REPORT ON THE DEVELOPMENT OF A PROTOCOL FOR PROFILING PROGRESS TOWARDS BEST PRACTICES IN SCIENCE

By **Loyiso Jita**

CHAPTER ONE

INTRODUCTION

In the two years since its inauguration, the government has made significant gains in its attempts to dismantle the remaining pillars of apartheid education. At the top of the list were issues of governance and management at national, provincial and local level, as the government sought to unify the numerous sub-systems created by apartheid policy. Recently however, there has been increased focus on the reconstructive aspects of the transformation process, i.e. the need for a new curriculum in South African schools.

In anticipation of the shift to research implementation over the next few years, EPU researcher Loyiso Jita conducted a benchmark study on the teaching of science in about 16 different schools in KwaZulu-Natal. This study sought to profile some of the exemplary practices observed and factors that either sustained or hindered these practices (Jita, 1998). The study facilitated a greater understanding of science teachers' practices and how they are shaped by the different contexts. Unsurprisingly, Jita also discovered that the teachers he observed and interviewed were uncertain of whether their practices were `best' or not. At present, there is no protocol to enable unequivocal determination of this issue, which educators would be able to use on their own to determine their progress towards meeting the pedagogical expectations of the new curriculum.

This project proposes to develop a pilot PROTEP protocol that teachers and educational leaders can use to benchmark teachers' practices. Teachers should be able to use it as a tool to inform others about their current practices, thereby providing a common yardstick on which discussions about improvements can be based. The tool will also allow policy-makers to identify areas of greatest weakness (i.e. those in which most teachers require assistance). The protocol has potential to assist decision-makers that want to know which additional resources are needed to improve science teaching and learning. The project therefore seeks to translate the Curriculum 2005 and other outcomes-based education (OBE) intentions for the Natural Sciences learning area into observable teacher behaviours, knowledge and attitudes characterising best practices.

However, developing such an instrument from statements of intention (in the form of curriculum frameworks) whose potency for raising learner achievement and improving instructional practice in science classrooms has not been demonstrated, would be premature and against decades of research that has shown an absence of a linear relationship between policy and practice. One way of resolving the dilemma is by constructing a protocol (the PROTEP) for indicating best practices by working backwards from practice to protocol. That is, by characterising specific instances of best practice and using this as a basis for comparison with the policy intentions of Curriculum 2005. Using the Third International Maths and Science

Study (TIMSS) results of mathematics and science achievement as some indicator of best practice in Natural Sciences, one can explore teachers' practices for the reverse mapping.

For the proposed research, detailed case studies of teaching practices in Japan and the United States of America (USA) will be used as exemplars for comparison with the TIMSS data for South Africa and policy intentions in this country. By contextualising the Japanese and US experiences, it is hoped that a hybrid protocol can be created and piloted in South African schools. In addition, this research is intended to be a basis for further development of work on indicators of excellence and quality in teaching and learning.

GOALS AND OBJECTIVES

Specifically, this research project seeks to address three sets of goals, viz:

1. To develop a protocol for profiling `best practices' in science education across the range of public schools of South Africa.

2. To identify patterns of progress towards `best practices' in a selected sample of practitioners - and therefore also their institutions - and thereby help policy-makers identify preliminary points of intervention in facilitating the changes envisaged in the new curriculum 2005: Natural Sciences.

3. To study international experiences of reforming instructional practices and gather evidence of best practice in science education and its applicability to South Africa.

CHAPTER TWO

RESEARCH METHODOLOGY

To address the questions posed in Chapter l, a case study approach was adopted to explore:

a) Curriculum innovations and teaching practices in South Africa in comparison to Japanese and US science education innovations.

b) Classroom practices of four teachers who have attempted to reform their practice in line with the new vision for curriculum in South Africa.

Four teachers were identified through a process of nomination (including self nomination) for piloting the PROTEP instrument. [1] For our purposes qualitative methods were the most appropriate. They are well suited to in-depth analysis of complex issues because they allow for rich descriptions and an understanding of the processes of change within local contexts (Miles and Huberman, 1984; Stake, 1995).

The Two Comparative Countries

South Africa is currently undergoing a thorough and difficult process of social transformation that involves the reconstruction of the school curriculum. The new curriculum vision encourages innovative and demanding teaching practices that make demands on teachers that are unparalleled in the history of South African education. Even internationally, there are few countries that have had to deal with changes in teaching practice as an aspect of overall social change. The search for models was therefore difficult. However, despite the absence of models that exemplify changes of a similar scale and nature, some countries have attempted innovations in their science education programmes with fairly satisfactory results. Japan and the US are two such countries that were selected for the comparative study. A number of criteria guided the selection.

An attempt was made to characterise best practices from comparatively detailed written case studies of two countries that exhibit high levels of learner achievement in science, as indicated in the recently published scores of the TIMSS. The USA (State of Michigan) and Japan were selected for further study. Despite the fact that these two countries are more developed than South Africa, the selection was also shaped by the fact that:

a) Of the 41 countries involved in the TIMSS international survey, South Africa was the only African country and one of only three developing countries (none of which did well).

[1] For ethical reasons, names of schools would not normally be mentioned in a report of this nature. However. due to the necessity for accountability to funding agencies, this policy has been waived. Two teachers from Berea North Junior Primary school, one teacher from Oressa Primary School in Isipingo and another from Isipingo Beach Primary school were used to pilot the PROTEP instrument.

b) An on-going reform effort aimed at encouraging best practices in science education existed in the selected countries.

c) There were significant similarities with the South African context,

d) In the case of the USA, the multicultural nature of that society and the policy challenge of fostering equity and access for Blacks in science and mathematics education, and experience with OBE in the 80s determined the choice.

e) In the case of Japan, non-western cultural practices have a greater influence on teachers' relations with learners and their classroom practices are similar to the cultural experiences of the majority of learners in this country, especially African learners. In addition, the majority of scientific literature is published in other languages, which presents a hurdle that Japanese learners must overcome.

f) An important consideration for both countries is that there is a wealth of comparative research literature on their education systems - in part because of their respective economic success. In addition, the Japanese education system is centrally organised, somewhat similarly to the South African system, while the US system is decentralised, and somewhat similar to our constitutional `separation' of powers for education.

g) Since the two countries participated in the Survey of Science and Maths Opportunities (SMSO), the TIMSS headquarters in Switzerland and the US can be expected to have a wealth of material and expertise on these education systems located in their research centres, and the Human Sciences Research Council (HSRC) can be expected to have the detailed analysis of the South African parts of the survey.

Data collection

A document and literature search on the characterisation of exemplary or recommended classroom practices, especially for science education, was done for each country. In addition, dimensions of classroom practice that require change were identified in South African curriculum documents. Japanese and US studies were reviewed on the basis of the categories developed from the South African documents On the basis of this literature survey, a draft PROTEP instrument was developed.

Interviews with Reformers

A range of local educators that have taken lead roles in efforts to reform science education or teaching in general in South Africa were interviewed. These included central office personnel with responsibility for curriculum and instruction, elementary school principals, policymakers and teacher educators.

Interview protocols were developed to ensure comparable data across all the informants. Interview questions were open-ended and every effort was made to adapt the questions to the particular informant. Interviews ranged from 30 minutes to 90 minutes, depending on the interviewee. All the interviews were tape-recorded and transcribed. This interview data did not essentially change the PROTEP instrument but facilitated a more critical look at the case study data and a greater understanding of why certain classroom practices prevail.

CHAPTER THREE

FRAMEWORK FOR DESIGNING THE PROTEP INSTRUMENT

1. The Concept of Growth

The approach to the design of the PROTEP instrument was based on the framework and methods discussed by Leithwood and Montgomery in their text *Improving classroom practice: using Innovation Profiles (1987:2-19).* Their framework is based on the assumption that individual and organisational change involves a process of growth and that human change processes are almost inevitably incremental. Rarely does one observe dramatic shifts in behaviour (particularly professional behaviour) in the short term. In addition the use of the term `growth' is only appropriate when these stages of change move in a desired direction.

2. Stages/Dimensions of Growth

The most fundamental change (or growth) that takes place in organisations is that pertaining to people's behaviour. In schools, increased effectiveness has been defined primarily as growth from current to preferred status (i.e., that of the transformed teacher). Thus stages of growth in teacher behaviour become a way of thinking about the gap between images and outcomes. That is, growth is considered in terms of whatever specific competencies and characteristics are associated with the prevailing image of good teaching.

These competencies and characteristics define what elements or dimensions of the teacher's practice will constitute the focus for professional intervention. Dimensions may be drawn from behavioural classification schemes. While there are a number of alternative classification schemes available (the best known being the cognitive, affective, and psychomotor categories developed by Bloom et al in 1956), a category system developed by Hall and Loucks (1978) has been used because of the practical advantages it offers over other schemes. It allows for specific definition of the types of concerns that implementers have about their work.

For instance, an in-service programme on learner questioning techniques will not be of much help to a teacher whose problem in implementing a new science programme stems from a lack of equipment. In addition, a principal who is uncertain of how to assist teachers in assessing learner growth will not gain much insight from yet another organisational development workshop.

3. Tasks Included in Developing a Profile

The framework, as a prescription for intervention, suggests several fundamental tasks to be performed in relation to each role after the goals for change have been established.

Planned change involves systematically applying procedures in a co-ordinated time frame to accomplish these tasks, which include:

- Identifying critical dimensions of growth
- Defining preferred status in terms of these dimensions
- Determining current status
- Identifying manageable stages of growth between current and preferred status
- Diagnosing obstacles of growth at each stage
- Designing and applying strategies for overcoming such obstacles
- Monitoring growth

Developing Innovation Profiles in relation to the teacher's role is a procedure that can be used to accomplish the first four of these tasks. Profiles help teachers to understand changes in instructional practices and curriculum decisions required by innovation. Such Profiles concretely specify these changes and provide a means for monitoring the nature and extent of implementation in the classroom. Profile development also requires advocates of change to provide. a defensible link between the changes they are promoting and benefits to learners beyond those realised by existing practices.

From general orientation to implementation, a number of tasks that apply to the teacher can be identified. Among these are:

1. To determine the overall goal(s) for change; fundamentally, such goals should focus on growth of learners and their aspirations.

2. To identify dimensions of teachers' classroom practices that will need to change if the overall goals for change are to be achieved.

3. To describe, within selected dimensions of teachers' classroom practices, those practices most likely to facilitate the achievement of learners' aspirations; this is a description of full implementation.

4. To describe, within these selected dimensions of teachers' classroom practices, steps that teachers can take to move towards practices that are most like those described as full implementation; such steps may be thought of as manageable stages of teacher growth.

5. To use these stages of teacher growth as a framework to assess the actual range of classroom practices presently being used by teachers to help learners achieve their goal(s) for change.

6. Once again, to use the stages of teacher growth as a framework to determine obstacles to growth faced by teachers in changing their practices,

7. To select and apply strategies to help teachers overcome such obstacles.

8. To monitor the progress made by teachers and observe the value of selected strategies in overcoming teachers' obstacles.

4. Dimensions of Teachers' Practices

The sources of information on dimensions of classroom practice that most need to be changed are twofold. The innovation itself (and what has been written about it) is the most obvious source. Curriculum guidelines, for example, are usually developed using criteria such as objectives, resource materials, instructional strategies, and the like; many other curricular innovations use similar dimensions that enabled the developers to capture their intentions for change.

Theories - curricular, instructional or, more broadly, educational theories - are the second source of information about dimensions. Such theories usually focus on selected variables plausibly related to learner outcomes (for example, time on task, IQ, learners' prior knowledge). Assuming the availability of relevant theory with well established links between variables and learner outcomes, this alternative seems well suited to promoting learner growth. Whether it is suited to implementing the explicit features of an innovation will depend on how closely those explicit features match the variables of concern in the theory.

In developing this PROTEP instrument, the former option (relying on the curriculum documents) was adopted, as assumptions about theoretical models at play in the new curriculum could not be made.

5. Defining Features within each Dimension

Given a set of dimensions identifying the practices that are important to change, the next step is to describe, within each of the dimensions, what is involved in the full implementation of the innovation.

Three sources of information can be brought to bear upon full implementation of an innovation: professional judgement; the developers' description of the innovation and related material; and information from research and evaluation studies. Each source has strengths and weaknesses that must be recognised. These depend, in part, on what the goal(s) for implementation are. The main concern of this project is to uncover those practices most valued by their developers. Well-specified innovations are extremely helpful for this task, as is access to the developers of the innovation. Developers may reveal, with some probing, intentions that did not find their way into written descriptions. A lot of the curriculum documents contain elements of the required practice, although these features are not pulled together to make a coherent whole.

Research studies may provide a general description of such practices and indicate their impact on learners. However, a shortcoming of many research studies is the limited description of effective practices contained in them. When the primary concern is to

implement the innovation, professional judgement provides the contextual information that is required to fill in the gaps left by the developer. In examining case studies of two other countries this project sought to capture research findings regarding exemplary practice. However, as described elsewhere in this report, the data collected was of little use and the assistance of a Japanese professional educator had to be enlisted to supplement the research data.

