Feuerstein's Mediated Learning Experience (MLE) and Self-concept of Biology Students

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I declare that FEUERSTEIN'S MEDIATED LEARNING EXPERIENCE AND SELF-CONCEPT OF BIOLOGY STUDENTS is my own work and that all the sources I have quoted have been indicated and acknowledged by means of complete references.

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ABSTRACT

This study focuses on the underachieving student. In particular, it examines the effect on a group of underachieving biology students, drawn from three standard nine classes in a girls' secondary school in Elsies River, of a short but intensive period of mediated learning experience.

The study was designed to show whether Feuerstein's mediated learning experience (MLE) could improve the self-concept of biology students.

The MLE intervention took the form of eight 45-minute sessions with the group of 10 students, with two sessions a day over a period of four days. The sessions were designed in accordance with the essential, and some non-essential, criteria for MLE.

The intervention was preceded by a test of the self-concept of the students, using the Self-Concept Inventory developed by Vrey & Venter (1983). Following the intervention, the students' self-concept was measured again, using the same instrument.

A significant improvement was observed between the first and the second measurement of self-concept.

In addition, the students were given an opportunity to give their view of the intervention by means of the MLE rating scale developed by the Cognitive Research Programme of the University of the Witwatersrand. All of the students reflected positively on the experience.

The study provides evidence that those students whom teachers often give up on - or who give up on themselves - are modifiable in the ordinary school setting through MLE. They can progress from being passive acceptors to active participants in the learning process, with a concomitant improvement in self-concept.

KEYWORDS

MEDIATED LEARNING EXPERIENCE

SELF-CONCEPT

CELL DIVISION

UNDERACHIEVERS

BIOLOGY EDUCATION

INTRODUCTION

According to Sanders (1993:13), most teachers are not happy with the way biology is being taught in schools. This observation is based on comments and papers at conferences by teachers and academic staff of tertiary institutions.

The lengthy content-laden syllabus leaves little time for practical work, during which students might discover and observe and interpret data for themselves. The syllabus fosters undesirable teaching methods which involve only the transmission of facts, rather than inquiry or interactive methods of learning. No guidance is given for teaching students to solve problems in biology.

The author states further (Ibid:15) that "one of our very real problems in South Africa is that the matric biology exam focuses on the testing of factual knowledge at the lowest cognitive levels, in spite of the fact that 40 percent of the higher grade exam is required to assess higher cognitive skills."

This suggests that those involved in setting the examination papers are not clear about what these "higher cognitive skills" are, or that they have little confidence in teachers being able to teach such skills.

The problem is complex and significant changes in the curriculum or the nature of the examination will no doubt have to await a change in policy on the part of the new educational authorities.

The ideal situation would be for the teaching of thinking skills to become a part of teacher training and a compulsory part of the curriculum. This would be a big step in the direction of an "emancipatory curriculum" (McKay and Rom, 1993:137), or a curriculum free of what Morrow (1989:168) calls "doctrinaire" thinking - the opposite of critical thinking.

Teachers often encounter appeals to educate the "whole" child. (Gunther, 1988:11; Vrey, 1979:216; Cawood, Strydom & Van Loggerenberg, 1980:9). One aspect of this is the positive development of the affective domain of the child.

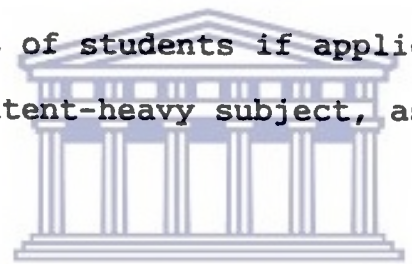
But the priority in the web of schooling seems to be on equipping students with basic skills - those of writing, reading and arithmetic. Along with this goes the "mastery" of certain subject contents. Very little time is allocated to reflecting on the processes taking place during the learning activity. Syllabi are comprehensive in setting out the learning materials, but little attention is given to instruction on how to learn, or how to facilitate meaningful learning, in the various school subjects.

Nickerson, Perkins and Smith (1985:6) say "it is an indisputable fact that many students do not acquire the ability to think effectively as a consequence of their educational experience."

Students may pass their school subjects without developing effective thinking skills. Research at the University of the Western Cape by Weil (1989) and Mehl (1985) indicated that although students achieved the entrance scores for particular subjects - accounting and physics in these studies - they experienced difficulties during their first academic year.

The Feuersteinian theory of mediated learning experience (MLE) holds out the promise to teachers of being able to teach thinking skills to students, irrespective of the subject being taught or the perceived "intelligence" or otherwise of the students.

For the teacher of biology (as no doubt for other subjects too) the critical question is: Can Feuerstein's MLE improve the thinking skills of students if applied within the context of this content-heavy subject, as presently defined by the curriculum?



For the biology teacher concerned to educate the "whole" child, including the affective realm, a key question is: Can Feuerstein's MLE assist in improving the self-concept of students whose educational experiences have left them with a feeling of inadequacy?

The research outlined below is an attempt the answer both these questions. The outcome suggests that they can both be answered in the affirmative.

CHAPTER 1: MOTIVATION FOR THE STUDY

BIOLOGY IN THE CLASSROOM

Biology is often called a "difficult" subject, full of foreign words and worms and snails. It is true that biology has many terms which students find difficulty in remembering and relating to. Consequently in the biology classroom, "remembering" is often emphasised and "learning", incorporating skills required for problem solving in biology, does not feature prominently enough.

Formal testing of biology students by the author, in all secondary school standards over the past nine years, reflects a general weakness in problem solving patterns where students are confronted with tasks to be completed.

There could be many reasons for this, but observation suggests that the following are significant contributing factors:

The attitude of students to the subject, which is compulsory at the school where the research was conducted, is not a healthy one. The subject is viewed as an isolated body of knowledge which the students feel

they have to master. This "mastery" of information brings us to the second problem.

Students invariably equate "learning" with memorisation of the facts. There is little interaction with the information presented and students rely heavily on their memory for class tests, practical tasks and examinations. There is thus a strong prevalence of "rote-learning" among biology students.

Ausubel, Novak and Hanesian (1978:144-146), see meaningful learning as taking place when new information is "relatable and anchorable to relevant established ideas in cognitive structure. They can be related to existing ideas in ways making possible the understanding of various kinds of significant relationships."

Students do not view the information as related to their existing biological concepts. Thus no combinatorial, relative or derivative types of relationships are made with their existing biological schemata.

The temporal span of retention is thus reduced and early information has to be "relearned" or "rememorised" for test and examination purposes. A compartmentalistic view of subjects is encouraged by the structure of the different school subjects.

In revision sessions, students often respond that they have not "gone over" the old work again and thus are unable to answer adequately those questions relating to earlier work in the syllabus. This probably means that they have not "rememorised" chunks of the earlier work.

For clearer insight into the issue of biology learning it is necessary to take a closer look at the microcosm of the classroom - the various forces at play that drive and determine the nature of the learning process in a particular subject.

Traditionally, teachers are concerned about what students learn and their scores in examinations for the subjects. To contextualise the problem, schools in the townships are usually overcrowded and teachers overworked. Set syllabi have to be completed within a given time and students of various abilities and backgrounds are grouped together.

This often leads to a situation where the relatively advantaged student becomes the focus for the teacher and her lessons, while the underachievers suffer neglect. Despite the organisational and structural problems that exist in our schools, teachers still feel under pressure to produce good results.

The issue of streaming versus mixed-ability grouping has its implications for the teachers in our schools. Although they

might agree with Kelly (1978:154) that students with learning difficulties must be seen as an intergral part of a mixed-ability class and not as special cases, not all teachers are skilled at facilitating such a mixture of abilities.

Traditionally, teachers are trained to teach a homogeneous group of students, with special courses offered for teachers interested in the "special" child. Secondary teachers are not generally concerned with the teaching of basic skills of reading and writing, yet there are students who have deficient reading and writing skills. These students, due to the educational system, have not been identified as having learning problems and have proceeded to graduate into secondary schools.

There is a marked shortage of facilities for the adolescent in secondary school who is experiencing difficulties with learning and problem solving. Mann, Goodman & Wiederholt (1978:2) summarise the situation when saying that "the field of learning disabilities... has been largely committed to developing basic skills in young children. This commitment was based upon the reigning philosophy of intervention programs - the earlier the better."

In our schools it is practically impossible to do a fair assessment at the end of a lesson to determine how each student has coped with the information. At this specific

school, the average time of 35 minutes per lesson puts further constraints on teaching and learning.

For biology in particular this has implications. A rough assessment suggests that students have to learn an average of five new biological terms per lesson. The general method of daily assessment is in the form of homework given, which students solve not by drawing on their experience of the lesson but by simply restating the answers as they appear in the textbooks - very often verbatim.

It has become clear to me during the past nine years of teaching at this particular school and through contact with other biology students that there are difficulties peculiar to the teaching and learning of biology as a secondary school subject.

According to the Education Bulletin Special Edition SS 9/86 (1986:1), the objectives of the Senior Certificate Biology course are the following:
"The objective of the syllabus is to provide a course which will develop in the pupils the following attributes:

1.1 an understanding of the fundamental principles based upon the study of living organisms
1.2 an awareness of biological relationships

1.3 an ability to make critical, accurate observations of biological material and to make meaningful records of such observations

1.4 an ability to analyse and to evaluate biological informaion, to formulate hypotheses and to suggest procedures to test them

1.5 an ability to communicate clearly when reporting information and expressing ideas

1.6 a respect for all living things and an urgent awareness of man's responsibilities in the preservation of life

1.7 a love and appreciation of South African fauna and flora and a recognition of the urgent need for nature conservation.

Although it is clear from these objectives that the syllabus does aim at teaching cognitive skills - "understanding", "awareness of relationships", "critical and accurate observations", "formulate hypotheses", "communicate clearly" - nowhere does it provide any guidelines as to the teaching of those skills. The introduction of the syllabus is the only section that addresses aspects of cognition. The rest pertains to the content and suggested teaching aids to a limited extent.

The "how" of learning is seriously lacking in biology teaching. The syllabus encourages the "here-and-now"

approach to biology teaching with a critical shortage of workshops or supplementary material available to teachers.

There are particular areas in the syllabus that are clearly related to one another - cell division, genetics, DNA replication and protein synthesis - but these are not set out as such. And these are the very topics that senior biology students experience particular difficulty with. No metacognitive activity is outlined or encouraged where students pause to deliberate on their thinking patterns and problem-solving skills.

There is no initiation or orientation of the beginning biology teacher. The interpretation of the syllabus, as well as its implementation, is not adequately guided by those responsible for doing so.

RATIONALE FOR THE STUDY

During an assignment as part of this degree programme, five students were given a problem-solving exercise on the section of genetics in the Std 9 syllabus. All except one student could recognise the correlational nature of various subsections of the subject. It was also during those clinical interviews and other assignments that insight was gained into how the underachievers tackled problems in biology.

These students presented themselves as passive recipients of information with disastrous effects on their thinking and problem-solving abilities in biology. Students were unable to draw on their own past knowledge of cell division for the genetic problem presented. In fact they never perceived the two as being related. They could not confidently make decisions and plan their course in the problem-solving activity.

The analysis was performed within the Feuersteinian framework and it was decided to continue this study in the same paradigm, the reasons for which will be discussed further in the section on theoretical framework.

During discussions with students on broader biological topics, the author was often taken aback by the insight shown by the low achievers at different times during the problem-solving process. It was during those informal discussions that an incongruity emerged between these students' weak performance at subject level and their brief moments of competence displayed at other times during the general discussions on easier subsections of the work.

In keeping with the Feuersteinian framework, these "moments of competence" were interpreted not as lucky strokes, but as an indication of the potential or the ability of those students given the opportunity of exposure to mediated teaching and learning experiences.

An apect of motivation for this research is what Feuerstein, Rand and Rynders (1988:xi) term "the principle of the possible". This is that whatever the student can be motivated and educated to do successfully just once becomes the level of reasonable expectation for the future.

ADOLESCENT UNDERACHIEVERS

Does a student do badly due to a negative self-concept or does a student have a negative self-concept due to repeated failure? According to Purkey (1979:20), this is an unresolved issue but "there is ample evidence to support the conclusion that unsuccessful students... perceive themselves and their relationships to the world around them differently than those who succeed." The author cites Durr & Schmatz' (1964) report that underachievers were more withdrawn and tended to lack self-reliance, a sense of personal worth and a feeling of belonging.

Adolescent underachievers are at a stage in their lives where they are faced with challenges that may negatively affect their learning. These students have often suffered years of despair, frustration and academic rejection. Gergen (1971:51-52) states that an individual's level of self-regard may be vitally affected by the social and educational surroundings. For the unsuccessful student the environment

in which he/she spends half of the waking day is not conducive to the formation of a positive self-concept.

Burns (1982:162) also contends that "cognitive development aids the adolescent in understanding himself and his world, enabling him to integrate all his experiences into a more comprehensive self-concept." If a greater part of those experiences, that of school life, is negative it has adverse effects on the construction of a healthy self-concept. This is particularly true of the underachieving adolescent.

Lerner (1981:123) is of the view that a problem with learning may influence every aspect of the student's world. She says that clinical teaching can provide therapeautic results and that progress in learning and problem-solving has a beneficial effect on personality, enhances feelings of self-worth and rekindles interest in learning.

Low-achievers are often labelled as "dim" or "stupid" by teachers and fellow students alike. This labelling has implications for the students' self-concepts as well as for their performance academically, perpetuating a feeling of futility that envelops the student and often the teacher too. Lerner (1981:42) sees labelling as stigmatizing which can prove to be a self-fulfilling prophecy that imposes limits on teacher expectations and reinforces a student's learning difficulty. She states that a child's cognitive

abilities are influenced by environmental conditions and experiences.

The present educational crisis and context contribute to low achievement and high failure rates. Within this educational culture it becomes easy for students and teachers to believe that it is impossible to bring about change in cognitive performance of students. In this cycle, many students who have the ability to enter tertiary level education are lost without their potential ever being realised.

CHAPTER 2: DESIGN OF THE STUDY

The research methodology of this study is more of a qualitative than a quantitative nature. It draws on a psychometric instrument of measuring self-concept, a series of intervention sessions and a rating scale for the subects' evaluation of the intervention. There is no elaborate statistical manipulation of data, but a comparison is made of self-concept measurements before and after the intervention.

DEFINING THE POPULATION

A group of 10 low-achievers were identified, using the following criteria: a survey of their biology results for the past two and a half years, including seven major examinations, class test and practical test performances. (The researcher is in the position of having taught this group biology for the last two and a half years.)

STAGE 1: CONSTRUCTION OF THE MLE QUESTIONNAIRE

A questionnaire on the MLE of these students was constructed, using guidelines based on the research of Klein (1991:213-240), Mintzker (1991:259-270) and Lidz (1991:271-285). The research of Sewell and Price (1991:294-314) was also useful in designing the questionnaire. Students were given approximately 15 minutes to complete the questionnaire. (See Appendix 1A.)

This questionnaire was constructed with the hope of gaining insight into the amount or level of MLE that these underachievers might have been exposed to.

According to Mintzker (1991:259), inadequate MLE occurs as a result of two broad categories of factors. One being characteristic of the recipient of the mediation that impairs the capacity to benefit from the exposure to MLE. The other category consists of the environmental factors which interfere with the capacity of the mediating agents to perform their functions.

Those mentioned as belonging to the latter category are "cultural discontinuity and social disruption caused by poverty or political oppression". The author states that in conditions of struggle, parents tend to restrict themselves

to the immediate physical and survival needs of their children.

It is with the last broad category in mind that the questionnaire was designed. Each of the set questions, when positively responded to, implies the presence of at least the three prerequisites of MLE. For example: "I often sit and chat to my parents" or "I am often consulted on household matters". The mediation of meaning, transcendence and reciprocity are strong possibilities when the above does happen in the home of a student.

