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**Primary teachers' recontextualization of a curriculum
innovation in Uganda**

By

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Thesis presented for the degree of:

DOCTOR OF PHILOSOPHY

School of Education

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DECLARATION

I declare that: *Primary teachers' recontextualizations of a curriculum innovation in Uganda* is my own work, except where indicated, and that it has not been submitted before for any degree or examination at any university.

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Date: September 2007

University of Cape Town

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ABSTRACT

This study constructs an account of teachers' recontextualizations of the 'problem solving approach', a pedagogic approach prescribed for teaching primary school science by Uganda's official curriculum. It describes how sixteen teachers, located in eight primary schools, interpret and enact the pedagogic prescriptions of the problem solving approach. The study further explores the extent to which school contexts in which the teachers work influence their recontextualizing processes.

The conceptual and analytical framework for the study draws on Basil Bernstein's theory of pedagogic discourse, extended with concepts from Paul Dowling's social activity theory. Drawing on classroom observations, interviews and official curriculum documents, the study explores the relationship between official curriculum prescriptions, teachers' recontextualizing processes and school contexts.

The analysis of teachers' recontextualizations highlights tensions between the envisaged pedagogic contexts and the structure and processes of schooling in Uganda. The relationships between curriculum implementation processes and school contexts demonstrate how teachers' pedagogic practice is differentiated according to the schools' achievement profiles.

The main contribution of this study is its theoretical insights into curriculum implementation processes. In particular, the study provides insights into the interplay between curriculum policy and its context of implementation at three levels of the education system: the macro-system level, school level and classroom level.

CHAPTER ONE: INTRODUCTION

This study investigates the implementation of a centrally mandated pedagogic innovation in Uganda, tracing its trajectory from an official curriculum into classroom practice. It specifically examines how selected teachers interpret and enact pedagogic prescriptions relating to the 'problem solving approach' in science. This pedagogic approach was introduced within the present national curriculum for primary schools, implemented from the year 2000.

My interest in this field of study originates from my professional and research background as an education scholar. My initial interest was sparked off by my Master of Education research study on the implications of the then proposed universal primary education programme on school resources (Namarome, 1996). The education climate in Uganda in the late 1990's, characterized by numerous educational reforms, presented a fertile environment for nurturing this initial interest. In 2000 I participated in a cross-country (Uganda, Kenya and Zimbabwe) exploratory research project on the state of basic learning competencies and life skills in primary schools (Kirumira, 2003). My case study on this project explored policy makers' perspectives on various curriculum initiatives within the formal and non-formal sector in Uganda (Sikoyo, 2003). In both projects I noted discrepancies between intended and implemented practice. This research experience alerted me to the general problem of the persistent failure of educational reforms to take root in schools and classrooms. The current project emerged from this research background.

The section following this introduction provides a contextual background to the study, focusing on education sector reforms in Uganda generally and curriculum change in particular. This is followed by a description of the salient pedagogic features of the problem solving approach as defined in the official curriculum. The subsequent section introduces the research problem and the final section of the chapter outlines the structure of the thesis.

1.1 Education policy reform in Uganda

This section provides a brief account of educational reforms in Uganda as a context for the curriculum change initiative on which this study is based. Uganda's curriculum change effort is part of a comprehensive programme of education reform embarked upon following the 1987 Education Policy Review Commission (EPRC) which culminated in the 1989 EPRC

report. This report is popularly referred to as the 'Kajubi Commission' after the name of its chairperson, professor Ssentenza-Kajubi. The 1989 EPRC report provides an historical account of education development from the inception of Uganda's independence in 1962 to the late 1980's, citing the various challenges the education sector experienced in that time. The report makes wide ranging recommendations for improving the different levels and dimensions of education. This report was followed by a Government White Paper on Education (1992) which outlines the Government's response to the commission's recommendations. These two reports provide a background to the current education sector policy reforms, painting a very bleak picture of the condition of the education sector in the mid 1980's when the current government assumed power. An excerpt from the introduction of the Government White Paper reads:

The quality of education has been seriously eroded at all levels due to depredations of war, civil strife and the consequent economic decline during the last two decades. Schools are ill-equipped, instructional materials are in short supply, teachers are poorly remunerated and demoralized, and many of them are unqualified. Literacy is still at an unacceptable low level. On the other hand, most curricula in education systems are not designed to equip the youth with productive skills. Worse still, there are all kinds of imbalances in the distribution of educational facilities; between urban and rural areas, between different regions and ethnic or nationality groups, between boys and girls and between rich and poor (Republic of Uganda, 1992, p.1).

The present government inherited an education system with low and declining quality in all its dimensions, compelling it to embark on an ambitious and rapid process of reconstruction and development. The education reform process in the early 1990s was driven by the imperatives of improving quality, expanding access and enhancing equity, efficiency and relevance in education. These aims were undertaken within the national framework of the Education Strategic Investment Plan (ESIP) (GoU-MoES, 1998). The ESIP framework is consistent with broader national policies defined in the 1992 Government White Paper on Education, Uganda Vision 2025 and the 1997 Poverty Eradication Action Plan (PEAP) (UNEB, 2003). The education sector reforms also conform to international education commitments, including the 1990 Jomtien Education for All (EFA) initiative and the Millennium Development Goals (MDGs) to which Uganda is a signatory.

