KwaZulu-Natal science teachers' views on professional development activities

by

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ABSTRACT

This study was concerned with science teachers' professional development activities in KwaZulu-Natal and finding out their views on the effectiveness of those professional development activities. It intended also to highlight both science teachers' perceived needs for improving their existing skills and ways of helping them to best address those needs. A postal questionnaire was sent to science teachers and interviews were conducted and tape-recorded with in-service providers. These data collection tools aimed at answering the questions: Firstly, what professional development activities are science teachers in KwaZulu-Natal participating in? Secondly, what kinds of professional development activities are considered to be the most effective? Thirdly, what competencies are recognised as in need of professional development? Lastly, what in the view of teachers and providers are considered to be the most effective ways of improving these competencies?

The data from both the postal questionnaire and interviews were coded, captured, analysed, and interpreted. Among the more significant findings were: (a) workshops were the professional development activity most attended by science teachers in the study closely followed by formal courses; (b) teachers considered formal courses that led to a degree or a diploma that helped them to improve professionally, as the most effective professional development activity while providers felt the quality of the development activity was more important than the type of activity; (c) teachers in the study considered the understanding of OBE and the new curriculum as their most pressing needs while providers saw the need for an improvement of content knowledge and pedagogical content knowledge; and (d) in the opinion of teachers, their daily practice would most likely be improved if equipped laboratories and libraries were made available.

These findings should assist policy makers and in-service providers in terms of rethinking ways of providing professional development activities by taking into account science teachers' perceived needs and views about the best ways of meeting these needs.

PREFACE

The work described in this thesis was carried out in the School of Education, Durban, University of KwaZulu-Natal, from August 2003 to April 2004 under the supervision of Professor Paul Hobden, Edgewood Campus, without whose suggestions and guidance this study would not have been achieved.

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- Science teachers in KwaZulu Natal who took time to complete a questionnaire related to the study.

- My parents: J. NKwaya and C. Nyirandatwa who took care of me from my childhood up to my adulthood.

- Professor Chrysologue Karangwa, my wife Sylvie Umubyeyi and my children who provided me with affection, social support, assistance and encouragement.

DECLARATION

This study represents original work by the author and has not otherwise been submitted in any form for any degree or diploma to any tertiary institution. Where use has been made of the work of others, it is duly acknowledged in the text.

C.M. KARASIRA

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LIST OF ABBREVIATIONS

ACE	Advanced Certificate in Education
BA	Bachelor of Arts
BSc	Bachelor of Science
CASME	Centre for the Advancement of Science and Mathematics Education
CASS	Continuous Assessment
DOE	Department of Education
FDE	Further Diploma in Education
HDE	Higher Diploma in Education
HED	Higher Education Diploma
INSET	In-service Education and Training
JSED	Junior Secondary Education Diploma
JSTD	Junior Secondary Teaching Diploma
MA	Masters of Arts
MEd	Masters of Education
MSc	Masters of Science
OBE	Outcomes-Based Education
PD	Professional Development
PEI	President's Education Initiative
PTD	Primary Teaching Diploma
PROTEC	Program for Technological Careers
SPTD	Senior Primary Teaching Diploma
STD	Secondary Teaching Diploma
UED	University Education Diploma

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DEDICATION

This thesis is dedicated to my lovely wife M. Sylvie UMUBYEYI, my children: Aurore UWASE, Gabin GANZA, Sabin SANGWA, Anelyse KARASIRASE, Alice UMURUNGI, Carmene ISHIMWE – NKOTANYI and the following victims of the Tutsi genocide: late Jean MUGAMAGE, late Lea KAYITESI, late father Modeste MUNGWARAREBA, late father Boniface MUSONI and late Emmanuel KATABANDAMA.

CHAPTER 1

INTRODUCTION

1.1   RATIONALE OF THE STUDY

In South Africa, mathematics and science education have been identified as critical areas for reform in schools because there are at present a large number of under-qualified and inexperienced teachers who lack both the subject knowledge and appropriate classroom teaching and management skills.
(Morar, 2002 III p.274).

Most African countries are currently facing a shortage of qualified and experienced teachers in the area of science and mathematics. Rwanda, my home country, is one of such African country where a shortage of qualified teachers in general and science teachers in particular is evident due to the 1994 genocide that killed more than one million people. In this country, the improvement of education in general, particularly science education is high on the agenda and teachers' professional development is recognized as a priority. However, little local research based information is available on how to achieve this priority.

In post-apartheid South Africa, the President's Education Initiative (PEI) was born to address educational concerns and in 1996 president Nelson Mandela appealed to the international community to assist South Africa with the re-skilling of, and support for, educators. In the PEI report Taylor, Diphofa, Waghmarae, Vinjevold and Sedibe (1999) highlight the following two areas as critical and in need of international assistance: (1) the upgrading and re-skilling of teachers in science, mathematics and technology; (2) the improvement of the quality of education in schools, including the improvement of teaching in large classes, in multi-grade classes in small farm schools, and in a multilingual environment.

In order to familiarize myself with and benefit from the South African experience in the area of science teachers' professional development, I saw the need to expose myself to research studies into the various strategies used and the effectiveness of the various

models of professional development. A familiarity with the South African science teachers' professional development activities and teachers' perceptions of the impact of these activities on their daily classroom practice as well as the effectiveness of those professional development activities in the science classroom context will enable me to think about what can be done in the Rwandan context to improve the quality of teaching and learning of science.

I recognize that South Africa, along with most African countries, has experienced political, social and economical transformations that have brought about changes on the educational scene. Bandi (1999) has noted that "classroom changes brought by such economical, political and social transformations in South Africa educational system are unquestionable and it is of a vital importance that all teachers, teachers in training, administrators and educational policy makers be informed about these changes "(p.5). These changes require professional development activities to inform and update science teachers by providing them with new skills to enable them to manage their science classrooms efficiently. These activities should be informed by teachers' expressed needs and their views about programmes most likely to improve their practice.

The improvement of teachers' competence in South Africa argues Morar (2002) is crucial because of the large number of unqualified teachers as a result of the educational inequalities that have characterized the South African schooling system in the past. This improvement is also needed because of changes brought about by the introduction of the new curriculum that emphasizes Outcomes-Based principles that require new teaching and learning skills and strategies and the introduction of new assessment techniques.

Both Rwanda and South Africa are undergoing a process of transformation and educators should be alert, ready to face new challenges and to stay abreast of educational development as a whole (Bandi, 1999). In this context, science teachers' professional development should be seen as a way of updating and improving science teachers' capabilities to achieve science education goals and to cope with changes in the new society.

In meeting this need, professional development programmes are likely to be successful to the extent that they are seen as addressing the beneficiaries' needs as well as being supported by them (Pather, 1995). Therefore, teachers' views about a particular professional development activity as well as the understanding of why some professional development activities are more successful than others are vital for the development of professional development programmes.

Based on this assumption, I intended in this study to determine the different forms of professional development programmes science teachers in KwaZulu-Natal participated in and explore science teachers' views about these professional development programmes offered to them. The study also aims to highlight science teachers' perceived needs for the improvement of their existing skills and acquisition of new skills. Assuming that some in-service programmes may be criticized for lack of direction and not being based on the real needs of educators, professional development providers and educational policy makers may find the findings from this research useful in understanding teachers' views and in the improvement or revision of the way INSET is provided in KwaZulu-Natal.

1.2   RESEARCH QUESTIONS

Guskey (2000) points out that the importance of evaluating professional development activities is expressed time and again by many writers. Guskey maintains that throughout the years, a lot of things have been realised in the name of professional development. However, what has not yet been done in a proper manner is to determine "what is the good and what is the rotten in professional development activities" (p. ix). He argues that the good of professional development is the result of well-planned activities aimed at improving teachers' classroom practice skills.

In order to ensure the effectiveness of the kind of teachers' professional development, which is provided, it is essential that the professional development relates closely to teachers' needs. This was the focus of this study and, my research looked for answers to the following questions from both teachers and in-service providers:

1.   What professional development programmes were science teachers in KwaZulu Natal participating in?

2.   What kind of professional development activities are considered to be most effective?

3.   What competencies are recognised as in need of professional development?

4.   What are considered to be the most effective ways of improving these competencies?

1.3   RESEARCH APPROACH

To answer the research questions a descriptive research methodology was used. The methodology aims at describing prevailing science teachers' views and beliefs about their needs and the effectiveness of professional development programmes provided in KwaZulu-Natal. A survey using a questionnaire as the primary instrument of data collection was selected as the most appropriate to describe science teachers' opinions about the way they were assisted to improve professionally. Information related to the research questions was gathered from a sample of two hundred science teachers to whom a postal questionnaire was sent. Fifty-one science teachers returned the completed questionnaire. In addition in-service providers such as University lecturers, project implementers and Department of Education advisors were interviewed. This was done to ascertain if providers had similar views to teachers. If they did not, then this would have major implications for the planning of professional development activities. The qualitative and quantitative data collected using both the questionnaires and interviews was coded and captured on computer, analysed and interpreted.

1.4   STRUCTURE OF THE STUDY

The first chapter of this study presented the rationale behind the research, the questions that the study intended to answer and the intended research approach. In the following chapters I will present:

1. The review of literature, that includes relevant theories and findings in connection with professional development activities used to help teachers improve the teaching-learning process of science in schools;

2. The research methodology that outlines the research method chosen to achieve the purpose of this study, the research tools or instruments that enabled the researcher to gather the required data and the techniques of analysis and interpretation used;

3. The analysis and discussion of the questionnaire;

4.   The in-service providers' interview results that have been summarised and interpreted in order to highlight providers' views about opportunities offered to science teachers as well as their opinion about what professional development activities are suitable for science teachers and what area of knowledge is nowadays of a crucial need;

5.   The summary, conclusions and implications of findings that will show how results of this research may contribute to the improvement of professional development programmes offered in KwaZulu-Natal. Suggestions and recommendations will also appear in this chapter.

CHAPTER 2

LITERATURE REVIEW

For the purpose of this study I have divided the literature review into six main focus areas all of which are relevant to the area of professional development of teachers. These focus areas are: (a) the understanding of what professional development is, (b) the different stages of professional development, (c) the need for professional development, (d) changes introduced by professional development in teaching and learning science, (e) the criteria for successful professional development, and (f) different types of professional development activities.

2.1   PROFESSIONAL DEVELOPMENT

2.1.1   Introduction

The current emphasis on teachers' professional development comes from the growing recognition of education as a dynamic professional field. Guskey and Huberman (1995) noted that "Educational researchers are constantly discovering new knowledge about teaching and learning processes and therefore as teaching professional expands, and evolves, educators need new types of expertise at all levels" (p.1). Other authors such as ·Laevitt and Klassen (as cited by Pather, 1995) support this view and state that in a changing and dynamic society, institutions in charge of education as well as educators cannot be static. They must address the new societal needs and new directions for the changing society. To address the real new needs of a changing society, educational reform requires teachers not only to update their skills but also to totally transform their role as teachers. Therefore, if educational systems establish new expectations for learners, teachers, and school communities for which some educators may not be prepared, it is important to prepare educators to meet these new expectations. To achieve this task, it is recognized that ongoing professional development is the key to keeping teachers abreast

of current issues in education and enable them to cope with new educational expectations and constraints.

Within the general literature there are many different terms associated with professional development as well as many definitions to explain what it is all about. Pather (1995) noted that "In-service education and training (INSET), in-service education, professional development and so forth are often used interchangeably for all the activities that contribute to the continuing education programme of professional personnel in the field of education" (p.19). In the field of education one of the more modern definitions for professional development is that of Guskey (2000) who defines it as "those processes and activities designed to enhance the professional knowledge, skills, and attitudes of educators so that they might, in turn, improve the learning of students" (p.16).

Other definitions include those given by: Pather (1995) making reference to Hoyle and explaining that professional development is "a popular term used to define the process by which teachers acquire the knowledge and skills essential for good professional at each stage of a teaching career" (p.24); Gray (1994) who mentions that professional development "is used to refer to opportunities offered to educators to develop new knowledge, new skills, new approaches, and new descriptions to improve their effectiveness in their classrooms" (p.5); de Feiter, Vonk and Van den Akker (1995) who add that professional development should be seen as a culture for educators to be continuously seeking and be helped to find ways of improving the quality of their practice; and Hopes (as cited by Pather, 1995) considers professional development as "...any activity which is directly related to improve the competence of a person by giving him/her opportunity to come to terms with a new set of responsibilities which are other than those for which he/she was originally trained" (p.26). These definitions emphasise both the improvement of existing teacher competencies and the development of new ones in response to changing contexts. In summary professional development provides opportunities for teachers to explore new roles, to develop new instructional techniques and methodologies, to refine their practice and to broaden themselves both as educators and as individuals.