6. Stages of Growth

Procedures for describing stages of growth vary according to how the number of stages is determined, the extent of the description provided for each stage, and the basis on which stages are justified. Some descriptions of stages of growth use a fixed number of stages, a few vary the number of stages, depending on the innovation. A fixed number of stages inevitably focus on what is similar in the change process and assume that there are predictable patterns of change whatever the innovation. This alternative seems suitable if one's purpose is to generalise across innovations as to amount of use, or to provide a summative assessment of such use. The `levels of use' system developed by Hall and Loucks (1978), with eight fixed stages (non-use, orientation, preparation, mechanical use, routine use, refinement, integration, and renewal) is an example of this approach. If, however, one requires detailed knowledge about a particular innovation to inform decisions about subsequent implementation strategies, then a fixed number of stages may not be helpful. This project was concerned with the development of an instrument that would capture the level of implementation and how progress can be profiled at different points of the implementation.

The conceptual structure used in the development of the PROTEP instrument is the Concerns-Based Adoption Model (CBAM) and one of its primary dimensions, the `concerns' expressed by individuals as they engage in the innovation-adoption process, will be examined. In CBAM, the concept of `concerns' has been developed to describe these perceptions, feelings, and motivations. Research studies have verified a set of stages that people appear to move through when they are involved in innovation implementation. These Stages of Concern provide a key diagnostic tool for determining the content and delivery of staff development activities.

The concept of concern was first described by Fuller (1969) who identified a set of concerns expressed by pre-service teachers as they moved through their teacher education programme. These changed from initial concerns unrelated to teaching (I'm concerned about getting a ticket to the rock concert next Saturday night), to concerns about self in relation to teaching (I wonder if I can do it), to task concerns about teaching (I'm having to work all night to prepare my lesson plan for tomorrow), to impact concerns (are children learning what they need to?).

Stages of Concern
6. Refocusing: The focus is on exploration of more universal benefits from the innovation, including the possibility of major changes or replacement with a more powerful alternative. Individual has definite ideas about alternatives to the proposed or existing form of the innovation.
5. Collaboration: The focus is on co-ordination and co-operation with others regarding the use of the innovation.
4. Consequence: Attention focuses on impact of the innovation on student in his/her immediate sphere of influence. The focus is on relevance of the innovation for students, evaluation of outcomes, including performance and competencies, and changes needed to increase student outcomes.
3. Management: Attention is focused on the processes and tasks of using the innovation and the best use of information and resources, issues related to efficiency, organising, managing, scheduling, and time demands are utmost.
2. Personal: Individual is uncertain about the demands of the innovation, his/her inadequacy to meet those demands, and his/her role in the innovation. This includes analysis of his/her role in relation to the reward structure of the organisation decision making, and consideration of potential conflicts with existing structures or personal commitment. Financial or status implications of the program for self and colleagues may also be reflected.
1. Informational: A general awareness of the innovation and interest in learning more detail about it is indicated. The person seems to be unworried about himself/herself in relation to the innovation. She/he is interested in substantive aspects of the innovation in a selfless manner, such as general characteristics, effects, and requirements for use.
0. Awareness: Little concern about or involvement with the innovation is indicated.

Source: Hall and Loucks, 1978, pp. 41.

7. Advantages of using the CBAM

a) In educational institutions change is a process, not an event. Too often policy-makers, administrators, and even teachers, assume that change is the pivotal result of an administrative decision, legislative requirement, new curricular acquisition, or procedural revision. They assume that a teacher is able to put aside an old reading text and immediately apply an individualised programme with great sophistication. Somehow the conviction lingers that with the implementation of the new programme in schools, teachers will automatically blend their talents to become effective teams. As reflected in *CBAM,* the reality is that change takes time and is achieved only in stages.

b) The individual must be the primary target of interventions designed to facilitate change in the classroom. Other approaches to change (e.g. organisational development) view

the composite institution as the primary unit of intervention and emphasise improving communication and other organisational norms and behaviours. CBAM, however, emphasises working with individual teachers and administrators in relation to their roles in the innovation process. CBAM works on the premise that institutions cannot change until the individuals within them change.

c) Change is a highly personal experience. Staff developers, administrators and change facilitators often attend closely to the trappings and technology of the innovation and ignore the perceptions and feelings of the people undergoing the change process. In CBAM, it is assumed not only that the change process has a personal dimension to it, but that this personal dimension is often more critical to the success or failure of the change effort than the technological dimension. Since individuals bring about change, their personal satisfactions, frustrations, concerns, motivations, and perceptions generally all play a part in determining the success or failure of a change initiative.

d) The change process is not an undifferentiated continuum. Individuals involved in change go through stages in their perceptions and feelings about the innovation, as well as in their skill and sophistication in using it.

e) Staff development can best be facilitated on an individual basis by use of a client-centred diagnostic/prescriptive model. Too many in-service training activities address the needs of trainers rather than those of the trainees. To deliver relevant and supportive staff development, change facilitators need to diagnose the location of their clients in the change process and to direct their interventions toward resolution of their particular needs.

8. Data Collection Procedures

To facilitate the implementation of an innovation, when a multidimensional description of growth has been developed, the decision needs to be made on how best to collect information about teachers' practices. More specifically, what type of data collection procedures will provide information allowing us to place a teacher's practices at one or more of the previously described stages of implementation? Analysis of records, self-report measures and observations are the most likely alternatives to choose from. For this report, classroom observation coupled with teacher interviews was used to generate the required data.

CHAPTER FOUR

DEVELOPMENT OF THE DRAFT PROTEP INSTRUMENT

The draft PROTEP instrument was developed through a thorough analysis of the new curriculum documents. Because information regarding the roles and expectations for teachers in the new curriculum framework is scattered throughout many different documents, intended for different audiences, the first stage in the process of developing the draft PROTEP involved selecting material for analysis,

Stage 1

This stage involved reading the curriculum documents and sorting them into categories based on their intended purpose and/or primary audience.

Curriculum Framework Documents

These are policy documents that address broader issues relating to the development of the new curriculum as a whole. They address issues of structure and process in curriculum development and are intended for a broader educational audience. However, despite their general orientation, these documents do raise a number issues that relate to desired instructional practices under the new curriculum framework. For the purposes of this report, analysis of these documents only focussed on those sections that address the role of the teacher in teaching-learning situations.

1. *A curriculum framework for general and further education and training. Discussion document developed by the Consultative Forum on Curriculum (Department of Education (DoE), December, 1995).*

   Although this document addresses itself mainly to curriculum developers and the principles that should underpin curriculum development processes, some of the comments and recommendations apply equally to teachers. That is, the recommendations represented the first steps in the reconceptualisation of teachers' roles.

   For example Section 7: Proposed Areas of Learning (pp. 32-37), begins to address the specific learning area concerns that constitute Section 5 of the PROTEP. Although very rudimentary descriptions are given under `Physical and Natural Sciences' e.g. methods and processes of enquiry/application etc., these themes reappear in later documents that address specific learning area concerns.

   Section 9: Learning Outcomes and Assessment (pp. 38-40), begins to describe some of the changes required in the current assessment models. For instance, emphasis is placed on the need for a diversity of assessment methods in order `to do justice to the

diversity of learners who must be accommodated'. Again this is a theme that reoccurs in other documents that deal with assessment.

Section 10: Implications for Teacher/Educator development (pp. 40-41), also begin to address shifts in instructional practices and places emphasis on the need for educator development. This section therefore begins to inform the Reflection and Professional Development section of the PROTEP and also the section on Classroom Practice.

2. *Curriculum Frameworks for the General phase of education. Centre for Education Policy Development (CEPD), January 1995.*

This compilation of reports by various task teams that began the exploration of the new curriculum approach contains sections relevant to the development of the PROTEP. For instance, *Approach to developing a flexible core curriculum for Science and Technology* by Melissa Rollnick and Helene Perold.

Section 4 in Part II of the report: What are the Implications for Methodology? (pp. 20-125) deals with several issues that have been captured in Section 1 (classroom management), Section 2 (classroom practice), and Section 5 (subject matter concerns) of the PROTEP.

The report identifies and discusses several roles for the teacher, e.g.:

1. Diagnostician (needs analysis in classroom practice in the PROTEP).

2. Mediator (facilitating learning in classroom practice in the PROTEP)

3. Facilitator (facilitating/supporting learning in classroom practice in the PROTEP). Sections 4.2 and 4.3 of the report address the specific subject matter concerns in the PROTEP.

Section 6.3 identifies more roles for the teacher: teacher as subject specialist, teacher as classroom director, teacher as member of the professional/or teacher association and union, and teacher as an employee in a bureaucracy. Points are raised about these roles in various sections of the PROTEP.

3. *A curriculum framework for General and Further Education and Training: Amended document revised by the Curriculum Development Working Group of the NCDC. DoE, July, 1996.*

This document, like its predecessor, addresses issues of curriculum development in general. However, two sets of appendices were useful in developing the PROTEP, Appendix 1: Learning Theories and Education for Development, Classroom Techniques Implications (pp. 43-44) and Appendix 2: Educational Implications for Methodology (pp. 45-52). Although these appendices begin to cluster together some of the classroom implications of the new curriculum, they still represent a synthesis

that includes every aspect of the new curriculum without attempting a proper analysis or categorisation of any of the cited implications. Many of the issues discussed also do not lend themselves to classroom observation. Therefore, only those aspects that recur in the later documents and those that can be described in terms that facilitate observation and/or intervention were selected for the PROTEP. The appendices helped with the definition of indicators for many sections of the PROTEP, viz. Management, Practice, Assessment, Reflection and Professional Development and Specific Learning Area Concerns.

4. *Reflections on the 21" century knowledge society, the new South African curriculum and implications for the new classroom, the new learning and new educators' teaching loads, professional and management development. Rensburg, I.L. (DDG, General and Further Education and Training, DoE) Paper read for Dr. Rensburg at a KASTE conference in Durban, 22 September 1997.*

   This paper also reflects on some of the implications of the new curriculum for teaching and learning. Three sections of this document address issues relevant to the development of the PROTEP, viz. New Learning Methodologies (pp. 4), The New Educator, The New Teacher (pp. 4 and p.6-7), and Quality Assurance and Assessment (pp 5 -6).

Issue Specific Documents (Describing Aspects of Classroom Practice)

The second set of documents examined were issue specific documents that focus on the particularities of classroom practice. Documents like this began to emerge later in the curriculum development process.

Assessment

1. Draft Recommendations for the development and implementation of assessment policy. DoE, n.d.

2. OBE and Assessment (Paper presented at the KASTE conference, Durban, 22 September 1997. Mrs van Rensburg (DoE, curriculum development).

3. Implementing OBE - 2: Assessment. DoE, Curriculum 2005 booklet, 1997.

Classroom practice

1. Implementing OBE - 1: Classroom Practice. DoE, Curriculum 2005 booklet, 1997,

School/classroom management

1. Implementing OBE - 3: School Management. DoE, Curriculum 2005 booklet, 1997.

Professional practice (including classroom management, assessment and other professional roles of the teacher)

1. Norms and standards for teacher education, training and development - Discussion document, DoE, 31 November 1997).

   Although this document is meant for teacher educators and pre-service educators, some sections were useful in drafting the PROTEP instrument. Section 5.5.4 on Teaching Studies was used in the development of the professional development and reflection concerns of the PROTEP. This section deals with `academic outcomes' for teacher learners. These outcomes were found to be relevant in so far as they apply to educators as learners in the classroom (the notion of lifelong learning). Section 5.5.4 also describes `occupational outcomes' for student teachers. Again the issue of teacher roles emerges in these norms and standards. Some of the teacher roles described (that were relevant to the development of the PROTEP) include the following: role as facilitator, role as materials developer, role as assessor, role as evaluator, role as needs analyst/diagnostician, role as learner supporter, role as teacher supporter, role as manager of learning systems, and role as administrator.

Documents Concerning Learning Areas (Learning Area Reports)

1. Draft statement on the national curriculum for grades 1-9, Government Gazette, Vol. 384 No. 18051 (6 June 1997) pp. 142 - 173. DoE.

2. Foundation Phase; Intermediate Phase, Senior Phase Policy Documents, pp. NS 1-NS25; NS 1-NS 28; NS 1-NS 25 respectively. October 1997, DoE.

   These documents describe learning outcomes, assessment indicators and range statements in different learning areas. For the purposes of the PROTEP these learner focussed documents were converted into statements that describe teaching practices that will hopefully lead to the achievement of the learner outcomes. That is, an attempt was made to create a similar document that would describe observable indicators of the kind of teaching practice that would achieve the outcomes described for learners. This was based on the premise that it is just as important for educators to acquire competency in science education as it is for learners, if not more so. Learner outcomes therefore represent minimum indicators of learning area competency for science teachers.

Stages 2 and 3

The second stage (identifying recurring themes) and the third stage (categorising the themes under five headings), which is conceptually and practically linked to the first stage involved identifying recurring themes in the literature. The recurring themes were categorised under five different headings that describe aspects of the teacher's work in a school/classroom, viz. Classroom Management, Classroom Practice, Assessment and Evaluation, Reflection and Personal Development and Learning Area Concerns.

It is worth noting that some of the themes identified appear in more than one category. As some of the themes appear in several documents and multiple focus areas, important themes have been repeated in several categories rather than listed (perhaps inappropriately) in only one.

Stage 4

The fourth stage in the development process involved writing out summaries of descriptors for each theme (now written out as an aspect of teachers' practice). These descriptors became the indicators or defining features of particular aspects of teachers' practice. The descriptors capture only the major identifiers in the themes. Although the identifiers may be constraining to users of the instrument, the last column (comments and notes based on observations and interviews) is design to offset this. Additional comments and descriptors may be generated and used during observations and/or discussions with teachers.