The education reform processes embraced all sectors of education. It revamped school infrastructure through a School Facilities Grant (SFG) and teacher education and professional development through the Teacher Development and Management Systems (TDMS) programme and it introduced evaluation and assessment initiatives such as the

National Assessment of Progress in Education (NAPE) and continuous assessment (CA) initiatives. However, none of these reforms impacted on the schooling system as much as the universal primary education (UPE) programme. Introduced at the beginning of 1997, UPE dramatically altered the education landscape in Uganda, doubling enrolment in primary schools from a low 2.6 million in 1996 to 5.3 million in 1997. Enrolments continued increasing to 7.6 million in 2004 (MoES, 2005). Net enrolment ratios in primary schools rose from 60 % in 1996 to about 90 % by the end of 2004.

In addition to increasing enrolment in absolute terms, Uganda has also made remarkable progress in overcoming other forms of disparity in access to formal schooling. Gender disparity in enrolment has declined considerably, tending to parity. In line with the equity principle, UPE also catered for special and disadvantaged groups, including children with special needs and those from the lowest income quintile (Ministry of Finance and Economic Planning Uganda, Budget Speech, 2005/2006).

In addition, the government in partnership with development partners such as UNICEF, Germany Technical Cooperation (GTZ) and Save the Children Norway (REDD BARNA), introduced alternative non-formal basic education programmes for children who could not enrol under the UPE programme due to life styles incompatible with the formal school system. These alternative programmes include Complementary Opportunities for Primary Education (COPE), Basic Education for Urban Poverty Areas (BEUPA) and Alternative Basic Education for Karamoja (ABEK). These programmes are run on flexible schedules compatible with the life styles of the target learners. I describe these initiatives in detail elsewhere (Sikoyo, 2003).

I provide a brief overview of the UPE policy here as it provides an important backdrop to schooling in Uganda during the research period. Although UPE is usually associated with *free and compulsory* basic education, in Uganda it was initially intended to provide free primary schooling to four children per household. However in the course of time the policy was reviewed to reflect the dynamic circumstances in the country and now provides basic education to all children of school going age in the country. UPE is not completely 'free' because government and parents share the financial costs. Nevertheless, the direct cost of schooling incurred by parents has been remarkably reduced in the UPE era. Further, UPE is

not yet compulsory as there has been no act of parliament to make it mandatory for parents to send their children to school.

UPE abolished the direct cost of schooling in the form of tuition fees previously incurred by parents, replacing these by providing schools with capitation grants for meeting expenditure on non-textbook materials and other operational costs. User fees in the form of tuition and other costs of schooling were key factors in keeping children out of school prior to UPE (Republic of Uganda, 1992). Further, government now supplies schools with textbooks and government-aided schools are forbidden to charge parents school dues except in urban areas, where they make a standard contribution towards utilities such as electricity and municipal water. However, parents are expected to provide their children with scholastic materials such as exercise books, pens, pencils and uniforms as well as lunch and other basic needs.

Following the introduction of UPE, a number of practices were implemented to cope with the high enrolment which resulted in classroom: pupil ratios ranging from 60 to over 100 learners. These include co-teaching and automatic promotion, among others. Co-teaching is a practice in which two or more teachers teach a class jointly, sharing instructional and classroom management roles. Automatic promotion allows learners to progress to subsequent grades regardless of whether they meet the academic standards or not. This practice has been criticized and blamed for the current decline in the quality of learning outcomes reflected in the national assessment of progress in education (NAPE) reports and curriculum review processes (UNEB, 2003; Read and Enyutu, 2004).

1.2 Curriculum reform

The 1989 EPRC argued that the previous curriculum was largely irrelevant and unresponsive to the needs of local communities (Republic of Uganda, 1989; 1992). It was perceived as primarily focusing on preparing learners for secondary education and not for everyday living. The EPRC also noted backlash effects of the national primary leaving examination (PLE) on the quality of teaching and learning, highlighting a dominance of rote and passive learning, which produced school leavers lacking critical skills such as problem solving. Muhanguzi (2005) reports how an impact assessment conducted on the School Health Education Programme (SHEP) after ten years of operation (1986-1994) demonstrated that children did not translate science knowledge into positive behavioural change in sexuality and health. She argues that whereas children's knowledge on health issues had increased

significantly, there was no corresponding behavioural change. In general, the previous curriculum was criticized as being excessively teacher-centred, promoting passive learning, leading to school leavers lacking problem solving skills (Republic of Uganda, 1989; 1992). To address the perceived imperatives of relevance and quality of education, a new primary curriculum was introduced in primary schools from the year 2000 as part of the Primary Education Reform Programme (PERP).

The new curriculum was expected to redress the foregoing weaknesses. The curriculum reform process was influenced by contemporary global developments in education, including the progressive pedagogy movement and calls for creativity, critical thinking and problem solving skills (Muller, 1998; Taylor & Vinjevoold, 1999; Duggan and Gott, 2002). In relation to the science curriculum, it was argued that there is a need for learning authentic, investigative and problem solving science (Osborne, 2002; Atkin, 1998; Hodson, 1998; 2003). At a national level the need for education to address environmental conservation, population and family life issues and health, especially with the advance of the HIV/AIDS epidemic, was a major concern. There was a quest for social relevance in the curriculum, premised on the argument that primary education is terminal for the majority of learners in Uganda (Republic of Uganda, 1992).