Sewell and Price (1991:296), refer to the extensive documentation of the persistent low academic performance among children of low socio-economic status. They mention further that "the style of the mother-child interaction is a critical factor influencing cognitive growth, especially among the high-risk population." Questions relating to the above aspect are numbers 2, 5, 7, 9, 10, 11, 12, 15 and 20.

The authors speak of the role of language in the interactive process, stressing the importance of the quality of communication between the mother and the child. Questions pertaining to this aspect of cognitive development are 1, 2, 6, 7, 12, 13, 14, 16 and 17.

Questions 3, 8, 10, 13, 14, 18 and 21 deal with what Feuerstein (1980:25) refers to as cultural transmission as a category of MLE. Through positive interaction with parents, relatives and grandparents the child gains access to information which would be unavailable to her/him if not communicated by the more initiated and experienced generation.

Lidz (1991:272-284) gives a useful survey of the literature that provides insight into the effect of the child's environment or socioeconomic status on the cognitive abilities of the child. The author reports that research has indicated that parents who were generally non-punitive had the most competent children.

STAGE 2: SELF-CONCEPT MEASUREMENT

The self-concept of the group was measured, using the SELF-CONCEPT INVENTORY of Vrey & Venter (1983b). (See Appendix 2.)

The scores were tabulated for comparison with a self-concept score after intervention had taken place. The instrument was selected as it was developed in a South African context, has been widely used and has reliability and validity co-efficients. In fact it is one of eight instruments used to develop a self-description inventory for African students as

it contains aspects that relate to the African adolescent life experiences. (Mboya, 1993:184)

Although it is accepted that self-concept is a multidimensional construct, (Burns, 1982:208-203; Marsh, 1992:35-42; Mboya, 1993:189-191), it was felt that a measurement of adolescent global self-concept would suffice for this study.

STAGE 3: THE INTERVENTION

The construction of the model draws on the examples and guidelines provided by Kopp-Greenberg (1991:241-258) and Kopp (1985). The content of the intervention was the cell division section of the Std 9 syllabus.

Feuersteinian intervention usually takes place in the content-free Instrumental Enrichment Programme. Nowhere does this study aim to use any of these instruments, but it shares the same convictions and framework. What has been done in this study, is to take Feuerstein's suggestion for further research and to provide content to Mediated Learning Experience. (Feuerstein, Rand, Hoffman & Miller 1980:399) This model will be the basis of the intervention. The details of the model are discussed in Chapter 6.

Arrangements were made with the school administration and parents of the students to implement the project at the school over a period of about two weeks. This was done in eight 45-minute sessions after school.

STAGE 4: A SECOND SELF-CONCEPT MEASUREMENT

A second measure of the students' self-concept was made, using the same instrument, after the intervention. This score was also tabulated for comparison with the first self-concept score. From a comparison of the results, conclusions are drawn about the relationship between Mediated Learning Experience and self-concept.

STAGE 5: THE MLE EVALUATION

Each student was given a condensed version of the MLE Rating Scale as set out by Skuy, Mentis, Dunn, Durbach & Arnott (1991:60-65). (See Appendix 4A for the MLE Rating Scale.)

The MLE rating scale provides the opportunity for students to rate the quality of mediation offered by the mediator. An analysis was made of the responses. (See Appendix 4B.)

CHAPTER 3: LITERATURE SURVEY

MEDIATED LEARNING EXPERIENCE

There has been ongoing research on MLE with some promising reports. Nickersen, et al.(1985:155-161) report that findings in the use of MLE are impressive. The authors comment on the effective use of MLE in countries like the United States, Canada and Venezuela where the IE programme has significant impact on students' lives. Kopp-Greenberg (1991:245) also states that MLE has been used effectively in Instrumental Enrichment and improved cognitive functioning in adolescents and adults.

Feuerstein, Rand & Rynders (1988) give accounts of their success with "retarded" performers, some of whom were Down's Syndrome persons. These case studies give support to the theory and practice of MLE.

"The more a child is subjected to mediated learning experiences, the greater will be his capacity to benefit from direct exposure to learning. On the other hand, a lack of MLE will produce an individual who will benefit very little from direct encounters with learning tasks." (Ibid:58)

Keane and Kretschmer (1987:49), in their research with deaf children and MLE, see mediated learning experience as helping individuals to learn how to learn and thereby enhancing their ability to adapt themselves to change.

In a South African context, the work of Skuy et al. (1987) indicates that individuals with learning problems gained much from mediated learning. Mehl (1985;1991) shows that science teaching can gain important principles from MLE theory.

Skuy, Lomofsky, Fridjohn & Green (1993:92-108) report that MLE, specifically the Instrumental Enrichment used with preservice teachers in a South African Teacher Training College, showed an improvement in the cognitive functioning and the self-confidence of the students and provided the student teachers with a facilitative approach to their prospective pupils.

Rutherford (1989:116) claims that with a mediational teaching style, students improved in the area of attitude, behaviour and motivation.

Haywood (1993:27-36) provides useful guidelines on a mediational teaching style and its implementation in the classroom. He concludes by saying that there are as many ways to mediate cognitive functions as there are good

mediators and also that good mediators use their personalities and feedback from the students to regulate their own behaviour and select mediational strategies.

Tzuriel (1991:95-115) presents a transactional approach wherein the affective-motivational aspects are addressed in the framework of MLE and cognitive modifiability. He portrays a circular relation between the cognitive and the affective-motivational realm. He suggests that rather than to analyse the sources of presented difficulties, the mediational approach is to work integratively on both levels. (Ibid:100)

This suggestion seems to echo Purkey's (1979:15-23) contention that academic performance and self-concept are intricately related. Tzuriel (1991:100) speaks in a broader sense when he says that "experience with most individuals shows that small modifications in either the cognitive or the affective-motivational realm immediately affect the other realm, which in turn becomes reciprocal."

SELF-CONCEPT AND ACADEMIC ACHIEVEMENT

According to the literature, research has shown that there exists a definite relationship between self-concept and academic performance, but as Sonn (1987:138) observes the

cause and effect relationship cannot be stipulated. Vrey (1978:115) also stresses the interaction between self-concept and achievement. He states clearly that there is no referral to cause and effect but "there seems to be a strong mutual relationship between these two phenomena". He cites Brookover (1965) as finding that the self-concept of children was related to corresponding changes in scholastic achievement.

What can be stated clearly though, is that "the relationship between self-concept and achievement is reciprocal" (Burns,1982:227). This implies then that self-concept manipulation can influence performance and that conversely, performance manipulation can influence self-concept. It is from the latter perspective that teachers are strategically placed to have an influence on both academic performance and self-concept.

Gurney (1987:134) states that from research it is difficult to say which is the causal agent, but that it is prudent for teachers to work both on achievement and self-concept at the same time. He reports a finding that the provision of remedial help functions to improve academic performance as well as self-concept.

Shaw, Edson & Bell's (1960:193) research indicates that in high school students there is a marked difference in the

self-concept of high achievers and low achievers. It is thus expected that a low self-concept is held by the students paticipating in this study, as their performance was measured as being consistently low for two and a half years. Purkey (1979:22-23) supports this view that low achievers, due to their experience of failure, generally have lower self-concepts than do higher achievers and will consistently have a smaller chance of performing better.

Vrey (1979:91-92) explains that school is a place where the child constitutes new relations. The effect that this has on his self-concept depends on his experience of efficiency, adequacy and success. An implication of this is that if this experience is negative it has an adverse effect on the self-concept. This has its bearing on the adolescent who has had repeated experience of failure. The author (Ibid:115) also argues that the self-concept is always subject to change depending on the experiences of the person. It follows then, although not simplistically, that positive school experience should alter the self-concept of the low achieving student.

It is in view of the above that the low achievers selected for this project were manipulated on a cognitive level within the Feuersteinian framework with the impact on the self-concept determined subsequently.

To my knowledge, there has been little investigation into the effects of MLE on the self-concept of students and specifically on the enhancement of the self-concept of underachieving students through the mediated teaching of biology.

Messina (1993:74) concludes that his research into reading comprehension and MLE supports the Feuersteinian view that MLE is the basis for building sound cognitive functions and future structural cognitive modifiability even in adolescent years. He states that the mediation in his research encouraged higher attainment by students. The author also notes that an aspect of his research "het die leerlinge se self vertoue en selfbeeld versterk" (Ibid:75) He also recommends a teaching model where the student sees the teacher as mediator, facilitator, adviser and friend. (Ibid:76)

CHAPTER 4: THEORETICAL FRAMEWORK

FEUERSTEIN'S THEORY OF STRUCTURAL COGNITIVE MODIFIABILITY AND MEDIATED LEARNING EXPERIENCE

The structural cognitive modifiability (SCM) theory is based on the assumption that people have the unique capacity to modify their cognitive functions to adapt to changing demands. Feuerstein et al. (1980:9) insist that in order to understand cognitive modifiability it is necessary to appreciate the difference between "structural" and "other kinds of change occurring in the course of development."

The authors state that cognitive modifiability refers to changes in the state of the organism, brought about by a deliberate program of intervention that will facilitate the generation of continuous growth by rendering the individual receptive and sensitive to internal and external stimulation. This means that if structural change is brought about, it will affect the individual's future reaction to stimuli.

The process of cognitive modifiability is seen as possible irrespective of the three conditions often considered as obstacles to change. These are: etiology, age and severity

of condition. The authors insist that, except for severe instances of genetic and organic impairment, individuals are open to modifiability at all ages and stages of development.

"The formulation of insufficient MLE postulates that cognitive impairments emerge not necessarily nor directly because of poor genetic endowment or organic deficiencies. They result instead from the absence, paucity, or ineffectiveness of the adult-child interactions that produce in the child an enhanced capacity to become modified, that is, to learn." (Feuerstein et al. 1979:70)

Feuersteinian theory, (Feuerstein et al.,1980:6-9) makes a cogent attack on the notion of intelligence being static and unchangeable, with the IQ-testing movement seen as one of the major factors contributing to such notions. The work of Piaget is seen to have demonstrated that the essence of intelligence lies not in its measured product, but in its active construction by the individual, thus exposing the myth that intelligence is fixed at birth.

The three main characteristics that describe structural cognitive modifiability are: permanence, pervasiveness and centrality. (Tzuriel & Haywood,1992:9) Permanence refers to the durabilty and endurance of the cognitive changes over time. A structural change is one that will remain in the

individual's cognitive repertoire ready for utilisation when required.

Pervasiveness refers to an assimilation and diffusion process in which the changes in one part significantly affect other areas of the individual's functioning.

Centrality refers to the self-perpetuating, autonomous and self-regulating nature of cognitive modifiability. "Once activated, the dynamics of modifiability propel the individual along a course of development that could not be anticipated on the basis of his previous performance." (Feuerstien et al, 1980:3) Structural cognitive modifiabitlity is brought about by mediated learning experience (MLE).

Feuerstein, et al. (1980:19) explicate the relationship between cognitive modifiability and MLE as follows: "Our contention is that mediated learning experience is the foundation on which cognitive structures are built and that even as late as adolescence, major and significant cognitive modifications are possible."

The theory of Mediated Learning Experience (MLE) was developed over the period of 1950 to 1963 during which Feuerstein worked with large numbers of children with problems of dysfunctional academic and intellectual

abilities. With years of observation, the theory of MLE was consolidated, pointing to the role of a human mediator in the development of the cognitive abilities of learners. In 1963 Feuerstein delivered a series of lectures at international universities at which a formal presentation was offered to audiences of behavioural scientists deeply involved in the study and remediation of socio-culturally disadvantaged populations. (Feuerstein, Klein & Tannenbaum; 1991:5)

The authors define MLE as a quality of interaction between the organism and its environment, the quality of this learning experience being ensured by the interposition of an initiated intentional human being who mediates the stimuli impinging on the organism. The mediator acts as a selector of stimuli from the environment and then "frames, filters and schedules them." (Feuerstein, Rand, Hoffman & Miller, 1980:16). By this process the child forms learning and behavioural patterns which detemine his/her capacity to become modified when later experiencing direct stimuli.

According to Feuerstein (1980,1991) another ingredient, the human mediator, is added to the Piagetian formula of "stimulus-organism-response" (S-O-R). Feuerstein,et al. (1991:7) present the formula, taking into account the human mediator, as follows: Stimulus-Human-Organism-Human-Response (S-H-O-H-R). This model depicts the human interposition

between the environmental stimuli and the child. The human mediator determines that the individual experiences the stimuli in a certain manner. MLE is thus the factor that determines differential cognitive development in individuals.

Feuerstein et al. (1980:59), argue that MLE does not refer primarily to the "what, where and when" of an interaction. It is rather the "how" of human interactions that characterises MLE. This implies that not all human interactions have a mediational value. The authors give the example of a "no" instruction by parents to a child to remove itself from imminent danger. The desired response is procured, but this does not aid the child in making future decisions about the sources of danger.

The same can be said of learning that takes place in a classroom. The teacher may be satisfied that students are familiar with particular content, but often there is no guarantee that the student will be able to solve problems in the related area or apply the knowledge gained. This, of course, is more possible when at least the first three prerequisites of a mediated interaction are satisfied.

There are some 11 criteria of MLE interaction. The first three of these criteria are considered to be essential

characteristics that describe and define all MLE interactions.

1. Intentionality and reciprocity

The intention of the mediator affects three dimensions of the interaction: the child, the mediator and the stimuli. According to Feuerstein, Rand & Rynders (1980:62), MLE encourages the child to perceive stimuli with clarity and precision. It follows then that a teacher, motivated by an intention to have particular knowledge adequately perceived, transforms the stimulus, rendering it more salient and attractive to the student. The mediator will also change the state of the child, rendering him more vigilant.

Intentionality in the classroom transforms the triangular relationship - teacher, stimulus, student - creating within the student prerequisites for cognitive modification. Intentionality also reflects the desire of the mediator to shape the child's functioning in a direction in keeping with his culturally determined values, goals and habits.

Feuerstein, Klein & Tannenbaum (1991:17), explain that any content, from the most elementary to the highest form of mental activity, can bear the special quality of MLE if shaped by intention. They go further by suggesting that the best way to evaluate the mediational quality of an

interaction is to detect the transformation produced by the intention.

Teachers can ask themselves "how different is the mediated event from the regular one?" For teachers it is especially useful to use the following guidelines to convey intent and reciprocity - amplification of voice, gestures, repetition, use of colour or any method to make the mediated stimulus seem different from a regular classroom one.

Within the constraints of the classroom, the mediation of intentionality and reciprocity could be totally lost as teachers are more than overloaded with syllabus work to be covered. It could become an effort on the part of the teacher to sustain a teaching style that conveys reciprocity and intentionality for each part of information dealt with. In larger classrooms, typical of the township schools, the possibility of distraction increases, which could counteract the mediational efforts of the teacher.

The transmission of intentionality and reciprocity has its positive influence on the self-concepts of students. Tzuriel & Haywood (1992:10) see the reciprocity aspect as being essential for the development of basic feelings of competence and self-determination. "Interactions imbued with reciprocal intentionality assist children to realize that their actions influence other people's behaviour and foster

their organismic belief that they can be agents of change." (Ibid:10)

Burns (1982:247) says that teachers' treatment, beliefs and expectations are part of the students' experience and thereby influence the students' developing self-concept. Through mediating intentionality and reciprocity - verbally and non-verbally - a teacher transmits to the students their status in the classroom and the message of the teaching is that the teacher views the students positively. By ensuring that the students "see" what he sees and "hear" what he hears in the lesson, the teacher acknowledges the students and forms a relationship that is inherently reciprocal.

2. Transcendence

Feuerstein, Rand & Rynders (1988:64) believe that "an MLE interaction is never limited to the immediate need that elicited it". The authors state further that of all the components of MLE, it is transcendence that is the most humanising.

The goal of a lesson could be to equip students with skills to adequately solve problems within an area of content. The intention of the teacher to make the student feel competent, does transcend the immediate or prime goal of a lesson.