Stage 5

Since it was necessary to construct an instrument that would profile teachers' practice for purposes of developing each individual towards excellence, the various levels of progress needed to be distinguishable. Thus, the Concerns-Based Assessment Model (CBAM) instrument, an approach piloted on OBE in the United States, was selected. The levels of concern describe the aspects that appeared to worry each teacher most during the observation and interview sessions. The levels range from Level 0 (where a teacher is not concerned at all with the new curriculum/may not have heard of it/continues doing things the old way) to Level 8 where a teacher is so involved in the new curriculum that she/he has found ways of improving her/his classroom practice way beyond what the new curriculum anticipated. Such teachers also begin to share their innovations with their colleagues (and essentially become advocates of the new curriculum).

Using the CBAM allows users of the PROTEP to identify and describe teachers' practices in such a way that it becomes easier to spot `flashpoints' and opportunities for intervention. It also allows for planning of appropriate interventions, for example it would not be appropriate to run a workshop on assessment for an educator who is still functioning at Level Zero. Such a person still requires orientation and background workshops. The same goes for someone at a higher level, who may only be worried about the assessment aspects of the new curriculum. In that case it makes little sense to send that person to a workshop on classroom management.

The draft PROTEP approaches teachers as workers who take responsibility for their own development. The column for notes and comments allows for issues arising from the classroom observations and discussions with the teachers to be included.

Revising and Piloting the PROTEP

The next stages will involve a revision of the draft PROTEP based on what was learned from interviews with some of the leaders in the new curriculum processes and from the case study literature. Piloting the revised PROTEP therefore also constitutes a stage in the refinement of the tool.

CHAPTER FIVE

INTERNATIONAL EXPERIENCES OF REFORMING INSTRUCTIONAL PRACTICES

By Loyiso Jita and Gregory McPherson

Introduction

Before discussing the case studies of instructional practices in Japan and the United States, a few introductory remarks are in order.

- It is important to note that the case study material is drawn almost exclusively from secondary sources. Primary sources, e.g. specific classroom descriptions, videotaped lessons, interviews with teachers, and other science education reformers in these countries, could not be obtained. This was partly because visits to the two countries were not permissible under the terms of the contract for the present study. Inevitably, descriptions of the educational practices in these countries are much more general than would have been preferred.

- Other materials containing closer descriptions of classrooms in the two countries are available for browsing at some of the TIMSS centres in the US (especially at Michigan State University). However, these documents and videotapes are not for sale. In addition, the TIMSS centre at the HSRC in Pretoria only has South African material of this nature.

- There was a dearth of even secondary sources on the Japanese case study (originally it had been proposed that most of this material be obtained on a visit to the USA). This compelled us to corroborate our impressions (generated from the secondary literature) through a series of interviews and consultations with a veteran Japanese teacher who is pursuing a senior degree at the University of Natal, Durban.

Despite the difficulties in locating relevant materials, effective use was made of the material found in the time available. The literature was analysed using the five categories of interest in the PROTEP instrument. That is, the review was narrowed to only those aspects that would allow comparison with the South African case material. The aim was to inform any potential revisions of the PROTEP in order to increase its usefulness.

Case Study No. 1: Instructional Practice in Japan

General

This report is a study of international experiences at reforming instructional practices with the intention of gathering evidence of best practice in science education and possibly applying it to South Africa, with particular reference to Japan.

Understanding the Japanese education system requires an understanding of the factors that mould Japanese learners. Particularly important are those components that influence them in their formative years. `The Japanese education system is one of the most influential agents moulding Japanese youth' (Johnson and Johnson, 1996:1). Schools in Japan operate at least 220 to 240 days each year as opposed to the normal 180-185 in the United States. The school day typically begins at 8:30 and lasts until 17:00. Academic work typically concludes at 14:30 with sports and other extracurricular activities taking up the remaining time. Given the large amount of time that Japanese learners spend in schools, it is only to be expected that the education system plays an important role in determining the fabric of Japanese society.

Japan's small size, lack of natural resources and scarce agricultural lands, among other things, has encouraged the idea that Japan's people are its most important resource. When compared to other countries such as South Africa and the USA, the Japanese population is relatively homogeneous-`98% of the Japanese have pure Japanese origin' (Gakusesika, 1984:28). Almost all the Japanese have similar cultural backgrounds and speak the same language. However, there are some cultural and behavioural differences.

The Japanese have a centralised school system controlled by the Ministry of Education. Japanese learners spend 240 days p.a. at school - 60 days more than US school children. Traditionally, learners attended school for half a day on Saturdays but this requirement is, at present, being phased out. The Ministry of Education determines course selection and textbooks. Japanese law ensures that all public schools are given the same quality of education, irrespective of the economic environment, by the Ministry of Education (Hiro, 1998). Japan is divided into 48 prefectures or provinces. Each prefecture has its own department of education and administers education according to national guidelines.

In recent years there has been greater devolution of authority to the provinces and textbooks are determined on a regional basis (Beaton et al, 1996). Textbook publishers in Japan publish a manual for teachers that provides detailed teaching plans and exercises for learners. The department of education in each prefecture provides booklets on relevant topics such as learner motivation, teacher stress, etc. In mathematics, teachers often ask learners to purchase one or two drill or practice workbooks that are used in the classroom and at home. The main instructional resources used in classrooms are `textbooks, supplementary materials, hand-outs made by teachers, manipulatives, etc' (Schmidt 1996:152). However, one can expect changes in resources utilisation as finance becomes more readily available and as teacher attitudes change.

Schools have limited authority over curriculum development. There is a uniform education system and both public and private schools are expected to follow national directives (Hiro, 1998). Learners in academic high schools, as compared to industrial and vocational high schools, are `compelled to take Mathematics, Social Studies, Japanese, Science, and English' (Johnson and Johnson 1996:2). Other subjects include Physical Education, Art, Music, and Moral Studies. The studies undertaken at vocational schools are more practical in nature. Here learners, who have dropped out of school or who want to obtain additional

qualifications, enrol for practical courses such as Information Technology, Computer Maintenance, etc. Recently, some vocational schools have been reclassified as high schools, a position of greater importance (Hiro, 1998).

The research dealt with five categories of teaching that included classroom management, classroom practice, assessment and evaluation, reflection and personal development of teachers, and specific subject matter concerns. These categories were intended to determine the perceptions about science teaching that could be considered relevant when comparing teaching in Japan to that of other countries. However, it should be remembered that there are various opinions about science teaching held by elementary schoolteachers and that these have been influenced by factors such as socio-economic issues, public opinion, attitudes towards scientific and environmental matters, and expectations of science and technology. This report depends mostly on secondary source material (Hiro, 1998).

1. Classroom management

   According to Schmidt et al (1996) lesson planning and preparation is done the day before. The lesson plan normally includes `the teaching objectives of the unit, student motivation techniques, a review of previous experiences of the learners, the sequence of presenting the new experiences, the steps of the learning process which include the introduction and development and conclusion, teaching and learning modes, teaching materials and aids, experiences to be acquired by the learners, teaching strategies and techniques to be used, the evaluation process, and the style of drill and review processes' (Schmidt et al, 1996:152). Much emphasis is placed on the lesson plan. Inhouse staff development programmes, usually held once a week, provide less experienced teachers with an opportunity to demonstrate teaching techniques they are developing to more experienced teachers. The inexperienced teacher's lesson plan is scrutinised and improvements are made to it.

   At the beginning of the school year, which begins in April and ends in April of the following year, teachers establish their goals for the year and these are submitted to the principal. School principals ensure that these goals concur with national objectives. In addition, teachers plan weekly objectives for the classes they teach, and targets for each lesson (Hiro, 1998).

   In comparing opinions about lesson planning, the teacher's role tends to dominate and learners are not allowed to make learning plans for themselves. More emphasis is placed on the `harmonious activity related to teaching, such as demonstration, questioning, suggesting, admiring, as well as the learning process' (Igekazu and Kinya, 1993:27).

   Teachers use various teaching facilities such as laboratories, the classroom, school grounds and the environment. Teaching strategies such as problem solving, case studies, and classroom demonstrations are employed to achieve the specific goals of the lesson. Japanese schools seem more fortunate than others in that there are `at least

one or two laboratories in each elementary school' (Igekazu and Kinya, 1993:25). Safety in the laboratory and the need to prepare learners for emergencies seem to be a priority. Of late, teachers are attempting to make greater use of the various teaching facilities in the community such as science centres and museums.

With regard to teaching materials, teachers `develop instructional material suited to students' ability levels and relevant to classroom objectives' (Igekazu and Kinya, 1993:28). They adapt and utilise a variety of teaching aids such as films, overhead projector (OHP) transparencies, and the printed media. However, not much use is made of microcomputer-based science instruction.

Corporal punishment in schools is legally forbidden. Traditionally, the Japanese schooling system was very rigid and school discipline was strict. The intense pressure of school life caused personal problems for both learners and educators. Presently, the curriculum is less demanding, resulting in a more flexible school life.

2. Classroom Practice

Each class has one homeroom teacher who is responsible for meeting the learners at the beginning and end of each day. The homeroom teacher gives guidance and counseling to learners and manages the administrative work of the class. There are usually about thirty learners in each elementary class. If the number exceeds forty, the class is divided into two classes (Schmidt et al 1996). In addition, homeroom teachers have responsibility for after school club activities such as sport, culture and science clubs.

The size of classrooms is legally defined (Schmidt et al, 1996). Classrooms have two doors (evidently in case of emergencies), one in front and one at the back on the same side of the room. The other walls are devoted to windows and writing boards. The walls in elementary classrooms are decorated with learners' drawings, calligraphy and *`han'* exhibits. During lessons learners are organised into groups of four to six called a *han*. The *han* moves desks together when working in groups.

During the lesson the *han* often works cooperatively, discussing science problems presented by the teacher. This group functions `as one unit of school life: they eat lunch together, clean up the school together and share classroom responsibilities together' (Schmidt et al, 1996:153). After the group work, learners are encouraged to work individually on suggested problems.

Before the lesson commences, learners and teacher show respect by standing *(kiritsu)* and bowing *(rei)* to each other (Schmidt et al 1996). This helps to set the tone of the workplace and indicates that work is about to commence. During the lesson teachers try to get learners to understand that there are multiple solutions to the same problem and that there are sometimes similarities in the correct solutions to problems. At the end of the lesson, the teacher collects the learner's workbooks and checks each learner's work. In this way common and specific needs/problems are identified.

Teachers utilise various teaching facilities such as laboratories, the classroom and the environment. The teaching strategies used include problem-solving, case studies and classroom demonstrations. Unlike the USA, there are generally one or two science laboratories per elementary school. Japanese teachers `do not teach the value of effort but teach learners to make an effort' (Peak, 1992:14). Effort is consistently portrayed as the key to success, and ability is de-emphasised in the classroom. Teachers use routine drills to instil perseverance, self-discipline and concentration from the elementary grades onwards. Perseverance is extended to academic subjects and daily homework plays an important part in this habit training. Surveys conducted in elementary schools in Japan indicate that `Japanese learners spend at least twice as much time on homework as USA children do' (Peak, 1992:14).

An important feature of Japanese education is the thriving industry of *juku* and *yobiko*. These are private, profit making, after school `cram schools' attended by approximately sixty percent of learners (Johnson and Johnson, 1996). The *juku* courses are designed to focus on the specific knowledge and skill learners need to pass the entrance examinations for high school. *Yobiko* helps learners with university entrance examinations.

Japanese society discourages learners from taking on part-time jobs. `Only twenty one percent of Japanese students report holding a part-time job, as compared to sixty three percent in the US' (Peak, 1992:15). Society views part-time jobs negatively and sees them as a distraction from the education of the young. However, the positive aspects of part-time work such as developing a sense of responsibility are overlooked.

3. Assessment and evaluation

Learners study five to eight subjects per semester. During the semester minor tests and assignments are given to all learners in the class, and a major test (examination) is conducted at the end of the semester. The evaluation of the learner's work includes an assessment of the learner's comprehension, attitude, interest and effort. After major tests have been evaluated, learners are sent home with their report cards, as well as their corrected test papers. Parents are at liberty to consult either the school principal or the subject teacher.

In Japanese schools, there is a tendency to pass learners with their grade cohort (Johnson and Johnson, 1996). Therefore, without the extra *juku* lessons, some learners fear that they will fall behind. Following on from the centralised education system, `there is also a framework to record students' progress' recommended by the Ministry of Education (Schmidt et al, 1996:151). Teachers use this framework to compile a semester report for the parents. The framework tracks the following areas of learning:

- Interest, motives and attitudes
- Thinking
- Knowledge and understanding
- Skills and procedures.

Teachers give priority to 'assigning individual work appropriate to the level of the students' ability and giving feedback promptly' and 'utilising fair and varied student evaluation measures such as paper-and-pencil tests, essay tests, checklists, interviews, etc.' (Igekazu and Kinya, 1993:29). After the lesson the learner's workbook is checked. This gives the teacher the opportunity to identify learner problems, evaluate the lesson plan, examine his/her teaching method, and engage in some general introspection. At some schools teachers believe that they 'must be well equipped with evaluation designs such as evaluation policy, assumptions, methods of data collection and analysis, discrimination of information, cost-benefit analysis, product assessment, etc.' (Igekazu and Kinya, 1993:29). This suggests that Japanese science teachers give priority to uniformity in the classroom.