Underlying the above definitions is the view that a teacher's career is a whole, from the initial education and training to retirement. It is evident that teachers should see that their profession involves a continuous and coherent set of changes. Those changes are not only guided by societal changes and new school exigencies but also by new experiences and innovations. Such changes within teachers' practice are not spontaneous

and cannot be developed overnight. They are the result of professional development based on an educator's need of improvement.

For the purposes of this study, teachers' professional development should be regarded as any activity that aims at helping teachers not only to enhance their professional knowledge and skills but also to cope with the constraints and exigencies of the classroom. Such activity should help teachers to keep continuously abreast with changes introduced by new curricula and new innovative instructional techniques and so forth.

2.1.2   Professionalization

Another term that often arises in the literature when discussing professional development is that of professionalization. According to de Feiter et al. (1995) "Professionalization refers to the development and improvement in the profession aimed at meeting exigencies and constraints of the profession" (p.54). For most people argues Hargreaves (1995), good teaching is a matter of teachers mastering the skills of teaching and the knowledge of what to teach and how to teach it. Teacher development, in this view, is about knowledge and skills development. In this context professionalization is seen as the mastering of skills and knowledge related to the profession. Doyle as cited by de Feiter et al. (1995) assumes that "a profession is an occupation the member of which is supposed to possess high level of knowledge, skills, commitment, etc" (p.55). At the core of this assumption is the idea that a profession bases its practices on a body of specialized knowledge and skills. However, teachers should not only be seen as individuals with specialized skills but also as professional persons with unique backgrounds, and life histories. This person as professional brings his values, knowledge, attitudes and so forth, to whatever professional role he is asked to play. In this context, profession is seen as a prestigious occupation, which implies a particular kind of commitment beyond knowledge and skills (de Feiter et al., 1995).

A contrasting view is that of considering the role of teaching as that of a technician who is asked to implement curricula and delivering curriculum content to learners as effectively as possible. Judging how well teachers achieve curricular implementation assesses this activity. In this way of viewing teaching as a profession, professionalization refers to a process by which teachers become increasingly able and willing to execute the curriculum and changes, as they are centrally prescribed. In this view of

professionalization it is obvious that the priority is to ensure minimum teachers' competences and knowledge and this must be continuously updated. This approach transforms the process of the education of teachers into one of training for acquisition of skills.

This view is seen as outmoded by Loucks-Horsley, Love, Siles, Mundry and Hewson (2003) arguing that "a teaching career is complex and uncertain, the complexity and uncertainty stem from the fact that professionals are constantly being asked to make decisions in particular circumstances. This requires teachers to be really professionals with specialized knowledge in contrast with the outmoded perspective of teachers as skilled technicians" (p.39). Teaching should be seen, in this context, argue de Feiter et al. (1995) "not as a technical activity that involves the execution of validated teaching techniques and strategies but as an activity involving the person as a whole. His scientific knowledge here is seen as something that informs the teacher but does not prescribe his practice" (p.56).

Arising from the review above professionalization should be understood in the following way in this study: it should be regarded as the process or journey that enables the acquisition of specialist knowledge, skills and attitudes required by educational profession involving the teacher as a whole. If professionalization is seen as the process of mastering of teaching knowledge as well as teaching required skills, such mastery cannot be reached overnight. It is a process that goes through stages. These stages will be described in the following section.

2.2   PROFESSIONAL DEVELOPMENT STAGES

Pellicer and Anderson (1995) argue, "Becoming a professional teacher is a journey, not a destination" (p.145). Based on this idea, a teacher's career should be regarded as a coherent whole and professional development seen as a process over time. It is expected that during the teacher's career changes will take place. These changes are influenced not only by personal experience but also by formal and informal experiences. The journey to achieving true professional status is a dynamic process that spans one's entire career in the profession, from preparation and induction to completion and retirement (Guskey et al., 1995). In support of Guskey's view, Mevarech (1995) considers

professional growth in education as a process of change in teachers' mental models, beliefs, and perception regarding learners' minds and learning. Teachers' professional growth passes through normal and predictable stages. A phase here is seen as a period in someone's career, which is identifiable by specific characteristics to that period.

Regarding stages through which teachers progress during their careers, Fessler (1995) indicates that Unruh and Turner in 1970 were among the first to propose the notion of career stages and suggested three periods that are: (a) The initial teaching period comprised between one and five years characterized by struggling with class organization, management, curriculum and acceptance by peers; (b) The period of building security comprised between six and fifteen years. During this period, teachers know what they are doing, they seek ways of improving their knowledge and background for not only degrees but also for the improvement of their practice; (c) The maturing period that is approximately 15 years and more is seen as a period of security in professional life. The secure attitude of teachers allows them to see change as a process, not a threat.

This categorization of teaching stages can enable one to classify teachers in categories such as: (a) first year teachers, (b) teacher with minimal competence and experience, (c) experienced teachers and (d) retired teachers (Fessler, 1995). However, the categorization that subdivides teachers' careers into three or four categories is seen as very simplistic and de Feiter et al. (1995) with their Southern African experience in professional development argue that a teacher's career comprises general developmental sequences that all teachers may go through during their career. Those phases are summarised as follow:

1. The pre-professional stage refers to the period of training associated with the initial college or university preparation for a degree or a certificate. It may also include retraining a practitioner teacher for a new role and providing teachers or future educators with knowledge and skills of the teaching profession.

2. The threshold stage refers to the first year of teachers' career that confronts them with all responsibilities of a teacher for the first time. Called survival period, this phase corresponds to the strive for acceptance by learners, and the focus on the mastery of daily new job constraints and exigencies.

3. The stage of growing into the profession is the stage during which attention is focussed on extending and improving a teacher's repertory by seeking and trying out new material methods and teaching strategies. This phase comprises the period between the second and the fifth or sixth year of teaching practice.

4. The first professional stage refers to the period correspondent to the stage during which teachers feel competent and effective after completing five or six years in the career. During this stage a teacher can be seen as a corner stone in the school.

5. The stage of reorientation towards oneself and the profession that is characterized by the rethinking about the profession and the career and sometimes the need to shift from the profession to another profession. This phase is that during which the teacher may question and doubt his/her commitment to teaching. Some teachers may drop out of teaching at this period and others may continue but with less enthusiasm and energy than in the previous phases.

6. The second professional stage that is seen as the stage during which some teachers reenergize them and continue on to further professional accomplishments. It precedes the last phase.

7. The stage of running down is the period before retirement (career exit) that is seen as the stage during which one is waiting for a rest after having offered all one's best to the profession.

In contrast with the previous model, de Feiter's model presents not only differentiation between mature teachers but also the phase that precedes the starting of the teaching career that is the pre-service phase or preparation phase to the profession. During the growth process, experience and additional training calm a teacher's fears and make him feel more comfortable in terms of what to teach and how to teach it. That growth goes through steps ranging from the inexperienced teachers to the experienced teachers on one hand and from an experienced teacher to a retired teacher on the other hand.

From the different ideas expressed above, it can be seen that it is generally accepted that a teacher's career is considered as a whole and that it goes through stages. As educators evolve in the teaching profession they become more exposed to new experiences that enable them to grow professionally from the novice teacher stage to the experienced teacher. However, many other stages can be identified in-between those two stages. Descriptions of the possible stages found in-between vary from author to author.

2.3   NEED FOR PROFESSIONAL DEVELOPMENT

Guskey & Huberman (1995) argue that "Never before in education has there been greater recognition of the need for ongoing professional development" (p.1). This recognition of the need for teachers' professional development lies in the assumption that practitioners in education are seen today as doing an inadequate job and efforts must be made to correct these inadequacies. Inadequacies mentioned here are seen as linked not only to the fact that no teacher cannot be trained to the point of adequacy before he qualifies and adequacy can only come with experience, but also inadequacy is linked to the fact that teaching involves complex activities of planning, observing, acting, reflecting, explaining that occur in a highly dynamic atmosphere. This highly and dynamic atmosphere is regarded by Loucks-Horsley et al. (2003) as characterized by intensive interactions between learners, teachers, knowledge and the environment in which this knowledge is delivered. The success of teachers in such an atmosphere and environment requires abilities to apply knowledge about students, content, curriculum, instruction and so forth, and to be given the opportunity to develop the skills needed to meet the demand of our increasingly changing and complex societies.

Concerning factors that create the need for professional development, Pather (1995) argues that many elements create a need for professional development such as curricula changes, shortage of adequately qualified teachers, and improving management skills. He notices that professional development needs are intensified by the rapid technological, scientific, social and political changes. In this context, professional development in all its forms should be seen as a crucially important element for raising the quality of education and maintaining an effective corps of science teachers as well as of satisfying the needs of educators and classrooms. Rathando (1997) adds "professional development should be seen as the way of helping educators to cope with rapid technological, scientific, social and political changes" (p.7).

In science and mathematics the formal education of the teacher is of a great importance (de Feiter et al., 1995). Research in science and mathematics shows that many scientific and mathematics concepts are counter-intuitive or otherwise difficult to grasp and retain not only for learners but also for teachers. Consequently, teachers with limited background in certain subject matter area may teach incorrect content or fail to recognize

and correct their students' distorted understandings. In developing countries the relationship between teachers' educational backgrounds and knowledge and learners performance is strong. This is because teachers are often the major source of knowledge in a situation where other resources such as books and newspaper are in short supply. This is the case for most rural African schools. If educators are seen as the only source of knowledge, it is important to continuously update their knowledge through not only formal education but also through informal education.

The literature informs us that there is a need for professional development and this need is based on the assumption that teaching is a complex profession that involves complex activities and teachers are given the initial tools and direction seen as not sufficient. Teachers' adequacy, as far as is possible, can only come with experience and continuing learning. Additional to the complexity of the teaching profession, the rapidity and constancy of technological, scientific, social and political changes are among major forces that advocate for ongoing professional development. The inadequate initial preparation for the teaching profession is also seen as an element that informs the need for a continuous updating and re-skilling of educators.

2.4 PROFESSIONAL DEVELOPMENT AND CHANGES

In a changing society changes are introduced in classrooms and those changes are brought by the introduction of new curricula, the introduction of new assessment techniques and new teaching strategies. The introduction of any change will work if teachers are able to change first and then implement the required new ways of teaching and learning. This should be seen as a process. Within the literature many ideas arise about professional development and changes that vary from author to author.

In the change process Taylor et al. (1999) argue, "Education systems are expected not only to act as vehicles for redress and transformation but also to produce the kind of citizen that will enable their countries to become globally competitive" (p.1-2). They continue saying that South Africa's first democratic government not only faced the above challenge but also those relating to the renewal and transformation of a racially divided and inequitable education system. In the first ten years of the government, the new national and provincial education departments have been concerned by two imperatives

that are: (a) the development and implementation of a policy, which will provide for redress of past inequalities and the provision of equitable, high quality and relevant education; (b) the complex process of amalgamating seventeen different education departments and the consequent redeployment and reorganisation of teachers and bureaucrats. This led to expectations of teachers' change.

Policy makers as well as professional developers should be aware of the how change happens in the educational settings argue Loucks-Horsley et al. (2003). Change is both an individual and an organizational phenomenon that affects each and every educator, as well as the school, the districts, universities and so forth. All valuable educational changes require individuals to act in new ways and this is demonstrated by new skills, behaviours and activities. It also requires people to think in a new way. Similarly, Hixon and Tinzmann (1990) mention that as changes occur in a society such as innovations, and new technologies, so changes are supposed to occur in the teaching learning process. Those changes will be meaningful only when those who work in and with schools have the opportunity to develop the new attitudes, beliefs, knowledge, and skills necessary to translate these new ideas and concepts into meaningful and specific plans for changes and to incorporate them into their day to day routines (p.3).

Spector (1986) is explicit about how to bring changes in the classroom. She argues that the introduction of needed changes in the classroom begins with teachers who should first change their ways of planning, teaching and assessing their work. Changes at the individual teacher level will have as consequences, changes in the children's process of learning and understanding and this could have an impact on the whole society.

Loucks-Horsley et al. (2003) note that "this idea of change is a long-term process" (p.49). They argue that when change occurs, it does not happen in one step, but is progressive. This progressive change is not smooth. It has been recognized that changing teachers' philosophy, beliefs, and practice is difficult because those teachers learned in different ways from those proposed and required for the implementation of the new curriculum and new societal constraints.