The teacher can explicitly transcend the primary goal of a lesson by relating various bodies of knowledge to one another; various subsections of the syllabus for a particular standard or of different standards. Here there is the explicit awareness on the part of the teacher of the intention to "transcend". This is easier done if the teacher is familiar with the subject as taught across the standards. This encourages the students to think beyond their immediate experience of the subject and also when they are further in the curriculum, to reflect on the earlier work done in the subject. This fosters familiarity and interaction with the subject that makes a student feel less isolated from the subject matter.

As a humanising agent, successful transcendence in MLE in the classroom fosters a positive view that the student forms of himself or herself in relation to the subject.

3. Meaning

According to Segal, Chipman & Glasser (1985:49), a learning interaction is not neutral, but has affective, motivational and value oriented significance. The teaching interaction in

the classroom also bears these characteristics. In cell biology the importance of cells, their functions and activities can be highlighted.

It is the mediation of meaning that Feuerstein et al. (1988:66;1991:24) call the "energetic" dimension of the interaction. It is the "why, what for and other questions related to causal and teleological relationships and reasons for something to happen or to be done."

In the classroom the situation arises where students are presented with information of which the implicit meaning is often lost. Within the constraints of the class environment the meaning or reason for doing a particular section of a syllabus is not made clear enough by teachers. Students just see the chunks of information within the "biology class" context - divorced from their existing schema. This fact that teachers are not always "animated by a need to mediate their own meaning has a negative outcome... as it is the effect of a lack of emotional-affective links between them and their... pupils." (Feuerstein, et al. 1991:26)

This implies that teachers who feel motivated to mediate meaning to their students foster a positive link between themselves and their students. Those teachers acknowledge students as worthy of knowing the reasons for knowledge being imparted. Again the successful mediation of meaning

has an inherent effect on the students' view of themselves. Mediation of meaning enriches the quality of the interaction between teacher and students. Students will come to feel that beyond the formal relationship there is a "link" between them and their teacher. The teacher draws on his or her own culture as well as that of the students to provide meaning to the activities of the classroom.

The teacher, by mediating meaning, at the same time transcends the immediate goal of the interaction in the lesson and cultivates within students the need to look for "meaning" in the wider sense of the term. (Feuerstein,et al. 1991:26) The authors emphasise that individuals devoid of an orientation to search for meaning are disadvantaged in many respects: cognitively, emotionally and in all ways which affect the motivational, energetic dimensions of life.

Teachers are in a position to have powerful influences on the self-concepts of students by mediating meaning and nurturing in students a need to search for meanings in broader school life. The "I have nothing to lose; So what" attitude of students could benefit from the mediation of meaning. Many students who have repeated experiences of failure feel that they are at school through no choice of their own and their main aim becomes to get out of the system.

PARAMETERS OF REINFORCING MLE

The parameters discussed below are not essential for MLE, but are responsible for the diversification of cognitve styles, creating great diversity in human existence. (Feuerstein, et al. 1991:28). The non-essential parameters combine with the essential parameters to make interactions between adults and children that of MLE.

1. Mediation of a feeling of competence

Feuerstein et al. (1988;1991) distinguish between competence and a feeling of competence. This distinction highlights the importance of the presence of a mediator. The authors feel that a feeling of competence is not a direct outcome of an individual's perception of his/her capacity, but that this feeling is dependent on the intervention of a human mediator who interprets competence and turns it into an awareness, feeling and consciousness of that competence. "The feeling has to be reflected in the views of others and in the interpretation given by them to one's behaviour as manifesting competence." (Feuerstein et al. 1991:30)

In this regard the teacher has a central role to play in the classroom experience. In terms of self-concept, the teacher is the significant other providing a continuous flow of

feedback to the student that invariably has an effect on the self-concept. The authors view the present system of evaluating and grading of students as being product orientated, and feedback to the student as often mechanical. The teacher adds the human element of the student's sense of achievement.

2. Mediating regulation and control of behaviour

Regulation and control of behaviour has two opposing aspects: the control of impulsivity and the initiation of behaviour. "In mediating control of behaviour, the mediator controls the system of the child's response prior to overt behaviour in order to inhibit impulsive behaviour or to accelerate the child's activity..." (Haywood & Tzuriel, 1992:11)

Impulsive behaviour is actively encouraged by the system of interaction in the classroom, where teachers and students work against time. Questions are posed and students raise their hands before giving adequate consideration to the questions. Their evaluation of their understanding being measured by the time elapsed before raising their hands. Those failing to raise their hands are seen as not grasping the question and are left behind.

The impulsive student also tends to complete the question along with the teacher in order to display a sense of understanding. What is often encountered is that the impulsive student provides an answer before the question is completed. Kopp (1985:54-57) sees the situation as amenable to change with the responsibility lying with the teacher to mediate the desired behaviour. She suggests a type of behaviour modification, where answers are not accepted unless controlled behaviour occurs.

Further suggestions are: to pose questions in group settings, where students have to consult one another before responding; to encourage students to mentally count to three before responding. She advises that the teacher assist the student to develop a system or plan for gathering information. This is particularly useful for biology-type questions, where students are presented with graphic information and have to select relevant data to formulate a correct response.

The other aspect, that of initiating behaviour, is related to feelings of competence. Students may have manipulated data correctly and come to a correct response, but fail to articulate their solutions due to a lack of confidence. The process-centered teacher has to interpret the inhibition and not be guided by the efficient respondents in the classroom. The majority of students who were selected for this project

are of this type. The teacher involved in mediating regulation and control of behaviour, according to Feuerstein et al. (1991:38), encourages "cognitive control of behaviour". He is not impatient with the thinking process and shows appreciation for those students engaged in reflective thinking before responding.

3. Mediation of sharing behaviour

(Mediation of individuation and psychological differentiation)

These two characteristics are in some ways opposed. Sharing behaviour encourages socialisation and a sense of unity with others, while individuation implies creating a sense of identity. Mediating these two parameters in balance in a classroom needs planning and consideration by the teacher as the mediator.

The teacher mediates sharing and individuation when asking a student to share his/her correct response with the class. The student gets credit for arriving at the correct solution but has the responsibility of sharing knowledge with others. Pair problem solving is another technique that fosters sharing behaviour, where students jointly arrive at a solution. These two parameters are constantly at play in the classroom and it is the role of the teacher to ensure that

one is not fostered at the expense of the other. Again, the adequate mediation of these two parameteres can only have positive effects on the self-concepts of the students.

MLE AND SELF-CONCEPT

The above parameters, essential and non-essential, encompass most of the ingredients that writers on self-concept see as important to enhance or positively influence a student's self-concept.

According to Feuerstein, Rand & Rynders (1988:x) "low functioning children lack both self-confidence and clear pathways to learning and the only way their needs can be met is if the two deficits can be addressed simultaneously..." They also assert that the teacher needs to be convinced that childrens' potentialities are indeed modifiable and that teachers need to convince students themselves of their modifiability. It is clear from this contention that the perception by the students of their potentialities is reinforced by their levels of performance.

This project is an attempt to improve students' academic performance and to positively affect their conceptions of themselves; in other words, to improve their cognitive and problem-solving ability and to enhance their self-concept,

with reciprocal effects on further performance. Central here is the theory of structural cognitive modifiability. Feuerstein et al. (1988:7) point to a required distinction to be made between "modifiability" and "change". Change is limited in scope, more specific and less sustained over a period of time. Modifiability on the other hand relates essentially to alterations that occur in the "individual himself, his personality traits, his thinking ability and capacity and his general level of competency" (Ibid 1988:7).

In the theory of MLE the affective-motivational factors that affect cognitive processes are not widely elaborated on. The authors do point to the way in which these factors of the affective domain can combine negatively to influence performance. In subsequent work, Feuerstein (1988;1991) does give more attention to the affective-motivational domain.

School is an area traditionally seen as a learning centre, yet as most teachers are aware, there are covert processes that operate at an informal level. School widens the range of possible self-evaluations for students. Teachers are in a position to modify learning procedures as well as existing self-concepts of their students. It is through the activities in the classroom that teachers become the "significant other." Burns (1982:163-201) sees the continual giving of feedback by teachers, interpreted by the students,

as an important way in which students learn ab themselves.

Sonn (1987:55), feels that "elke onderwyser kan verhoed dat voelens van minderwaardigheid en frustrasie by sy leerlinge onstaan deur hulle met die nodige respek te bejeen. Die onderwyser moet leerlinge daarop wys dat elke mens uniek is. Op die wyse kan die onderwyser die nodige selfrespek by sy leerlinge ontwikkel wat hulle sal aanspoor en motiveer om... in hulle skoolwerk te presteer." Here the mediation of competence, regulation of behaviour and individuation is directly called upon. Burns (1982:393-404) also mentions that a student should feel supported by the teacher and not overwhelmed. This can be done by mediating feelings of competence and individuation.

When a teacher consciously mediates the parameters of MLE in the classroom, the positive effects on the teacher-students relationship is implicit. Wilson & Morrow (1961:501-510), concluded in their research that a student's academic performance is related to the relationship between the teacher and the student.

CHAPTER 5: CELL DIVISION AND MLE

The model for intensive mediated learning experience is an attempt to explore MLE at an operational level. The model will attempt to mediate the learning of cell biology, bearing the cognitive demands for that section in mind.

In terms of the cognitive functions described by Feuerstein et al. (1980:73-75), the cognitive demands for this section of biology will be analysed and the lessons planned accordingly. The authors do mention that the list is not definitive or exhaustive. The elements are conceptualised for the purpose of analysis, understanding of underlying processes and for didactic purposes.

THE COGNITIVE FUNCTIONS RELEVANT TO THE TEACHING OF CELL DIVISION

A. INPUT PHASE

This involves the quality and quantity of the information or data selected as the students attempt to solve a problem.

1. Sharp and focused perception

The student must be able to delineate graphic and verbal data precisely in order to gather adequate data necessary for a solution, eg. the shape and sizes of different cell types; the absence or presence of membranes indicating different stages of cell division; the absence or presence of different cell structures indicating the stages of cell division.

2. Systematic exploration of the learning situation

Students need to plan their information gathering and scanning. They need to recognise the different cell types. They also need to read the instructions carefully before attempting to answer the questions. Often students associate question types with certain diagrams and teachers find responses that are totally irrelevant to the questions set. What also happens frequently is that students become engrossed in answering one part of a question and fail to attend to a second part.

3. Precise understanding of words and concepts

This is particularly important as biology is loaded with terms and concepts. If students do not recognise these terms

in questions or learning materials, the elaboration and the output phase of the mental act is severely affected.

4. Understanding of time and space concepts

Students need to have a micro and macro perception of biological structures. They have to locate the cells within the plant and human body. Different types of cells are involved in the different types of cell division - the cells of the reproductive organs of animals and plants undergo meiotic and mitotic division, whereas ordinary somatic cells only undergo mitotic type of cell division. Students need to "transcend" diagrams and place the cells in their contexts.

Students must also know when the types of division should or would take place in the organism, eg. meiosis during gametogenesis. Students must also be able to predict the results of the types of cell division - one cell dividing mitotically would result in two identical cells and one cell dividing meiotically would result in four cells with half the chromosomal number of the parent cell. The sequence of the stages of the two cell division types is important for the student to predict and reflect on the activity of the cell organelles.

5. Ability to use information from more than one source

Often more than one diagram is given and students are required to derive an answer that needs careful consideration of both or more diagrams. Sometimes the answers to questions are implicit in the wording of the question itself as well as in the diagram.

B. THE ELABORATIONAL PHASE

This relates to the way in which the individual makes use of the available data to formulate a response.

6. Ability to think about information stored in the brain

Problems are usually represented graphically and students need to decode that data in order to process a solution. In problem solving, students need to use previously gathered information of the cell structure and the process of cell division to arrive at an answer. They have to understand the differences between the two types of cell division, the differences between cell division in plant and in animal cells and also the sequences in the stages of the two types of division. The students should not only be reliant on concrete, but also on abstract information.

7. Ability to select relevant cues

Students have to recognise cues necessary to arrive at a correct response. The shape of the cell and also the number of outer membranes are cues to cell type; chromosomal arrangement are cues to the type of cell division; chromosomal arrangement are cues to the specific phases in the division; chromosomal number is a cue to the type of cell division; presence or absence of certain cell organelles are cues as to the type of cell and the phase of the division.

8. Ability to make comparisons automatically

Students need to be motivated to consider and compare different diagrams in their specific phases, and to understand what those differences and similarities imply. From those comparisons important relationships can be established.

9. Ability to automatically summarise information

This function focuses on the students' need system, rather than on the inability to summarise. Students need to produce relationships between different given sets of information. Students will not be successful at understanding cell division or the problems relating to cell division if they

interact with the information in a fragmented manner, but need to pull and tie things together to get a clearer perception of the information.

10. Need to pursue logical evidence

Feuerstein et al. (1980:95-96) state that this is an attitude. Students are often not aware of, or disturbed by, their illogical responses to questions. For example, as a response to the question of why mitosis can never be called a reduction division, students often respond by saying that meiosis is the reduction division. They do not consider the consequences if mitosis were to be a reduction division - generations would alter dramatically and classifications of organisms would not be a reality; ie. the chromosomal number of species, and therefore characteristics, would not be kept constant over generations.

11. Ability to engage in planning behaviour

Students need to set goals and determine the steps necessary to achieve those goals. For example, if the student is required to illustrate graphically a particular cell type at a specific stage of a cell division type, she needs to construct a plan and know the implications of each step in the pursuit of the answer.

C. THE OUTPUT PHASE

This refers to the ability of the individual to communicate the results of a particular elaborative process.

12. Mature communication

This is particularly important in examination situations where students present their solutions in vague and general terms, not utilising accurate biological concepts and terms. The assumption is that the teacher knows what the student is trying to convey.

13. Controlled and planned expression of ideas

Students need to plan their reponses in terms of sequence and also be aware of the steps involved to reach a certain goal. Written responses are often untidily given with evidence of the students' changing their decisions about their answers - diagrams and words are crossed out and sometimes correct answers are replaced by incorrect responses.

14. Precise and accurate use of words and concepts

This is important in a content subject like biology that is laden with jargon. This function is related to the ability

of students to think about and use previously gathered information and also to their need for accuracy and precision. Students need to cultivate a desire to make biological terms part of their verbal repertoire.

CHAPTER 6: THE INTERVENTION PROCEDURE

STAGE 1: THE MLE QUESTIONNAIRE

This questionnaire (see Appendix 1) was administered to the students in order to gain some insight into the extent of MLE, particularly in the home environment, while they were growing up.

The responses indicate that some MLE had occurred in the experiences of these students, but that MLE had not occurred sufficiently to produce students with high levels of cognitive modifiability. (See Appendix 1 for a summary of responses to the questionnaire.)

For the questions relating to the socio-economic status of the students, there was an overwhelmingly negative response (questions 2, 5, 7, 9, 10, 11, 12, 15, 20.) For the questions pertaining to communication (1, 2, 6, 7, 12, 13, 14, 16, 17), negative responses outweighed the positive responses. The impliction of this was noted by the teacher in the communication skills of the students in normal classroom activity.

The picture is different where questions relate to cultural transmission as a category of MLE. Most of the students seem to have quality time with the extended family, whereby especially the grandparents shared their pasts. In this way these students had access to information outside the field of their experience.

Eighty percent of the students responded positively to the question which asks whether they were always punished for their wrongdoings. As noted earlier, Lidz (1991:291) observes that the literature indicates that less punitive parents have the most competent children.

The questionnaire was intended only to provide a rough indication of the extent of MLE of the students, and its outcome was not considered to have any vital bearing on the intervention which followed. The aim of the project was to provide a spate of intensive mediated learning experience to see whether this would bring about a relative change in the cognitive abilities of the students, and also in their self-concepts. This could be done irrespective of the base, in terms of prior MLE, from which the students were setting out.