4. Reflection and personal development

Teachers obtain a *`teaching* qualification from a local authority', but before they are permitted to teach they are expected to undergo a 'teachers' employment examination' (Hiro, 1998). In addition, newly qualified teachers are put on probation for the first six months of their careers. However, the positive attitude and high degree of commitment Japanese teachers show towards their work is evident from the following statements:

> *I always try to give my best when I prepare for my science class'.*
>
> *'During and outside of teaching activities a teacher must always demonstrate and give witness to his/her love for children, human beings, and education'.*
>
> *'I motivate my students to learn science'.* (Igekazu and Kinya 1993:30).

Teachers hold regular subject group meetings where didactics and other issues pertaining to their particular subject are discussed. They also attend subject seminars at other schools, which provide an opportunity to mix and exchange views with a different set of teachers. While attendance at internal and external school seminars is encouraged, attendance at meetings organised by the prefecture or district authority is obligatory.

Staff development programmes are held regularly within Japanese schools. This is unlike the USA, where teachers acquire much of their in-service training by attending classes in institutions that offer graduate courses enabling teachers to obtain advanced degrees and acquire salary increases. Teachers in Japanese schools are given the opportunity `to demonstrate to the other teachers in the school the teaching techniques they are developing in order to emphasise the value of being recognised as an important part of the group or the school' (Igekazu and Kinya, 1993:30). These staff development meetings are usually held once a week. Newly recruited and junior teachers prepare lesson plans and teach the lesson under the observation of more experienced teachers who examine and make changes to the lesson plan. At the end of the lesson the more experienced teachers give advice to the junior teacher and present

him/her with a revised lesson plan. In this way they hope to bring about an improvement in teacher competencies and the quality of teaching.

Teachers also regularly update their knowledge in their area of specialisation and in laboratory techniques, procedures and safety, demonstrating once again that laboratories play a central role in science education in Japan. Innovative approaches are continuously being applied to improve Japanese education. A growing number of schools and universities have implemented a system whereby learners evaluate teachers. This gives learners the opportunity to give feedback about, among other *things,* the teacher's method of teaching and the course content. In this way an attempt is being made to ensure that learners are receiving quality *instruction*.

5. Specific subject matter concerns

Teachers place great emphasis on the aesthetic aspect of science teaching in elementary schools. This may be viewed as an illustration of the difference in the objectives of teachers in the USA and Japan. One of the main aims *when* selecting objectives in Japan is to encourage children to become aware of and respond in a positive manner, to the beauty and orderliness of their environment. To this end, `an essential aspect of science education is to find ways of inculcating, [in learners], the ideals of beauty and orderliness in nature, a love of nature, adjustment to nature, and working with and not conquering nature' (Igekazu and Kinya, 1993:26).

Teachers emphasise and encourage learners `to ensure and formulate the existence of problems, promote problem-solving skills needed for inquiry, develop an interest in science, and acquire growth of scientific thinking and instrument skills' (Igekazu and Kinya, 1993:26). Natural resources such as rainfall are identified and the formation of the resource is traced. Relationships between concepts such as temperature and humidity are explained and terms such as evaporation and condensation are identified. Learners are taught the judicious utilisation and management of resources and the importance of Japan's limited natural resources is stressed.

The Japanese Ministry of Education determines the number of class hours that must be devoted to each subject. In the elementary school the total number of class hours devoted to science are 68 for the first grade, 70 for the second grade, 105 for third through to seventh grades, and 140 for eighth and ninth grades. It is recommended that approximately 70% of this time be spent on practical activities and laboratory work. According to Nakayama (1987), `the development of cognitive skills in science is one of the most important goals of education in Japan'. This is achieved by letting learners `...have first hand experience with real objects and understand the ideas from real things and phenomena through problem solving processes' (Nakayama, 1987:25). This indicates that not only is science taught from grade one onwards, but it is also taught via inquiry procedures and `hands-on' activities. At the elementary level, this contrasts with the USA where `the normal pattern is to teach little or no science and what little is taught is generally through textbook readings' (Lawson, 1990:497).

The scientific enquiry fostered in elementary school children is carried forward to junior high schools and the national course of study for junior secondary science has recently been revised (Schmidt et al, 1996). The Ministry of Education's stated objectives for science are:

- *to enhance students' interest in nature*
- *to foster the ability to think scientifically through observation and experimentation*
- *to deepen students' understanding of natural events and phenomena* (Schmidt et al, 1996:156).

These objectives underscore the Japanese pre-occupation with fostering a love of nature and a desire to live in harmony with nature. The junior high school science curriculum traditionally had a more academic orientation with greater attention given to the acquisition of basic skills and knowledge at the expense of understanding and thinking. It is claimed that the new reform measures will place more emphasis on understanding, thinking, and interest in the academic subject areas (Schmidt et al, 1996).

Case Study No. 2: Instructional Practice in the USA General

The USA has a decentralised system of education with each state determining its own subject curricula. General curricular guidelines, teacher training and certification requirements and length of the school year are some of the many aspects that are decided by the state (Valverde, 1995). Although local school districts have much autonomy and independence in curricular and instructional decision-making, there is a considerable degree of consistency among educational systems both within and across states. Local education authorities play a key role in instructional policy-making (Price, 1995). This is particularly true of certain states, such as Michigan, which has a history of deference to local control of schools. The choice of textbooks, for example, is a local decision. In fact, the implementation of new educational policy has to consider the role of the local education authority in the education system.

Despite the decentralisation of education, appropriate topics to be included in the mathematics and science curricula are actively discussed and debated, especially at primary and lower secondary school levels. The leaders of this debate are mathematics and science reformers who want a more conceptually driven approach to the teaching of these subjects (Blank and Pechman, 1995). Local education authorities, therefore, have begun to restructure both the curriculum and the teaching of mathematics and science.

The USA, unlike Japan, has many demographic differences. The population is heterogeneous; almost all Americans, with the exception of native Americans, can be considered to have come originally from elsewhere. While they may speak a common

language, there are many other spoken languages, religions and races with various cultural and behaviour differences.

Compared to Japan, the education system in the USA is highly decentralised with many of the key educational policies and decisions made by local communities within the different states. Other differences between the two countries can be seen in their educational policies, regulations, financing, curriculum standards, teacher training, instructional materials, and other matters related to education. The existence of differences in fundamental values, socio-economic issues, public opinion, attitudes towards scientific and environmental matters, and expectations of science and technology, has influenced the opinions of elementary science teachers.

In most lower secondary schools (primary schools), teachers have their own classrooms and learners move from one room to the other during the break between lessons, which is usually five minutes. There are between six and eight lesson periods per day with periods averaging fifty minutes in length. The problem of learners carrying too many books from room to room is overcome by providing them with lockers located in the school hallways.

According to Tomlinson (1992), organiser of an Office of Educational Research conference, the American public tends to believe that the academic success of learners is dependent on the quality of their teachers and their textbooks. When learners themselves were asked, the overall impression gained was that they lack motivation. Numerous conferences were held and many research efforts made to investigate the lack of motivation among American learners. Researchers subsequently attributed it to:

- Learners having few incentives to study
- Many school practices discouraging learner effort
- Peer pressure often discouraging effort and achievement.

Once this lack of motivation was understood, a number of recommendations were made in an effort to change this state of affairs:

- Every effort should be made to make learning the highest priority in the lives of learners.
- Teachers should focus the attention of learners on the educational substance that is critical to the learners' future.
- The realisation that the connection between learning and academic effort is powerful should be instilled in learners.

However, to achieve these goals teachers `need to tap the effort as well as the ability of the learners' (Tomlinson, 1992:3). The aforementioned investigation and the resultant conference demonstrate that various educational institutions are aware of deficiencies in the system and are making attempts to rectify the situation. It is against this background

that an assessment of science and mathematics teaching and learning in the USA was attempted. Not an easy task considering that each state has it's own education system and that local authorities may differ in their interpretation of state policy.

The PROTEP research dealt with five categories of teaching that included classroom management, classroom practice, assessment and evaluation, reflection and personal development of educators, and specific subject matter concerns. These categories were intended to determine the perceptions about science teaching that could be considered relevant when comparing teaching in the USA to that of other countries.

1. Classroom management

Teachers in the USA often construct lesson plans:

- *`that promote intellectual and creative development among children, taking into account levels of readiness, development, deficiencies, status of cognitive development, objectives etc.*
- *to facilitate process skills such as observing, describing, measuring, etc., and*
- *that cultivate the process of science to enable children to acquire the desire too know, question, search for data and meaning that demand verification'* (Shigekazu and Kinya, 1993:27).

The emphasis is on informal learning plans that allow individual learners to develop their own activities so that teachers can assess levels of readiness, development, deficiencies and cognitive development of learners. This can enable learners to acquire a desire for knowledge, willingness to question existing knowledge and enthusiasm to search for data and meaning, and to demand verification. In some schools, the learners are often allowed to devise learning plans for themselves (Shigekazu and Kinya, 1993). Unlike Japanese teachers, who stress safety in the laboratory, teachers in the US `devise experiments conducted in such a way as to help children think and be conscious of the purpose of performing the experiment' (Shigekazu and Kinya, 1993:28), While allowance is made for individual, small group and whole-class instruction, satisfactory work from the individual learner is required for promotion purposes.

Teachers utilise various teaching methods and strategies in their classrooms. These include problem solving, case studies and classroom demonstrations. Learning is not confined to the classroom and use is made of the outside environment and laboratories, notwithstanding that there are very few laboratories in elementary schools. Ample use is also made of community institutions such as science centres, museums and natural conservation areas. Of late, teachers have been keen to make more use of audio-visual devices and microcomputers in their lessons.

The teaching materials used in schools are `suited to the students' ability levels and relevant to classroom objectives' (Shigekazu and Kinya, 1993:28). A variety of instructional materials and media such as `films, OHPs, transparencies, software, etc.' are used in the classroom to achieve lesson objectives (Shigekazu and Kinya, 1993:29).

Lessons at the primary level tend to be based on what is in the textbook (Schmidt et al, 1996). This contrasts with Japanese lessons, where greater emphasis is placed on inquiry procedures and hands-on activities. In the USA, the widespread use of the textbook continues all the way up to K-6 (grade 6) where `the normal pattern is to teach little or no science and what little is taught is generally through textbook readings' (Lawson, 1990:498). The teacher's edition of the textbook contains basic information such as lesson objectives, lesson guidelines, answers to exercises found in the textbook and suggestions for possible follow-up activities. Most of this information is presented in the page margins next to the content material and is easily accessible (Schmidt et al, 1996). In addition:

> *[American] publishers frequently produce a supplementary materials kit containing overhead worksheets to be produced for learners, supplies for special projects or activities, posters, and other items for display or demonstration* (Schmidt, 1996:199).

This leaves us in no doubt as to why US teachers rely so heavily on the textbook. Despite widespread condemnation by educational reformers, tracking (streaming of learners into high, middle and low groups) remains a common practice in US schools. This practice is particularly rife in the so-called academic subjects such as English, Mathematics and Science. While the teacher uses the same textbooks and lesson plans, he/she often finds that expectations for the low groups have to be lowered. This practice has the additional disadvantage of negatively labelling particular groups as slow learners which may de-motivate them (Schmidt, 1996).

In some classrooms a parent is often present and assists the teacher with the more mundane tasks such as running errands, correcting papers, etc. in an attempt at alleviating the teacher's workload. Besides teaching and being responsible for a classroom, teachers usually have additional, general supervisory responsibilities. These typically include hall duty, cafeteria duty, and general supervision at sports meetings or cultural performances. These duties are allocated on a rotating basis and often encroach on teachers' tea breaks or lunch times. In some districts teachers unions have lobbied successfully to do away with this type of supervision, thereby creating more time for teachers to devote to lesson planning and teaching (Schmidt, 1996).

Teachers are typically required to maintain records of learner attendance and the number of occasions a learner is late for a lesson. Absenteeism and late arrival are reported to the administrative office. Normally there are disciplinary consequences for

regular defaulters. Other typical administrative duties include maintaining an inventory of instructional and laboratory resources and materials.

2. Classroom practice

In the classroom, teachers `assign work appropriate to the level of student ability and give feedback/evaluation promptly' (Shigekazu and Kinya, 1993:29). Teachers take time to identify learners with special needs and inclinations and provide them with the necessary support, such as extra lessons after school, or referring them to appropriate specialists for assistance and guidance. In this respect, the US federal government provides assistance for `at risk' leamers and underachievers through funds allocated to states under the Elementary and Secondary Education Act. These funds essentially provide for remedial education for `at risk' learners. While the Japanese educational system tends to emphasise uniformity rather than individuality, the US system emphasises the development of potential based on the specific needs and interests that the learner possesses. The necessary support is provided to each learner `based on his/her special characteristics and personality' (Shigekazu and Kinya, 1993:29).

Teachers use a variety of `science class competency tests and evaluation instruments to measure cognitive, process skills, and attitudes' (Shigekazu and Kinya, 1993:27). This is also evident in the diagnostic and evaluation procedures used in planning instruction. In Michigan, cognisance has been taken of the disparity in the numbers of girls and boys taking mathematics and science. Consequently, schools and businesses have entered into partnerships with education authorities and individual schools to run programmes that better prepare girls, especially from minority groups, for an increasingly technical society (Gipson, 1997).