It follows that change within a professional development context should also be seen as a slow and evolving process. Even if sometimes there is pressure to scale up and quickly implement broad-based change without being careful, educational change should be based on problem-solving and comprehensive planning process. Professional development must shift from its emphasis on working on teachers, to working with them toward improving the teaching–learning process. Given that change is a long-term process,

for it to succeed and have a positive impact, a certain amount of environmental stability is required, mainly in continued political and financial support for the change (de Feiter et al., 1995).

Loucks-Horsley et al. (2003) note the following assumptions about change. They argue that change is a process not an event that is made by individuals first, then the organization. It is a highly personal experience and it entails developmental growth in feelings and skills. If professional development is to introduce effective change in the daily school practice, it should consider the teacher as the core of the change. Fullan (1991) also highlights the idea that change is a process and describes the change process as consisting of four steps that are: active initiation and participation, pressure and support, change in behaviour and belief and ownership.

Loucks-Horsley et al. (2003) emphasize that change cannot happen in isolation. It must be part of a whole changing educational system. Consequently, Morar (2000) notes that the introduction of educational changes in South Africa should be seen as a great challenge that requires the involvement not only of policy makers but also the ownership of innovations by teachers. Pather (1995) shares this view arguing that not only the ownership of innovations by teachers is of a great importance but also the involvement of teachers in the change process is needed. He specifies that, when teachers are involved in the change process, form the planning stage to the execution stage, and they express and demonstrate growth in terms of skills and competencies to implement changes.

From the literature above on professional development and change, it can be noticed that it is generally accepted that teachers must change first for institutional change to occur. Both individual and institutional changes are evolving, slow and long term processes. For change to be introduced successfully educators must have the ownership of innovations and an environmental stability is required to support change.

2.5   CRITERIA FOR SUCCESSFUL PROFESSIONAL DEVELOPMENT

Within the literature many criteria for successful professional development are proposed and what follows is a survey of some of the main criteria that appear repeatedly such as the ownership of innovations, assessed needs, collaboration, and so forth.

Professional development providers must take into account that teachers are adult learners and that for professional development to be successful, it is important to consider adult learners differently from the way we consider child learners. In doing so, the principle of androgogy should be clearly defined in professional development programme objectives (Pather, 1995). The principle of androgogy requires a learning environment highly supportive and participative. Consequently there is the need to give adult learners the opportunity to participate in the planning and delivering of professional development programmes.

Hixon and Tinzmann (1990) mention that teachers' motives to be part of professional development are crucial in bringing about needed change. Teachers' motives can be increase in salary, career planning, keeping up with developments, filling up lacunae, removing insecurity, and meeting colleagues. Rust and Dalin as cited by de Feiter et al. (1995) also emphasize teachers' motives and maintain that extrinsic rewards such as certification, increased salaries, university credentials are the main motivators for being part of a professional development programme and for its success.

A number of what they consider to be essential factors are highlighted by Loucks-Horsley et al. (2003) who propose, "an effective and successful professional development is one that:

- is driven by a well-defined image of effective classroom teaching and learning;
- provides opportunities for teachers to build their content and pedagogical content knowledge and examine their practice;
- is research based and engages teachers as adult learners in the learning approaches that they will use with their students:
- provides opportunities for teachers to collaborate with colleagues and experts;
- supports teachers to serve in leadership roles;
- has a design based on students learning data and
- links with other parts of the education system" (p.44).

The identification of teachers' needs that should be taken into account is raised by Owen et al. (1988) who maintain that an effective professional development should:

- address issues of concern identified by teachers themselves,
- take place over an extended period of time,
- provide opportunities for reflection and feedback,
- take place as close as possible to the teachers' own working environment,
- enable participating teachers to feel a substantial degree of ownership,

- have the support of both colleagues and the school administration, and
- involve groups of teachers rather than individuals from a school.

The relationship between identified needs and ways of addressing these perceived needs is mentioned by Fullan (as cited by de Feiter at al., 1995) who remarks that it is important to be aware that the importance of perceived needs is obvious for any professional development to be successful. However, it is recognised that precise needs are often not clear especially when a system is facing multiple changes. In this case, needs become more and more clear when people are engaged in the change process as well as when people progress toward meeting some perceived needs. Feiter et al. (1995) argues that the success of any professional development depends not only on the design of intervention, the availability of funds and material but is also dependent on teachers' preparedness for change and their feeling of being concerned by the outcomes of interventions.

Another criterion for successful professional development is that of teachers' commitment and working conditions. de Feiter et al. (1995) argue that even if the teacher is seen as probably the most influential factor in the core educational process, there is a need to identify what aspect of his/her background is most decisive in the teaching and learning process. They recognize that updating teachers' knowledge is not sufficient and notice that teacher commitment is as important factor, as are working conditions for educators. A fully competent teacher may perform less than adequately in the classroom if he/she is working in a disorganized and unsupportive atmosphere. On the other hand, teachers with minimum competencies may work satisfactorily if given supportive and favourable conditions.

Wilson and Berne (1999) consider professional development as a ticket to any reform and argue that an effective professional development should (a) ensure collaboration that produces shared understanding, (b) require collective participation, (c) focus on crucial problems of curriculum and instruction, (d) be conducted often enough, (e) be congruent with and contributing to professional norms and habits.

From the views mentioned above it can be seen that the following criteria can be used to determine the likelihood of the success of professional development programmes:

- Is it based on assessed teachers' needs?
- Are teachers involved in the planning and implementation?
- Do the proposed changes fit with the teaching environment and context?

- Are the teachers prepared and motivated for change?

- Do teachers have a sense of ownership of the proposed innovations?

- Is the programme seen as a collaborative action that is supported by teachers and authorities?

- Will the programme not only improve teachers' skills, attitudes and knowledge but also be based on the curriculum requirements?

It is also obvious that even if all the above criteria were met, the implementation of any professional development is dependent on contextual factors such as the cultural environment, the mode of governance, and the quality of the education and training of the teaching force. Here emerges the idea that the implementation of a particular wide scale professional development programme for successful curriculum change requires striking a balance between the need for improvement and the country's capacity to meet exigencies of that implementation and to handle educational innovations.

2.6   TYPE OF PROFESSIONAL DEVELOPMENT ACTIVITIES

In the literature, different approaches to professional development and models by which teachers might be assisted to keep abreast with classroom changes are proposed. I will highlight some of them and finally, according to my experience and the practical context of professional development in South Africa, I will identify models that fit with the mentioned context.

Gray (2000) considers that there are a number of key forms of support that are available for science teachers and categorizes them into broad categories: (a) courses and workshops in support of change, (b) written material and equipment, (c) in-school support. He considers courses and workshops as the most common form of support provided to science teachers. He suggests that workshops need to be conceived and run in a manner that engages teachers to participate in the change process. This classification would be seen as a broad categorisation of professional development activities.

In contrast to Gray (2000), Owen et al. (1988) suggest eight models by which teachers should be assisted. They argue that those models are a synthesis of good

professional development practice and are drawn from theoretical perspectives and practical experience. The proposed models are summarized as follows:

1. a structured qualification that is considered as formalised professional development providing organised courses over a fixed time frame and covering a range of selected themes and issues through regular sessions;

2. a sandwich course that consists of two sessions, between which school level trials of themes presented in the first session are sandwiched. The second session will focus on sharing of experience from classroom trialling;

3. in-school intensive is a kind of professional development programme conducted within a school, targeting a group of people to whom presentations and illustrations on classroom practices are done;

4. the establishment of school cluster groups is considered as a model that contributes to the formation of a network of a group of schools. Members of the network meet regularly to address common purposes and reflect on their daily practices and difficulties;

5. the postal model considers the mail as important and the best way of disseminating information. It consists of sending written material to teachers by post expecting to receive feedback by the post from teachers;

6. the pre-service model is a kind of professional development programme that includes exposing pre-service teachers to best classroom activities produced by experienced teachers. The exposure of pre-service teachers is done through trial, with them both on their own and in the classroom situation. It involves trying a number of activities and analysing them and their impact on the teaching and learning process;

7. peer tutoring is a model based on the assistance provided by a trusted and experienced teacher in monitoring and helping colleagues to improve their skills;

8. activity documentation consists of teachers sharing, in groups, activities that resulted from their successful classroom experiences. Notes and equipment for those activities are collected, analysed and summarized.

This categorization is more detailed than the previous one and includes details of the organization, the source of information and procedures used to improve teacher's knowledge and skills. It also includes the pre-service model that really refers to pre-service educators, which is outside the scope of this study.

An alternative view is that of Pather (1995) who considers the philosophy underlying professional development and the context guiding its planning and implementation and classifies INSET models into eight categories that are:

1. Traditional INSET model that refers to courses related to the curriculum and aimed at explaining syllabus changes, and organizational changes in school. Organized as lecture or workshops, this model includes one-shot type of courses that are seen as having limitations;

2. The deficit model based on assumptions that problems in schools are linked to the deficiencies in the teacher, this model is also called remedial model and is delivered or organized as lectures, workshops, and seminars to fill in teacher's lacunae;

3. The continuing education model is the one that is based on the principle that the improvement of knowledge is lifelong. The continuing education model is also called developmental perspective model, this model sees professionalization as a long-term process, not a short-term process. It should be extended over the whole life;

4. The school-focussed model is seen as bottom top model in contrast to the traditional and deficit that are considered as top down models. It refers to training offered on site to satisfy teachers on site-identified needs;

5. The research-based model refers to any professional development aimed at introducing in schools new instructional techniques that have been researched and identified as most effective;

6. The urban and rural school development model that suggests the involvement of community members as well as teachers in proposing ways that can improve the teaching and learning processes;

7. The concerns-based adoption model refers to any professional development that is based on the probing from schools of concerns to be addressed through professional development intervention;

8. The whole school model is a school directed professional development programme aimed at assessing and addressing school practices.

Taking into account, among other factors, the nature of teachers' available knowledge base, Tillema & Imants (1995) propose development-oriented models of training that are: (a) The training for conceptual change model which aims at restructuring and providing teachers with relevant subject matter knowledge and pedagogical knowledge. This model

focuses on altering the teacher's own knowledge; (b) The cognitively guided model concentrates on increasing the teacher's knowledge of learner's cognitive levels and their student's problem solving capabilities; (c) The study group of teachers' model is a professional development model aims at promoting teachers spirit of working in group to adjust and generate knowledge as well as to increase teachers' capabilities of managing learners study group and cooperative learning; (d) The sharing model aims at promoting change in teaching practice and focuses on the sharing of teachers' views about their classroom experience, practices, their beliefs with the aim of promoting and improving their current practice.

When looking at the general population of science teachers, they have not had the opportunity to experience many of these professional development models. The following is the categorisation and terminology that would be more easily recognised by local teachers and hence is used in this study: (a) formal structured courses that lead to a degree or a diploma, (b) short structured courses that lead to a certificate, (c) workshop training courses of more than one day, (d) meetings, seminars and presentations that are part of or a full day, (e) in-school support programmes and (f) conferences. Most types of professional development activity can conveniently be fitted into the above mentioned categories.

2.7   SUMMARY

This review of literature highlighted professional development especially in the field of education. Professional development and professionalization are seen as important elements that enable the teacher in general and the science teacher in particular to cope with the needs imposed by changing societies. The discovery of new teaching strategies as well as changes introduced in the educational system should be accompanied by the updating of teachers competencies and expertise to introduce them in the classroom.

The acquisition of expertise and new competencies by teachers is a process that should be seen as of a crucial need. It goes through stages from the initial training or the pre-service training to retirement. It is a process that aims at developing a culture of looking forward and trying on a daily basis to improve the way we deal with the daily teaching activity.

If the improvement of expertise and competencies are seen as lifelong, policy makers as well as in-service providers should provide teachers with opportunities to update their content knowledge, their pedagogical content knowledge as well as their contextual knowledge. This is done in KwaZulu-Natal but little is known about areas of knowledge that need to be improved. From the perspective of teachers, little is also known about which kind of professional activity, aimed at improving teachers' expertise in general and science teachers' competencies in particular, is most effective. The following chapter will outline methods, techniques and strategies used to find out the professional development activities experienced by teachers, the real and perceived needs of teachers, and science teachers' opinions about the effectiveness of professional development activities available to them.

CHAPTER 3

RESEARCH METHODOLOGY

Having set out the research questions and reviewed relevant literature, this chapter will focus on the how the research questions will be answered. In aiming to explain processes that led to finding answers to the research questions, the research design and sampling procedure are presented, data collection and instruments of data collection are highlighted, and techniques used to analyse and interpret collected data are mentioned.