STAGE 2: THE FIRST SELF-CONCEPT MEASUREMENT

This group of low achieving students confirmed the conclusion of Kimball (1958:406-415), Purkey (1979:18), and Burns (1980:227) that low achievers possess a low self-concept. As mentioned earlier, the instrument used was the Self-Concept Inventory of Vrey & Venter (1983b). The results were the following:

Student	Self-concept Score
1.	21
2.	39
3.	45
4.	51
5.	60
6.	59
7.	44
8.	54
9.	44
10.	58

According to Vrey & Venter, (1983a:19) these student are in the range of a low self-concept. They indicate that a score between 38 and 62 can be classified as a low self-concept score. It is significant that the first student had an extremely low self-concept score of 21.

STAGE 3: THE INTERVENTION

The short programme of intensive mediated learning experience in biology was provided with the following aspects taken into consideration.

a. The incorporation of the essential characteristics of MLE as well as the non-essential characteristics.

b. The cognitive function relevant to the learning of cell division as set out in Chapter 5 above.

c. The teacher tries to encourage maximun participation by the students in each session.

A more detailed account is given of the lesson sets below. (This is summarised in schematic form in Appendix 3A, Tables 1 to 4.) The sessions are discussed in sets of two, as they were designed as related pairs with regard to content. This also avoids repetition in the description of the sessions, which follow a similar pattern.

Firstly, an account of how the essential and non-essential parameters are incorporated into the sessions

will be given. Secondly, the cognitive functions encouraged during the sessions will be discussed. Lastly, a discussion of other observations made during the progression of the sessions will be discussed. For reference, the diagrams used during the sessions are provided. (See Appendix 3B.)

As mentioned before, the sessions were planned by consulting the model of Kopp-Greenberg (1991:241-259): A Model for Providing Intensive MLE in Preschool Settings.

ELABORATION ON THE SESSIONS

The teacher found the sessions to be quite dynamic and fluid, so it was not possible to adhere to any rigid lesson plan. The main intention was to share the contents of each lesson, with an effort being made at input of the essential and non-essential parameters, and cognitive functions enhancement.

SESSIONS 1 & 2: INTRODUCTION TO CELL DIVISION
SIGNIFICANCE OF CELL DIVISION

THE ESSENTIAL CHARACTERISTICS OF MLE:

1. Intentionality and reciprocity

The teacher reminded the students that they were participating in a research project (for which their permission had been previously obtained). The project involved the use of a different teaching method from that they were familiar with in the normal biology classes.

The plan of the programme, including an outline of the content, was put to the students and was accepted by them. The students were thanked for their participation in the project. With this an effort was made as suggested by Kopp-Greenberg (1991:221) to "come between the students and the material, thoughts or events in the environment in an attempt to focus the attention of the child".

2. Meaning

The significance of cell division was discussed by putting the following question to the students: "Why is it important that cells in the human body have to make more cells?" The

question was deliberately put in this way, void of scientific terms, so that the students could relate to the question more easily.

In groups of two, they discussed the question and five minutes later each pair was asked to give their response. Each response was tabled and from there, with the input of other students and the teacher, adequate responses were formulated. The following came out of the discussions: women needed to replenish their blood cells lost at menstruation; damaged tissues needed to be repaired; dead cells needed to be replaced; more cells were needed in order for the embryo to grow after fertilisation.

These responses reflect emotional involvements on the part of the students during their discussions. As Feuerstein (1991:24) states, this is the "energetic dimension of the interaction, it answers questions of `why and what for'". The students were actively involved in sorting out the whole meaning and significance of cell division itself and the importance of knowing why cells divide.

3. Transcendence

Students were asked to reflect on their past knowledge of the structure of the cell and its organelles as covered in detail in the Std 8 syllabus. Students were requested to

close their eyes during this exercise. As the imagistic domain was tapped, they were encouraged to travel inside the cell, mentioning the organelles as they were encountered and then making a stop at the nucleus. This was intentionally done as the role of the nucleus in cell division was taken up in sessions three and four. As they named the organelles the teacher mentioned the functions and emphasis was put on the function of the nucleus and the chromatin network. The students were told that the next set of sessions would focus on the role of the nucleus. The term "karyogamy" - nuclear division - was discussed, with the teacher sharing the etiology of the word and relating the term to prokaryotic organisms as discussed earlier in the Std 9 syllabus.

THE NON-ESSENTIAL ASPECTS OF MLE

4. Regulation of behaviour

The teacher determined the pace of the activities, both in the imagistic and concrete realms. The students were instructed when to reflect, examine organelles and write down and share their responses on a rotating basis. At the same time they were guided as to when to make allowances for the spontaneous responses of other students. In this way an awareness was mediated to engage in behaviour appropriate to the learning activity. (Kopp-Greenberg,1991:252)

5. Feeling of competence

The teacher acknowledged all students' responses by writing them on the blackboard and, with further disussion, formed adequate solutions. The smaller groupwork elicited better interaction, with students feeling safer to share their ideas. During these two sessions the teacher repeatedly emphasised the students' ability to successfully engage and complete instructions and activities.

THE COGNITIVE FUNCTIONS

1. Comparative behaviour

Students were asked to compare the structures of plant and animal cells. They mentioned the differences between these two cell types and noted the importance of the absence or presence of certain organelles in dividing plant and animal cells, ie. the general shape of the cell; the absence of centrioles on plant cells; the absence of a cell wall in animal cells; the presence of pits in plant cells. Diagrams were projected and students listed the differences between dividing and non-dividing plant and animal cells.

2. Focused perception

In their reflection on plant and animal cells, they closed out all other stimuli and focused on cell structures alone. At the instruction to mentally switch from a plant to an animal cell and vice versa, they were asked to "see" significant organelles or notice the absence thereof in particular cell types. As they made the mental stop at the nucleus this was enlarged and projected onto a screen. This exercise demanded focused concentration as well as the utilisation of information stored from previous work covered. Where students could not do the latter, cues were provided for the exercise to continue.

3. Space and time concepts

Students were instructed to concentrate on cells at a micro level and to notice the details of the cell organelles. They were taken through an organism level of organisation to systems, organs, tissues and cellular arrangement of living tissue.

The cyclical nature of cell division was explained with the stages involved. It was also emphasised that these stages of the divisions proceeded with no noticeable pause between the stages, but the positions of the cell structures provided the cues as to the stage of the division.

4. Thinking about information stored

This was explicitly done when students were asked to recall and compare the structures of plant and animal cells as covered in the previous year's syllabus. Assistance was given to those students experiencing difficulty.

5. Selection of relevant cues

Students were sensitively made aware of their errors when selecting irrelevant cues when responding to a question of comparing plant and animal cells. In cooperation with the students, categories of comparison were drawn up: cell shape; organelles absent or present; structures absent or present.

6. Controlled and planned expression of ideas

The teacher here modelled the planning process in accepting all responses and formulating a single acceptable response from their input. During the sessions the teacher also thought aloud to model for the students a response to a particular question where they failed to give the correct answer.

Eg. "What must I look for?"

"A centrosome tells me that this is an animal cell and because the nuclear membrane is not clear this cell is in the process of dividing. The chromatin network is visible as chromosomes, which is another sign that the cell is dividing."

OTHER OBSERVATIONS

At first these students were hesitant to participate in the disussions. They expressed their unfamiliarity with the think-aloud process. This is understandable as they are the very students who are more that often overlooked in the usual classroom activity. They also successfully hide behind the better achieving students in the class.

Midway through the second session, attempts were noticed at participation. In their pairs they felt much easier about participation, but were still hesitant when having to report their conclusions and responses. A sense of "recharged" commitment was detected at the end of the second session. This was verbalised by a few students who said that they conceived of this section of the syllabus as being particularly obscure, but now saw the possibility of a better understanding of this section of work.

Due to the student pairing and the teacher being able to acknowledge each of their responses, which is not always possible in the ordinary class, the teacher noticed that generally unresponsive students offered their own ideas in their pairs.

SESSIONS 3 & 4: ROLE OF NUCLEUS IN CELL DIVISION MITOSIS

THE ESSENTIAL CHARACTERISTICS OF MLE

1. Intentionality and reciprocity

Students were involved in "summation, repetition and framing" as suggested by Kopp (1985:12), in order to orientate them and provide a basis for these sessions to develop. During the sessions students were involved in making diagrams, labelling verbally, writing, and formulating and answering questions individually and in groups.

Several times the teacher verbalised her intentions when giving instructions and also informing them of the reason for engaging in an activity. Eg. "We repeat what we completed yesterday so that we can link it to what we are going to do today and tomorrow." Feuerstein (1991:17) states that "reciprocity is a way to turn an implicit intention into an explicit, volitional and conscious act."

2. Meaning

A reflection on the previous sessions' conclusions on the significance of cell division was done in order to bring the students into touch with the importance of the activities in those sessions. In discussions with the students, meaning and significance was brought to the classwork by sharing with them a belief that they were capable of grasping and solving problems in cell division and pointing to the highlights of the previous sessions.

On the content level, the importance of the chromosomal constancy of species was discussed and students were made aware of how efficiently the process of cell division ensured this. The teacher asked them why they thought it was important to know the diagrams with their labels. Meaning was conveyed when the teacher told them that the presence or absence of labels gave abundant cues about a particular cell. For example, a cell with an absent nuclear membrane and centrioles present, with the single chromosomes on the equatorial plane, indicated a dividing animal cell at the metaphase stage of mitosis. The following are the cues: nuclear membrane not visible and visible chromosomes indicate a dividing cell; centrioles indicate that the cell is an animal cell; single chromosomes indicate that the cell is undergoing a mitotic division; the arrangement at the equatorial plane of the cell indicates that the phase in the

division is metaphase. The teacher emphasised that in an examination situation the students should be vigilant and look for such cues when solving a problem.

3. Transcendence

As the session progressed, the teacher tried, where possible, to link the contents with past work covered and more importantly to the meiotic type of division. At each phase of mitosis the points of comparison were highlighted. Eg. prophase: single chromosomes appear during mitosis, but at meiosis the chromosomes are double. At that stage the specific labelling and terms as they relate to a meiotic division were omitted.

As the mitotic explanation continued, further points of comparison were highlighted. At metaphase the chromosomes lie singly at the equatorial plane and the centromere splits at anaphase, but at metaphase of meiosis the chromosomes lie in their homologous pairs at the equatorial plane and the centromeres do not split at anaphase of meiosis.

The principles of cell division were emphasised with the appropriate diagrams. Students were made aware that the same principles applied to a meiotic division, but the behaviour of the chromosomes was slightly different.

After the discussion of telophase in mitosis, the teacher put the following statement to the students: "These singly stranded daughter chromosomes appear as complete double stranded chromosomes at prophase of a next mitotic division." This initially left the students uneasy and the teacher used this opportunity to briefly relate how this is possible due to DNA replication where the complementary strand was synthesised in the nucleus. This exercise was transcendent in nature as it clearly went beyond the immediate goal of the session, with future work being linked to the present material discussed.

NON-ESSENTIAL FACTORS OF MLE

4. Sharing behaviour

This was done mainly by the teacher sharing her knowledge or information and so to speak "unlocking" the mystery of the reappearance of those single stranded chromosomes as double stranded at the prophase of a subsequent division.

In their pairs, students also shared their ideas with each other while trying to answer the questions.

5. Regulation of behaviour

The teacher determined the pace of the activities by telling the students what, how and when to do certain things. Eg. "First fill in the labels. Now, taking the labels into consideration, decide whether this is a plant or an animal cell. Each time you must provide a reason for your answer." With subsequent diagrams in these sessions the necessity for detailed instruction of this nature diminished.

6. Feeling of competence

Again, all responses were acknowledged. Students suggested why each response could, or should not, be included in the answer. With the teacher, students explored the possible causes for incorrect responses so that students could reflect on their own thought processes.

COGNITIVE FUNCTIONS

1. Comparative behaviour

With the dividing plant and animal cells projected onto a screen, students had to compare the diagrams to determine the cell type. They also had to compare diagrams of dividing cells to determine the phase of division at which each cell

was. They needed to engage in extensive comparison to arrange the cell in the correct sequence of mitotic division. Here there was also the need to compare the given diagrams with those mental images they had of a standard plant and animal cell.

2. Concepts of space and time

This was encouraged by asking students to place the diagrams so that they depicted the correct sequence for cell divison. During this exercise they were asked to verbalise the reasons for their answers. It was pointed out to them that cells at different parts of the body undergo divison at different times and that the process occurred as the body demanded new cells to be produced. Students were constantly reminded that these events occurred on a micro level and in order to observe them we needed to make use of microscopes. They were then shown a slide of dividing cells in an onion root tip and a fish embryo, where the demand for rapid cell production is high.

3. Thinking about information stored in the brain

Diagrams with only the outlines of the cell were projected which the students had to complete in order to indicate a given phase of division. This required students to reflect on the information discussed in the sessions as well as on

the information of the previous syllabus in order to complete the task.

4. Mature communication modalities

For students to share their responses they needed to employ correct biological terms. Students were given clear directives as to the way in which they had to communicate their answers. They had to regard the other students in the group as needing to know every detail. They were encouraged to provide all the evidence necessary "for the listener's comprehension of the information conveyed" (Feuerstein 1980:99).

This presented a challenge, as the teacher summarised their responses and evaluated them in terms of concepts and terms omitted. The other students were invited to take the recommendations and present more appropriate versions of the responses.

5. Perception of relationships

Throughout the sessions, the teacher deliberately related aspects of the material being discussed to later or earlier work in the syllabus.

OTHER OBSERVATIONS

The students seemed more relaxed and keen to participate in discussion than in the previous sessions. The correct responses were acknowledged not only by the teacher but also spontaneously by the groups. The guidance, corrections and direction that punctuated the sessions were well taken and positively responded to by the students.

SESSIONS 5 & 6: INTRODUCTION TO MEIOSIS

MEIOSIS I

ESSENTIAL CHARACTERISTICS OF MLE

1. Intentionality and reciprocity

As with the other sessions, a brief overview of the principles of cell division was given with the participation of the students. Students were reminded that in meiosis the same phases occurred, but that in meiosis there were two nuclear divisions and that the division resulted in four haploid cells. The students were actively encouraged to ask question which were responded to by the teacher as well as the rest of the group. At the beginnings of these sessions and throughout the teacher and students were "alternatively responding to each other" (Tzuriel 1991:97) and there was evidence of the students relating to the information.

2. Meaning

The following statement was put to the students: "All humans have 46 chromosomes in their body cells, yet all humans originate from two human cells at fertilisation." After extensive discussion, it was concluded that we needed to know the mechanisms governing sex cell production

(gametogenesis). Students conveyed the need for knowledge about the behaviour of chromosomes during the production of sex cells in order to preserve chromosomal constancy in species. Students were also made aware that a knowledge of meiosis was necessary for clearer understanding of the mechanisms of genetics - a later section in their syllabus.

The quality of discussion in response to the statement had clear motivational significance as students reflected on their own being and origin and on that of their possible offspring.

3. Transcendence

From the above, transcendence was mediated in that students perceived the meaning of the information for the present activities of those sessions and also for the future section of genetics.

At the discussions of inheritance, students reflected upon their uniqueness - as individuals having their own genetic constitution - and upon their similarities with their parents; of being a mixture of their mother's and their father's genetic make-up. As Tzuriel (1991:97) states, transcendence has taken place when there is a reaching out for goals that have nothing or little to do with the original activity. Students were very happy to share their

unique characteristics and inherited personal traits with the rest of the group.

NON-ESSENTIAL CHARACTERISTICS OF MLE

4. Sharing behaviour

"Sharing behaviour reflects the need of the individual to go out of his own self in the direction of participating with others to make others participate with him" (Feuerstein 1991:40). As mentioned above, the students willingly participated in exchanging information about their inherited and unique characteristics. Among the traits cited were tongue rolling, eye colour, hair texture, hair colour and skin colour. The students responded to the initial statement through discussion and further questions to the teacher and challenges to the rest of the group.