In urban district classrooms `ethnic diversity is the rule' (Schmidt et al., 1996:154). Teachers claim that `everyone in a group deserves equal respect, attention, and opportunity ...which is necessary for the support of a democratic society based on freedom, equality, respect, and justice' (Shigekazu and Kinya, 1993:31). Teachers seem to put great emphasis on the needs of individuals; however, co-operative learning at the primary level is encouraged. Many teachers show commitment to their profession by diligently preparing for their science class. Evidence of this can be seen in the claim that they `always strive to give their best' when preparing for and teaching science' (Shigekazu and Kinya, 1993:30).

Although Lawson (1990) and Schmidt et al (1996) believe that teaching is too textbook orientated, some primary school teachers do spend a lot of time on `hands on' activities in the classroom. This may involve plant growing, care of the fish tank, observation of an ant colony etc., in an area of the classroom devoted to science. The lesson structure is very child-centred as opposed to 'subject-centred'. Teachers believe that a child-centred approach can instil an interest in the subject, making it easier for the child to tackle more substantive, content-related instruction later on (Schmidt, 1996).

The high failure rate, among `learners of colour and learners from economically challenged circumstances' (Spillane et al, 1995:113) became a matter of concern for local education authorities (LEAs) in some parts of Michigan. Even more disturbing were the low symbols achieved by kindergarten, grade one and grade two learners. To address the problem, urban LEAs offered teachers professional development that focused on topics such as `alternative assessment', `multicultural education', `learning and teaching styles' and `multiple intelligences'. In addition, LEAs pursued an OBE approach (Spillane et al, 1995).

3. Assessment and evaluation

Teachers use a variety of `science class competency tests and evaluation instruments to measure cognitive, process skills, and attitudes' (Shigekazu and Kinya, 1993:29). This is also evident in the diagnostic and evaluation procedures used in planning instruction. In addition, various learning strategies such as `pop quizzes', question-answer-response exchanges etc, are used to achieve lesson objectives and assess learners' ability. Test and assignment results, as well as report cards, are timeously sent out to parents, who are at liberty to consult the school principal or the subject teacher on ways of improving test scores.

Teachers are continually assessing their learners. This is done through:

- *Observing critical incidents in the classroom*
- *Formulating hypotheses about the causes of incidents*
- *Questioning students to test their hypotheses*
- *Interpreting student's responses, and*
- *Adjusting their teaching plans accordingly* (National Research Council, 1996:87).

This information, gathered on-site, as well as information obtained externally, enables the teacher to make judgements about:

- *The developmental appropriateness of the science content*
- *Student interest in the content*
- *The effectiveness of activities in producing the desired learning outcomes*
- *The effectiveness of the selected examples*
- *The understanding and abilities students must have to benefit from the selected activities and examples* (National Research Council, 1996:87).

Most states have a public state examination for grades 3, 9 and 12 (i.e. early elementary, middle and secondary school) where learners are examined in Science,

Mathematics and Reading. The general result for each school is made public through the media (although learners' names are not mentioned). These external assessments are also used for:

- *Formulating policy*
- *Monitoring the effects of policies*
- *Enforcing compliance with policies*
- *Demonstrating accountability*
- *Making comparisons*
- *Monitoring progress towards goals* (National Research Council, *1996:87).*

Moreover, the LEA assesses schools in each local district. The school, the teachers and the effectiveness of specific programmes are examined and a report is made available to taxpayers (National Research Council, *1996).*

4. Reflection and personal development

Teachers are fortunate in that they can avail themselves of a variety of educational services offered by state education authorities, universities, the business sector and non-governmental organisations. Unlike the internal staff development programmes conducted in Japanese schools, in the US, teachers improve their scientific knowledge and teaching techniques mostly via outside agencies. Teachers acquire in-service training by attending classes in institutions that offer graduate courses and this enables them to acquire advanced degrees and earn salary increases (Shigekazu and Kinya, *1993).*

US schools have a long summer break, similar to schools in Japan, and educators use the opportunity to update and refine their scientific knowledge. Institutions, such as the University of California hold summer courses for elementary, secondary and `crossover' teachers - those teachers without an adequate science background (Taagpera et al, *1987).* In addition, a Centre for Science and Mathematics Education has been established at the California State Polytechnic to:

- *Promote the professional development of public school teachers of mathematics, science and computer education*
- *Improve the teaching and learning of science in the schools*
- *Promote the study of science and mathematics by all students, particularly females and minority group members* (Jacobs, *1989:61).*

Typical activities by means of which the centre accomplishes these goals are on-site consultation, delivery of instruction in both content and methodology at the university,

an interactive television network to school sites, publication of a quarterly newsletter of practical values to educators, and an annual conference for educators (Jacobs, 1989).

In Michigan, the State Department of Education provides a resource guide on environmental and conservation issues for teachers' use. The catalogue identifies resources available in Michigan including science organisations, interpretive facilities, travelling naturalists, major and minor curriculum materials, publications, workshops and conferences (Carruth, 1989). This guidebook can also be used for `exploring the issues of vision, teaching, curriculum, and assessment that should be considered and debated in the move towards scientific literacy' (Blakeslee and Kahan, 1996:13).

While mention has been made of only two states, it should be noted that these are merely examples of the type of support provided for educators in the USA.

5. Specific subject matter concerns

Generally, teachers tend to focus on individual learning. An examination of teachers' overall teaching objectives (`I always give a child the chance to be intrigued by objects and events in his environment and to be curious about his surroundings' and `I encourage children to acquire the ability to observe things and events in order to perceive and identify them') reveals that events in the child's environment feature prominently in teaching (Shigekazu and Kinya, 1993:26). On the other hand, encouraging children to `be free from bias, prejudice, and superstitions, and to acquire values such as open-mindedness, critical-mindedness, and intellectual honesty' shows that teachers in the US are preoccupied with democratic ideals (Shigekazu and Kinya, 1993:26). However, learners are also encouraged to expose tentative ideas and explanations to others and to reconsider their thinking in the light of the data at hand.

With regard to teaching content US teachers, like their Japanese counterparts, `believe that teaching content must consider the natural and social environmental needs of the learner' (Shigekazu and Kinya, 1993:28). To this effect, the content is organised in such a way that opportunities are provided for learners to participate in `planning, implementing, and evaluating activities in individual and group projects' (Shigekazu and Kinya, 1993:26).

The American Association for the Advancement of Science (AAAS) uses the term scientific literacy to indicate what school learners have to achieve. Their notion of scientific literacy centres on a thorough understanding of scientific ideas. They argue that the school science curriculum should focus more on scientific ideas and less on scientific content. To achieve this goal they believe that teachers should focus on:

- *Reducing the emphasis on factual details and rote procedures and increasing the emphasis on ideas.*

- *Increasing the emphasis on connections across disciplines.*

- *Increasing the emphasis on connections between science, mathematics and technology.*

- *Increasing the emphasis on scientific habits* of *mind*

- *Increasing the emphasis on the history of science, mathematics and*

To achieve this they urge educators to replace the `cookbook laboratories and rote learning approach to science instruction with guided inquiry and problem solving' (Thompson, 1991:22).

In the 1990s, influential organisations such as the National Science Teacher's Association, the National Science Foundation, and the National Education Goals Panel reported that `the science preparation of American children is deficient' (Reed and Calhoun, 1993:17). Some states, such as California, attempted to address this deficiency by producing a `Science Framework' guide to curriculum and materials in its public schools. California devised the Framework to be the backbone of its six-year plan to freshen, revamp, and improve the teaching of science. The Framework emphasised a thematic approach to teaching science. Elements of reform included:

- *Instructional materials (which had to he vetted by a state panel)*

- *Teacher development programmes viz. staff development workshops* • *Technology in the schools*

- *Assessment programmes* (Reed and Calhoun, 1993:17).

Although implementation of the plan was limited due to a lack of state funds, it is an on-going project and is indicative o£ the attempts being made to increase scientific literacy among learners (Reed and Calhoun, 1993).

The knowledge that learners are expected to acquire during the course of K-12 education (grades 1 - 12), is divided into eight categories. These are:

- *Unifying concepts and processes in science.*

- *Science as inquiry.*

- *Physical science.*

- *Life science.*

- *Earth and space science.*

- *Science and technology.*

- *Science and personal and social perspective.*

- *History and nature of science* (National research Council, 1996:88).

The first category is applicable to all grades because the `understanding and abilities associated with these concepts' have to be developed throughout a learner's schooling career. Because each content standard `subsumes the knowledge and skills of other standards', they are designed to be taught as a whole (Reed and Calhoun, 1993:18).

Concluding Remarks

As suggested in the study proposal, these case studies are intended (together with information from interviews with local leaders of curriculum reform) to inform any potential revisions of the draft PROTEP developed earlier from the curriculum 2005 literature. As with the original study proposal, the revised version places much emphasis on local information (from the interviews) to help revise the PROTEP instrument. The case studies therefore operate as a yardstick to be used in the development of an original South African instrument for profiling progress in teachers' instructional practice.

CHAPTER SIX

PILOTING THE PROTEP INSTRUMENT IN FOUR GRADE ONE CLASSROOMS IN KWAZULU-NATAL

School 1: Mrs A and Mrs S

Background

- The school was selected on the basis of a recommendation by Mr Paul Hobden, an active science educator working with schools in KwaZulu-Natal (KZN). The school had piloted some innovative curriculum development programmes in the past. Access and the potential to observe some innovative practices that would enable the piloting of the PROTEP instrument were the main basis for selection.

- The school is divided into junior and senior primary phases and is located in the Berea North area of Westville, a suburb of Durban.

- It was formerly a model C school (state aided) that has been absorbed into the public school system.

- The school is well supported financially by parents and local industry and both classrooms observed were very rich in resources.

- The school has a reputation for innovation and is often approached by local universities who wish to undertake pilot projects o£ one kind or the other.

- The school has an excellent principal who also teaches art and computers at the school.

- The grade one teachers at the school are working collaboratively on piloting some aspects of the new OBE curriculum 2005. In the interviews, emphasis was placed on the fact that not all aspects of the new curriculum are in place at the school. In fact the school has not `abandoned' its previous curriculum programme but is finding ways of improving its instructional offering through the new curriculum 2005 approach.

- The school day is organised as follows:

  8:15 - 8:30 Religion/Moral lesson/Life Skills
  8:30 - 9:00 Writing
  9:00 - 10:00 Mathematics
  10:00 - 10:30 Recess/Break
  10:30 - 11:30 Reading

  (on some days of the week the remainder of the school day is spent studying Music/Art/Computers)

- Observations lasted up to 11:30, i.e. about three-quarters of the junior primary school day. Interviews were conducted during the recess and also in between classroom observation.

- Science is often covered during the first ten minutes of Life Skills or Theme of the week (if at all). During the week of observation, Fruit Farming was the theme and some scientific aspects were covered. However, as will be described in the sections dealing with each teacher's PROTEP analysis, the science that was covered was very rudimentary and did not come close to what is demanded by the reforms.

- Two teachers were observed at this school, Mrs A and Mrs S.

Mrs A: Comments and Notes (Observation and interview)

1. Classroom Management (CBAM level 4 - 5)

1.1 Planning

- At this grade level much of the information on planning was obtained from the interviews with Mrs A. That is, information on the specific learning area outcomes and on the critical cross-curricular outcomes was not presented in obvious terms during the lesson. The critical learning area outcomes were, however, well documented in the teacher's planning file.

- During the lesson, some statements and instructions to the learners served to communicate the expected performance indicators for the learners. For example, in the mathematics lesson, the teacher communicated to the learners that she expected them to be able to `solve problems in real life using what you [the learners] know about addition and subtraction'.

- In this lesson, the researcher was able to observe learners not only attempt to solve a problem in `real life' terms but also witnessed them communicate and defend their varied problem solving approaches to their peers (see lesson segment 1 below).

- Assessment strategies that involved writing, verbal responses, (public) explanations to peers and drawing pictures were all explored during this half-day of classroom observation.

- *More direct communication with learners about the specific learning area outcomes, in particular, performance indicators and range statements, still requires development in Mrs A's classroom management approach.*

Lesson Segment No. 1

The context is a Science theme in a Mathematics lesson. Learners are engaged in problem solving activities. This is coupled with another (regular) class activity called 'story-time'.

T	We've been talking about apples, pears, peaches and other fruits and all about farmer Brown's farm, not so?
SS	Yes.
T	Now let's help farmer Brown solve his problem. He has planted nine (9) appletrees (draws one apple tree on the board). But Mrs Brown is a greedy wife, she wanted sixteen (16) trees. Now farmer Brown wants to please her; how many more trees must he go and plant the next day to please her?
S_1	seven (7).
T	How did you get that answer?
S_1	I used my fingers (demonstrates using fingers).
T	(writes down S_1's approach in her collection of SS portfolios).
S_4	I drew nine (9) trees, and then drew more this side (pointing) to make sixteen (16).

1.2 Management of resources/materials

- As described in the introduction, Mrs A's classroom was very resource rich, with both visual and textual materials (some bought, but most teacher or learner made). There was visual material all over the walls of the room, such as mathematical tables, letters of the alphabet, and different colours and their names.

- These visual and textual materials were integrated into Mrs A's lesson. For example, a poster showing different types of apples (from a newspaper cutting) was used to discuss the science theme of fruit farming. Learners were expected to discuss this poster on the basis of their own experiences. Some of the learners were able to identify the different types of apples they had brought in their lunch bags. Others were able to discuss the different tastes of apples they had eaten from those on the chart.

- Another example of the use of resources was in the Mathematics lesson, where a home balance scale was used to explore the concept of equality (`equal sign' problems as they called them) in a Mathematical equation.