3.1   DESIGN OF THE STUDY

Kane and O'Reilly-de Brun (2001) recognize that "a problem or an issue that a researcher is studying should determine not only the research design but more importantly research techniques used, not the other way around" (p.107). They consider each research technique as a specific tool matched to a research problem. To best answer the research questions a descriptive research design was used. Descriptive research aims to interpret what is and how what is. Cohen, Manion and Morrison (2000) argue, "Many educational research methods are descriptive. They seek to describe and to interpret what is" (p.169). A descriptive research study focuses on conditions and relationship that prevail. It seeks to point out views, and attitudes that are held. It tries to find out processes that are going on. This study claims to be descriptive research because it aimed at describing views held by science teachers about the professional development programmes offered to them in KwaZulu-Natal.

When determining the data collection techniques it is important to ensure of the fitness of the design with the research questions and the kind of information or data needed to answer the research questions. In this particular case, a survey was considered to be most appropriate. A survey, argue Kane et al. (2001), is "appropriate to inform the researcher about what is happening, what people say they do, think, and feel" (p.111). A survey enabled the prevailing science teachers' professional development programmes as well as science teachers' views about these models to be described. Beside the survey that

essentially used a questionnaire, an interview was organised targeting the providers of professional development activities.

3.2   THE SAMPLING

Participants in this study were from a sample of KwaZulu-Natal science teachers who provided information related to views about professional development programmes they had experienced. In addition a sample of professional development programme providers in the same province was targeted.

Using a survey method in gathering data requires a representative sample from the whole population to ensure a measure of statistical confidence, and to ensure that characteristics observed occur with a degree of regularity (Cohen et al., 2000). In this case, it was not easy to extract a systematic sample from the wide population of KwaZulu-Natal science teachers. An opportunistic sample was extracted from mailing lists of science teachers. These mailing lists were obtained from CASME and Natal University.

The Centre for the Advancement of Science and Mathematics Education (CASME) is a non-profit education development agency that focuses on professional development of mathematics and science educators, particularly from disadvantaged areas of KwaZulu-Natal. From the CASME mailing list the names of 150 science teachers were extracted The University of Natal organises courses that enable in-service science teachers to improve their qualifications. Such courses lead to a B.Ed. Honours or an Advanced Certificate in Education (ACE) or other postgraduate qualifications. From the mailing list of Natal University, especially from the Edgewood campus 50 science teachers were selected. The Combined mailing list of science teachers was 200 teachers in total and questionnaires were sent to all 200 teachers. Responses were received from 51 teachers giving a return of about 25% which is within accepted norms for questionnaire surveys.

In order to obtain information from providers, individuals from a number of organisations such as CASME, PROTEC and Toyota Teach Programme who were all active science education professional development providers, were approached. In addition science education lecturers from the university and science subject advisors from the DOE were selected. In all seven individuals agreed to be interviewed and constituted the providers sample. They were grouped into the three categories of Department of Education advisors, project implementers and University lecturers.

3.3   METHOD OF DATA COLLECTION

In order to collect data required to answer the research questions, a questionnaire and an interview were used. These instruments enabled both qualitative and quantitative data to be gathered with the intention of describing KwaZulu-Natal science teachers and providers' views about the effectiveness of professional development programmes.

As indicated by Kane et al. (2001) "a survey method of gathering data can take two different forms that are: (a) a form of a questionnaire in which the respondent fills out a form, or (b) an interview schedule, where the researcher asks to the respondent the questions directly" (p.111). Even if both questionnaire and interview schedule are referred to as "questionnaire", it is recognized that there is a technical difference between them and the questionnaire needs more care and attention since the researcher is not interacting directly with the respondent.

Even if a written questionnaire needs more care, it presents advantages and disadvantages. Some of the advantages of a questionnaire over an interview are presented by Cohen et al. (2000) who argue, "for instance, it tends to be more reliable; because it is anonymous, it encourages greater honesty; it is more economical than the interview in terms of time and money and there is a possibility that it can be mailed" (p.129). Its disadvantages on the other hand are that there are a too low percentage of returns and for any questionnaire there is a need to pilot it and refine the content, wording and length appropriate for the targeted sample.

3.3.1   The questionnaire

A postal questionnaire (appendix I) with return envelopes was produced with questions that required short answers, ranking questions, multiple-choice questions and rating scale questions. The final version of the questionnaire that could be completed in fifteen minutes was the result of long revision process. The first draft was discussed and revised by the researcher and his supervisor. From this first draft emerged the second one that also passed through discussion and revision. From this discussion and revision process, aimed at producing a questionnaire that not only fits with the research questions but also that should be completed easily by respondents, a third draft was produced. The third questionnaire draft was piloted with four science education lecturers at Edgewood

Campus for comments and suggestions on the language, format and content. From their comments and suggestions resulted the pilot version of the questionnaire.

The pilot questionnaire was sent to 15 science teachers from different backgrounds to be completed as a pilot study. The teachers were asked to complete the questionnaire and their responses were examined to ascertain whether any questions were ambiguous or difficult to understand. The responses were also examined and analysed to ascertain if the information they provided would be sufficient to deal with the research questions or if further questions were required. Cohen et al. (2000) recognize that "pre-testing a questionnaire is crucial for its success" (p.260). Pre-testing of a questionnaire is done through a pilot study. It is recognized that a pilot study should increase not only the reliability and validity of the questionnaire but also its practicability. The pilot study enabled the researcher to: (a) ensure the clarity of the questionnaire items, (b) know the time taken to complete the questionnaire, (c) identify repetitive questions, (d) identify misunderstandings and (e) try out the coding for data analysis.

After the pilot study no major changes were done to the questionnaire, but the researcher noticed that some of the pilot sample could not provide their views on different professional development programmes because they were novices in their teaching career and therefore they had not yet been exposed to more than one professional development programme. This was one of the reasons why the university and CASME science teachers' lists were used to obtain the final sample. These were all teachers who were involved in some form of professional development. The final revised version of the questionnaire was then sent to the 200 science teachers on the above lists.

3.3.2   The interview

Interviews were conducted on an individual basis and with the authorization of interviewees a tape recorder was used (see letter of informed consent: appendix II). The interview schedule (appendix III) that was used was the result of revision of a first draft produced by the researcher. Comments and suggestions made by the supervisor of this dissertation on the interview schedule draft as well as comments and suggestions from four lecturers from Edgewood campus enabled the researcher to produce the final version that was used.

An audiotape-recorded interview of thirty minutes was held with the targeted individuals in charge of science teachers' professional development at the DOE level, at

Natal University level involved with INSET provision and at Project implementer's level such as CASME, PROTEC and Toyota Teach Program.

An interview, argue Kane et al. (2001) should have a clear pre-determined focus, but should be also flexible. Pather (1995) adds that interview allows for immediate feedback and enables the researcher to follow-up that leads to obtain greater clarification and additional data. In addition, interviews are relevant when one wants to explore something in depth, when one wants to get a better understanding of information gathered using other means.

It is important for any researcher to assure respondents and interviewees, of confidentiality of information gathered. That is why I assured respondents and interviewees that all information obtained from them would remain confidential and that no information would be released or reported that identified participants or their school (see covering letter on the first page of the questionnaire in appendix and letter of informed consent).

3.3.3   Validity and reliability

One central issue in considering the reliability and validity of a research study in general and of a questionnaire survey in particular is that of sampling. "An unrepresentative, skewed sample, one that is too small or too large, can easily distort the data and, indeed, in the case of a small sample, prohibit statistical analysis" (Morrison, 1993 as cited by Cohen et al., 2000, p.120).

In both quantitative and qualitative researches, reliability can be regarded as a fit between what the researcher records as data and what actually occurs in the natural setting that is being researched (Cohen et al., 2000, p.119). Reliability says Brock-Utne (1996) as cited by Cohen et al. (2000, p.120) requires qualitative research to be holistic, it strives to record the multiple interpretation of, intention in and meanings given to a situations and events. Here the notion of reliability is construed as dependability. This notion raises the important issue of respondent validation and suggests that the researcher needs to go back to the respondents to check if findings are dependable. One of the limitations of this study was that the researcher couldn't go back to the respondents and find out the dependability of findings. The constraints on time and resources in this masters' research project prevented him from doing so.

Cohen et al. (2000) state that it is very easy for a researcher to slip into invalidity. They indicate that invalidity can enter at any stage of a piece of research. The attempt to avoid invalidity is essential for the researcher to have confidence in the elements of the research plan, data acquisition, data processing analysis, and interpretation. In order to minimize problems with validity, the researcher ensured not only of the fitness of the research methodology with the purpose of the study but also of the validity of instruments of data collection. The validity of used data collection instruments was likely to be high because they went through a process of a rigorous and systematic refining.

Internal validity seeks to demonstrate that the explanation of a particular event, issue or set of data, which a piece of research provides, can actually be sustained by the data. In the case of this study, instruments used to gather data were worked and reworked to produce tools that could provide data purported to answer efficiently the researched questions. External validity on another hand refers to the degree to which the results can be generalized to the wider population, case or situation (Cohen et al., 2000, p.109). However, in the case of this study, participants who came from a very specific group of teachers make up the sample. Results from this study cannot be generalized to the whole science teacher population in KwaZulu-Natal but they can only be extended to science teachers who participated in professional development activities.

It is also recognized that the use of more than one technique in gathering data, the information gained about an issue is stronger than that gained using one technique (Kane et al., 2001, p.108). However, even if in the case of this study, the use of both a postal questionnaire and an interview was made on two different groups and thus the reinforcement is seen as not strong, the same issue was viewed from two different frames of reference and from them emerged some common ground.

3.3.4   Data analysis

To facilitate categorization of collected data, the questionnaire was constructed in a manner that questions related to particular themes were grouped into sections. A pre-coding of some answers expected from the respondents was done. It is important to recognise that when a researcher receives back the completed questionnaires, his/her task is to reduce the mass of data obtained to a form suitable for analysis. This process is called data reduction (Cohen et al., 2000). Data reduction is considered as the coding of data in preparation for the analysis. However, prior to the coding, complete returned

questionnaires need to be checked in order to notice and eliminate errors made by the respondents. This process is called editing. In the case of this study, after receiving back the completed questionnaires the first task was the editing of complete questionnaires; the second task was coding the data into categories. The coding and summarizing of data was done through their capture on spreadsheets and such coded and summarized data was analysed and interpreted. Data analysis provided with percentages, means, and tables that were interpreted in order to answer research questions.

In addition the tape-recorded data collected by interviews was transcribed, categorized, and summarized after repeated listening to recorded tapes. The categorization of the tape-recorded information gained from interviews was done with the research questions in mind.

3.4 SUMMARY

This chapter has provided a description of different stages through which the researcher went in order to answer the research questions. The need of determining the research design has been shown and that this design should respond to the criteria of fitness for the purpose of the research. The research design led to the identification of the target population from which a sample could be extracted. The sampling procedure was explained. The rigorous process, including the piloting, through which the questionnaire was developed, was outlined. A similar process was described for the collection of the interview data. The data coding, capturing and analysing were described. In the following chapter the findings of questionnaires analysis are presented.

CHAPTER 4

ANALYSIS OF TEACHERS' QUESTIONNAIRE

This chapter of the study presents a summary of the questionnaire analysis. In particular it focuses on science teachers' professional development programmes teachers participated in as well as kind of professional development science teachers considered as the most effective in terms of helping them to improve their daily practice. It aimed also at exploring areas of knowledge for which science teachers felt they need more support and improvement and ways they consider would help them to improve those areas.

Information revealed by the questionnaire helped to outline (a) science teachers' background information, (b) participants' experience of professional development activities, (c) science teachers' views about the most effective professional development activity, (d) science teachers' current professional development needs, (e) science teachers' views about the best way of meeting teachers' professional development needs; and (f) science teachers' views about ways of improving their daily practice.

4.1   TEACHERS' BACKGROUND INFORMATION

A summary of responses of science teachers concerning their experience in their teaching careers as well as the location of their schools is reported in Table 4.1 below. The examination of the table indicates that science teachers who participated in this study were from both rural and urban schools. As far as teaching experience is concerned, they ranged from "experienced" teachers to "beginners" or novice teachers. Thirty seven percent of the science teachers had teaching experience that ranged from one to five years, 24 % had experience that ranged between 6 and 10 years and lastly 39 % had experience in teaching that exceeded 11 years. From the table below it appears that teachers who responded to the questionnaire were mostly experienced teachers with over 60 % having more than 5 years experience. This could be seen as a sign of stability in the corps of science teachers.