5. Individuation

The discussions invariably pointed to their uniqueness as individuals not only in their genetic make-up, but in the different ways in which they approached and solved the problems posed in the sessions.

6. Regulation of behaviour

This was encourgaed by the rotation of reporting within the groups. One person was made responsible to facilitate the interaction in the groups to ensure that all the students had input in the discussions. The teacher moved between the groups to observe.

COGNITIVE FUNCTIONS

1. Focused perception

Their attention was drawn to the details in the diagrams depicting the different stages in meiosis I. They were encouraged to attend to each diagram in a discriminate way and to utilise relevant cues when attempting to solve a problem.

2. Planned and systematic exploration of the learning situation

With the mediation of the regulation of behaviour in the previous sessions, this aspect was encouraged to a large extent. Students were guided in their pace and activity when working in the sessions. Special consideration was given to the necessity for the students to be guided with respect to

inhibition as well as initiation. Students were guided in terms of the time investment for particular problem types. Eg. when reproducing a diagram of a plant cell at prophase of meiosis I, it is unnecessary to depict cell organelles that differentiate a plant and animal cell. Instead, only the shape of the cell and the absence of the centromere should provide the cue. It is also useful to use only two pairs of chromosomes when having to depict all the stages in meiosis as the problem of drawing more chromosomes becomes a waste of time and writing space in the three subsequent phases.

3. Precise understanding of words and concepts

In addition to the terms utilised in mitosis, the students needed to know and employ the new concepts and terms unique to meiosis - bivalents, homologous, tetrad, chiasmata, haploid. The teacher consciously modelled the usage of the known and the new terms so as to encourage their use.

Students were once again reminded that accurate usage of biological terms was important when presenting solutions to biological problems, both in the classroom and in the exams.

4. Ability to think about information stored in the brain

For the students to have progressed to the explanation and the understanding of meiosis, they needed to rely on and use their knowledge of cell structure and mitosis. The principles of the mitotic division had to be applied to the meiotic division.

5. Time and space concepts

Once again students were taken on an imaginative journey through organs to tissues and came to a stop at the tissues of the reproductive organs as this is where meiosis takes place, where the diploid number of 46 chromosomes is reduced to the haploid number of 23 for each gamete (sex cell).

In the past, students often stated that meiosis takes place in the sex cells. This is incorrect as it takes place during sex cell formation. The above exercise was done to orientate the locus of this type of cell division. The 46 chromosomes in the somatic cell are reduced to 23 by meiosis and the second meiotic division, which is essentially mitotic, takes place to increase the number of sex cells.

During the completion and production of their own diagrams, students needed to be familiar with time and space concepts to precisely grasp instructions and to organise their output.

OTHER OBSERVATIONS

The sharing of ideas and participation in discussion became more spontaneous and confident. Students felt more at ease within the group and with the teacher. Some of the usually non-participating students in the normal classroom expressed surprise at their own correct verbal and written responses to questions. Fellow students started encouraging one another during the discussions which indicated a confidence in their own evaluations of others' responses.

SESSIONS 7 & 8: MEIOSIS II

CYTOKINESIS

THE ESSENTIAL CHARACTERISTICS OF MLE

1. Intentionality and reciprocity

Students were told that at the conclusion of these sessions they would be capable of answering adequately any section on cell division in an examination situation. The necessity of understanding cell division for the later grasping of the genetics section was emphasised.

All questions were answered by the teacher and students were taken, with their participation, through a summary of the content of the work done up to that stage.

2. Meaning

The teacher conveyed the meaning of meiosis II as the conclusion of the karyotic reduction division. Cytokinesis concluded the division of the whole cell. At the end of the meiotic division a comparison with the mitotic division can be made and tabulated. The students tabulated the differences observed thus far.

3. Transcendence

In these sessions, as throughout the intervention programme, the explicit intention of the teacher was to mediate a feeling of competence to the students. The mediation of a feeling of competence is transcendent in nature by the virtue of the intention of the mediator.

The review and evaluation of the session is also transcendent as it goes beyond the information handled in the sessions. The secondary objective of this assignment, that of enhancing the self-concept of the students through these intensive MLE sessions, transcends the immediate goals for each of the sessions. However a more detailed analysis of this aspect will be considered later.

NON-ESSENTIAL PARAMETERS

4. Mediating of sharing behaviour

Much effort was made on the part of the teacher for the students to perceive her as another participating learner in the development of the sessions. This was particularly emphasised in the last set of sessions were the teacher learnt of their unique genetic characteristics and also shared hers with the students.

With the evaluation and reflection on the sessions the teacher had the role of a learner wanting to know from the students their interpretation of the sessions.

The teacher also shared with the students what these sessions had highlighted for her, ie. that each student had the potential to understand information and solve problems if the essential parameters of MLE were observed; a demonstration of how each student had her own set of experiences that she brought to the learning situation and also that a general feeling of well-being was created when students better grasped the explanations and successfully completed problems; and that by observing the essential and other parameters of MLE, the teacher felt satisfied with the mode in which the whole learning process in these sessions had taken place.

5. Individuation

During these sessions students were required to complete their responses remaining seated next to their partners, but their manipulations had to be done individually. During the report-back session attention was drawn to the different ways in which each student responded to the problems posed. At this stage the teacher felt that it was in order to encourage individuation as "individuation can best be developed as a process of mediation which is preceded and

accompanied by sharing behaviour, meaning, transcendence and all the emotional engagement underlying MLE" (Feuerstein 1991:42). In the preceding sessions, energies were directed to sharing, transcending and mediating competence.

6. Mediation of a feeling of competence

This was energetically done, not only from the signals that the students interpreted from the teacher, but as reflected in the interaction and responses by the rest of the group to one another in their attempts to solve the problems. This feeling of competence is necessary for the students to approach the examinations, if only for this section, with confidence.

Special attention was given to Feuerstein's warning (1991:29) that competence does not necassarily imply a feeling of competence on the students' part, but to generate this feeling requires the intervention of a mediator who interprets the mastery and the competence and turns it into an awareness, feeling and consciousness of competence for the students.

COGNITIVE FUNCTIONS

1. Ability to seek relevant cues

Students needed to be aware of the absence or presence of certain cell structures that depict cytokinesis in different cell types. For example, the formation of a cell plate from the centre to the periphery of the cell indicates a plant cell in the process of cytokinesis and a constriction from the periphery to the centre indicates an animal cell during cytokinesis. In addition to this the presence or absence of structures provided a further clue as to the type of cell in cytokinesis.

As mentioned previously, this cognitive function was tapped when students had to denote the type of cell, type of division and the phase of a particular division. For example, the presence of centrioles indicates an animal cell; the presence of pits and/or a cell wall indicates a plant cell; chromosomal position and visibility of nuclear membranes indicate particular phases in the dividing process; the presence of homologous pairs, tetrads and chiasmata indicate a meiotic division. Throughout, students were encouraged to verbalise the cues employed to arrive at their responses.

2. Need to pursue logical evidence

This was particularly relevant when students were asked to calculate possible chromosomal numbers of the resulting cells. For example, a somatic cell always has 2(n) or the diploid number of chromosomes, while the sex cells or gametes always have the (n) or haploid number of chromosomes. This also implies that a cell with an uneven number of chromosomes has to be a gamete.

Students needed to project daughter cell numbers and chromosomal numbers from given specimens. For example, when four somatic cells with a chromosomal number of twelve undergoes meiosis, the result would be 16 gametes with a chromosomal number of 6.

3. Mature communication modalities

Again the students needed to understand terms and concepts used from the previous sessions to adequately respond and communicate their responses to the rest of the group. Excessive gesticulation and use of general terms were severly discouraged for these sessions so as to persuade the students to employ the correct terms and concepts. Where the students experienced difficulty, the other students were encouraged to fill in the correct terms.

OTHER OBSERVATIONS

Adequate attempts and solutions were provided for the problems posed in these sessions and students felt more confident in sharing their responses with the group. A sense of satisfaction was detected among the students themselves at their increasingly correct answers. Students felt supported by the group in their efforts.

The initially hesitant students were much more spontaneous in sharing their ideas and answers with the group. There was expression by some students that they were eager to test their skills in class tests and the forthcoming examinations.

As Feuerstein (1991:17) states, interactions "animated by an intention and an effort to create a relationship of reciprocity can be viewed as powerful and rich in behavioural, mental and emotional components." The teacher felt deeply satisfied at the reciprocal nature of the relationship between herself and the group, the progression from hesitancy to spontaneity in some students and their mastery of not only the content of cell division, but that of the principles of division in cells. At the conclusion of these sessions, a feeling of confidence and motivation was communicated by the students.

STAGE 4: A SECOND SELF-CONCEPT MEASUREMENT

At the conclusion of the sessions the students were informed that a second self-concept test would take place. Clear instructions were given and students were encouraged to answer the test in the most honest way, as they had done previously. We met at the same time the following day at the same venue. The same instrument - Self-Concept Inventory (Vrey & Venter:1983b) - was used. The result follows, in comparison to the first self-concept measurement:

STUDENT	1st RESULT	2nd RESULT
1.	21	40
2.	39	60
3.	45	81
4.	51	69
5.	60	65
6.	59	70
7.	44	64
8.	54	63
9.	44	58
10.	58	76

These results are discussed in Chapter 7 below.

CHAPTER 7: CONCLUSION

The results of the study indicate that for all the students there was an increase in their second score for the same self-concept test. According to the classification of Vrey & Venter (1983a:19) these students, with the exception of student 1, would now fall into the category of having a medium self-concept.

It can then be concluded that for each of the students their self-concept was influenced in a positive manner by exposure to mediation during the sessions.

It can also be concluded that there was a successful mediation of the need to change, as "not often encouraged for a person who is a retarded performer" (Feuerstein, Rand & Rynders 1988:83). The students and the teacher witnessed a significant change in the students' behaviour from passive acceptance to active participation in the learning process towards the end of the sessions.

Traditionally, underachievers are viewed by teachers as unchangeable entities and often predictions are offered

about their future academic attainments. Feuerstein et al. (1988) argue that "the possibility of change needs to be understood clearly by professionals and must be actively pursued through their mediational efforts". (Ibid:84). One may at this stage add that it is also important for educators to be aware that successful meditational efforts imply an enhancement of an underachieving student's self-concept.

Schuler (1987:7) ascribes student passivity to earlier inadequate mediated learning experiences. For this group it was determined by the questionnaire that there was this deficiency. After sessions 1 and 2 the students participated more and this participation increased throughout the subsequent sessions.

One can thus say that, with the progression of the sessions, as the positive interpretation of their environment increased so their self-concept improved. For these sessions and this study, a reciprocal relationship between MLE and self-concept was displayed.

Burns (1982:288) claims that teacher attitudes, values and

teaching methods do have an impact on the students' self-concept formation. MLE as a teaching method, implying a teacher's commitment to the possibility of change in the student, inherently creates a climate in which the self-concept of students can be developed in a positive way.

It could be argued that over a period of time, their self-concept and participation levels may be retained and improved if comparable levels of mediation are sustained in the classroom.

A study over a longer time period, with a group receiving continued mediation and a control group not receiving such mediation, would be required for more definitive conclusions to be drawn on such changes. The author is inclined to accept what Feuerstein, Rand & Rynders (1988:xi) have called "the principle of the possible". This is that whatever a student can be motivated and educated to do just once becomes the level of reasonable expection for the future.

In the present instance, the point made at the outset needs to be repeated: viz. that this is more of a qualitative than a quantitative study. In addition, it deals with human subjects rather than inanimate materials and the

intervention is more clinical in nature than experimental.

Evidence has been accumulated with regard both to MLE and the measurement of self-concept. If other researchers were to emulate this study, even in a different subject area, the outcomes could reliably be compared with those of this study provided that a relevant and standardised self-concept test were applied before and after the intervention and provided that the intervention itself were designed within the Feuersteinian framework detailed above.

To say that any introduction of mediated learning experience in a small group or classroom situation will result in a significant increase in the global self-concept of the underachieving learner would be too wide a claim to be justified by this study. But the study does support the conclusion that even a short but intensive period of content-related mediated learning experience, carefully structured along Feuersteinian lines, will improve the self-concept of underachieving students, at least in the short term.

The study does answer positively the initial questions of whether MLE improves thinking skills and whether MLE enhances the self-concept of students whose educational experiences have left them with feelings of inadequacy.

THE WAY FORWARD

This study indicates that for this group of 10 underachievers, intensive MLE related to content did influence the self-concept of students positively. MLE as a teaching method encapsulates the conditions for self-concept enhancement.

It would be challenging to construct a model in which larger volumes of subject information could be translated into the MLE framework for presentation in the usual classroom setting where larger numbers of students are encountered.

BIBLIOGRAPHY

1. Ausubel, D., Novak, J.D. & Hanesian, H. 1978. Educational Psychology: A Cognitive View. 2nd Edition, New York: Rhinehart & Winston.

2. Burns, R. 1982. Self-Concept Development and Education. London: Holt, Rhinehart and Winston.

3. Cawood, J., Strydom, A. & Van Loggerenberg, N. 1980. Doeltreffende Onderwys. Cape Town: Nassou

4. Education Bulletin Special Edition. 1986. Pretoria: Government Printers.

5. Feuerstein, R., Rand, Y. & Hoffman, M. 1979. The Dynamic Assessment of Retarded Performers: The Learning Potential Assessment Device: Theory, Instruments and Techniques. Baltimore: University Park Press.

6. Feuerstein, R., Rand, Y. & Tannenbaum, A. 1979. Effects of Instrumental Enrichment on the Psycho-educational development of Low Functioning Adolescents. In Journal of Educational Psychology. 83: 539-550.

7. Feuerstein, R., Rand, Y., Hoffman, M. & Miller, R. 1980. Instrumental Enrichment: An Intervention Programme for Cognitive Modifiability. Baltimore: University Park Press.

8. Feuerstein, R., Rand, Y, & Rynders, J. 1988. Don't Accept Me As I Am: Helping "Retarded" People To Excel. New York: Plenum Press.

9. Feuerstein, R., Klein, P. & Tannenbaum, A. 1991. Mediated Learning Experience: Theoretical, Psychosocial and Learning Implications. London: Freund Publishing House.

10. Fischer, R. 1990. Teaching Children To Think. England: Simon & Schuster.

11. Gergen, K.J. 1971. The Concept of Self. New York: Holt, Rhinehart and Winston.

12. Gunther, C.F.G. 1988. Aspects of Educational Theory. Stellenbosch: University Publishers.

13. Gurney, P. 1987. Self-Esteem Enhancement in Children: a Review of Research Findings. In: Educational Research Vol. 29 No. 2.

14. Haywood, H.C. 1993. A Mediational Teaching Style. In: International Journal of Cognitive Education and Mediated Learning. Vol. 3 No. 1 Pg.27 - 37.

15. Haywood, H. C. & Tzuriel, D. 1992. Interactive Assessment. New York: Springer Verlag.

16. Kelly, A. V. 1978. Mixed Ability Grouping. Theory and Practice. London: Harper Row Publishers.

17. Keane, K. J. & Kretchemer, R.E. 1987. Effect of Mediated Learning Intervention on Cognitive Task Performance with a Deaf Population. In: Journal of Educational Psychology. Vol. 79 No. 1 Pg. 49 -53.

18. Kimbal, B. 1958. Case Studies in Educational Failure During Adolescence. In: American Journal of Ortho-Psychiatry. Vol.23

19. Klein, P.S. 1991. Molar Assessment and Parental Intervention in Infancy and Early Childhood: New Evidence. In: Feuerstein,R, Klein, P. & Tannenbaum, A. (Eds) MLE: Theoretical, Psychosocial and Learning Implications. London:Freund Publishing House.

