Working within Lydia's relatively liberal instructional strategy which encouraged individualism, the more fluent students, the backbenchers, were able to quickly understand the major components of Lydia's strategy and begin to reshape their own participation in it. Initially, the backbenchers had influenced classroom events by focusing Lydia's attention on their contribution and thereby claiming a disproportionate involvement in dialogue as a result of their fluency in oral skills. The less fluent members of the class, the front and midbenchers, seem to have realized their disadvantage, and had sought to equip themselves with the ostensibly more acceptable anglicized accents used by the backbenchers.

But while the front and midbenchers had striven to learn the communication patterns of the backbenchers, the latter had consolidated their influence not only on classroom dialogue but also on the pace at which the teacher delivered content and on the types of activities that she regularly asked students to undertake. But in seeking to influence the pace of learning, the backbenchers had subtly exploited techniques that fitted well into Lydia's own instructional strategy in order to meet their own needs and, in fact, had convinced Lydia that they had no other purpose in exploiting such techniques except learning and consolidating what they had been taught. The techniques which were staged by students, and which might be considered disruptive to some students who did not willingly participate in them, were, however, mostly beneficial to the whole class, since their use forced Lydia to clarify fuzzy concepts, elaborate on explanations, bring more students into discussion and debate, and generally, contribute to the creation of a classroom atmosphere of ease where the expression of independent thought was encouraged. It could be argued, of course, that the techniques wasted class time by diverting Lydia from her mental lesson plan and by sometimes introducing subjects for general discussion which had dubious relevance to the biology syllabus. It is, perhaps, reasonable to assume that Lydia was really the final arbiter in this matter. Since she did not actively seek to put an end to such episodes, it can only be assumed that she regarded these episodes as useful to her overall instructional strategy and to the teaching-learning process.

In contrast, Charity's overall instructional strategy and the resulting participation strategies by students were characterised by three negative elements, namely; progressive disengagement from academic work by both the teacher and students; attention to minimal compliance by both the teacher and students; and teacher-student interactional and learning difficulties undergirded by a dubious class status system.

First, Charity perceived the majority of students in her class as generally dull and unmotivated. Charity's perspectives were supported by a school-wide belief that students who attended Urbana were generally selected from the bottom end of achievement of primary school graduates. Consequently, few teachers expected students to be able to tackle secondary school work with zeal and competence. Charity set relatively low expectations for students' academic achievement, and the school's continuing downward slide on performance on public examinations only served to re-affirm the credibility of the self-fulfilling prophecy of predicted failure. Although Charity and other teachers recognised that there were a few students who could do reasonable academic work, they were, nevertheless, convinced that what they regarded as the failure of school management to control discipline had pre-empted the classroom teacher's ability to help such students.

On their part, students learned that teachers in the school regarded them as dull and unmotivated, so that they progressively came to define their own ability to learn within similar terms. Students came to define their own participation in learning in terms of Charity's categorization, which served as a blinder to both students and teacher. A student who tried to work hard, even for a single lesson, had little chance to move to the 'good' category, since Charity kept several factors in mind whenever monitoring the work of individual students. And since it was difficult for any student to transcend the limitations of all these factors, all at once, students worked in a cycle of defeat. For Charity, the categorization became a blinder at two levels. For those students in the 'lazy group' the multiplicity of factors involved meant that there was no redemption. For students in the good group, a slip up on just one factor was sufficient to make them join 'the bad and lazy ones'. In the final analysis, there was no sure way of escaping from the cycle of regression for the whole class. Significantly, students came to learn that Charity's actions and reactions to their behaviours and work progress were highly predictable in her dual instructional strategy. They, therefore, developed, tested and perfected mechanisms by which they came to control events in the classroom by influencing the way Charity apportioned and used class time. Since Charity's emphasis was on first achieving social control in order to bring about a suitable classroom atmosphere conducive to teaching and learning, students also learned how to extend the temporal boundaries of this social control so as to reduce the academic demands made upon them.