Table 4.1 Teachers' experience and location of schools

Experience		1-5 years	6-10 years	11 +
	Number	19	12	20
	%	37	24	39
School location		Rural	Semi-rural	Urban
	Number	29	1	20
	%	58	2	40

Teachers' responses to the background section of the questionnaire showed also that they were mostly natural science or biological science teachers (52 %) and physical science teachers (41 %). Forty seven percent of the participants in the study were teaching from grade 10 to grade 12 and 53 % were teaching grades below 10.

Information gathered on science teachers' qualifications when they started teaching and qualifications they gained while in service is reported in the Table 4.2 below. From the table it can be seen that the majority of participants in the study (60 %) had a 3-year diploma such as a STD obtained at a college of education. The number who specifically mentioned that they had a BSc or a BA at the beginning of their teaching career was only 9 (18 %). The table shows also that teachers gained subsequent qualifications during their careers. At the beginning of their careers 18 % had a four-year university qualification but currently 31 % revealed that they gained such qualification during their careers. Similarly 18 % of the teachers had a three years university qualification when starting the teaching career but 33 % gained the qualification during the teaching career. Over 60% of the teachers had improved their qualifications. This is a sign of teachers' desire to improve their qualifications and thus improve professionally.

Table 4.2 Teachers' qualifications when starting the teaching career and extra gained qualifications

Category	3 years college primary	3 years college secondary	3 years university	4 years university	Masters	No response
Qualifications start	PTD, SPTD	STD, JSTD, JSED	BSc, BA BEd	HDE, HED, UED	MSc MA	
Number (51)	8	23	9	9	0	2
Percent (%)	15	45	18	18	0	4
Number of extra qualifications	0	0	17	16	2	16
Percent (%)	0	0	33	31	4	31

The following table summarizes teachers' responses to the question related to their feeling of being adequately qualified to teach subjects they were teaching or not.

Table 4.3 Teachers' feelings of being adequately qualified or not

Adequately qualified	Yes	Not sure	Insufficient	Almost	Not yet
N (51)	45	1	1	1	3
Percent (%)	88	2	2	2	6

From the table above it can be pointed out that most science teachers (88%) considered themselves as adequately qualified to teach the subject they were teaching. However, one respondent felt unsure of being adequately qualified, one mentioned that his/her qualification was not sufficient, one considered himself/herself as almost qualified and three science teachers considered themselves as not yet qualified to teach the subject they were teaching.

In summary information gathered from the science teachers about their background revealed that: most of them were experienced having been in the teaching career for more than 5 years; the most common qualification was a three years college diploma at the beginning of their careers; the science teachers' sample covered both rural and urban schools; from the sample was nearly evenly divided between grade 10-12 teachers and those teaching lower grades; and the overwhelming majority considered themselves as adequately qualified to teach the subjects they were teaching, i.e. physical science, natural science or biological science.

4.2 TEACHERS' EXPERIENCE OF PROFESSIONAL DEVELOPMENT ACTIVITIES

This study attempted to explore teachers' experience of professional development activities. Questions were asked to obtain data on: (a) forms of professional development activities science teachers had participated in during their career, (b) professional development activities they had participated in during the last two years, (c) professional development activity they considered as the most effective and the least effective to help them to improve professionally and lastly (d) professional development activities they did not participate in. This has been done because it is recognised that professional development activities form a key component in improving the quality of science teachers. But little is known locally about forms of professional development activities teachers have been exposed to as well as teachers' views on the efficacy of those activities.

4.2.1 Professional development programmes attended

The summary of responses to the number and type of professional development activities participated in during their career is given in Table 4.4. From the table below, it can be seen that workshops were by far the most well attended professional development activity with not only a total attendance of 116 but also over 60 % of the teachers indicating that they had attended three or more workshops in their careers. Formal courses came at the second position and meetings came at the third position. Other forms of professional development activities were less popular. In-school support was revealed as the least experienced with less than 20% of the teachers having experienced this type of professional development activity.

Table 4. 4   Science teachers' participation in professional development activities during their careers

PD activities / Attendance	Formal courses	Short courses	Workshops	Meetings	In-school support	Conferences
Never participated	12 (23%)	22 (43%)	6 (12 %)	15 (29 %)	36 (71 %)	26 (51 %)
Participated	38 (74 %)	31 (61 %)	45 (88 %)	36 (71 %).	15 (29 %)	25 (49)
Once	12 (23%)	12 (23%)	6 (12%)	11 (22%)	3 (6%)	6 (12%)
Twice	8 (16%)	11 (22%0	7 (14%)	7 (14%)	3 (6%)	7 (!4%)
More	18 (35%)	8 (16%)	32 (63%)	18 (35%)	9 (18%)	12 (23 %)
Total number of attendances	82	58	116	79	36	56
Ranking in attendance	2nd	4th	1st	3nd	6th	5th

In order to find out if teachers had been experiencing more professional development recently given the introduction of the new curriculum, teachers were asked which professional development activities they had participated in during the last two years. Again, workshops and formal courses were the most attended as shown by the Table 4.5

Table 4.5   Percentages and numbers of teachers' participation in professional development activities the last two years

Professional development activities	Teachers' participation % (100)	Teachers' participation N (51)
1. Formal courses	42 %	21
2. Short courses	14 %	7
3. Workshops	60 %	30
4. Meeting and seminars	16 %	8
5. In-school support	4 %	2
6. Conferences	6 %	3

It can be seen that although the percentage of attendance most recently is different to the percentage overall during their careers, the relative ranking is similar and workshops and formal courses would be considered as currently and overall the most frequently experienced kinds of professional development activities.

4.3 SCIENCE TEACHERS' VIEWS ABOUT PROFESSIONAL DEVELOPMENT ACTIVITIES

Teachers were asked which of the professional development activities they had experienced, they considered as the most useful in meeting their needs and which were seen as having least impact. Table 4.6 represents the summary of teachers' responses.

Table 4.6 **Percentages of teachers expressing their views about the most effective professional development**

Professional development activities	Numbers of teachers considering the activity as most useful (n=40)	Percentages of teachers considering the activity as most useful.
1. Formal courses	20	50 %
2. Workshops	16	40 %
3. Meeting and presentations	2	5 %
4. In-school support	1	2.5 %
5. Conference	1	2.5 %
6. Short courses	0	0 %

From the table above, it appears that science teachers considered formal courses that lead to a degree or a diploma as the most useful professional development activity for their personal professional development. This is closely followed by workshops. However, teachers did not mention short courses and it is suspected that they might have aggregated with either long-term formal courses or workshops for this question. From the teachers' perspective professional development activities (as shown by Table 4. 6) were not seen as being of equal effectiveness. Some were seen as more useful than others.

Science teachers were also asked to express their opinion about professional development activities that they considered as having very little impact on their professional growth. Seventeen science teachers did not express their opinion and ten teachers considered that there is no useless professional development activity. However twenty-four teachers did and the Table 4.7 summarizes the science teachers' opinions.

Table 4.7   Teachers' opinion about the least effective professional development

Professional development activities	Numbers N=24	Percentages of teachers who consider the activity as least useful
1. Meetings, seminars and presentations	11	46 %
2. Workshops	9	37.5 %
3. Short courses	2	8 %
4. In-school support	2	8 %
5. Formal courses	0	0 %
6. Conferences	0	0 %

From this table it can be seen that eleven science teachers agreed that meetings, seminars and presentations were of a minimal usefulness and nine considered workshops as least useful in improving personal professional growth. Given the large number of workshops attended by teachers this could be an indicator that they are not achieving as much as would be desired by the organisers.

Science teachers were also asked if they have ever been offered opportunities to attend a professional development activity and decided not to participate. Most science teachers revealed that they have never decided not to participate in a professional development activity, for which they have been offered the opportunity to participate. This was an indication that teachers were keen to participate in available professional development activities.

4.4   SCIENCE TEACHERS' CURRENT NEEDS

Teacher participants in the study were asked to rank their needs from 1, the most pressing to 7, the least pressing need for professional development. Thirty-four science teachers out of fifty-one ranked their needs and results are shown by the following table.

Table 4.8   Teachers' ranking of their current professional development needs

Professional development needs	Sum of ranks	Rank	Numbers						
			most				least		
			1	2	3	4	5	6	7
Improving the understanding of OBE and new curriculum.	110	1	9	4	8	5	1	5	2
Learning new practical skills and investigation skills.	117	2	8	6	2	5	9	2	2
Learning new methods of teaching.	118	3	3	9	6	6	6	3	1
Development of pedagogical content knowledge.	126	4	9	2	4	6	4	6	3
Development of management skills	142	5	1	4	9	6	5	6	3
Improving the understanding of CASS.	157	6	1	6	6	2	4	7	8
Development of content knowledge.	180	7	2	3	1	4	5	5	14

Professional development needs with the lowest sum of the rankings were the needs that the teachers considered most important to meet. On the other hand, professional development needs with the highest sum of rankings were seen as the least pressing needs.

Table 4.8 reveals that, in the teachers' opinion there was a pressing need to improve their understanding of OBE and the new curriculum. It reveals also that science teachers saw a need to be helped to learn new practical and investigative skills and new methods of teaching science. Teachers also expressed the need to become familiar with pedagogical content knowledge and new management skills.

It is interesting to note that the sum of rankings for development of content knowledge was 180, the highest by far. This means that the sample of science teachers saw this as a lowest priority in terms of needs. In addition to the professional development needs suggested by questionnaire, teachers expressed the need to develop computer literacy and to learn more about inclusive education. Identifying teachers' needs is one thing and addressing these needs is another. The following section reports how teachers thought these needs should be addressed.

4.5   THE BEST WAY OF IMPROVING AREAS THAT NEED PROFESSIONAL DEVELOPMENT

The ideal situation is to address deficiencies in teachers' competencies as they are discovered, but it is important to use the best available techniques to do so. The choice of an adequate measure that is to address identified needs should be based on teachers' views and ideas. Forty-six science teachers out of the fifty-one expressed their views about the best ways of addressing deficiencies in areas that need to be improved and this is shown in Table 4.9

The questionnaire revealed that teachers considered formal courses the best way of addressing deficiencies linked to science content knowledge (57%). However, meetings, seminars and presentations were seen as not likely to improve the content knowledge, since none of the teachers mentioned these kinds of professional development activities for this purpose. Formal courses were also considered as the best way of improving pedagogical content knowledge (37%). Here again, none of the teachers mentioned meetings, seminars and presentations as being useful for improving this area of knowledge.

Table 4. 9   **Teachers' ranking of the best ways of meeting their professional development needs**

	Number of teachers N=46	Formal course	Short course	Workshop	Meeting, seminar & presentations	In-school support programme	Conference
Best activity of improving content knowledge	N	26	8	6	0	3	3
	%	57	17	14	0	6	6
Best activity of improving pedagogical content knowledge	N	17	10	12	0	3	4
	%	37	22	26	0	6	9
Best activity of improving new methods of teaching	N	10	11	13	8	3	1
	%	22	24	28	17	7	2
Best activity of improving management skills	N	3	11	17	10	2	3
	%	7	24	37	22	4	7
Best activity of improving the understanding of OBE	N	6	8	17	3	5	7
	%	13	17	37	7	11	15
Best activity of improving the understanding of CASS	N	5	5	21	2	10	3
	%	11	11	46	4	22	7
Best activity of improving new practical and investigation skills	N	7	13	12	2	11	1
	%	15	28	26	4	24	2

There was no clear activity which was considered the most effective for learning new methods of teaching such as cooperative group work, the use of video, concept mapping and so forth. Workshops, short courses or formal courses all had similar support (between 22 and 28%) Workshops were considered as the most appropriate activity for meeting needs related to management skills (37%). Short courses or meetings, presentations and seminars were similar in ranking (24% and 22% respectively) and were chosen by about a quarter of the respondents.

Again in the case of improving understanding of OBE, workshops were chosen by about 40% as the most effective followed by short courses and formal course (17% and

13% respectively). Surprisingly conferences received its highest response (15%) for helping to improve this OBE related need.

In the opinion of the teachers, the improvement of the understanding of new continuous assessment techniques can best be achieved if teachers are provided with opportunities to attend workshops (46%). Formal courses and short courses in this case were seen as having less effectiveness on the acquisition of assessment skills.

There was no clear activity that was considered the most effective for improving new practical and investigative skills. Workshops, short courses and in school support all had similar support (between 24 and 28%).

In this and the previous section, science teachers' needs and the professional development activities most likely to meet those needs have been identified. Such identification is of a great importance for in-service providers who need to take teachers opinions into consideration. It can be seen that teachers definitely see some activities as more effective than others in developing particular competencies.