Thus the present curriculum places a high premium on learner-centred pedagogy underpinned by constructivist approaches to learning. Another key feature of the present curriculum is its integrated design, intended to overcome the fragmented nature of knowledge and promote holistic and meaningful learning so as to facilitate its application in different life contexts (Republic of Uganda, 1992). For example, the previous science syllabus, which was based mainly on basic science and health education, was revised to integrate themes relating to environmental education and population and family life education to constitute the current integrated science syllabus.

The present study focuses on the problem solving approach, a pedagogic approach introduced within the integrated science syllabus. A detailed analysis of these curriculum documents is presented in chapter five. The documents highlight three main features: First, the official curriculum seeks to promote learners' active role in pedagogic processes where the teacher plays the role of 'facilitator' while the learners take responsibility for their own

learning, participating as 'self-regulating' learners. This aims to promote the learners' initiative and creativity.

Secondly, the curriculum emphasizes lesson structures involving activity based instruction through activities such as group work and other learner-directed activities. Activity based instruction is encapsulated in the notion of 'learning science by doing' which aims to minimize passive learning associated with the previous curriculum. Within activity based instruction, the curriculum lays emphasis on activities associated with the 'scientific processes' of investigation such as experiments and other practical science work. These processes are intended to provide learners with opportunities to experience the 'scientific methods' employed by practising scientists and to develop logical and systematic problem solving abilities.

The third feature of the problem solving approach relates to knowledge relationships. The curriculum instructs teachers to relate science knowledge across the different topics and themes of the syllabus, as well as to knowledge from other school subjects and to everyday life. Promoting learners' ability to apply knowledge in new ways and contexts is a key ingredient of the problem solving approach.

1.3 Focal research problem

This study addresses two main research tasks. The central task of the study is to construct an account of how selected teachers recontextualize the problem solving approach. This includes an account of the teachers' interpretations of the problem solving approach as outlined in the official curriculum and of the ways in which they enact the pedagogical principles of the approach in their classroom practice. To address this task I do two things. I describe 'what' the teachers interpret as the salient pedagogic *features* of the problem solving approach and its pedagogic *benefits*, i.e. 'why' they deem the approach essential for teaching and learning science. In addition, I construct an account detailing 'how' the teachers employ the problem solving approach in pedagogic practice. Here I focus on the structure of pedagogy and the type of instructional content transmitted in the 'problem solving lessons'.

The second research task is to examine why teachers recontextualize the problem solving approach in particular and different ways. Here, I examine the teachers' 'recontextualizing

rules' highlighting the factors that regulate their classroom practice with a specific focus on factors within the school context. I explore the interplay between classroom practice and school contexts and the implications of these for curriculum implementation. The focal research problem is expressed in the following two central research questions:

1. How do selected primary school teachers recontextualize the problem solving approach?
2. Why do the teachers recontextualize the problem solving approach the way they do? In what ways does the school context in which the teachers practice influence their recontextualizing processes?

Sub questions

I pose a number of sub questions to operationalise the foregoing research tasks:

- What mode of pedagogic practice does the official curriculum project through the problem solving approach?
- What do the teachers interpret as the main features and pedagogic worth of the problem solving approach?
- How do the teachers enact the pedagogic principles of the problem solving approach in classrooms?
- What types of content are transmitted in the problem solving lessons?
- What instructional strategies are employed to transmit content in the problem solving lessons?
- Why do the teachers employ the problem solving approach the way they do?
- In what ways do the school contexts in which the teachers practice influence their recontextualizing processes?

The first sub-question concerns the problem solving approach as defined in the official curriculum. This question is posed to provide a basis for the analysis of teachers' recontextualizations. The other sub-questions focus on *how* and *why* the teachers recontextualize the problem solving approach in particular ways.

In order to address these questions, this study investigates how sixteen primary school teachers, teaching in eight schools, enact these pedagogic features in classroom practise so as to gain insights into curriculum implementation processes. In particular the study aims to highlight relations between the teachers' classroom practise and the school contexts in which

they work. The eight research schools were selected to reflect heterogeneity in class size and academic achievement profiles in the area of study. The rationales for these two criteria are provided in chapter four.

1.4 Outline of the thesis

Chapter one introduces the study and provides a contextual background to education reforms in Uganda, highlighting the curriculum change efforts in which the problem solving approach originated. The chapter describes the key features of the problem solving approach as defined in curriculum policy and sets the research agenda by introducing the research problem and tasks.

Chapter two reviews literature on curriculum implementation, highlighting the different theoretical perspectives in this scholarship along with their main premises. The chapter also reviews literature relating to curriculum reforms involving progressive pedagogies globally and in Africa and examines the challenges of enacting these reforms.