Lesson Segment No. 2

The context is a Mathematics lesson. Mrs A is sitting on the floor with a group of learners doing problem solving (she explained that this is a group that requires more of her attention). The other groups in her class are working independently on worksheets. Learners are engaged in problem solving activities. This is coupled with another (regular) class activity called 'story-time'.

T (holds up a big piece of cardboard with an 'equal' (=) sign on it). What does this mean?
S_3 Equals.
T Yes, but what does it mean?
SS What ever you put on one side, you must put the same on the other side.
T Yes (she then restates the definition given by the learners).
T (takes the balance scale and puts the letter seven (7) on one side of the scale). Does it balance?
SS Nooo, you need to put seven (7) on the other side (pointing to the empty side of the balance).
T (removes the No 7 and puts No 4 on one side of the balance). How can we make it equal?
SS Put this (pointing to a bunch of numbers in a pile)…
T (interrupts) Wait, what is the problem here?
SS We need to put something that's equal to No. 4.
T Yes, how do we do it?
S_1 Put three (3) plus one (1) on the other side.
T Yes, but why not 31?
SS Three (3) plus one (1) is four.
T (puts No 4 on one side, hangs an equals sign (=) in the middle and then puts Three (3) plus one (1) on the other side).

1.3 Management of learning systems

- At this level, the teacher interprets the entire learning programme for the learners.
- *Specific Science lessons are not taught but Science is captured in the weekly theme section (at the beginning of the day) and revisited time and again during the learning of Mathematics, Reading and other learning areas - illustrating some degree of integration of the learning areas (see for example the Farmer Brown storytelling, Mathematics segment). The integration is not based on a deeper understanding of the subject matter of the different learning areas.*

1.4 Administration

- Mrs A's record keeping system is elaborate. She has a folder on each learner, which she uses as that learner's portfolio.
- The portfolio contains notes of her assessment of each learner on each major class activity, samples of the learners' work, details about their participation in class, attendance etc.
- Sometimes Mrs A takes time during the lessons to fill in the assessment forms in the portfolios e.g. during the mathematics activity on Farmer Brown activity (referred to earlier) she wrote down details of each learner's problem solving strategy in their portfolios. That is, as each leaner submitted his/her work for assessment, Mrs A made notes in his/her file.

- Learners in Mrs A's class are split into three groups based on the pace at which they complete various tasks in the class, thereby suggesting that her assessments are used as a basis for instructional decisions.

- *The only problem with these grouping is that they did not appear to he flexible and temporary, nor did it appear that they could be rearranged easily as learners caught up with the work. Mrs A, in fact, referred to one group as the `brighter' group, indicating that in her opinion, their ability to cope with the pacing of class tasks was based on intrinsic/natural intelligence.*

2. Classroom Practice (CBAM Level 4 - 5)

2.1 Needs analysis

- It was clear from the variation in the use of resources (even for the different groups in the class) that some form of needs analysis has been done by the teacher. For example, in the Mathematics lesson, while the yellow group worked with Mrs A on the carpet, the other two groups worked independently on worksheets.

The Yellow and White Groups: Lesson Segment No. 3

The context is a Mathematics lesson. Mrs A is sitting on the floor with the yellow group of learners doing problem solving (she explained that this is a group that requires more of her attention). The other groups in her class are working independently on worksheets. Each learner has been given a set of papers with nine sets of numbers to work with.

T (arranges the numbers on the floor).
SS (also spread their sets of numbers on the floor).
T Make a sum with No 30 and No 6.
S_5 30 plus (+) 6 = 36.
T Yes, now write it out in your books.
SS (learners write the sum in their books and then take time to show their writing to the teacher who approves, making comments such as 'well done', or putting a tick next to the sum).

In the mean time the white group is working on a worksheet with problems such as this one:

4 + ------ = 8

9 + ------ = 10

----- + 4 = 8

- *It was not clear how Recognition of Prior Learning (RPL) featured in Mrs A's analysis (f at all), except that in her lessons she made some connections to things/experiences that were familiar to the learners. When probed on this issue during an interview, she described it as something she did 'informally'.*

2.2 Facilitating learning

- The environment in Mrs A's classroom appeared to be very stimulating to the learners. The classroom is organised in such a way that learners can work independently and on their own initiative on some classroom tasks.

- There was a deliberate flow from whole class discussion to group work and to individual work. For example, the weekly theme was discussed as a whole class activity but the mathematics problems arising from the theme were addressed only with the yellow group. Learners, however, solved problems individually, finding individual and different approaches to helping farmer Brown. Learners were then expected to discuss and negotiate their problem solving approaches with the rest of the group.

2.3 Supporting learning

- Mrs A's initiatives to provide one-on-one tutoring to learners that are struggling are very deliberate.

- She keeps up-to-date records on each learner's development and progress.

- Being soft-spoken herself, Mrs A treats all her learners with respect.

- *It was not clear, however, how societal and other influences on learners impacted on her work (and this was not explored during the interviews).*

3. Assessment and Evaluation (CBAM Level 2 - 4)

- Mrs A makes informed choices of a variety of assessment strategies in her classroom. Report back to the whole group, written exercises, drawings/picture displays, teaching others, etc. are all used as measures of assessment. It is remarkable that the application of all these assessment strategies was observed in a single day.

- The information resulting from these assessments is used to guide instructional decisions. For example, in making the decision to move from whole class discussion to individual work (on problem solving), Mrs A stated that she based her decision on her observation that most of the learners were giving correct responses during the whole class questioning and therefore indicating that it was `time to move on'.

- *The only area of concern for Mrs A was the `reporting' of this assessment and evaluation to the various stakeholders. This problem was common to all the grade one teachers at her school and they were waiting to pilot a new instrument for reporting learner progress to parents. The problem has been compounded by the lack of models in this regard*

4. Reflection and Personal Development (Levels 2 and 4) 4.1 Self-assessment

- *There is no systematic recording of practice or of instructional decisions. Neither are records of analysis of practice kept.*

- Mrs A argued that mentally she engages in self-assessment `all the time'.

- Despite the limitations in terms of self-assessment, Mrs A has opportunities to meet and reflect with other grade one colleagues at the school at least once a week. The records (minutes) of these weekly meetings capture the records of practice and the teachers' analysis of them.

4.2 Teacher support

- It became apparent to the researcher, after observing another teacher at the school, that Mrs A's practice is very similar to that of the other grade one teachers at the school. They all use the same format, the same lesson segments (whole class, group work, individual work), and the same assessment instruments and approaches, etc.

  This is because teachers work together as a team, planning together, observing each other's lessons, and have undergone similar staff development workshops (a few years previously the school was chosen as a pilot for a new mathematics curriculum development initiative by a university/NGO consortium).

4.3 Professional development

- The teachers at this school are very fortunate in that professional development has been emphasised by the principal.

- They are encouraged to attend a variety of workshops on professional development, including OBE workshops in their district.

1. Specific Subject Matter Concerns (CBAM Level 0 - 1)

- This is the area of greatest weakness in Mrs A's practice.

- No specific Science learning outcomes or subject matter are targeted.

- Science is an illegitimate component of the first ten (10) minutes on the weekly theme (on life skills).

Mrs S: Comments and Notes (Observation and Interview)

1. Classroom Management (CBAM *level 4 - 5)*

1.1 Planning

- As was the case with Mrs A, much of the information on planning was obtained from the interviews with Mrs S. That is, information on the specific learning area outcomes and the critical cross-curricular outcomes was not presented in obvious terms during the lesson. The critical learning area outcomes were, however, well documented in the teacher's planning file.

- During the lesson, some statements and instructions to the learners served to communicate the expected performance indicators for the learners. For example:

Lesson Segment No. 1

T (selects leaders from each of the three groups in the class to hand out children's writing books). Put the books on top of each one's bench. The rest of you look at me and let me tell you what we'll be doing. (She begins writing on the blackboard, beginning with the date and writing 'sugar comes from sugarcane that is grown on the farm').

This emanated from the theme of fruit farming. The focus that day was on sugarcane and how it is used to make household sugar.

S_2 (puzzled) What are we doing?
T We are going to be ***writing***.
SS (learners move back to their desks and begin writing).
T Put your hand up when you have finished. (Teacher moves around marking learners' books and commenting on their performance e.g.
to S_4: 'That writing is getting a little too big'.
to S_5: 'I do not like your tails'.
to S_7: 'Why is that [letter] sitting in the air, not on the line?'

1.2 Management of resources/materials

- As described in the introduction, Mrs S's classroom is very resource rich, with both visual and textual materials (some bought, but most teacher or learner made). There is visual material all over the walls of the room, such as mathematical tables, charts with partners of ten (to add and subtract numbers to make up or from ten), and newspaper posters showing healthy foods.

- These visual and textual materials were integrated into the lesson. For example, the learners used the following mathematics chart to assist them with addition and subtraction.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120

Lesson Segment No. 2

T I have seven (7) apples and daddy brings another ten (10). Don't shout the answer.
S_7 17.
T How did you do it?
S_7 I went down (pointing to the column containing seven) and said plus ten on the table.
T Yes, you used the table.
S_{11} (bursting to explain his method) I made a sum, seven (7) plus ten (10) and got seventeen (17).
T Yes, so you made a sum and used the table, good!

- *Mrs S then asked learners to use the healthy food chart to analyse their lunch boxes. It was not very clear, however, how this fitted into the rest of her lesson(s). It appeared to be a stand-alone task (although it did challenge learners to apply their newly acquired knowledge).*

1.3 Management of learning systems

- As before, at this level the teacher interprets the entire learning programme for the learners.

- *Specific Science lessons are not taught but Science is captured in the weekly theme section (at the beginning of the day) and revisited time and again during the learning of mathematics, reading and other learning areas - illustrating softie degree of integration of the learning areas (see for example the writing exercise 'sugar comes from sugarcane that is grown on the farm). The integration is not based on a deeper understanding of the subject matter of the different learning areas.*

1.4 Administration

- Mrs S's record keeping system is elaborate. She keeps a folder on each learner, which she uses as that learner's portfolio.

- The portfolio contains notes of her assessment of each learner on each major class activity, samples of the learners' work, details about their participation in class, attendance etc.

- Sometimes Mrs S takes time during lessons to fill in the assessment forms in the portfolios e.g. during the Mathematics activity on adding seven apples to the ten that daddy bought she wrote down details of each learner's problem solving strategy in his/her portfolio. That is, as each leaner submitted his/her work for assessment, Mrs S made notes on his/her file.

- Learners in Mrs S's class are split into three groups based on the pace at which they complete various tasks in the class, thereby suggesting that her assessments are used as a basis for instructional decisions.

- *As in Mrs A's class, these groups did not appear to be flexible and temporary and it did not seem as if they could be easily rearranged as learners caught up with the work. Mrs S also referred to the `brighter' group, implying that their ability to cope with the pacing* of *class tasks was based on intrinsic/natural intelligence.*

2. Classroom Practice (CBAM Level 4 - 5)

2.1 Needs analysis

- It was clear from the variation in the use of resources (even for the different groups in the class) that some form of needs analysis has been done by the teacher. For example:

The Squares and Circles Groups: Lesson Segment No. 3

The context is a Mathematics lesson. Mrs S is sitting on a floor with the triangles group of learners engaged in problem solving (as in the case of Mrs A, this group requires more of Mrs S's attention). The other groups in her class are working independently on worksheets.

The circles group is working on 'halves' and 'doubles'.

halves	10 - (5)	doubles	5 - (10)
	8 - ( )		4 - ( )
	6 - ( )		3 - ( )

In the mean time the squares group is working on an additional activity using the throw of a dice to determine numbers to add to other numbers

3 + (throw a dice) = ?
6 + (throw a dice) = ?
(throw a dice) + 9 = ?

- *It was not clear how RPL featured in Mrs S's analysis (if at alit, except that in her lessons she made some connections to things/experiences that were familiar to the learners.*

2.2 Facilitating learning

- The environment in Mrs S's classroom appeared to be very stimulating to the learners. The classroom is organised in such a way that learners can work independently and on their own initiative on some classroom tasks.

- There was a deliberate flow from whole class discussion to group work and to individual work. For example, the weekly theme was discussed as a whole class activity, but the mathematics problems arising from the theme were addressed only with the triangles group. Learners, however, solved problems individually, finding individual and different approaches to the `seven plus ten apples' problem. Learners were then expected to discuss and negotiate their problem solving approaches with the rest of the group.

2.3 Supporting learning

- Mrs S's initiatives to provide one-on-one tutoring to learners that are struggling are very deliberate.

- She keeps up-to-date records on each learner's development and progression.

- Although she speaks in a very loud voice and is tough on learners who do not pay attention, Mrs S treats all her learners with respect.

- *Like Mrs A, it was not clear how societal and other influences on learners impacted on her work.*

3. Assessment and Evaluation (CBAM Level 2 - 4)

- Informed choices of a variety of assessment strategies are made in this classroom. As described earlier, report back to the whole group, written exercises, drawings/picture displays, teaching others, etc. are all used as measures of assessment. Similarly, it is remarkable that the application of all these strategies was observed in one day.

- The information resulting from these assessments is used to guide instructional decisions.