20. Kopp, K. 1985. Cognitive Enrichment Workbook. Unpublished. University of Tennessee.

21. Kopp-Greenberg, K. 1991. Model for Providing Intensive Mediated Learning Experience in Preschool Settings. In : Feuerstein, R. et al (Eds) MLE: Theoretical, Psychosocial and Learning Implications. London: Freund Publishing House.

22. Lerner,J. 1981. Learning Disabilities
Boston: Houghton Mifflin Co.

23. Lidz, C.S. 1991. MLE Components and their Roots in Theory and Research. In : Feuerstein, R. et al (Eds) MLE: Theoretical, Psychosocial and Learning Implications. London: Freund Publishing House.

24. Mann, L., Goodman, L. & Wiederholt, J. 1978. Teaching the Learning Disabled Adolescent. Boston: Houghton Mifflin Co.

25. Marsh, H. 1992. Specificity Relations Between Academic Achievement and Academic Self-Concept. In: Journal of Educational Psychology. Vol 84 No. 1: 35 - 42.

26. Mboya, M.M. 1993. Development and Construct Validity of a Self-Description Inventory of African Adolescents. In. Psychological Reports Vol.72: 183 -191.

27. McKay, V. & Romm, N. 1992. People's Education in Theoretical Perspective. Cape Town: Maskew Miller Longman.

28. Mehl, M. 1985. The Cognitive Difficulties of First Year Physics Students at the University of the Western Cape and Various Compensatory Programmes. Unpublished Thesis. University of Cape Town.

29. Messina, M.M. 1993. Die Ontwikkeling van Leeskomprehensie-vaardighede by Afrikaans- Eestetaalleerlinge (HG) aan die hand van Feuerstein se Bemiddelde Leerervaring. (BLE). University of the Western Cape: Unpublished Master's Thesis.

30. Mintzker, Y. 1991. When the Baby Does Not Smile Back: Obstacles to Successful MLE. In: Feuerstein, R. et al (Eds) MLE: Theoretical, Psychosocial and Learning Implications. London: Freund Publishing House.

31. Morrow, W.E. 1989. Chains of Thought. Pretoria: Southern Book Publishers.

32. Morrow, W.R. & Wilson, R.R. 1961. Child Development - Family Relations of Bright High-Achieving and Lower-Achieving High School Boys. New York: McGraw Hill.

33. Nickersen, R., Perkins, D. & Smith, E. 1985. The Teaching of Thinking. London: Lawrence Earlbaum Associates.

34. Purkey, W. 1979. Self-Concept and School Achievement. New Jersey: Prentice Hall Inc.

35. Rutherford, J. 1989. Instrumental Enrichment: A Cognitive System. In: Snyden, D. (ed) Cognitive Approaches in Special Education. London: Falmer Press.

36. Sanders, M. 1993. Can We Change Biology Teaching by Changing the Matric Exam? In: IMSTUS News. Summer 1993, No. 23.

37. Schuler, A.L. & Perez, L. 1987. The Role of Social Interaction in the Development of Thinking Skills. In. Focus on Exceptional Children. 19 (7): 1- 11.

38. Segal, J., Chipman, S. & Glasser, R. 1985. Thinking and Learning Skills. Volume 1. London: Lawrence Earlbaum Associates.

39. Sewell, T.W. & Price, V.D. 1991. Mediated Learning Experience: Implications for Achievement, Motivation and Cognitive Performance in Low Socio-economic and Minority Children. In : Feuerstein, R. et al (Eds) MLE: Theoretical, Psychosocial and Learning Implications. London: Freund Publishing House.

40. Shaw, M.C., Edson, K. & Bell, H.M. 1960. Self-Concept of Bright Academic Underachieving Students as revealed by an Adjective Check List. In: Personnel and Guidance Journal, Vol. 39.

41. Skuy, M. & Shumkler, D. 1987. Effectiveness of the LPAD with Indian and Coloured Adolescents in South Africa. In: International Journal of Special Education. Vol 2: 131-149.

42. Skuy, M. & Mentis, M. 1991. Mediated Learning Experience: Working Manual. Johannesburg: University of Witwatersrand Press.

43. Skuy, M., Lomofsky, L., Fridjohn, P. & Green, L. 1993. Effectiveness of Instrumental Enrichment for Preservice Teachers in a Disadvantaged South African Community. In: International Journal of Cognitive Education and Mediated Learning Experience. Vol.3 No.2 : 92 - 108.

44. Sonn, R.A. 1987. 'n Empiriese Ondersoek na die Aard van die Self-konsep van Senior Leerlinge en Studente aan Tersiere Inrigtings en hul siening van die Invloed van die Self-konsep op Akademiese Prestasie en Beroepskeuse. Cape Town: Unpublished Doctoral Thesis, University of the Western Cape.

45. Tzuriel, D. 1991. Cognitive Modifiability, Mediated Learning Experience and Affective Motivational Processes: A Transactional Approach. In : Feuerstein, R. et al (Eds) MLE: Theoretical, Psychosocial and Learning Implications. London: Freund Publishing House.

46. Vrey, J.D. 1979. The Self-Actualising Educand. Pretoria: Unisa Press.

47. Vrey, J.D. & Venter, M.E. 1983a. Manual to the ASCS (Adolescent Self-Concept Scale). Petoria: Unisa Press.

48. Vrey, J.D. & Venter, M.E. 1983b. Self-concept Inventory. Pretoria: Muckleneuk, University of South Africa.

49. Vygotsy, L.S. 1978. Mind in Society: The Development of Higher Psychological Processes. Cambridge: Harvard University Press.

50. Weil, S.H. 1989. Addressing the Problem of Cognition in a First Year Accounting Course at the University of the Western Cape. Unpublished Thesis.

51. Whimbey, A. 1984. The Key to Higher Order Thinking in Precise Processing. In: Educational Leadership. September, Pg. 66 -70.

52. Whimbey, A. & Lockhead, J. 1980. Problem Solving and Comprehension. A Short Course in Analytical Reasoning. Pennsylvania: Franklin Institute Press.

MEDIATED LEARNING EXPERIENCE QUESTIONNAIRE

Below are the results of the quesionnaire which the group of students completed, with the results alongside. Participants were asked to tick the appropriate "YES" or "NO" response for questions 1 to 14. Questions 1 to 15 also required a "YES" or "NO" response, but provided space for the participants to elaborate if they chose to do so.

	YES	NO
1. I attended pre-school.	5	5
2. As a child, I was encouraged to ask question.	3	7
3. I had many playthings as a child.	5	5
4. As a child, I was punished for my wrongdoings.	8	2
5. My mother always gives the reasons for her instructions.	3	7
6. I ask questions freely in the home.	3	7
7. My parents often read to me as a child.	2	8
8. There are topics that cannot openly be discussed in the home.	3	7
9. My mother always answers me immediately.	5	5
10. I regularly do things together with my family.	3	7
11. I am often consulted about household matters.	4	6
12. I often sit and chat to my parents.	2	8
13. I have often spent good times with my grandparents.	6	4
14. I enjoy the company of my relatives.	7	3
15. Did your mother work when you were small?	9	1
16. Were you often told to "know your place" as a child?	8	2

17. Were you often corrected when speaking, as a child?	9	1
18. Do your parents speak of their childhood?	5	5
19. Would you describe your parents as strict?	7	3
20. Do you PLAN things regularly with your parents?	1	9
21. Would you describe your parents as optimistic?	5	5

SELF-CONCEPT INVENTORY

INSTRUCTIONS

Each item in this questionnaire consists of contrasting descriptions of two people, A and B. Read both descriptions in each item and compare yourself with each one. Then decide which of the two resembles you the most. On the right hand side of each item are two letters, A and B. If you are more like A draw a cross over the letter A on the right hand side of the page. If you are more like B, draw a cross over the letter B on the right hand side of the page. Perhaps you may not be exactly like either, but you must decide which of the two best describes you. In each item draw a cross over either A or B. Do not mark both in the same item.

Follow the same procedure for each item. There is no time limit, but work quickly and answer every item.

NOTE

A and B do not represent the same persons in each item. Therefore your answer to one item should not influence your answer to another.

Please enter the following personal details:

NAME: .....

SEX: .....

DATE OF BIRTH: .....

MARK A WITH A CROSS IF YOU ARE MORE LIKE A
MARK B WITH A CROSS IF YOU ARE MORE LIKE B

1. A is usually in perfect health
   B is seldom completely well ..... | A | B |

2. A easily loses all self-control
   B usually remains very calm ..... | A | B |

3. A is generally proud of his family
   B is often ashamed of his family ..... | A | B |

4. A is usually unpopular; his company is seldom sought after
   B is usually popular; his company is generally sought after ..... | A | B |

5. A rebukes people who use coarse language
   B never has the courage to rebuke people ..... | A | B |

6. A would rather win than lose a competition
   B is indifferent to the results of a competition .. | A | B |

7. A considers himself attractive
   B considers himself unattractive ..... | A | B |

8. A always feels inferior in company
   B never feels inferior in company ..... | A | B |

9. A often feels guilty about the ease with which he tells a lie
   B is not aware that he ever tells a lie ..... | A | B |

10. A is usually too selfconscious to offer help to other people
    B is always helpful and enjoys it ..... | A | B |

11. A changes his behaviour if he becomes convinced that he is wrong
    B often continues with behaviour even though he knows it to be wrong ..... | A | B |

12. A often postpones to the next day what should be done today
B never postpones work to another day ..... A B

13. A likes to be well-dressed and neat in all circumstances
B dislikes always being neat ..... A B

14. A is often peevish and moody for long periods
B is seldom if ever in a bad mood ..... A B

15. A usually looks forward to family gatherings
B does not like family gatherings ..... A B

16. A wishes that others would show interest in him more often
B is satisfied with the attention he gets ..... A B

17. A usually takes the side of the majority
B usually decides for himself what is right and stands by this decision even though he stands alone ..... A B

18. A sometimes drives through a stop street without stopping
B never drives through a stop street without stopping ..... A B

19. A is usually aware of pain somewhere in his body
B is seldom aware of any pain ..... A B

20. A is completely satisfied with himself
B is not satisfied with himself ..... A B

21. A is usually suspicious of his family's conversations and conduct
B is never suspicious of his relatives ..... A B

22. A is someone who makes friends very easily
B does not usually make friends easily ..... A B

23. A often does things which cause him to feel ashamed afterwards
B seldom does things which cause him to feel ashamed afterwards ..... A B

24. A sometimes feels like swearing when things go wrong
B never becomes so upset when things go wrong ..... A B

25. A is usually untidy
B is seldom really untidy ..... A B

26. A is as friendly to other people as he would like to be
B is not as friendly to everyone as he would like to be ..... A B

27. A is very sensitive to what his family says about him
B does not easily feel hurt by what his family says about him ..... A B

28. A usually gets on very well with other people
B's relationships are easily disturbed by trivialities ..... A B

29. A sometimes uses questionable methods in order to be ahead
B never considers using questionable methods ..... A B

30. A is inclined to gossip too much
B never gossips ..... A B

31. A is usually aware of feeling unwell
B seldom feels unwell ..... A B

32. A knows that he can usually solve his problems
B is always afraid that he will not be able to solve his problems ..... A B

33. A often feels unhappy because he has so little love for his family
B is satisfied that he loves his family ... . A B

A4

34. A always sees other people's good points
B seldom sees other people's good points ..... A B

35. A often feels unhappy because his life does not measure up to the high standards which others set for him
B seldom cares what others expect of him ..... A B

36. A is someone who often enjoys a shady joke
B never laughs at shady jokes ..... A B

37. A feels that his weight is correct
B often feels worried about his weight ..... A B

38. A often experiences despair because he does not keeps to his principles
B never experiences despair because he does not keep to his principles ..... A B

39. A would never be unfair to his family
B is not particularly scrupulous about being fair to his family ..... A B

40. A always finds it difficult to forgive someone who has accused him falsely
B readily forgives others ..... A B

41. A does not like everyone that he knows
B likes everyone he knows ..... A B

42. A is satisfied with his appearance
B does not feel happy about his appearance ..... A B

43. A is always envious of traits of character which he perceives in others
B is never envious of character traits which he perceives in others ..... A B

44. A is someone with little love for his fellowman
B will often do himself down in order to favour others ..... A B

45. A always feels self-conscious in the company of strangers
B seldom feels self-conscious in the company of strangers ..... A B

46. A's behavious is always irreproachable and honourable in all circumstances
B worries about his behaviour which often leaves much to be desired ..... A B

47. A takes little interest in the doings of other people
B takes an intense interest in the actions and conversations of other people ..... A B

48. A feels perfectly happy about his height
B is often selfconscious about his height ..... A B

49. A can never persevere with a task until it is finished
B perseveres to the end with every task he undertakes ..... A B

50. A always treats his parents very well
B often neglects his parents ..... A B

51. A finds it very difficult to enter into a conversation with strangers
B talks to strangers with the greatest of ease ..... A B

52. A will always return change when he is given too much
B does not trouble to return change when it is too much ..... A B

53. A often feels that he is angry with the whole world
B rarely feels irritable or sulky ..... A B

54. A feels dissatisfied with certain aspects of his physical appearance and would change them if he could
B is satisfied with his physical appearance just as it is ..... A B

55. A can usually hold his own in any situation
B finds it difficult to hold his own in all situations ..... A B

56. A usually ignores the wishes of his parents
B always considers the wishes of his parents ..... A B

57. A is very religious
B is not very religious ..... A B

58. A feels that other find it difficult to make friends with him
B is sure that others make friends easily with him A B

59. A feels dissatisfied because he is often unwell
B is satisfied with the state of his health ..... A B

60. A does not become annoyed when he is rebuked
B cannot tolerate rebuke ..... A B

61. A sometimes has serious quarrels with members of his family
B never has serious quarrels with members of his family ..... A B

62. A is always friendly
B is not always friendly ..... A B

63. A's family seldom ask his opinion
B's family consults him about most of their affairs. A B

64. A longs for more attention from the opposite sex
B is satisfied with the attention he gets from the opposite sex ..... A B

65. A usually performs well
B often performs badly ..... A B

66. A's family criticize him often
B seldom offends in the eyes of his family..... A B

67. A is sometimes irritable when he is unwell
B is never irritable when he is unwell ..... A B

68. A is particularly popular amongst friends of his own sex
B is not very popular amongst friends of his own sex ..... A B

69. A thinks that his family does not love him
B is completely sure of his family's love ..... A B

70. A likes to care for his body to the best of his ability
B often feels guilty because he neglects his body... A B

71. A often acts without first considering the consequences of his deeds
B carefully considers the consequences before he takes action ..... A B

72. A is particularly popular with the opposite sex
B is not very popular with the opposite sex ..... A B

73. A feels that his family is suspicious of everything he does
B is sure that he is trusted by his family in everything ..... A B

74. A occasionally thinks about improper things which cannot be discussed
B never thinks about improper things ..... A B

75. A enjoys exacting work
B prefers routine work ..... A B

76. A easily changes his opinions; he never disagrees
B firmly adheres to his convictions ..... A B

77. A has relatives who will support him in any situation
B does not have relatives on whom he can rely in any situation ..... A B

78. A is calm and composed in almost any circumstances
B can never defend his viewpoint in a calm and composed manner ..... A B

79. A often gets cross when he is thwarted
B seldom gets cross when he is thwarted ..... A B

80. A feels very energetic most of the time
B feels tired and lethargic most of the time ..... A B

81. A is a member of a very happy family
B's family is not very happy..... A B

82. A does not feel inferior to his friends
B feels inferior to his friends and acquaintances in many ways..... A B

83. A usually finds it very difficult to reach a decision
B considers the available information and usually decides quickly ..... A B