4.6   IMPROVING TEACHERS DAILY PRACTICE

4.6.1   Effective practice.

The researcher wanted to know more about what would help science teachers improve their daily practice and what kind of professional development activity teachers would be chosen if they were given all facilities as well as necessary funds to improve their daily teaching practice. Teachers' opinions about the improvement of their daily practice are developed in the following section. Science teachers were asked to indicate their level of agreement with statements (see Table 4.10) about how their daily practice could most effectively be improved. Possible levels of agreement were between one (strongly disagree) and five (strongly agree). The following table summarizes teachers' levels of agreement with statements that were provided.

Table 4.10 Teachers' ranking of best way of changing classroom practise

Ways of changing classroom practice	Strongly Disagree				Agree	Mean	SD
	1	2	3	4	5		
1. Registering for a formal course that lead to a degree or a diploma	4	4	4	15	23	3.9	1.25
2. Doing a short course focussing on one of my needs.	0	0	4	32	14	4.1	0.7
3. Participating in a few one-day workshops focussing on one of my needs.	1	2	5	27	15	3.9	0.88
4. Having a number of meetings dealing with my identified needs.	1	5	6	27	11	3.8	1.04
5. Attending a conference on the teaching of science	2	2	5	25	16	3.9	0.99
6. Obtaining in-school support and having someone coming to my school and assist me	1	5	9	19	15	3.8	1.01
7. Being provided with physical resources such as equipment, apparatus and chemicals.	1	2	1	12	34	4.4	0.88
8. Being provided with resource books, science teaching guides, teacher journal and magazines.	0	2	0	16	32	4.5	0.69
9. Collaborating and meeting with teachers in my school and neighbouring schools to discuss teaching science	1	1	1	16	29	4.3	0.83

From the Table 4.10, it can be seen that the means of the level of agreement with the given statements were all above level 3, i.e. they agree that these all could play a role in improving classroom practice.. However, some statements met with a higher level of agreement than others . Those statements are providing science teachers with resource books, science teaching guides, teacher journal and magazine (No. 8); providing science teachers with physical resources such as apparatus, equipment and chemical (No.7) and, the statement that emphasizes collaboration between teachers in a school and teachers from neighbouring schools (No.9).

It is interesting to note that these three statements all draw attention to support at or near the schools, which can be used on a regular daily basis. With the exception of in-school support, all the other proposed ways of support require the teachers to go away from schools.

4.6.2   Best activity

Science teachers were also asked the kind of professional development they personally would choose if they were offered access to all facilities and necessary funds, including leave from school, to improve their daily teaching practice in their respective schools. Forty five science teachers out of 51 answered the question and the responses are summarized in the Table 4.11.

Table 4.11   Teachers' choice of activities given all facilities and funds

Activities	N (45)	%
1. Formal courses	22	49
2. Short courses	8	18
3. Workshops	0	0
4. Meetings and seminars	3	6
5. Conferences	0	0
6. Specific requests	12	27

From the table it can be seen that 27% made specific requests. These teachers did not mention a specific activity but rather focussed on the competency or resource they wanted. Requests include the improvement of pedagogical content knowledge, improving familiarity with OBE, improvement of management skills, improvement of computer literacy, as well as having access to resource books or well-equipped library.

For those who chose a specific activity, formal courses were by far the most popular choice. In their response they provided many reasons for their preference of going to formal courses. The main reasons given are: (a) formal course will help them to gain more knowledge and information that will increase their self-esteem; (b) formal courses can change their teaching interest and their teaching abilities; (c) formal courses would further develop the content knowledge and could help the improvement of concepts; (d) formal courses will help them to upgrade their qualification. It appears here that formal courses in teachers' opinions would not only make them more qualified in terms of a degree or a diploma but, would also increase their confidence in the classroom and would develop their conceptual knowledge. In other words, being able to take formal courses

without the stress of having to find the money and time and so forth would enable them to become more competent and confident, and would increase their esteem in the profession.

4.7   SUMMARY

This chapter analysed the responses in fifty-one completed questionnaires from science teachers in KwaZulu-Natal. The respondents were both from rural and urban schools and were evenly divided between physical science, natural science and biology teachers teaching grades 10 to 12 and lower grades. The majority of them had a three-year college diploma such as STD when they started teaching and felt adequately qualified to teach the subject they are teaching.

Of the different types of professional development activities which were organised in KwaZulu-Natal, workshops were the most frequently attended both during their careers and during the last two years. Formal courses and workshops were seen as the most effective forms of professional development.

Expressing their needs, teachers revealed that the understanding of OBE and the new curriculum was their most pressing need. This understanding was closely followed by the need of learning new practical and investigations skills as well as the need of learning new methods of teaching science. Asked to point out the best way that they felt would address these expressed needs, respondents indicated that different activities were suited to improving different competencies. For example workshops were the best way of improving understanding of OBE and new curriculum while formal courses were the best way for improving content knowledge and pedagogical content knowledge. They also indicated that some competencies could be improved by a variety of activities. For example improving methods of teaching could be achieved equally successfully by using formal courses, workshops or short courses.

Concerning the improvement of science teachers' daily practice, respondents agreed most that providing them with well equipped laboratories and updated libraries, along with opportunities for collaboration with local teachers, would help them to improve their daily teaching practice.

In order to see the significance of these teachers' opinions and to provide a balancing view, the interviews with the in-service providers were done and have been analysed in chapter 5.

CHAPTER 5

INTERVIEW ANALYSIS

5.1 INTRODUCTION

The purpose of the interviews with providers was to gather information about the range of professional development activities offered in KwaZulu-Natal as well as providers' views about the effectiveness of these in-service activities. The interviews also aimed at gathering providers' opinions about science teachers' needs, as any mismatch would have significant implications for the planning of professional development activities.

The interview schedule (appendix III) was subdivided into three sections. The first section contained a series of questions related to teachers improving their competence. The second section focussed on science teachers' needs and effective professional development to meet these needs and, the last section dealt with science teachers' needs to achieve classroom change.

This chapter presents an analysis of recorded data gathered from seven different people. Those interviewees were from the in-service provider institutions of the DOE, CASME, Natal University (Edgewood Campus), the Toyota Teach Project and PROTEC. For the purpose of reporting, the providers were categorised into three types of in-service providers based on the type of support offered. The chosen categories were: University lecturers, departmental advisors and project implementers.

5.2 PROFESSIONAL DEVELOPMENT ACTIVITIES

5.2.1 <u>Professional development opportunities offered to science teachers</u>

In-service providers were asked about the opportunities offered to science teachers to improve their daily classroom practice and develop new competencies. Providers were

all in agreement that there was a need for teachers to improve their qualification and therefore they provided opportunities for this to happen. It was indicated that the opportunities were provided for "the improvement of science teachers' knowledge" (University lecturer) while another provider indicated that their goal was " to bring teachers' competence to a level where they actively question what they are doing, use their understanding as to how knowledge is developed to build concepts" (Project implementer).

It was apparent that not all in-service providers offered the same types of professional development activity to help teachers to gain new knowledge. Different opportunities have been provided by the different sectors. University lecturers mentioned formal courses such as the Advanced Certificate in Education (ACE), previously called Further Diploma in Education (FDE) as opportunities offered to science teachers. These were offered specifically "to help science teachers to upgrade and increase their competences" (University lecturer). On the other hand, the four other interviewees from the Department and project implementers spoke of informal activities that did not lead to a qualification such as workshops and in-school support. In most cases, these were offered to teachers to cope with Outcome Based Education (OBE) and the new skills required. One provider mentioned, "we offer workshops, classroom support and inspiration" (Project implementer) and another one mentioned, "in-school support programme provides support in connection with the school realities" (Departmental advisor). The opinion was expressed that those professional development activities should be OBE based so that teachers could cope with OBE and the new ways of teaching and learning science. Some providers used a combination of activities as indicated by a project implementer "most of our projects are 80 % classroom support and 20 % workshops. We use workshops to deal with the content and then show teachers how to teach that content".

It was also indicated that not all opportunities for participation were freely available. While formal courses could be attended by most, only a few projects offered in-school support.

5.2.2   When are the activities organised?

Recognising that teachers are busy during the school term dealing with their daily tasks, the question arises as to when such activities were organised? A number of different times were used by providers. The majority (five) indicated vacation days and weekends

as the appropriate moment to organise professional development activities such as workshops and formal courses. However, one project implementer indicated, "I offer 13 three hour sessions to teachers per semester. Those sessions are organised on Saturdays during the semester". A departmental advisor indicated, "such activities are organised at the beginning of the school year and in the afternoon". It appeared that vacation days and Saturdays were the most common occasions to organise professional development activities. However, activities also took place in blocks e.g. at the beginning of the year, in school vacation and in a few cases after school in the afternoon.

5.2.3   Facilities offered

All interviewees were asked about facilities offered to science teachers who attended professional development sessions. Providing professional activities is one thing and offering facilities to make life easier for participants and to create a supportive atmosphere for such activities is another thing. There were diverse responses to the question related to what is provided in terms of facilities to participants participating in professional development activities. These responses ranged from providing nothing at all to providing accommodation, food and transport. Providers gave financial means as the reason why facilities offered vary from one provider to another.

Most in-service providers recognised that teachers need to be provided with facilities such as accommodation when they come from far and if sessions will take more than one day as mentioned by a project implementer, "… teachers were provided with transport, accommodation and food during long sessions". Additional to accommodation, transport and food being offered when necessary, providers revealed, "Several resources are offered to teachers…teaching guide, teaching aids…" (Project implementer). Five interviewees indicated that facilities such as food and accommodation make professional development sessions more productive.

In-service providers indicated that the provision of facilities was conditional on providers' financial resources and constraints. That was why sometimes no special facilities were offered to participants and efforts were made to reduce costs such as transport costs as illustrated by one response from an implementer: "professional development activities are organised as close as possible to teachers places".

5.2.4   Teachers' perceived attitudes towards in-service activities

Interviewees were asked about science teachers' attitudes towards the professional development activities. All providers indicated that science teachers were enthusiastic and positive about professional development activities. They seemed to enjoy the support brought by in-service providers aimed at helping them to improve their competencies and skills. For instance one provider from the University said: "Science teachers' attitudes are positive regarding what is offered in terms of helping them to feel more comfortable".

5.3   PERCEPTION OF TEACHERS' NEEDS

The in-service providers were asked about what they considered as the most pressing need for science teachers in KwaZulu-Natal. This was asked as while providing science teachers with professional development sessions was important on one hand but on the other hand ensuring that those sessions and activities were really addressing teachers' needs was of a vital important.

Most interviewees were of the same opinion as the University lecturer who said: "I think that science teachers' most pressing needs can be expressed in terms of content knowledge and pedagogical content knowledge; what to teach and how to teach it". The majority of in-service providers indicated that teachers need a lot of support in terms of their conceptual development or the improvement of the understanding of concepts and ways of teaching those concepts.

In contrast to the general opinion expressed above, one project implementer stated, "most teachers I worked with know the subject matter. However the pedagogical approach is sometimes limited by what is available" (project implementer). This in-service provider also indicated a need for management skills. This might indicate that given resources, teachers would be able to show their pedagogical content knowledge.

Overall, there was not one need that was seen as the most pressing but rather a number of needs that were required to be addressed. Content knowledge and pedagogical content knowledge have been mentioned by most in-service providers (6 comments), other needs indicated were familiarity with the curriculum (6 comments) and management skills including laboratory management skills (3 comments).

5.4   EFFECTIVE PROFESSIONAL DEVELOPMENT ACTIVITY

5.4.1   Most effective

In-service providers were asked about what they considered as effective professional development activities to address the identified teachers' needs. There was no consensus about one professional development activity that would address teachers' deficiencies. In-service providers had different opinions about professional development activities considered as appropriate ways of helping teachers to improve professionally. Most in-service providers indicated that a number of activities could be useful. For example a university lecturer mentioned, "Courses like the ACE programme can help teachers to improve their daily practice as well as workshops. Short courses and in-school support would also have a certain impact on the teaching and learning process".

In-school support was highlighted by one in-service provider, the project implementer who said: "The best way to improve teachers is to work with them in the classroom. It is there that we see their ineffective approaches to teaching a particular topic and the gaps in their content knowledge ". Another in-service provider considered all professional development activities as relevant. He stated that their usefulness depended on the way they are organised as exemplified by this quote: "The effectiveness of a professional development activity depends on how it is done not on which one is done. All professional development activities are important but their effectiveness depends on the quality of content offered and the way they are organised and if they deliver or not " (Project implementer).