Recent discussion about learning by high school students in the USA, particularly the urban poor, have expressed concern over a phenomenon in which schools and students appear to strike a bargain such that while classrooms are kept socially peaceful, this is achieved at a substantial cost to academic learning (Sedlack *et al.* 1985). Charity's practical classes were not socially peaceful, basically because of Charity's studious refusal to conduct instruction in the presence of what she saw as students' indiscipline. Yet it was clear that progressively, through the first and second year of research, Charity's growing capacity and desire to control students' social initiatives were matched by students' increasing capacity to organise events and crises which were disruptive of genuine instructional efforts. During practical lessons, Charity's ability to control discipline had become confused with teaching (Weisenbeck & Buchman 1981) while students' ability to keep Charity's attention focused on their social initiatives had become confused with learning. During non-practical lessons, social peace was achieved at the expense of genuine attempts to present, explain, discuss, explore, assess and understand biological concepts by students, and by substitution of merely dictating and copying notes by Charity and students respectively. Therefore, teaching and learning biology had been reduced to attending to the minimum requirement of 'holding a class'.

Several factors within the total school environment, in Charity's perspective, and in students' overall perspectives, contributed to both Charity's and the students' progressive disengagement from academic work. Shultz *et al.* (in press) in studying aspects of the cultural organisation of social relationships in communication in school and at home have noted that the literature presents four explanations of why recurring interactional and learning difficulties are encountered by students and their teachers as they engage in academic learning tasks. First, some arguments put the greatest explanatory weight on individual characteristics of the student, his inadequacy in terms of motivation, intelligence, or physical and emotional state. Second, some arguments seem to locate the main responsibility of teacher-students' interactional difficulties outside individuals, namely, in the structure of a class based society. Third, some arguments see teachers and students as equally responsible for producing each other's interactional difficulties and misbehaviour. Fourth, some arguments locate the problem of students' consistent misbehaviour in lack of knowledge by students and their teachers of one another's culturally learned expectations for appropriate social behaviour. This view assumes a mismatch between sets of standards of communicative etiquette. It is interesting that Charity used all the four explanations to account for the problems she and her students were experiencing in the total school environment and during the teaching-learning process as was evident in the content of her public counselling routine.

Two other factors concerning the physical and social environment of Urbana,

namely its location in what Charity and other teachers referred to as no man's land and its consequent lack of a solid supportive community, were seen by teachers as directly related to students' home backgrounds and their difficulties in learning. Unfortunately the conduct of various school routines was seen by Charity and other teachers as lending support to these disparities. If, as teachers constantly pointed out, many students came from home backgrounds characterised by difficult living conditions; had attended primary schools which had not allowed them the freedom to begin to learn independently; and now lived with parents or guardians who had little experience with secondary school education; then serious thought should have been given to students' academic needs. In a day school, where students spend a great deal of their time away from school at weekends and evenings, abilities such as: being able to learn independently; to work on assignments without help and support from colleagues and teachers; to organise an individual study timetable amidst a variety of chores and distractions; to whip up and maintain motivation for academic work in a non-academic environment of a home that may have very limited amenities and facilities; should all be some of the most important skills to be learned early in secondary school. There was no school-wide effort to help students to acquire such skills, except the allocation of 40 minutes a day, per class, for teacher supervised prep time. But in the absence of other supportive decisions such as the maximum number of assignments per subject per week, a sensible policy on size of assignments in all subjects including biology, and the relationship of assignments to class work, prep time allocation made no dent in the otherwise ambiguous exercise of monitoring students' academic progress at Urbana.

Many teachers, including Charity, believing that school management had failed to enforce overall discipline, had decided to spend a great deal of class time enforcing discipline instead of teaching. Students soon learnt that learning had to be done under strict supervision and a certain amount of harassment, and that if assignments were not done at home, they would always be done at school — as punishment — during class time. Many potentially competent teachers such as Charity, ultimately became ineffective classroom teachers since they had to spend much of their time unsystematically and automatically reacting to unanticipated situations, students' initiatives (Brophy 1979) and recurring students' crises in the social arena. Consequently, Charity and other teachers allowed only certain types of interactions between students and themselves and among students. Thus the recitation-style of teaching ensured that teachers ostensibly dominated the pace of instruction and the kind of subject matter presented (Anang *et al.* 1982). Yet precisely because this instruction allowed only certain interactions, students spent a lot of time attempting to introduce unacceptable modes of interaction. Similarly, because the interactions allowed by the teacher limited the kind and amount of assistance given to groups and individuals, students were able to

transform content and subject matter into inaccurate and incorrect misrepresentations of the original biological concepts.