84. A is usually cheerful irrespective of circumstances
B is only cheerful when things go well..... A B

85. A feels that he is highly respected by his family
B thinks that he is unimportant in the eyes of his family..... A B

86. A often regards himself as a bad person
B regards himself as a good person ..... A B

87. A is a good mixer and usually enlivens the company
B often wishes that he could be more sociable..... A B

88. A feels guilty because he seldom goes to church
B finds his church attendance satisfactory ..... A B

89. A takes an interest in his family and visits them often
B does not take much interest in his family..... A B

90. A is always very polite to strangers
B often finds himself lacking in courtesy..... A B

91. A is very clumsy and awkward in certain situations
B seldom suffers from clumsiness and awkwardness... A B

92. A is satisfied that he faithfully observes the virtues of honesty, integrity, loyalty, truth= fulness, etc.
B often feels guilty because he neglects these virtues..... A B

93. A is almost never reserved or selfconscious
B is usually reserved and selfconscious with strangers and particularly with people in authority ..... A B

94. A is very nervous when he has to appear before a group of people
B almost never suffers from nervousness ..... A B

95. A is someone who does not feel particularly guilty if he is compelled to tell a small lie
B is someone who never tells a lie ..... A B

96. A's religion offers him considerable inspiration, comfort and hope
B constantly worries about his religion ..... A B

97. A is easily worried
B seldom suffers anxiety ..... A B

98. A often feels guilty about his frequent irresponsible behaviour
B is satisfied that he fulfils his responsibilities A B

99. A usually understands the members of his family very well
B frequently misunderstands his family ..... A B

100. A is someone who sacrifices much to help the underpriviledged
B is hardly aware of the poor, cripples, blind people etc. and ignores rather than helps them .. A B

APPENDIX 3A TABLE 1

SCHEME OF SESSION SETS

SESSIONS 1 and 2. INTRODUCTION AND THE SIGNIFICANCE OF CELL DIVISION

MLE CRITERIA	COGNITIVE FUNCTIONS ENCOURAGED
1. Intentionality - coming between students and information - orientation of group: nature of sessions & content	1. Comparative behaviour - comparison of plant and animal cell structures
2. Meaning - significance of cell division - emotional involvement = need for repair and replacement of damaged & old tissue = growth of fertilised ovum to full maturity	2. Focused perception - reflecting on plant and animal cell structures - diagrams projected: nucleus & cell types
3. Transcendence - reference to past information = cell structures - use of imagination for reflecting on cell strucures - projecting: the role of the nucleus in future sessions	3. Time and space concepts - reflection on cell structures - micro- & macro cell structures projected & located - cyclical nature of cell division - division as needed by body
4. Regulation of behaviour - determine pace of activities	4. Thinking about information stored - Std 8 syllabus recalled - mental and oral revision
5. Feeling of competence - acknowledge all responses for formulation of correct answers - smaller groups: less threatening	5. Selection of relevant cues - in comparison of cell types
	6. Controlled and planned expression - teacher as model for planning

OTHER OBSERVATIONS

1. Initial hesitance of students

2. Reluctance to participate in groups and to individually respond to questions.

3. Difficulty in moving from one modality to another, eg. from concrete to imaginary, from diagrams/graphic to verbal.

APPENDIX 3A TABLE 2

SESSIONS 3 and 4. ROLE OF NUCLEUS IN CELL DIVISION

MLE CRITERIA	COGNITIVE FI
1. Intentionality - summation and framing - repetition - involving students: = illustrations = labelling = questioning = groupwork	1. Comparat - comparin - comparin
2. Meaning - stressing the importance of chromosomal constancy - significance of = identifying labels = identifying diagrams at different stages in cell division	2. Space and time concepts - sequencing of phases - division as needed by organism
3. Transcendence - reflection - anticipation = refer to DNA replication = chromosomal structure indicative of phase and division type = refer to genetics	3. Thinking about information - reflect on previous work
4. Sharing behaviour - teacher as model - groupwork/pairs	4. Mature communication modalities - encouraged appropriate use of terminology
5. Regulation of behaviour - facilitation of responses	5. Perception of relationships - pointing to relationships between immediate information and later/earlier work
6. Feeling of competence - acknowledging responses - explore causes for incorrect responses	

OTHER OBSERVATIONS

1. Students appeared more relaxed.

2. Participation increased.

3. Responses less hesitant.

4. Attempts to use more language than gestures in responses.

APPENDIX 3A TABLE 3

SESSIONS 5 AND 6. INTRODUCTION TO MEIOSIS & MEIOSIS I

MLE CRITERIA	COGNITIVE FUNCTIONS ENCOURAGED
1. **Intentionality** - repetition - comparison	1. **Focused perception** - analysis of diagrams, focus on cues
2. **Meaning** - emotional involvement by discussion of personal traits - importance of reduction division: = constancy of chromosomal number = crossing over for variation	2. **Planned and systematic exploration** - economic use of time - related to regulation of behaviour
3. **Transcendence** - reflection on personal traits inherited from parents - anticipation of offspring's possible traits - discuss "intelligence" as only a result of genetics or not	3. **Understanding of words & concepts** - discussion of meiosis vocabulary - encouraged usage of new terms
4. **Sharing behaviour** - sharing discussion of personal characteristics	4. **Thinking about stored information** - principles of mitosis applied to meiosis with the differences noted
5. **Individuation** - recognition of uniqueness	5. **Time and space concepts** - recognition of phases - site of gametogenesis and reduction division
6. **Regulation of behaviour** - rotation of reporting responses	

OTHER OBSERVATIONS

1. More confident discussion and reporting.
2. Increased use of correct terminology.
3. Active participation in discussions on personal inhereted characteristics.

APPENDIX 3A TABLE 4

SESSIONS 7 and 8. MEIOSIS II & CYTOKINESIS IN PLANT AND ANIMAL CELLS

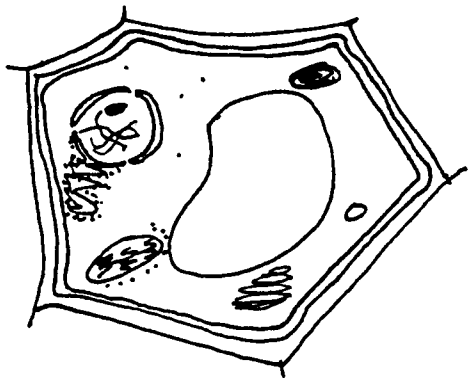
MLE CRITERIA	COGNITIVE FUNCTIONS ENCOURAGED
1. Intentionality - comparing meiosis & mitosis - scheduling of tasks & steps	1. Selection of relevant cues - cell shape for plant/animal cell - cytokinesis in plant/aminal cell - organelle position for phase of cell division
2. Meaning - clarify division principles - observe differences in strucure and behaviour of chromosomes - discuss significance of meiosis	2. Pursuing logical evidence - for calculations of chromosomal number
3. Transcendence - reflect on need for constancy of chromosomes as discussed earlier - attempt to make students feel their responses worthy	3. Mature communication modalities - reporting responses to rest of group using appropriate terms
4. Sharing behaviour - share responses with partners and whole group	
5. Individuation - individually completed tasks compared with partner	
6 Feeling of competence - competence mediated - acknowledge students' confidence	

OTHER OBSERVATIONS

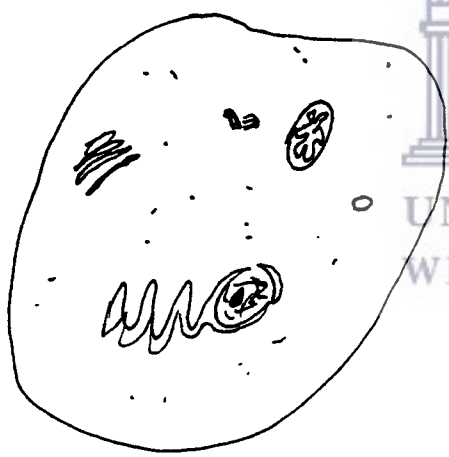
1. Adequate attempts at illustrations and labelling.
2. Satisfaction among students at their responses.
3. Initially hesitant student much more interactive.
4. Students expressed confidence for this section of the examination.

APPENDIX 3B

SESSIONS 1 and 2



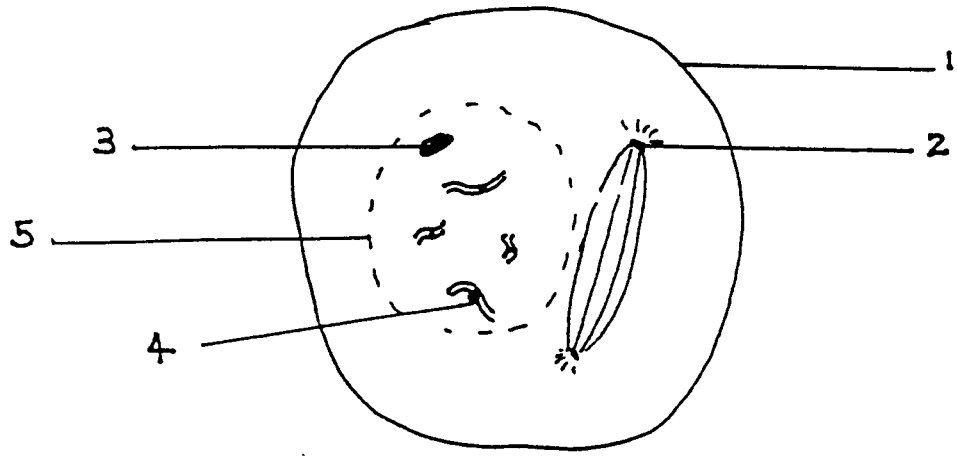
A PLANT CELL



AN ANIMAL CELL

APPENDIX 3B

DIAGRAM session 3 & 4



1. a. What type of cell is represented here?

   b. Give a reason for your answer.

2. a. Name the phase of the mitotic division represented.

   b. Give a reason for your answer.

3. What phase will follow this one?

4. a. At wwhich phase will number 4 split?

   b. What are the separate part of 4 called?

   c. Part 4 splits, yet when a daughter cell of A starts dividing, 4 reappears as double stranded. How is this possible?

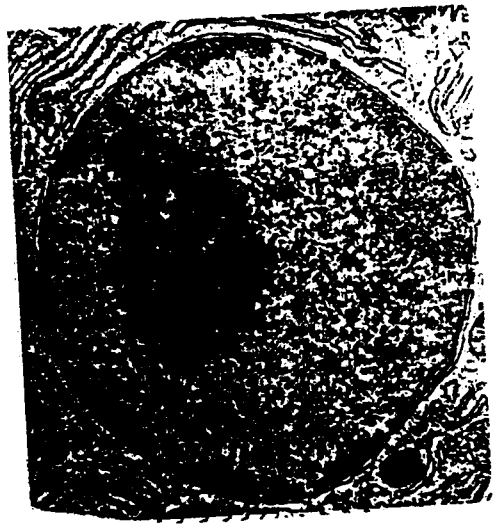
5. a. In which cell type does mitosis occur

   b. Why is mitosis important to living organisms?

6. a. What does the prefix "karyo" refer to?

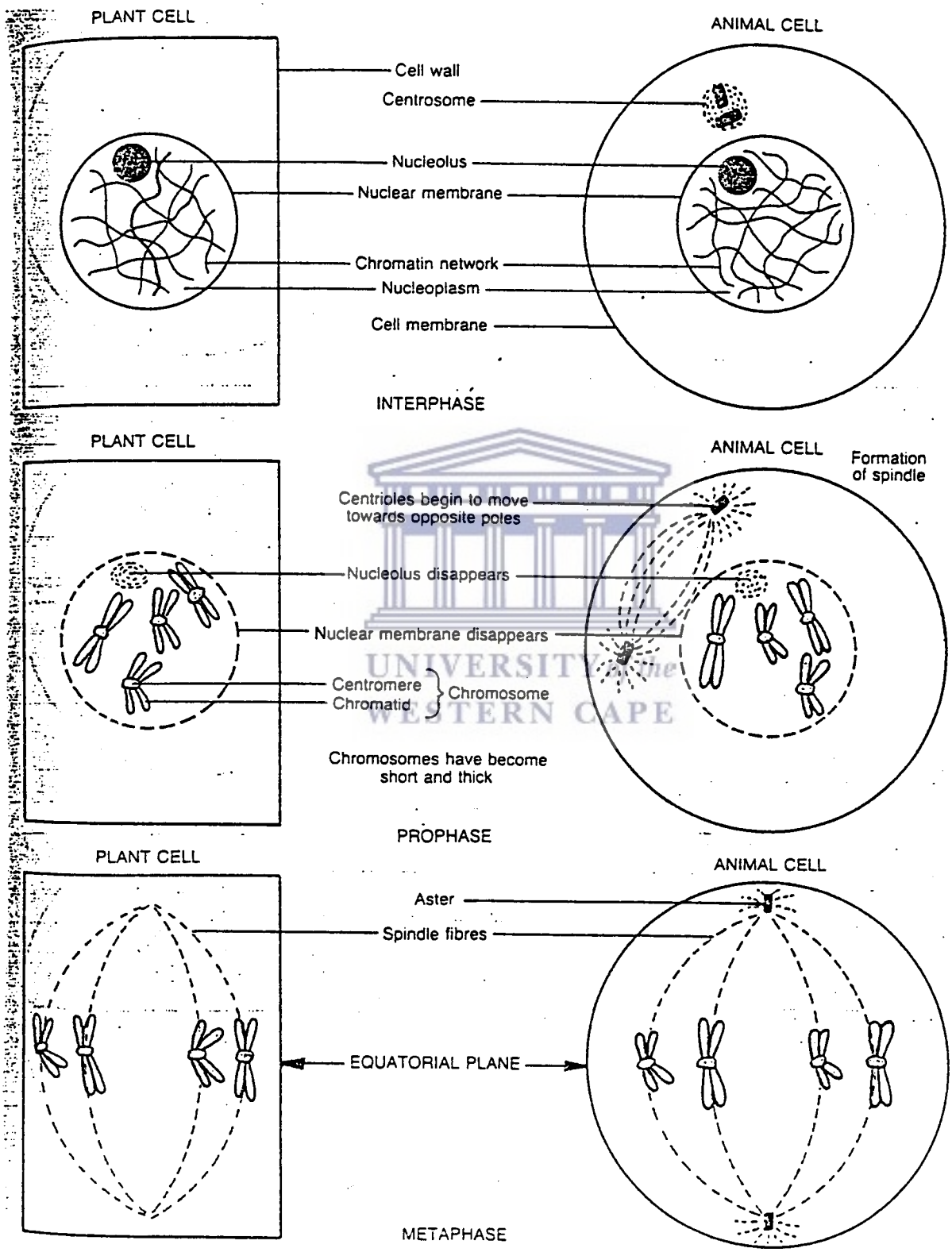
   b. What is karyokinesis?