5.4.2   Least effective

In-service providers were asked to point out what they considered as the least effective professional development programme in terms of helping science teachers to cope with classroom practice. Three in-service providers expressed an opinion that conference papers were ineffective. For example a University lecturer stated that, "Papers presented at conferences have high standards and would be difficult for teachers to understand. Those papers do not make a direct impact on the teaching in the classroom " Another in-service provider, the Project implementer stated: "Teachers would consider any professional development activity that does not involve them as not effective or as of a minimal effectiveness"..

5.5   CLASSROOM CHANGE

Professional development activities are ultimately aimed at bringing positive change and improvement in the classroom. Questions were, therefore asked relating to the areas of need and the professional development activities that could best bring about classroom change. Questions asked of all interviewees were: "What areas of science teachers' competencies do you consider as of a crucial need to be improved in this province, in order to bring about change in the science classroom?; and "What kinds of professional development activities are likely to improve those areas?

The responses were not much different from those given when asked what teachers' needs were. The majority of in-service providers share similar opinions as exemplified by the following quote: "areas that need to be improved are content knowledge of the subject matter, the pedagogical content knowledge…the other is the understanding of the OBE within the context of science teaching" (University lecturer). It appeared that those three areas were seen as crucial for implementing changes in the science classroom. Additional to those three areas, one provider mentioned again management skills.

When asked which professional development activities were likely to help teachers improve their classroom practice, in-service providers' responses revealed that they did not have specific ideas and ways of addressing needs related to classroom change. Some responses were very general: "Any professional development activity that help teachers to shift from the traditional way of teaching: chalk-talk-textbook would be likely to impact on the classroom management and change" (University lecturer). Others emphasized a range or combination of ways as exemplified by this interviewee response: "I think that ACE courses are sufficient to address the content knowledge and the pedagogical content knowledge. Those courses are also OBE based. However, workshops are needed as well as in-school support…" (University lecturer).

5.6   SUMMARY

Professional development activities are important activities that are needed in order to help science teachers as life long learners to achieve their goals. When the providers were asked which activities should be focussed on there was not complete agreement among them. However, it appears that all would agree to some degree that content knowledge; pedagogical content knowledge, management skills and familiarity with the new curriculum were all needed. When asked what professional development activities were seen as suitable for the improvement of those needed competencies a similar response was obtained. No single method was identified as superior or more suited to developing the above-mentioned competencies. However, the opinion that a combination of methods and or the quality of the activity offered would be effective was strongly held.

CHAPTER 6

SUMMARY, CONCLUSIONS AND IMPLICATIONS FOR FURTHER RESEARCH

6.1 SUMMARY AND CONCLUSIONS

This study set out to explore the opportunities for professional development of science teachers in KwaZulu-Natal. In particular it had as its focus four questions: (a) what professional development activities were science teachers in KwaZulu-Natal participating in? (b) what kinds of professional development activities were considered to be the most effective? (c) what competencies were recognised as in need of professional development? (d) what in the view of teachers and service providers are considered to be the best ways of improving these competencies.

To answer these research questions, a descriptive research design was used. Given constraints of time and resources, a survey of teachers using a postal questionnaire and selected interviews of providers were seen as most appropriate data gathering instruments to achieve research goals. Fifty-one science teachers drawn from a variety of backgrounds, with different lengths of teaching experience and from both rural schools and urban schools completed the postal questionnaire. Despite the varied backgrounds and qualifications that they had and the recent major changes in our curriculum, the overwhelming majority (88%) indicated that they were adequately qualified to teach the subject they were currently teaching. To obtain a different perspective on the professional development, seven in-service providers drawn from University lecturers, Project implementers and Department of Education advisors were interviewed. In the following sections, findings to the research questions are presented and discussed.

6.1.1 Professional development activities experienced.

In answer to the question of what professional development activities are science teachers participating in, it was found that there was a wide range experienced by the

participants in the study. All of the six different types of professional development activity identified had been experienced by at least some of the teachers. These were: (a) formal courses, (b) short courses, (c) workshops, (d) meetings and seminars, (e) in-school support and (f) conferences.

Although all activities mentioned above were available in KwaZulu-Natal some were more commonly experienced than others. The teachers reported that workshops were the most commonly experienced professional development activity closely followed by formal courses. For example in the last two years 60% had participated in at least one workshop and 40% had been involved with a formal course. This confirmed Gray's findings (2000) in which he found that formal courses and workshops were common forms of support provided to science teachers in South Africa. There are two possible reasons for this high level of attendance of workshops reported in the current study. The first is that teachers genuinely preferred to go to workshops. The second is that workshops were what in-service providers were in fact providing and evidence from teachers within this study indicated that teachers would not decline but rather take up whatever opportunities were offered to them.

Within the literature there is convincing evidence that there is a need to have in-school support as part of professional development activities to ensure that acquired knowledge and skills, through workshops and formal courses, were implemented in the classroom environment. In addition, in-service providers use in-school support activities as ways of not only ensuring of the implementation of knowledge and skills gained through organised professional development activities, but also as means of identification of teachers real needs or teachers new needs for the implementation of gained knowledge and skills in the classroom environment. Unfortunately, teachers had the least experience of this form of professional development mainly because it was only offered by some in-service providers in some projects limited to particular schools. It was not within the scope of this study to document exactly what quantity of courses had occurred during the last few years and their availability to teachers. This would have given a better indication of relative availability of professional development activities.

6.1.2   Opinions about the most effective professional development activity

In response to the question dealing with what kinds of professional development activities were considered as the most effective for helping teachers' professional growth

it was found that teachers and providers found some more relevant than others. In teachers' opinion formal courses and workshops they had experienced were seen as most effective and considered as likely to impact not only on their personal professional growth but also on their daily classroom practice. They felt that the seminars, meetings and presentations they had experienced were of least usefulness. However, providers showed a lack of consensus about the professional development activity appropriate for helping teachers to improve professionally. They seemed to propose a range of professional development activities and tended to indicate that the effectiveness of a professional development activity depended more on how it was done and not on which activity was done.

A successful and effective professional development in my view should not be seen as an event that is separated from teachers' day-to-day responsibilities and activities. It should help and support teachers' development both as individuals and as educators and should be seen as addressing goals for school improvement. An efficient professional development activity should also be integrated in the classroom environment and should provide teachers with the opportunity to make a difference, to improve their daily practice.

6.1.3   Areas in need of professional development and ways of addressing those needs

In answer to the question of what competencies are recognised as in need of professional development the teachers chose improving their understanding of OBE and learning new practical and investigation skills as competencies that needed more emphasis. This was closely followed by learning new methods of teaching They indicated that improving their content knowledge was their least pressing need.

In contrast with the science teachers' view, most in-service providers noted that a number of teachers' skills required to be addressed. In particular both their content knowledge and pedagogical content knowledge were seen as pressing needs. This is consistent with Morar's findings (2002) who indicated that presently there are a large number of under-qualified and inexperienced teachers in South Africa who lack both the content knowledge and required teaching skills. However, they also acknowledged that familiarity with the new curriculum was needed, something also recognized by Adler (2002b) who saw this as a key component of teachers' knowledge.

In answer to the question of best ways to address their needs, teachers chose different activities to meet different needs. To meet the needs they considered the most

important, workshops was the most common choice of professional development activity. Although they had different priorities, both the providers and teachers agreed that the most appropriate activity to improve content knowledge and pedagogical knowledge were formal courses. However, they also mentioned that the best way to help teachers to improve is to work with them in the classroom. Teachers only selected classroom support as a means for the learning of new practical and investigational skills. It is obvious that this is an area that needs attention. Because so few teachers have had experience of classroom support, they do not select it as a primary means of meeting their needs. Perhaps they chose workshops and formal courses, as these are activities with which they are most familiar. However, providers having had more experience of it, see in-school support being more effective because it would better fit with the practicability of OBE and CASS in the classroom context.

However, if teachers are seen as the most influential factor in the core educational process (de Feiter et al., 1995), teachers' opinions and views should be placed at the centre of any design of professional development activities. In-service providers should therefore take into consideration teachers' opinions and views expressed here and plan appropriate professional development activities.

6.1.4   Daily practice and classroom change

In response to the question about what would help them personally to improve their daily practice and introduce change in the classroom the teachers chose ways that revolved around the provision of resources and local collaboration among teachers ahead of a variety of professional development activities. This is a very significant finding because teachers are saying that if they had a choice they want physical resources to improve the learning environment and the opportunity to collaborate with their peers. Outside help is not first on their list. They prefer support which is close to school i.e. they do not have to travel away from school to a workshop or meeting to get the support. It is in the school in the form of laboratory apparatus, teacher guides and local teachers. If teachers had experienced in school support then it is possible that they might also have given this a higher agreement than they did. When classroom change was discussed with the providers, they indicated that the introduction of changes in the classroom should be preceded by teachers' improvement of their subject matter, their pedagogical content knowledge and the familiarity with OBE and new curriculum. One finding that this study has highlighted

is that teachers definitely have more confidence in their subject content knowledge than the providers do.

When asked what activity they would choose given all the resources and opportunity to make it happen, the majority chose participation in a formal course. This would appear to be a contradiction as earlier it was reported that teachers chose workshops as the most appropriate activity to meet their needs. The question of perceived needs and the means of meeting those needs are very interesting. There appear to be several aspects of teachers' motivation that need to be considered. The first motivation is the need to advance in the area of straight content knowledge and pedagogical content knowledge. The logical meeting of that need seems to be, provided the means of accessing them are available, formal courses and workshops. The second motivation is the need for career advancement, pay, and status. This obviously is best satisfied by formal courses that lead to qualifications. However, these courses cost a lot of money, time and commitment and so workshops are more attended. If these constraints are removed (as was suggested in the question asked) then teachers will choose formal courses.

Whatever their choices and motivations we do know that in any change process aimed at improving teachers' daily practice, teachers should be placed at the core of the change and be provided with opportunities to develop and build new understanding, new skills, and new beliefs in order to participate efficiently in the change process. This should be done not only by providing teachers with new knowledge related to the subject matter, but also by enabling him to understand new directions brought in by the new educational system requirements and empowering them with the necessary resources to achieve their goals.

6.2   IMPLICATIONS FOR FURTHER RESEARCH

This study explored professional development activities science teachers participated in in KwaZulu-Natal, science teachers and providers views about those professional development activities as well as areas of competencies where science teachers felt they need more assistance in terms of improvement. The study was narrowed because of time constraints and resources. Additional to time constraints, the study would have been carried out on a big sample and the interview would have been made on teachers to

confirm the dependability of the questionnaire responses. The providers' interviews would have been held before the teachers' questionnaire and would have guided the development of the questionnaire. It is also acknowledged that the results from this study cannot be extended to all science teachers in KwaZulu-Natal, because participants came from a very specific group of teachers and thus are not representative of the whole population of science teachers. The teachers who have never participated in professional development activities are under-represented by the sample. However, given time and resources the study would have been done on a more representative science teachers' sample. Those are limitations of this study

However, the study has made its modest contribution and developed fruitful lines of thought about professional development activities in KwaZulu-Natal. Findings from the study should provide policy makers and in-service providers with insights into science teachers' experiences of professional development activities and into their needs and ways they thought those needs could best be addressed.

This study has also been carried out to enable the researcher to be exposed to teachers' experience of professional development activities. Additional to the exposure to such experience, the researcher aimed also at transferring the gained experience to the Rwandan context, a country in which teachers' professional development in on the agenda but little is known about how to bring about change and support to teachers to help them improve professionally. The time has arrived to find out what are Rwandan science teachers views, needs and so forth in an effort to start the process of improving their daily practice. This initial study has made this possible.

Meanwhile gates are opened for more detailed research to further explore science teachers' views on professional development in KwaZulu-Natal. Specific studies could now be initiated with a focus on rural science teachers and urban science teachers to illuminate differences and similarities, if any, between their views as well as their needs. Similar studies could be conducted on experienced and in-experienced teachers, qualified and un-qualified teachers, and so forth. The in-depth understanding of the choice of a particular professional development activity as the most suitable to improve a competency would help in the understanding of why some activities are seen to have little impact on teachers' daily practice. Simply persuading teachers by pointing out that such professional development activity is likely to impact on the improvement of the understanding of OBE is not sufficient. A study on precisely how teachers think such an activity should be organised; who would be seen as the best provider; what would be seen as the best

environment in which such activity could be organised, are all areas that could be productively researched. In addition, a teacher, unless of unusual strength of personality, is unlikely to make a real impact in the classroom unless there is an adequate "in the school" and education department support such as regular advisor visits. In addition, off-site professional development activities need on-site support and the nature of this on-site support relationship needs to be thoroughly researched by some courageous person with adequate resources and time.