More significantly, the instructional strategies adopted by Charity emphasized more the completion of homework and notes than the actual learning and mastery of new knowledge. By claiming that completion of assignments was evidence of students' readiness for new learning, Charity had displaced the goals of teaching and learning with the mere writing and reproduction of various texts by students. Ultimately, even when opportunities for new learning existed, as in the numerous practical lessons, Charity would categorise students according to her perceptions of their ability to grapple with content, and would subject students to incomplete and truncated instruction, ultimately making only mechanical and trivial demands on their intellectual abilities. Against this background, students had also come to under-estimate their own abilities to learn and sought to challenge teachers' authority not on academic grounds, but within the social arena of classroom discipline and order.

But what the data have revealed is an important aspect of effective peer learning among secondary school students. Research on peer learning in the classroom has traditionally concentrated on the kindergarten level where children where said to learn from each other skills such as general attentional support, referential specificity and effective communicative exchanges (Cooper *et al.* 1980, Corsaro 1985, Cadzen 1986). It was quite clear that in both Lydia and Charity's class, secondary school students influenced and 'tutored' their peers in more or less the same skills as those taught to younger children, particularly, in the area of effective communicative exchanges and access to classroom dialogue.

It is not possible to answer here an important question, namely how much biology content students in the two classrooms actually learnt and understood. But the preceding sections have emphasized the fact that unless the social agendas of teachers and the majority of students in the class coincide, little academic learning will actually take place. In Lydia's class, even though some students superimposed their own goals on Lydia's objectives, they achieved this within an overall instructional strategy designed to afford students as much opportunity as possible for working toward the three goals of teaching and learning biology in Kenya schools, namely: developing a scientific approach through practice of the scientific method and through learning and using various science processes; learning basic biological concepts; and acquisition of certain attitudes such as rationality, a scientific approach to the solution of problems in their environment, confidence, co-operation with others in the solution of problems in the community, and ability to communicate biological knowledge.

In Charity's class, a lot of time for learning biology was wasted in apparently negotiating a workable social agenda which was never really achieved during the practical lessons. This, coupled with incomplete instruction by the teacher,

followed by students' transformation of procedural instructions, resulted in a situation where the unsystematic practice of science process skills implied that neither the scientific method nor the relevant biological concepts were actually practised and learnt correctly. Charity and her students agreed on the social agenda for the non-practical lessons. But as earlier pointed out, agreement on the social agenda was achieved at the expense of genuine attempts to present, explain, discuss, explore, assess and understand biological concepts by students. Merely dictating and copying notes by Charity and her students had been substituted for genuine teaching and learning respectively. The goals of teaching and learning biology had been effectively reduced to the minimum requirement of 'holding a class'.

Utlimately, the nature of the school environment and personnel's perspectives of their roles and abilities are crucial factors in academic learning. At National the school management had sustained an overall environment of pragmatic support and recognition of authority to teachers as individuals and as 'the staff'. Consequently individual teachers such as Lydia counted on the recognition and support of management in their diverse roles as administrators, classroom teachers and disciplinarians. Such pragmatism in the environment probably encouraged teachers to develop more balanced perspectives of the abilities of their students so that they were able to set relatively reasonable social and academic expectations for students.

At Urbana, management's relatively fuzzy vision of the school's values and work procedures resulted in disregard for teachers' individual and collective authority as administrators and disciplinarians. As a result, teachers felt inadequate in their teaching roles and therefore developed an exaggerated sense of their need to impose their authority and discipline on students during class time. In a situation characterised by non-responsive management, where teachers operated by force of habits and perspectives constructed according to old timers' beliefs; and where students' overall intellectual, economic, social and psychological backgrounds and needs were neither appreciated nor encompassed by school routines, the social environment became a severe constraint to the achievement of the goals of schooling. On one hand, teachers and students who adapted and fitted into the existing school environment found themselves in a cyclical reproduction of the same beliefs and practices, few of which contributed to intellectual and social growth. Precisely because they had adapted so well, they did not strive to inject change into the workings of the school and classroom environments. On the other hand, teachers such as Charity and her students who had not adapted very well to the school's existing social environment spent most of their class time on devising strategies and counter measures that would enable them to survive one another on a daily basis. Even though such strategies embodied elements of change, these fragmentary and combative initiatives could

hardly be counted upon to make a dent in the pernicious social environment which had become a trap in time and space for all who worked at Urbana.

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