APPENDIX 3B
SESSIONS 3 and 4

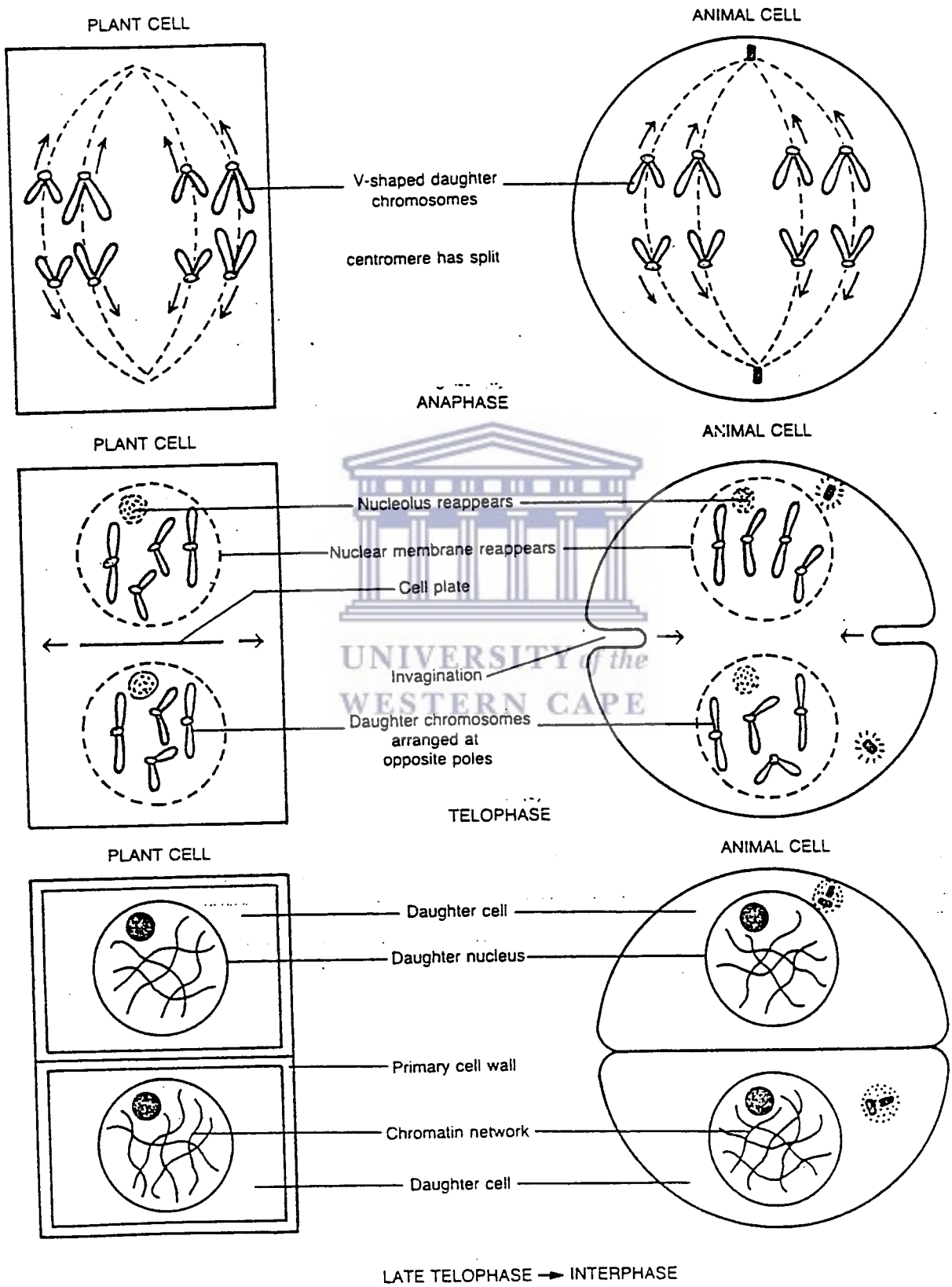


T H E N U C L E U S

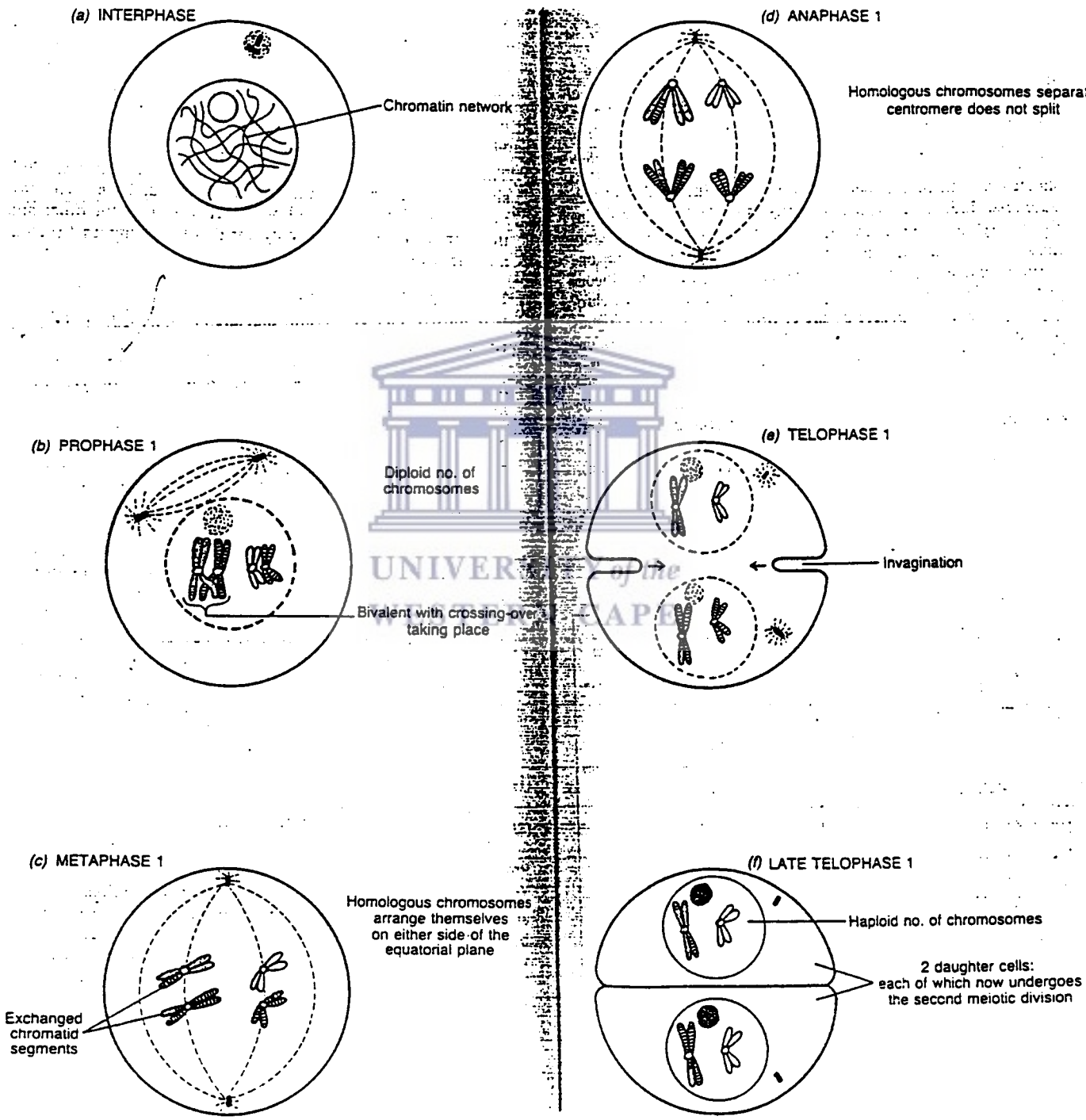
APPENDIX 3B
SESSIONS 3 and 4 / 5 and 6



APPENDIX 3B
SESSIONS 3 and 4 / 5 and 6

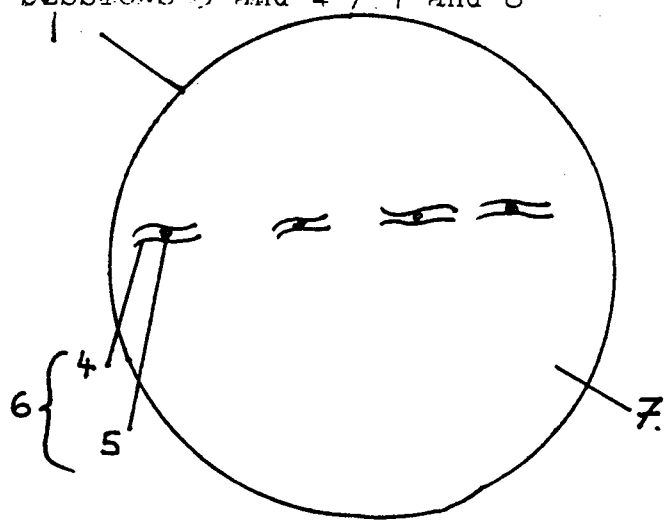


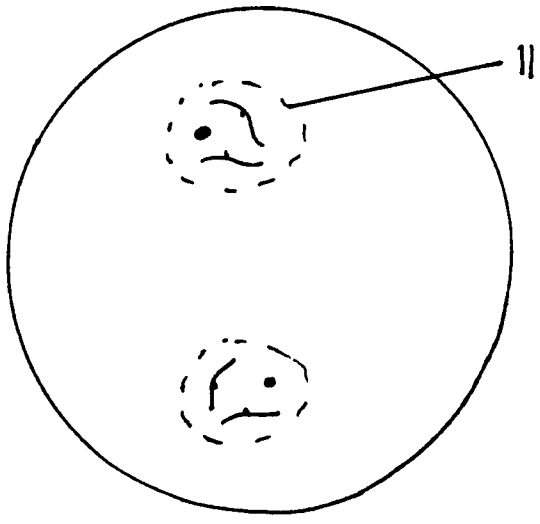
APPENDIX 3B
SESSIONS 5 and 6

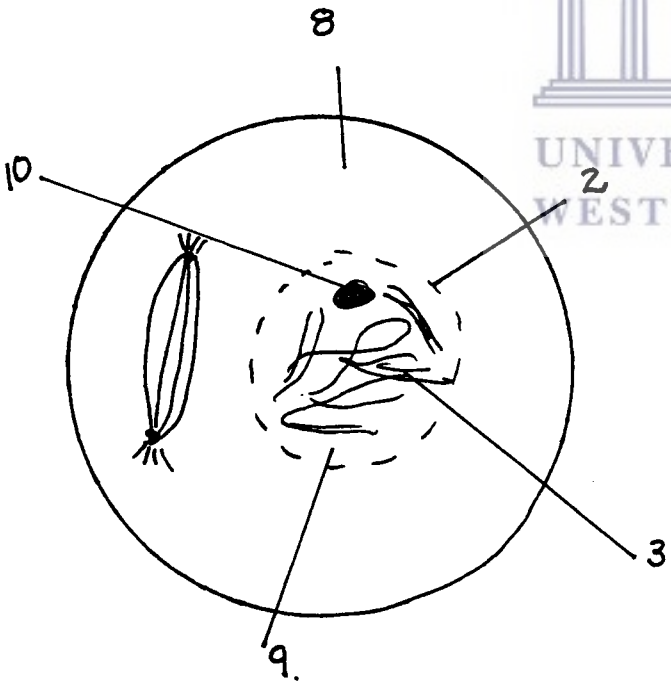


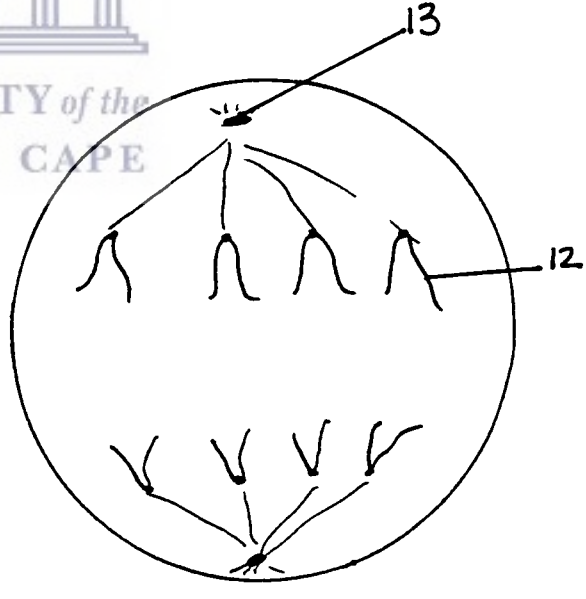
APPENDIX 3B

SESSIONS 3 and 4 / 7 and 8



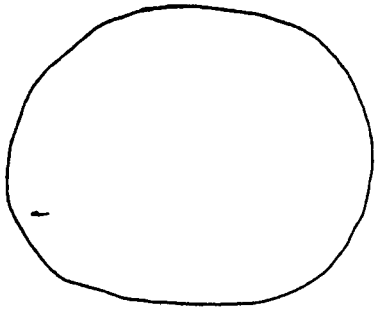






APPENDIX 3B

DIAGRAM SESSION 7 & 8



1. Use the outline and fill in the components so that this animal cell represents one at metaphase in meiosis I. The cell has six chromosomes.
2. When would meiosis occur in your own body?
3. Which stages precede and follow the stage you depicted above?
4. At which phase would crossin-over occur?
5. Give another term for a bivalent.
6. How many daughter cells will be formed if this cell were to complete meiosis?
7. What would these daughter cells be known as?
8. How many chromosomes would these daughter cells have?

APPENDIX 4A THE MLE RATING SCALE

This rating scale affords the opportunity to rate the quality of mediation being exercised by a mediator (eg. a teacher) in terms of the major criteria of Mediated Learning Experience. Each criterion is presented below in terms of a negative pole which reflects a negation of mediation in that sphere, and a positive pole, which indicates fulfilment of the major criterion of mediation in that sphere.

A rating of performance at the mid-point on the scale would indicate a neutral finding (that is, no evidence is provided for either sound mediation or a negation thereof). A rating at the point nearer to the negative or positive pole will reflect a negative or positive tendency away from or towards mediation respectively, while a rating <u>at</u> the positive or negative end will indicate a generally positive or generally negative set of behaviours.

To carry out your rating simply put a cross (X) on top of the point selected along the continuum. Please rate at only one of the five points given.

1. INTENTIONALITY AND RECIPROCITY

Fails to engage pupils				Provides effective teacher-pupil interaction

2. MEANING

Fails to provide purpose/ relevance of activities or subjects				Makes explicit the values and importance of activities/subjects

3. TRANSCENDENCE

Fails to apply activities/subjects beyond the immediate situation				Promotes good bridging ideas/ opportunities/applications in a broader context

4. COMPETENCE

Emphasises negative aspects of work/behaviour				Emphasises areas of strength/success

5. REGULATION AND CONTROL OF BEHAVIOUR

Aggravates child's impulsivity/ unplanned behaviour	Promotes awareness of the need for control/planned behaviour

6. SHARING BEHAVIOUR

Emphasises competition at the expense of co-operation	Encourages opportunities for co-operation (eg. groupwork)

7. INDIVIDUATION

Encourages conformity	Positively values divergent responses and individual differences

8. GOAL PLANNING

Sets unrealistic, arbitrary and/or no goals	Helps child set and plan clear goals

9. SEARCH FOR CHALLENGE, NOVELTY

Emphasises routine, conventional approaches/activities	Encourages creativity/ appropriate risk taking

10. SELF-CHANGE

Encourages external criteria for measuring progress	Promotes self-evaluation of individual progress

APPENDIX 4B RESULTS OF THE MLE RATING SCALE

1. INTENTIONALITY AND RECIPROCITY

			2	8
Fails to engage pupils				Provides effective teacher-pupil interaction

2. MEANING

		2	3	5
Fails to provide purpose/ relevance of activities or subjects				Makes explicit the values and importance of activities/subjects

3. TRANSCENDENCE

			3	7
Fails to apply activities/subjects beyond the immediate situation				Promotes good bridging ideas/ opportunities/applications in a broader context

4. COMPETENCE

		1	3	6
Emphasises negative aspects of work/behaviour				Emphasises areas of strength/success

5. REGULATION AND CONTROL OF BEHAVIOUR

			2	8
Aggravates child's impulsivity/ unplanned behaviour				Promotes awareness of the need for control/planned behaviour

6. SHARING BEHAVIOUR

			3	7
Emphasises competition at the expense of co-operation			Encourages opportunities for co-operation (eg. groupwork)	

7. INDIVIDUATION

		1	4	5
Encourages conformity			Positively values divergent responses and individual differences	

8. GOAL PLANNING

			3	7
Sets unrealistic, arbitrary and/or no goals			Helps child set and plan clear goals	

9. SEARCH FOR CHALLENGE, NOVELTY

		1	3	6
Emphasises routine, conventional approaches/activities			Encourages creativity/ appropriate risk taking	

10. SELF-CHANGE

		1	2	7
Encourages external criteria for measuring progress			Promotes self-evaluation of individual progress	