Chapter three presents the theoretical and analytical framework for the study. This study primarily draws on Bernstein's theory of pedagogic discourse (Bernstein, 1990; 1996; 2000). The theoretical framework is extended with concepts from Dowling's social activity theory. The chapter discusses relevant concepts from the two theories adopted to conceptualize curriculum implementation and pedagogic practice. Bernstein's key concepts of classification and framing provide an internal language of description for pedagogic practice, focusing on 'how' pedagogy is structured. Dowling's concepts of domains of practice and distributing strategies provide theoretical tools for conceptualizing instructional content and its transmission, describing 'what' is transmitted in classrooms. The chapter further highlights how theoretical concepts are operationalized to constitute the analytical framework, the external language of description, in dialogue with empirical data and in relation to the curriculum policy prescriptions for the problem solving approach.

Chapter four addresses design and methodological issues. It discusses my rationale for adopting a multiple case study approach and describes the sample of schools and teachers. The chapter describes the data collection and analytical procedures and shows how the external language of description developed through dialogic relations between theoretical

constructs and the data. The chapter discusses the limitations of the study and the strategies undertaken to enhance validity.

Chapter five presents an analysis of the curricular and pedagogic guidelines for the problem solving approach. It discusses the salient features of pedagogic practice for the problem solving approach projected in the official curriculum documents. The chapter interprets the key features of the problem solving approach in light of the study's analytical framework as a basis for the subsequent analysis of teachers' recontextualizations.

Chapters six, seven and eight present the empirical findings of the study. Chapters six and seven present an account of teachers' recontextualizations of the problem solving approach in classroom practice. Chapter six focuses on the classification and framing of pedagogic discourse and analyzes this in terms of pedagogic modalities. Chapter seven describes the instructional content transmitted in the lessons in terms of its degree of specialization and mode of transmission. These aspects are described in terms of Dowling's concepts of domains of practice and distributing strategies, respectively.

Chapter eight presents an account of teachers' recontextualizations of the problem solving approach constructed from the interview data. The first part of the chapter describes the teachers' interpretations of the problem solving approach in relation to its key features and pedagogic worth. The second part of the chapter focuses on the teachers' recontextualizing rules which highlight their rationales for enacting the problem solving approach in particular ways. The chapter concludes with an account of how the schools' organizational contexts influenced teachers' recontextualizing processes.

Chapter nine summarizes the analysis presented in chapters six, seven and eight, highlighting the main findings of the study. In particular the chapter compares teachers' recontextualizing processes in high and low achieving schools. Chapter ten provides an overview of the thesis, and draws conclusions from the study highlighting its main contribution. The chapter discusses the limitations of the study and indicates areas for further research.

CHAPTER TWO: CURRICULUM IMPLEMENTATION-THE LITERATURE

This chapter reviews literature in the broad field of curriculum change and implementation. It highlights the salient debates in this field so as to contextualize the problematic of the current study. The chapter begins with a brief overview of curriculum policy implementation studies in Uganda and then discusses the international literature, highlighting different perspectives on curriculum implementation research. Following this, the chapter examines curriculum reform literature relating to progressive or 'learner-centred' pedagogy with a special focus on Africa. The chapter concludes by showing how the study contributes to and extends the current debates on curriculum implementation.

2.1 Curriculum implementation in Uganda

Most empirical work on education policy and implementation in Uganda is dominated by Government publications and commissioned studies, World Bank reports and privately funded studies by international donor agencies (See for example, Nishimura, Yamano & Sasaoka, 2007; Read & Enyutu, 2004; Ward, Bourne, Penny & Poston, 2003; World Bank 1998; 2001). These are mainly large scale studies which portray the macro picture of policy implementation focusing on indicators such as enrolment and drop out rates, teacher: pupil ratios and textbook: student ratios as measures of efficiency. Important as these macro-indicators are, they tend to 'mask' complexities of curriculum implementation at school and classroom levels. Other studies on curriculum policy and implementation include Sikoyo (2003), Kabatereine (2003) and Kirumira (2003). These exploratory case studies examine various curriculum initiatives in basic education policy and highlight how these are taken up in classrooms. Ward et al. (2003) examine the effectiveness of education policy implementation in Kenya, Uganda and Tanzania, focusing on the socio-political environment in which educational policies are created.

Another collection of studies on education policy implementation, including curriculum implementation, has been undertaken by postgraduate students. These include the implementation of continuous assessment in primary schools (Nakabugo, 2004; Namubiru, 1999); trends and rationales for policy changes in basic education (Ocheng-Kagoire, 2004), the impact of Universal Primary Education on school resources (Namarome, 1996) and the quality assurance functions of the inspectorate of education (Wakoko-Masaba, 2004;

Nyivuru, 2003). Nkwanga (1992) examines the effectiveness of teacher education programmes. These studies provide useful insights, although most employ survey instruments to solicit teachers' general experiences and opinions on various aspects of implementation. On the whole, there is a poor tradition of classroom based research in Uganda.