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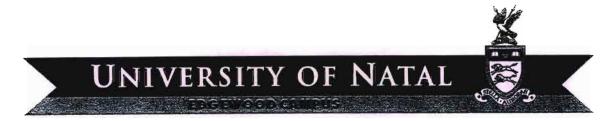
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APPENDIX I   **TEACHERS POSTAL QUESTIONNAIRE**

UNIVERSITY OF NATAL

13 October 2003

Cnr Richmond and Mariannhill Roads, Pinetown 3610
Fax (031) 2603595, Tel (031) 2603447   hobden@nu.ac.za

The Science teacher

Re: Study on Professional Development activities.

Dear Sir / Madam

Could you please assist Mr Casimir Karasira in a study he is carrying out as part of his Master of Education studies. He is a registered student of Natal University (Student Number 202513562) and is studying Science teachers' views on the effectiveness of their professional development experiences in KwaZulu Natal. In order to discover what their views are, he has compiled the attached questionnaire, and we should be grateful if you would kindly answer the questions contained in it in order to enable him to reach his research goal.

We realise that you have many professional responsibilities to fulfil, but hope that you will find time for this one. We wish to assure you that all information obtained will remain confidential and that no information released or reported will identify participants or their schools.

Please return (by post) the completed questionnaire in the envelope provided to the above address. If you have any queries please feel free to contact us below. Thanking you in anticipation of a positive response.

Yours sincerely

Prof. Paul Hobden
Project supervisor
Programme Director: Science Education
School of Education, Edgewood Campus

Crispin Hemson
Head of School
School of Education
Faculty of Education

Section I. <u>Biographical data</u>. Please complete the following table

Name: (optional)	
Year first started teaching. e.g. 1979	
Qualification (s) when you started. e.g. STD	
Subsequent qualifications gained while teaching. e.g. ACE (Biology)	
What is your main teaching Discipline? e.g. Biology, Natural science, physical science etc.	
What is your main level of teaching? e.g. Grade 10-12	
Current School.(optional) e.g. KwaShaka Junior Primary	
Would you consider this a rural or urban school? e.g. township school in a rural area	
Do you consider yourself as adequately qualified to teach the science you are teaching?	

Section II. Your experience of professional development activities

A. MODELS

What models of professional development have you participated in since you started teaching?

Please tick in the relevant columns to show how often you have participated in these INSET activities. (**0 = never attended   1 = only once   2= twice   3 = more than two times**)

What have you participated in?	0 never	1 once	2 twice	3 many
1. **Formal Courses** that lead to a degree or a diploma e.g. ACE, FDE				
2. **Short Courses** of two or three weeks duration that lead to a certificate e.g. Computer literacy certificate				
3. **Workshops** Training course over more than one day e.g. 3 day on assessment				
4. **Meetings, Presentations, Seminars** (part of or full day) e.g. talk by overseas visitor				
5. **In-school support** programmes e.g. project where someone visits every week for six months				
6. **Conferences** (lasting a few days) focussing on teaching (not union activity) e.g. KASTE, SAATPS etc.				
1. **Any other?** Please specify: _____				

B. __MOST USEFUL__.

Of the professional development activities you have experienced (<u>see table above in Section II.A</u>) some would have been more useful than others.

i). Which in your opinion, was the __most useful__ for your personal professional development. Please give reasons for your answer.

_____

_____

_____

_____

ii). Which in your opinion was the __least useful__? Please give reasons for your answer.

_____

_____

_____

C. __DID NOT PARTICIPATE.__

Were you ever offered opportunities to attend a professional development activity but decided not to participate?

Yes_____ No_____

i). If your answer is **yes**, then please indicate what the professional development activity was.

_____

_____

ii). Explain what prevented you from participating?

_____

_____

_____

_____

D. __MOST RECENTLY__

What professional development activities have you participated in during the last 2 years i.e. during 2002 – 2003?

_____

_____

_____

_____

;ection III. **What are your current professional development needs?**

A. NO FURTHER NEEDS:
If you feel that you do not require any further professional development opportunities please state this here.

_____

B. RANKING OF NEEDS
Please rank your professional development needs in relation to each other.
(If you have no needs at all then leave this table blank)
Allocate 1 to what you consider as your first need, 2 to what you consider is your second need etc and 7 to what you consider as your last or least important professional development need.

Professional development needs	Rank in order of *most important need* (1) to *least important need* (7).
I. **Development of content knowledge** e.g. improving understanding of electricity or cells or chemical reactions	
II. **Development of pedagogical content knowledge**. . e.g. obtaining ideas on how to teach content, student misconceptions, designing learning programme etc.	
III. **Learning new methods of teaching**. e.g. learning about using cooperative group work, using video, concept mapping etc.	
IV. **Development of management skills**. e.g. how to improve classroom discipline and management, planning the teaching programme etc.	
V. **Improving the understanding of OBE and new curriculum**. e.g. discussing the purpose of the new curriculum, what change it requires of teachers etc.	
VI. **Improving the understanding of CASS** e.g. learning techniques of continuous assessment such as rubrics, etc.	
VII. **Learning new practical and investigation skills** e.g. use of apparatus, doing investigations, practical demonstrations etc.	

C. OTHER NEEDS
Do you think that there are other important needs that are not mentioned above ?

_____

_____

D. COLLEAGUES NEEDS
Which of the above do you think is most needed by science in your education district?

_____

_____

Section IV. What is the best way?

A. YOUR VIEW
    What is your view of the best way to meet teachers' professional development needs?

Below is the same list of professional development activities used in earlier questions.
Please refer to it when completing the table below.

Type of professional development activities.

A. *Formal Courses that lead to a degree or a diploma e.g. ACE, FDE.*

B. *Short Courses that lead to a certificate, e.g. Computer literacy.*

C. *Workshops training course over more than one day e.g. 3 day on assessment.*

D. *Meetings, Presentations, Seminars (part of or full day) e.g. talk by overseas visitor.*

E. *In school support programmes, e.g. project where someone visits every week for six months.*

F. *Conferences (lasting more than a day) focussing on science teaching (not union activity) e.g. science teacher association conference.*

G. *Any other? Please specify._____*

INSTRUCTIONS: Indicate by placing a letter (corresponding to the type of professional development activity) that you consider is most likely to meet the need.
e.g. if you think that a short course will be the best to improve your content knowledge then put a B in the box next to statement number 1 dealing with development of content knowledge..

	Area of professional development need:	Best activity to improve this area. (Place letter in this column).
1.	**Development of content knowledge** e.g. improving understanding of electricity or cells or chemical reactions etc.	
2.	**Development of pedagogical content knowledge.** e.g. obtaining ideas on new approaches to teach content, student misconceptions, learning difficulties, approaches etc.	
3.	**Learning new methods of teaching** e.g. cooperative group work, using video, concept mapping etc.	
4.	**Development of management skills.** e.g. improving classroom discipline and management, dealing with CASS forms.	
5	**Improving the understanding of OBE.** e.g. the purpose of the new curriculum, what changes it requires of teachers.	
6.	**Improving the understanding of CASS** e.g. learning techniques of continuous assessment such as rubrics, etc	
7.	**Learning new practical and investigation skills.** e.g. use of new apparatus, doing investigations, practical demonstration etc.	
8.	**Other needs?** Please specify_____	

B.   IMPROVING YOUR DAILY PRACTICE.

i) **Effective Practice**   Please tick in the box indicating your level of **agreement** with the following statements. (This question assumes that all educators can improve the effectiveness of their teaching.)

In my opinion, the most effective way of changing my classroom practice is	Strongly disagree 1	Disagree 2	Neither agree nor disagree 3	Agree 4	Strongly agree 5
1. Registering for **formal courses** that lead to a degree or a diploma.					
2. Doing **a short course** focussing on one of my needs. E.g. Investigation skills.					
3. Participating in a few one day **workshops** focussing on one of my needs. E.g. Investigation skills.					
4. Having a number of **meetings** dealing with my identified needs. E.g. meeting once a month on					
5. Attending a **conference** on the teaching of science					
6. Obtaining **In-school support** and having someone coming to my school and assist me. E.g. once a week.					
7. Being provided with **physical resources** such as equipment, apparatus, chemicals.					
8. Being provided with **resource books**, science teaching guides, teacher journal and magazines.					
9. **Collaborating** and meeting with teachers in my school and neighbouring schools in the district to discuss teaching science					
10. **Some other activity** ? Please specify._____					

ii). **Best activity:** What kind of professional development would you choose to attend if you were offered access to all facilities and necessary funds, including leave from school, to improve your own **daily teaching practice** in your present school ?

_____

_____

iii) **Reason:**   Why would this make a difference to your **daily teaching practice** ?

_____

_____

_____

Thank you for your time

APPENDIX II: LETTER OF INFORMED CONSENT

Dear..................................

I am a Masters student in Science Education at the University of Natal. As part of my research project, I would like to interview in-service providers like yourself who has an experience in this area. The interview will last appreciatively 30 minutes and will be conducted at place and time convenient to you and I would like your permission to tape-record the interview.

Your participation is entirely voluntary and if at any time you wish to withdraw, you will be free to do so. In the transcript of the interview no really name will be used and your identity will be kept anonymous.

The data will be used for my Masters in Education dissertation and will not be used for other purposes without your permission.
Thank you for your assistance.

Yours sincerely

Casimir Mutabazi KARASIRA.
University of Natal
Edgewood Campus
Private bag X03
Ashwood 3605

APPENDIX III: INTERVIEW SCHEDULE.

1. Aims of the interview.

This interview intends to gather information about INSET providers' views on professional development programmes offered in KwaZulu-Natal. The main aim is to find out through this interview:

    a. Opportunities offered to teachers to improve professionally.

    b. Professional development programme seen as most effective for the improvement of science teaching practice among offered opportunities.

    c. Area of science teachers' knowledge and skills that need to be improved for good practice and classroom change.

2. What is professional development?

Teachers' professional development is used to mean opportunities offered to teachers:

    a. to develop new knowledge, new skills, new approaches and,

    b. to improve their effectiveness in their classrooms.

It can also be seen as a process whereby teachers may be helped to become more professional.

3. Structure of the interview.

Questions of this interview are divided into three sections. The first section comprises questions related to the focus on opportunities given to science teachers in terms of means to improve their practice and become more competent to meet classroom exigencies. The second section focuses on science teachers' needs and effective professional development to improve the teaching learning practice. The third and last section focuses on science classroom change and includes questions related to actual science teachers need to achieve classroom change and areas of teachers' knowledge that need to be improved.

3.1. Focus on policy and opportunities offered.

    a. How does your institution (University of Natal, DOE, project, etc) see its role in science teachers' professional development in KwaZulu-Natal?

    b. How does your institution (University of Natal, DOE, Project, etc) intervene in terms of achieving its role in science teachers' professional development?

    c. What kind of opportunities does your institution (University of Natal, DOE, Project, etc) offer to science teachers to develop new competencies?

    d. When such activities intended to provide science teachers with new skills are organised?

    e. How does your institution (University of Natal, DOE, Project, etc) facilitate such activities or make them easy to participants?

    f. What do you think science teachers' views (attitudes) are on those opportunities you offer to them?

    g. Any comments?

3.2. Focus on science teachers' need and effective professional development.

a. What are science teacher's most pressing professional development needs in KwaZulu-Natal?
b. How do you know/recognize these as important needs?
c. Do you consider that those needs are likely to impact on school science achievement?
d. What kinds of professional development programmes are offered to meet science teachers' needs?
e. What do you consider as professional development programme most effective to meet identified science teachers needs?
f. Why do you consider this programme as most effective?
g. What do you consider as least effective professional development programme in terms of helping science teachers to cope with science classroom practice?
h. Why do you consider this programme as of a minimal effectiveness?
i. Any comments?

3.3. Focus on classroom change.

a. What areas of science teachers' competencies (content knowledge, pedagogical content knowledge, contextual knowledge, class management skills, laboratory management skills, familiarity with the curriculum, OBE, CASS, etc) you consider is of a crucial need to be improved in this province?
b. Why do you consider this area as an urgent need to be improved?
c. What is the impact of deficiencies in this area on the class achievement?
d. What kinds of professional development programmes are offered to address deficiencies in the area mentioned?
e. Given resources, what kind of programme do you consider should be the most effective to address the identified areas deficiencies?
f. Why do you consider the mentioned programme as the most effective?
g. What programme do you consider is not successful in addressing deficiencies in the area mentioned above?
h. Why do you consider this programme as least effective?
i. Any comments?

END