- *The problem of `reporting' of this assessment and evaluation to the various stakeholders was raised in an interview with Mrs S. This problem is common to all the grade one teachers at the school and they are waiting to pilot a new instrument for reporting learner progress to the parents. The main problem so far has been the lack of models in this regard.*

4. Reflection and Personal Development (Levels 2 and 4)

4.1 Self-assessment

- *There is no systematic recording of practice or of instructional decisions. In addition, no records of analysis* of *practice are kept.*

- Mrs S has made a direct relationship between the weekly grade one teachers' meetings and the need for reflection and assessment. As the Head of Department at this grade level, she is responsible for these reflection and peer assessment initiatives.

- Despite the limitations in terms of self-assessment, the minutes of these weekly meetings allow records of practice and teachers analysis thereof to be captured.

- Mrs S also drew attention to the fact that she visited each grade one teacher's classroom at least once a quarter, or more often should the situation demand (if one of the teachers `really battled' with some aspect of the work).

4.2 Teacher support

- The practices of Mrs S and Mrs A (and apparently, that of the other teachers at this school) are very similar. They all use the same format, similar lesson segments (whole class, group work, individual work), and the same assessment instruments and approaches, etc. This is because teachers work together as a team, planning together, observing each other's lessons, and have undergone similar staff development workshops (a few years back the school was chosen as a pilot for a new mathematics curriculum development initiative by some university/NGO consortium).

4.3 Professional development

- The teachers at this school are fortunate in that professional development has been emphasised by the principal. As the Head of Department at this level, Mrs S is responsible for making sure that each teacher gets the opportunity to attend at least one workshop during the school year.

- Teachers are encouraged and supported to attend a variety of workshops on professional development, including OBE workshops in their districts.

6. Specific Subject Matter Concerns (CBAM Level 0 - 1)

- This is the area of greatest weakness in the practices of both Mrs S and Mrs A.

- No specific Science learning outcomes or subject matter are targeted.

- Science is an illegitimate component of the first ten (10) minutes of the weekly theme (on life skills).

School 2: Mrs K Background

- The school was selected on the basis of a recommendation by Mr Preggie Naidoo, the deputy chairperson of the National Association of School Governing Bodies (KZN). The school is located in a relatively affluent Muslim community, but is not privileged in terms of its resources. It is, therefore, a school trying to cope with the problem of dwindling resources at a time of increasing demands. The school had also served as an OBE model for `township' schools, some of which have visited the school in order to see OBE in practice. This combination of factors made the school an interesting choice for this study. In the final analysis however, access and the potential to observe some OBE pilots that would allow for the piloting of the PROTEP instrument were the main basis for selection.

- The issue of the school's dwindling resources was emphasised by the principal when he introduced the researcher to the staff. He requested that staff be co-operative in the hope that `in the long run the project may bring us some resources'.

- The school is divided into the junior and senior primary phases and is located in a predominantly Muslim community about 15 km outside Durban.

- It is formerly a House of Delegates (HoD) school that has been absorbed into the public school system.

- The school boasts a very participatory style of leadership through the principal and heads of department.

- The grade one teachers at the school are working collaboratively on `phasing in' some aspects of the new OBE curriculum 2005. In interviews, it was explained that this meant that the new curriculum co-existed with the `old phonics' approach to teaching and learning. Mrs K explained that she often uses the different instructional approaches on alternate days.

- As it turned out, on the day of the researcher's observation Mrs K had planned to teach using the traditional approach.

- Mrs K felt that the OBE approach emphasises group work at the expense of individual work. She prefers the OBE approach to Reading and the old phonics approach to Writing.

- The grade one teachers come together once a week for common planning and sharing of resources. They also meet with other grade one teachers in the circuit at least once a month.

- Mrs K complained that she is forced to alternate the new curriculum with the old because of the lack of textbooks at the school.

- Observations lasted up to 11:30 a.m. i.e. about three quarters of the junior primary school day. Interviews were conducted during the recess and in between observations.

- Mrs K explained that the focus of the implementation in the district is on Life Skills and Numeracy. As a result no science could be observed unless something occurred that she could tie in with the Life Skills lessons. She gave as an example `dental week' but did not reveal the extent to which Science had been brought into these lessons.

Mrs K; Comments and Notes (observation and Interview)

1. Classroom Management (CBAM level 4 - 5)

1.1 Planning

- At this grade level much of the information on planning was obtained from the interviews with Mrs K (as in the other cases). That is, information on the specific learning area outcomes and on the critical cross-curricular outcomes was not presented in obvious terms during the lesson.

- The critical learning area outcomes and the specific Life Skills and Numeracy outcomes were well documented in the teacher's planning file.

- During the lesson, some statements and instructions to the learners served to communicate expected performance indicators for the learners. For example, in the following exercise she says `Use the alphabet map to get the treasure. First use the alphabet as a clue to find the words [beginning with that letter of the alphabet]. Write down the words in full, and then draw a picture [of what the word describes]'.

- Assessment strategies that involved writing, verbal responses, (public) explanations to peers and drawing pictures were all explored during this half-day of classroom observation.

- *More direct communication with the learners about the specific learning area outcomes (more especially), performance indicators, and range statements still requires development in Mrs K's classroom management approach.*

1.2 Management of resources/materials

- As described in the introduction, Mrs K s classroom has very few visual and textual resources. Most of the available material is teacher or learner made and it is all located on the wall closest to the teacher's table.

- Available resources were integrated into Mrs K's lesson. For example, the treasure hunt poster was used to learn reading and writing:

Lesson Segment No. 1

Mrs K places the chart on the board and leads a discussion on what learners can see in the picture. Learners are able to follow the story of a pirate who is using all manner of foul methods to look for the treasure. She then invites them to locate the treasure on their own charts by following all the letters of the alphabet up to the last one (where the treasure is located). They work in groups, taking turns to locate clues and drawing pictures.

T (gets learners to assign numbers to each other, from 1 to 7, to facilitate taking turns to find words).
SS (take turns looking for words beginning with a particular letter of the alphabet, write them on the chart and make a drawing of the object).

1.3 Management of learning systems

- At this level, the teacher interprets the entire learning programme for the learners.
- *Specific Science lessons were not observed. Science is captured in the exceptional and special topics that came up front time to time, all integrated into the Life Skills learning area. The integration is not based on a deeper understanding of the subject matter of the different learning areas.*

1.4 Administration

- Mrs K s record keeping system is elaborate. She keeps a folder on each learner, which she also uses as that learner's portfolio.
- The portfolio contains notes of her assessment of each learner on each major class activity, samples of the learner's work, details about his/her class participation, attendance etc.
- Mrs K explained that she uses the time after the learners have dispersed for the day to record her impressions of their performance. She does this using ticks and `small comments' on each learner.
- It was not clear how the information on the assessment sheets was used to assist her in making instructional decisions.

2. Classroom Practice (C$AM level 2 - 3)

2.1 Needs analysis

- It was not clear how the needs of the learners shaped Mrs K s classroom resources or instructional approaches/decisions. For example, while she required learners to work in groups, the groups were formed in a random fashion and her decisions to move from group work to individual work were based more on past experience than on current needs.

2.2 Facilitating learning

- In the interview, Mrs K indicated that she shuttles between learner and teacher centred approaches.

- In the learner centred approach, she encourages learners to work independently and in groups and to take initiative in classroom tasks (for example, in the treasure hunt activity group leaders emerged within the groups without prompting).

- *The learning environment was not always encouraging though, as some groups degenerated into contests between some learners (perhaps indicating their relative inexperience with group work).*

2.3 Supporting learning

- During the group work, Mrs K moved between the groups assisting them in their tasks. However, her assistance focused more on group dynamics than the content of the task.

- Although Mrs K keeps detailed checklists on each learner, it was not clear how she used the information to assist her in making instructional decisions

3. Assessment and Evaluation (CSAM Level 2 - 4)

- Mrs K made informed choices of a variety of assessment strategies in her classroom. Report back to the whole group, written exercises, drawings/picture displays, teaching others, etc. were all used as measures of assessment.

- *Like the two teachers profiled earlier, the main area of concern for Mrs K was around `reporting' of this assessment and evaluation to the various stakeholders. As with the first two teachers, the main problem was the lack of models in this regard.*

4. Reflection and Personal Development (Levels 2 and 5)

4.1 Self-assessment

- *There is no systematic recording of practice or of instructional decisions. Neither are records of analysis of practice kept.*

- Mrs K remarked that often `things do not go as planned' and that she has to ‘change plans'. She does not keep a systematic record of these changes and, in fact, she couldn't remember a specific example of such a change `off hand'.

- Despite having weekly meetings with her colleagues at the school and monthly meetings with her colleagues in the circuit, these are mostly spent on planning and resource development rather than on professional reflection.

4.2 Teacher support

- Grade one teachers at this school are given a number of opportunities to work together and with colleagues from outside. For example, Mrs K and one of her colleagues have developed a `resource package' on Postal Services for use by other teachers in the circuit.

- There are no collaborative ventures that focus on classroom instruction.

- As mentioned in the introduction, management of the school is very supportive of the need for further growth and development among the staff.

4.3 Professional development

- Teachers at the school are encouraged to attend a variety of workshops on professional development, including OBE workshops in the district.

6. Specific Subject Matter Concerns (Levels 0 -1)

- This is the area of greatest weakness in Mrs K's practice.

- No specific science learning outcomes or subject matter are targeted.

- Science rarely comes into the lessons.

School 3: Mrs C

Background

- The school was randomly selected from a pool of schools that had been affected adversely by the recent spate of rationalisation decisions in KZN. The school had lost about four teachers and was battling to meet its current mandate of implementing the new curriculum. Piloting the PROTEP instrument under these circumstances would allow sensitivity to some of the real world problems that exist in schools. However, once again the final decision was based on access and the potential to observe the implementation of OBE.

- The school is divided into junior and senior primary phases and is located in a working class, formerly Indian township about 12 km outside Durban.

- It was formerly a House of Delegates (HoD) school that has now been absorbed into the public school system.

- The school is relatively advanced in terms of its efforts at racial integration. Many more African children attend this school than either of the two schools profiled earlier.

- Upon entering the premises, one is struck by the unkempt grass, older buildings and the atmosphere of general disadvantage (in terms of physical resources).

- However, Mrs G did not make much of these disadvantages but instead, spoke at length about the human resource problem the school is facing as a result of rationalisation decisions.

- The principal and the acting Head of Department, Mrs G, are the two grade one teachers at the school.

- In the words of Mrs G, `we are really trying hard against the odds... we really began OBE in May' (about three school months before the researcher's visit to the school). Mrs G drew attention to the fact that implementation of OBE has only just begun and that teachers are not yet proficient in it.

- Unlike the other two schools, which have class numbers in the 30s, Mrs G has 44 learners in her class.

- On the day of the observation, she was teaching a lesson on Shapes, aiding the discussion by examining different kinds of houses in the community.

- The lesson began at 8:15 and continued until about 10:30.

- No Science content was observed or taught.

Mrs G: Comments and Notes (observation and Interview)

1. Classroom Management (CBAM level 4 - 5)

1.1 Planning

- As in all the other cases, at this grade level much of the information on planning was obtained from the interviews with Mrs G. That is, information on the specific learning area outcomes and on the critical cross-curricular outcomes was not presented in obvious terms during the lesson.

- The critical learning area outcomes were well documented in the teacher's planning file.

- During the lesson, some statements and instructions to the learners served to communicate the expected performance indicators for the learners. For example: `I am going to come around to hear about your house and see your drawings'.

- Assessment strategies that involved writing, verbal responses, (public) explanations to peers, drawing pictures and creative writing (poetry), were all explored during this half-day of classroom observation.

- *More direct communication with the learners about the specific learning area outcomes (more especially), performance indicators, and range statements still requires development in Mrs G's classroom management approach. Even when communicated, Mrs G indicators were very general and did not relate much to the major topic of Shapes.*

1.2 Management of resources/materials

- As described in the introduction, Mrs G's classroom has few resources or visual and textual materials. Most of the available material is teacher and learner made and it is all

the lesson. The drawings on the chart (made by Mrs G) included a flat, a shack, a hut, a wigwam, etc.

- In her introduction, Mrs G engaged learners in a discussion of the different types of houses in their communities (and other social issues such as why some people are homeless).

- Learners' experiences featured prominently throughout the class discussion:

Lesson Segment No. 1

T What is your house?
S_1 It's a stairs.
T Oh, to me it looks like a flat.
S_1 It's big, though.
T This group drew a very interesting house.
S_4 Yes, (puts drawing on the board for the class to see) me and my cousins stay in this house.
T Say my cousins and I live in this house.
S_4 My cousins and my aunt also live in this house.
T And you share many other things, isn't it?
S_4 Yes.

1.3 Management of learning systems

- At this level, the teacher interprets the entire learning programme for the learners.

- *No specific Science lesson was observed, and it was not clear under what circumstances (if any) Science gets taught in Mrs G's classroom.*

1.4 Administration

- Mrs G's record keeping system is elaborate, She keeps a folder on each learner, which is also used as that learner's portfolio. In many cases, Mrs G has had to make the folders herself, using plastic covers, because many parents are not able to afford to buy them.

- The portfolio contains notes of her assessment of each learner on each major class activity, samples of the learner's work, details about his/her class participation, attendance etc.

- It was not clear how the information on the assessment sheets was used to assist her in making instructional decisions.

2. Classroom Practice (CBAM level 2 - 3)

2.1 Needs analysis

- It was not clear how the needs of the learners influenced Mrs G's classroom resources or instructional approaches/decisions.

- She was, however, very sensitive to the needs of her learners. For example, when some learners said they were hungry during the lesson, she established a corner where a learner could go and have one bite of his/her sandwich before rejoining the group.