UNESCO and World Bank publications portray an impressive picture of education in Uganda, citing its experience in reforming the education sector as a model of success for other Sub Saharan countries. In particular, these reports laud Uganda's efforts in implementing UPE and introducing alternative basic education initiatives, as well as the country's progress in achieving gender parity and marshalling the government's strong political support for education reform processes. In this regard, Uganda is considered to be a 'star performer' and among the few Sub Saharan African countries that have come close to attaining the Millennium Development Goals for education (Penny, Ward, Read & Bines, 2007; Birdsall, Levine & Ibrahim, 2005; Ward, et al., 2003). Despite these achievements, the World Bank (2001) acknowledges that the toughest challenge to improving policy implementation lies closer to the classroom, at the level of individual schools and districts. This view is corroborated by evidence from a number of small scale studies (Sikoyo, 2006, 2005, 2003; Nakabugo, 2004; Kabatereine, 2003; Namubiru, 1999) which report challenges in implementing curriculum policy directives in schools and classrooms.

From the perspective of international development agencies, Penny et al. (2007), Nashimura, et al. (2007) and Ward et al. (2003) emphasize that, despite Uganda's overall improvement in access to basic education, the quality of primary education remains a challenge. Ward et al elaborate:

Increased access to primary schooling has not been matched by improvements in quality and equity: there are significant deficits in classrooms, teachers and textbooks and national averages are masked by regional disparities (2003, p.133).

Further, Penny et al. (2007) observe that education sector reforms need to give more attention to the processes and context of educational change. This study makes a contribution to this call by examining the processes through which curriculum policy is enacted in schools and classrooms.

The foregoing literature suggests a discrepancy between macro-indicators of education policy and the micro picture of implementation in classrooms and schools. This is unsurprising given the global experiences of curriculum policy and implementation discussed below.

2.2 Curriculum implementation: an international perspective

Curriculum reform is considered to be a crucial medium for educational transformation (Chisholm & Leyendecker, 2007; Potenza & Monyokolo, 1999) and means for leveraging change to serve broader societal imperatives (Republic of Uganda, 1992; NCDC, 1999, 2000). Despite this expectation, the persistent failure of curriculum change to take root in classroom practice remains a salient problematic and focus for curriculum implementation scholarship (Ball, 1998). Scholars propose diverse factors as key in mediating the curriculum implementation processes, making curriculum change and implementation a highly contested field. This section will highlight some of the issues dominating debates in this field. But I will first examine the broad paradigms of curriculum implementation research.

Traditionally, curriculum policy and implementation research construed implementation as 'putting into practice' the plans of policy makers (Spillane et al., 1996, p.431). Morris & Scott (2003) argue that the traditional focus on the gap between education policy and its implementation results in a form of 'implementation myopia' which views policy as unproblematic. However, this view has over the years evolved into numerous perspectives most of which argue that local actors adopt an active stance towards policy and reshape policy makers' proposals to suit their local work contexts. Two dominant approaches are employed in curriculum implementation research: a fidelity approach and a mutual adaptation perspective (Snyder, Bolin & Zumwalt, 1990; Fullan and Pomfret, 1977). The fidelity approach adopts a technical-rationalist perspective which inquires whether implementation matches the intended goals of curriculum change. In other words, this approach is concerned with how well curriculum implementation mirrors what the curriculum reformers intended. Against this standard, reforms are seen as ineffective when implementers adapt, add or omit features of the original blueprint.

In contrast, the adaptive approach examines the complexities of the change process, highlighting how innovations are transformed during the process of implementation (Fullan & Pomfret, 1977). This approach grew out of a large scale study of curriculum change in the

USA, the Rand Change Agent (Fullan & Pomfret, 1977; McLaughlin, 1976). The adaptive approach holds that teachers, like other practitioners, seek to add their personal signatures to mandated reforms by adapting these to their contexts, rendering implementation a 'mutually adaptive process between the user and the institutional setting' (Fullan & Pomfret, 1977, p.360).

Christie (1999) analyses implementation failure from the standpoint of policy and makes a distinction between a 'rationalist' and a 'contingency' approach:

From the rationalist perspective, the 'problem' lies with implementers who are variously seen to be lacking in capacity or will. From the contingency perspective, the 'problem' lies in the nature of policy itself which is contested and uncertain (p.284).

Christie concludes that both rationalist and contingency perspectives neglect implementation issues, thereby compromising the capacity of policies to deliver change.

A consistent finding from the literature is that curriculum initiatives are seldom implemented as legislated. Rather, they undergo varying forms and degrees of modification and adaptation during implementation (West, 2005; Farrel, 2000; Cuban, 1998; Darling-Hammond, 1990), a phenomenon that has been described as 'mutual adaptation' (Fullan & Promfret, 1977). Adaptation is 'mutual' because it is not unidirectional: policy may shape practice and practice in turn shapes policy by influencing what local actors make of policy ideas and proposals (Drake & Sherin, 2006; Cuban, 1998; Ball, 1998). In other words, teachers adapt the curriculum to their practices and they also adapt their practices to fit curriculum requirements.

The following section presents some of the major perspectives of curriculum implementation and their main premises.

Perspectives on curriculum implementation processes

Researchers have attempted to explain the success (or lack of success) of curriculum policy changes from different theoretical and methodological perspectives. Implementation theorists such as Fullan (1991) and Fullan & Promfret (1977) argue that centre-periphery models of curriculum change do not recognize the complexity of the implementation process hence they emphasize the need to 'manage' change effectively. However, sceptics of the implementation theorists (Morris & Scott, 2003; Jansen, 1998; Nhundu 1997; Papagiannis,

Klees & Bickel, 1982) maintain that wider socio-political factors are more important in determining whether particular innovations succeed or not and therefore the mode of implementation is irrelevant. They assert that the socio-political environment provides more powerful incentives for local actors' actions than does the instructional profit gained from innovations.

A substantial body of empirical work (Drake & Sherin, 2006; Campbell, 2006; Cuban, 1998; Ball & Bowe, 1992; Helsby 1995; Curtner-Smith, 1999; Proudford 1998; Shkedi 1998; Yung 2002; Nias 1989, 1991; Webb & Vulliamy, 1999a, 1999b; Vulliamy, Kimonen, Nevalainen & Webb, 1997; Kirk & Macdonald 2001; Neves & Morais 2001; Spillane 1999; Spillane & Zeuli, 1997) focuses on the central role of teachers in curriculum implementation. Cuban (1998) describes teachers as the 'foot soldiers' of reform. These scholars attribute the success or failure of reforms to teachers' actions. It is, therefore, imperative to understand the complexities inherent in teachers' crucial role in interpreting and enacting curriculum policy initiatives. An implicit assumption underlying centrally directed educational reforms is that teachers are both willing and able to adapt their pedagogic practice in appropriate directions, yet evidence from the aforementioned studies does not support this supposition.

The studies cited above illustrate how teachers in diverse contexts respond to curriculum changes, highlighting how they interpret and enact mandated change. They all demonstrate that curriculum policies do not translate into practice in a linear fashion. Instead implementation entails some degree of negotiation and adaptation. These studies identify a range of factors and 'filters' as mediating teachers' curriculum implementation efforts. These include teachers' professionalism, professional identities and self-identities, their epistemologies and beliefs on instruction, professional preparation, discursive histories and a range of school contextual factors, among others.

Professional issues: professional development, empowerment & agency

Stenhouse (1975); Potenza & Monyokolo (1999); Rowell (1995) and Broadhead (2001) focus on teachers' professional development. They assert that because teacher development is an integral part of effective curriculum change, teachers need to develop skills and adopt ideologies congruent with the changes advocated. They argue that, unless teachers adopt the ideology underpinning curriculum change, innovations are likely to be 'recreated' and 'adapted' to suit their own instructional ideologies. In relation to implementation of

curriculum 2005 in South Africa, Potenza & Monyokolo (1999, p.236) note that ‘...the success of the new curriculum depends on the training and support that teachers receive, and their ability to mobilise and manage resources around them to implement the curriculum’.

Ensor (1999) draws attention to the intricate relations between curriculum change and teacher education underpinning curriculum reform processes. She questions the implicit assumption underlying curriculum change that teacher education automatically delivers curriculum change. She suggests that the transfer between teacher education and classroom practice is not ‘seamless’, rather it is mediated by what teachers select from the teacher education programme (their recontextualizations from its practices), their education biographies and school settings. Ensor demonstrates that recontextualizing from teacher education is largely determined by a teacher’s access to recognition and realization rules for the ‘best practice’ provided under teacher education programmes.

Another group of studies (Yung, 2002; Proudford, 1998 and Vulliamy, et al., 1997) posits that curriculum implementation is effective when teachers are professionally empowered during implementation. These researchers frown upon bureaucratic controls on implementation which police teachers to ensure that they implement the mandates of policy makers. They suggest that teachers should be supported, encouraged and provided with opportunities to make improvements on their own or in partnership with other stakeholders. In contrast, McDonnell and Elmore (1987) maintain that sometimes a measure of bureaucracy and pressure is necessary to get education reforms accepted at the school level. However, Oslon (2002) and Christie (1999) argue that, despite the diverse approaches used to institutionalize educational reform, including systemic change, school by school approaches, teacher development and imposed change directed by education policy objectives, teachers modify reforms during implementation.

Campbell (2006); Ball & Bowe (1992); Helsby (1995); Curtner-Smith & Matthew (1999); Proudford (1998); Shkedi (1998) and Yung (2002) analyze curriculum implementation in relation to teachers’ professionalism. Some of these researchers (Ball & Bowe, 1992; Helsby, 1995; Curtner-Smith & Mathew, 1999; Proudford, 1998; Shkedi, 1998 and Yung, 2002) employ what they call an ‘emancipatory approach’ to curriculum implementation. This approach is premised on the view that teachers mediate external pressures upon them through the ‘filter’ of their professionalism. They suggest that curriculum change ought to

empower and emancipate teachers by promoting their professionalism. An emancipatory approach is conceptualised as entailing three key elements: professional confidence, professional interpretation and professional consciousness.

Professional confidence relates to a condition where teachers have the authority and capacity to make important decisions about the way in which they conduct their work. Professional interpretation refers to teachers' ability to deconstruct or critically analyse the policy text and interpret it in such a way that it works in the interests of teacher professionalism and transformative educational change. Professional consciousness entails a capacity to problematise taken-for-granted assumptions and values which underpin policy response and professional practice. Professionally empowered teachers are described as demonstrating a 'writerly' stance to policy interpretation while those who are not empowered adopt a 'readerly' stance (Ball & Bowe, 1992).