- While Mrs G required learners to work in groups, these were formed in a random fashion and her decisions to move from group work to individual work were not directly related to the current needs of the learners.

2.2 Facilitating learning

- In her interview, Mrs G indicated that she shuttles between learner and teacher centred approaches.

- *The learning environment was not always encouraging though, as some learners opted to work individually within the groups.*

2.3 Supporting learning

- During the group work, Mrs G moved between the groups assisting them with their tasks. She was flexible and allowed those who wanted to drift out of the groups to do so without focusing attention on them.

- Mrs G kept detailed checklists on each learner and monitored them as she moved from group to group. She also used their presentations to the class to provide her with information on their progress and performance. However, it was not clear how she used this information in making instructional decisions.

- One of Mrs G s rare qualities was her sensitivity to the learners. She explained that as a member of the local community, she was always careful `not to take any learner for granted'.

3. Assessment and Evaluation

- Mrs G made informed choices of a variety of assessment strategies in her classroom. Report back to the whole group, written exercises, drawings/picture displays, teaching others, etc. were all used as measures of assessment.

- *Like the teachers profiled earlier, the main area of concern for Mrs G was around "reporting" of this assessment and evaluation to the various stakeholders and the lack of models in this regard*

4. Reflection and Personal Development (Levels 1 and 5)

4.1 Self-assessment

- *There is no systematic recording of practice or of instructional decisions. Neither are records of analysis* of *practice kept.*

- Despite holding weekly meetings with her colleagues (at school) and monthly meetings with her colleagues (in the same circuit as Mrs K), these meetings are used mainly for planning and resource development rather than for professional reflection.

4.2 Teacher support

- Grade one teachers at Mrs G's school have been given a number of opportunities to work together and with colleagues from outside. Mrs G has not been able to attend many of these meetings since she was only been appointed as a grade one teacher in May.

- There are no collaborative ventures that focus on classroom instruction.

- As mentioned in the introduction, management at the school is very supportive of the need for further growth and development among the staff.

4.3 Professional development

- Teachers at the school have been encouraged to attend a variety of workshops on professional development, including OBE workshops in the district.

5. Specific Subject Matter Concerns (Levels 0 - 1)

- This is the area of greatest weakness in Mrs G's practice.

- No specific Science learning outcomes or subject matter are targeted.

- It was not clear if Science teaching/learning ever occurred in Mrs G's classroom.

CHAPTER SEVEN

MAIN FINDINGS AND LESSONS LEARNT FROM USING THE PROTEP INSTRUMENT IN FOUR CLASSROOMS

- Although the new curriculum as a whole constitutes a single but comprehensive innovation, the approach taken in constructing the PROTEP instrument has been to separate the components of the innovation into distinct but interrelated parts of the whole. In using the PROTEP instrument to profile teaching practice, the teachers can focus on specific parts/components that they wish to develop further. Much as this approach is useful (to ensure that teachers can focus on manageable chunks of the innovation), its major weakness lies in the fact that it creates a somewhat artificial distinction between parts of what is essentially a single whole. That is, it is difficult, and sometimes not useful, to separate the different aspects of a teacher's practice in the classroom. However, as an analytic tool, the PROTEP instrument is useful.

- In its original construction (informed mainly by the desire to capture as much detail on each aspect of teacher practice as possible), the PROTEP risked fragmenting aspects of classroom practice even further. For example, classroom management could be viewed as the sum of such aspects as Planning, Management of resources/materials, Management of learning systems, and Administration. In applying the CBAM framework to this PROTEP instrument, it became necessary to look at chunks of instructional practice within a lesson. For example, instead of asking the teacher about his/her Planning, or Resource management approach singularly, classroom Management is considered holistically and the question is asked: at what level of concern (CBAM) is the teacher operating in his/her classroom management approach? From a teaching point of view, examining chunks of practice made much more sense. However, when identifying needs for professional development intervention, an examination of the components may be more useful.

- Although there is complementarity between the qualitative indicators of Progress Towards Excellence in the PROTEP instrument, viz. the `Levels of Concern' section and the `Comments and Discussion' section, some tensions were detected during the implementation. For instance, the `Comments and Discussion' category, which derived mainly from the research processes of Observation and Interviewing tended to be rather too labour intensive and produced elaborate descriptions of each teachers' practice that may require too much time to analyse and interpret. For those who are concerned with obtaining quick information to guide staff development interventions, the PROTEP process may be too long. For the latter purpose, the CBAM Levels of Concern data may be more useful. This tension becomes even more significant if the PROTEP instrument is designed for teachers to use for self-reflection and assessment. This dilemma remains unresolved at this stage as the PROTEP is designed to provide information on instructional practices for the purpose of research and to provide concise information to guide immediate professional development interventions.

Although the major focus of the study at this stage is on piloting the PROTEP instrument, some important findings on the practices of the pilot teachers were made:

- Subject matter concerns were the weakest at this grade level. The specific learning area outcomes were not mentioned or recognised by any of the teachers. There is reason, therefore, to argue that very little Science (if any) is taught at this grade level. In the context of the new curriculum, which seeks to encourage not only Science learning but a different approach to Science, this finding is significant.

- There was little evidence of systematic reflection on practice by the teachers. Some opportunities for collaboration existed among the teachers, but these were mostly around sharing of resources and `survival skills'. There is a need to encourage collaboration around what happens during instruction.

- There is serious confusion about how to report on assessment to the various stakeholders. The main problem in this regard is the lack of models or exemplars. Teachers appeared to be confused as to whether they were on the `right track' on issues of assessment in general.

- Further work on how to make the PROTEP instrument more accessible and manageable to classroom teachers is needed. We would be reluctant, however, to employ self administered questionnaires (as was done in the original development of the CBAM in the USA). Our experience with such questionnaires is that they are unreliable indicators of what actually happens inside the classrooms.

- It is important to capture the developmental approach that the PROTEP instrument emphasises. The teachers' practices should thus be seen as stages in a process of growth and development.

- As it stands at present, there is no place for contextual background issues in the PROTEP instrument. For example, there is little information about the subject matter preparation of grade one teachers (which may account for why Science is not a part of their day-to-day agenda). Such information would be required in order to design a flexible and appropriate course of intervention. The introductory section of this report captures some of the school and classroom background issues. Policymakers who want to use the PROTEP instrument may not need such contextual or background information. However, this information is useful, especially if the target is to provide assistance to the development of individuals based on their own progression.

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APPENDIX

PROTEP Instrument

ASPECT OF THE TEACHERS' PRACTICE	INDICATORS/DEFINING FEATURES	LEVELS OF CONCERN (as outlined in CBAM)	COMMENTS AND NOTES (observations & interviews)
1. Classroom Management			
1.1. Planning	▪ clearly stated specific learning area outcomes ▪ clearly stated critical cross-curricular outcomes ▪ clearly defined performance indicators and range statements ▪ different aspects of development that need assessing are identified ▪ different methods/tools for assessment identified		
1.2. Management of resources/materials	▪ textual and visual materials are selected and prepared ▪ appropriate materials are made as required and the environment used as a resource for learning		
1.3. Management of learning systems	▪ learning programmes are organised and interpreted for the learners ▪ an integrated programme of learning is designed		
1.4. Administration	▪ an efficient record system is maintained (e.g. re: attendance, performance, participation, teachers' practices and decisions) ▪ clear but flexible time frames are developed		

ASPECT OF THE TEACHERS' PRACTICE	INDICATORS/DEFINING FEATURES	LEVELS OF CONCERN	COMMENTS/ DISCUSSION NOTES
2. Classroom Practice			
2.1. Needs analysis	▪ the needs and requirements of each learning context are identified ▪ common and specific needs/problems of learners are recognised ▪ changing needs and circumstances are accommodated ▪ prior learning is recognised (RPL)		
2.2. Facilitating learning	▪ appropriate learning experiences are designed ▪ learners are motivated to take the initiative. Learner centred approaches are adopted ▪ opportunities for both individual and group learning are provided ▪ learning of relevant knowledge, skills and values is encouraged ▪ a positive learning environment is created		
2.3. Supporting learning	▪ learners are treated with concern and respect ▪ opportunities for counselling/tutoring are provided for those in need ▪ societal and other influences on learners are acknowledged ▪ academic success is recognised and encouraged		

ASPECT OF THE TEACHERS' PRACTICE	INDICATORS/DEFINING FEATURES	LEVELS OF CONCERN	COMMENTS/ DISCUSSION NOTES
3. Assessment and Evaluation			
3.1. Linking assessment with classroom practice/management	▪ different aspects of development that need assessing are identified ▪ informed choices on appropriate assessment strategies are made ▪ assessment is used to make decisions on teaching and learning		
3.2. Assessment strategies	▪ RPL ▪ baseline diagnostic assessment ▪ formative and continuous assessment approaches ▪ self assessment/peer assessment		
3.3. Evaluation	▪ judgement on learner progress is made ▪ judgements on causes of learners' success/failure are made ▪ judgements on learners' potential for academic growth are made ▪ judgements on effectiveness of instructional approaches adopted are made (reflection on practice)		
3.4. Accountability	▪ proper recording and reporting of assessment data (and judgements) is made. Reports for different stakeholders are produced ▪ learners' work is marked and extensive feedback given ▪ evidence of learner performance is collected (e.g. samples of work)		

ASPECT OF THE TEACHERS' PRACTICE	INDICATORS/DEFINING FEATURES	LEVELS OF CONCERN	COMMENTS/ DISCUSSION NOTES
4. Reflection and personal development			
4.1. Self-assessment	▪ a record of one's practices and decisions is made (e.g. diaries, notes, journals etc.) ▪ the record of aspects of that practice is analysed (what surprises were there, what worked/did not work etc.)		
4.2. Teacher support	▪ knowledge and expertise is shared with other teachers (talking about practice) ▪ involved in collaborative ventures with other teachers (e.g. observing and commenting on each other's practice) ▪ takes part in mentoring younger teachers ▪ the support and assistance available from professional associations and unions is utilised		
4.3. Professional development	▪ opportunities for professional development (PD) are created (e.g. meet with other subject teachers, register for a professional/academic qualification, form reading groups, etc.) ▪ available PD opportunities provided by the employer/ NGOs are utilised ▪ work with others in curriculum/management committees		

ASPECT OF THE TEACHERS' PRACTICE	INDICATORS/DEFINING FEATURES	LEVELS OF CONCERN	COMMENTS/ DISCUSSION NOTES
5. Specific subject matter concerns	Teachers organise learning experiences, within the specific subject matter context of science as defined by the four themes used to organise the natural science curriculum: ▪ the planet earth and beyond ▪ life and living ▪ energy and change ▪ matter and materials The learning experiences should be designed to provide skills, knowledge and values identified in the rest of this column.		
5.1. Use of process skills to investigate scientific phenomena	▪ identification of phenomena ▪ investigative questions formulated ▪ plan of action formulated ▪ data collected ▪ analysis, evaluation and interpretation of data ▪ communication of data		
5.2. Understanding of concepts and principles, and 'acquired knowledge' in natural sciences	▪ knowledge of science concepts and principles in practical situations related to daily life are developed and used		
5.3. Application of scientific knowledge and skills to problems	▪ problems are identified ▪ relevant information is gathered (reading, discussions etc.) ▪ relevant scientific knowledge is selected ▪ relevant scientific skills are selected ▪ decisions are made ▪ plan of action is communicated		

ASPECT OF THE TEACHERS' PRACTICE	INDICATORS/DEFINING FEATURES	LEVELS OF CONCERN	COMMENTS/ DISCUSSION NOTES
5. Specific subject matter concerns (cont.)			
5.4. Understanding of how scientific knowledge and skills contribute to management, development, and utilisation of natural and other resources	▪ natural and other resources are identified ▪ importance of sound management practices for resources 'is acknowledged' ▪ management, development, and utilisation practices are investigated ▪ alternative strategies and responsible decision making regarding renewable and non-renewable resources are explored ▪ findings and conclusions are communicated		
5.5. Use of scientific knowledge to support responsible decision making	▪ issues are identified ▪ relevant scientific information is gathered ▪ information is prepared for decision making ▪ alternatives are considered ▪ reasons for decisions are communicated		
5.6. Understanding of relationship between science and culture	▪ science is acknowledged as being influenced by cultural factors ▪ science is acknowledged as just one way of looking at and explaining the world		

ASPECT OF THE TEACHERS' PRACTICE	INDICATORS/DEFINING FEATURES	LEVELS OF CONCERN	COMMENTS/ DISCUSSION NOTES
5. Specific subject matter concerns (cont.)			
5.7. Understanding of the changing and contested nature of knowledge in the natural sciences	▪ people's contributions to science through the ages are identified ▪ scientific theories are seen in their social and historical context ▪ contributions to a scientific theory by scientists from different backgrounds are acknowledged ▪ scientific explanations of phenomena are acknowledged as being open to change		
5.8. Knowledge and understanding of ethical issues, bias and inequities related to the natural sciences	▪ variety of view points are acknowledged ▪ variety of origins of bias and inequity are considered ▪ scientific inputs are used		
5.9. Understanding of the interaction between the natural sciences and socio-economic development	▪ evidence is provided of how science and technology are used ▪ the way in which scientific and technological developments have changed the lives of people is analysed ▪ the impact of technological innovations on scientific work is explored ▪ scientific literacy is related to the accessibility, application and communication of science		