This approach to curriculum implementation raises pertinent questions. Whose interests are at stake in having empowered teachers and what consequences does this empowerment have for policy implementation? Is there an assurance that professionally empowered teachers always implement policies in the manner legislated? Evidence from Yung (2002) demonstrates that the teachers who interpreted policies in a 'writerly' manner did so at the expense of fulfilling policy requirements. The emancipatory approach to curriculum implementation seeks to empower teachers, thus this approach is normative rather than descriptive in explaining why teachers respond the way they do to policy changes.

Contemporary curriculum reforms implicitly project teachers as 'passive' professionals (Hayes, Mills, Christie, & Lingard, 2006). Yet Campbell (2006); Court (2006); Sloan (2006) and Rodger (2006) argue that teachers exercise agency in responding to curriculum reforms as part of their practitioner wisdom and judgment. Campbell (2006) observes that, 'public discourse as well as academic research is changing from viewing teachers as 'passive agents whose behaviors are leveraged (negatively or positively) in seemingly predetermined ways by curricular changes to an expanded vision of teacher agency' (p.115). These studies highlight how 'curricular authority' vested in mandated change interacts with teachers' professional authority during implementation. They associate curricular authority with teachers' accountability to schools, districts and central government and teachers' professional authority with teacher identity and agency.

Focusing on teacher identity and agency, Court (2006); Sloan (2006) and Rodger (2006) argue that teachers exercise their professional authority to adopt or adapt curriculum reforms in ways that are grounded in their professional judgment, discretion and proficiency. Sloan points out how teachers may use their authority to resist or adopt some aspects of reforms in highly reasoned and principled ways. Although Sloan, Court and Rodger draw attention to teacher agency, Campbell (2006) emphasizes that teachers have an obligation to respect the integrity of mandated curricular reforms and the processes of fulfilling them.

The present study reiterates Campbell's argument that professional authority does not exonerate teachers from fulfilling curriculum policy mandates.

Teacher identity: self-identity and professional identity

Other studies (Nias, 1989, 1991; Webb & Vulliamy, 1999a, 1999b; Vulliamy, et al., 1997; and Shkedi, 1998) focus on the role of teachers' self-identities in curriculum implementation and suggest that these identities are powerful mediators of teachers' interpretations of and responses to imposed changes. They argue that external directives are not powerful enough to transform the educational values which provide the core rationale for teachers' actions. Nias (1989) highlights how the protection of core self-defining values constitutes a high priority in teachers' professional lives.

Whereas the foregoing studies focus on self-identities, yet another group of researchers (Drake & Sherin, 2006; Rodgers, 2006; Moore, 2005; Drake, Spillane & Ackles, 2001; Kirk & McDonald, 2001; Spillane & Jennings, 1997; Cohen & Ball 1990; Cohen & Barnes, 1993) examine teachers' professional identities as the key mediating factor in curriculum implementation. They suggest that teachers' accumulated professional experiences influence how they enact instructional change. They point out that, where the philosophy of a curricular innovation significantly differs from teachers' professional theories and beliefs, teachers feel compelled to 'domesticate' the curriculum to align it to their professional belief systems.

Drake and Sherin (2006) and Kirk and McDonald (2001) examine how teachers' professional identities in relation to subject allegiances shape their interpretations of curriculum policy. In addition, Drake and Sherin examine how teachers' identities as learners and teachers of a particular subject, in this case mathematics, influence their curriculum implementation processes. They suggest that experiences as teachers and learners

of mathematics determine how teachers adapt curriculum innovations in classrooms. In general, these researchers argue that teachers adapt curriculum initiatives in response to their understandings of a lesson, abilities of their learners and constraints of time, materials and other resources in their local school contexts. The self-identity and professional identity perspectives suggest that efforts to understand teachers' responses to change ought to consider teacher identities. However, they pose the dilemma of how to synchronize teachers' identities with the requirements of curriculum reforms so that instructional change is not sacrificed at the expense of preserving teachers' identities.

Sociological perspective on curriculum implementation

A further group of studies (Morais, Neves & Fontinhas, 1999; Neves & Morais, 2001a, Neves & Morais, 2001b; Morais & Neves, 2001c and Kirk & Macdonald, 2001) examines curriculum change and implementation from a sociological perspective which highlights the influence of power and control on teachers' actions. This perspective draws on Bernstein's theory of pedagogic discourse which conceptualizes curriculum implementation as entailing various selections and adaptations, a process he calls 'recontextualization'. Bernstein conceptualizes the production and reproduction of school knowledge as a relay of power and control from the macro level of society to the micro processes of schooling in general, and teaching and learning processes in particular. This suggests that curriculum implementation as the process through which school knowledge is 'reproduced' entails power and control relations. Details on the recontextualizing processes and the translation of power and control from the macro to micro levels are examined in relation to the theoretical framework in chapter three.

Morais, et al. (1999) analyse changes in theories of instruction in science reforms in terms of sociological concepts of power and control legitimized between teachers and learners. Neves & Morais (2001b) explore the power and control relationships between the ministry of education officials and teachers inherent in the text of science syllabi. In general, these studies attribute change in the implemented curriculum to multiple factors including the power and control relations between the ministry of education and teachers, teachers' ideologies, the social context of the school, relations between school and home background of learners and teachers' inability or unwillingness to enact mandated instructional change. They suggest that this dynamism enables change to take place.

Ensor (1999) examines teachers' 'recontextualizing' processes focusing on how teachers draw on teacher education to constitute their classroom practice. Ensor's study draws on Dowling's (1998) social activity theory to show how teachers adapt instructional practices as they recontextualize these from one site to another. She shows the extent to which teachers' recontextualizing processes are explained by their take-up of practices from initial teacher education, their educational backgrounds and the school contexts in which they work.

A situated cognitive perspective on curriculum implementation

Spillane (2002; 2000); Cohen & Barnes (1993); Cohen & Ball (1990); Resnick (1991); Porac, Thomas and Baden-Fuller (1989); Orland-Barak, Ben-Or and Levi (2004); Macnab (2003); Blignuat (2005) and Helsing (2007) examine curriculum implementation in relation to teachers' cognitive processes. Spillane (2000) and Spillane, et al. (2002) spearhead this approach. Drawing on cognitive theories, these researchers identify a gap in current curriculum policy research as inadequate attention to 'how' implementers come to understand 'what' policy asks of them. The cognitive perspective endeavours to fill this gap by focusing on how teachers as 'implementers' interpret and enact curriculum policy.

With regard to interpretation, this perspective holds that curriculum policy is not 'given' or 'static'. Rather, teachers construct meanings from the policy message. In other words, they suggest that teachers need to first 'make sense' of what policy requires them to do prior to responding to its requirements. Scholars in this group argue that whether teachers adopt, adapt, modify or reject policy requirements depends on the understandings which they construct from policy and their previous views and understandings on instruction. This framework is premised on the view that behavioral changes in individuals are fundamentally cognitive. In this regard, it foregrounds a constructivist learning theory that holds that people draw on their prior knowledge and experiences to construct new understandings.

Researchers using this approach argue that teachers assimilate new experiences and information through their existing knowledge structures, implying that teachers' interpretation of policy depends significantly on their repertoire of existing knowledge and experience. They point out that curriculum policy is unlikely to take root when it is at odds with teachers' central conceptions of instruction. Blignuat (2005) reports that the teachers he researched interpreted and enacted the Outcomes Based Education (OBE) curriculum in South Africa in the light of their previous knowledge of what constituted good teaching and

learning. Orland-Barak et al. (2004) refer to relations between a teacher's previous views on instruction and ideas foregrounded by a new curriculum as 'dialogues between old and new'. They suggest that this process is gradual and characterized by inconsistencies between teachers' previous pedagogical content knowledge and the new curriculum.

The cognitive perspective suggests that 'sense-making' is situated in and influenced by the social, physical, and cultural contexts of the sense-maker. Therefore, it focuses on interactive systems that are larger than the behaviour and cognitive processes of an individual and suggests that knowledge is distributed in the social, material and cultural artefacts of this collective environment. Resnick (1991) and Porac, et al. (1989) argue that individuals draw upon existing reservoirs of individual and collective knowledge to figure out what particular policies mean. The situated cognitive perspective proposes that teachers' 'sense-making' or interpretation of policy is a function of the interaction of three dimensions: their existing cognitive scripts, the situation (*context*), and the policy message (Spillane, 2001, 1999; Spillane et al., 2002).

Spillane (1999) adopts the notion of 'zone of enactment' to describe the space where external reforms meet teachers' instructional practice and in which teachers construct ideas about reformed practice. He describes an effective enactment zone as one that is social and characterized by continuous deliberation about practice. He suggests that on-going deliberations between a teacher and her colleagues, as well as with experts outside the school, play a central role in curriculum reform processes by aiding teachers' interpretations of policy. Although interaction in professional 'communities of practice' may support teachers' interpretations of curriculum as suggested by Spillane (1999), Billet (2001) and Hatano and Inagaki (1991) argue that this is not an end in itself. They suggest that the actual understandings that teachers construct from curriculum policy are internalised individually and in this view one's comprehension is essentially a private practice. Billet argues that there is interdependence between *what* is afforded to individuals by social practice and *how* individuals select to engage and construct from what is afforded. She emphasizes that the social is as much an individual as it is a collective phenomenon.

Although this study does not adopt the situated cognitive framework perspective, it considers the context of curriculum implementation important and examines ways in which teachers' school contexts influence their pedagogic practice.

A pedagogical perspective on curriculum implementation: teachers as 'learners'

Closely associated with the situated cognitive approach discussed above, is the pedagogical perspective which conceptualizes curriculum implementation as a learning process. The pedagogical perspective conceptualizes the curriculum policy-practice relation as a teaching-learning process with policy makers as the 'teachers', the teachers as 'learners' and the policy message as the 'curriculum'. Spillane, Peterson, Prawat, Jennings & Borman (1996); Drake, et al. (2001); Spillane & Zeuli (1997); Cohen and Barnes (1993) and Cohen and Ball (1990) employ this pedagogical perspective. The pedagogical frame to curriculum implementation is premised on the view that instructional reforms propose fundamental changes in popular notions about teaching, learning and subject matter, necessitating extraordinary amounts of learning by local actors (Spillane, et al., 1996).

This perspective draws attention to three key influences on teachers' learning: the context in which teachers learn, the ideas they bring to their encounters with policy texts and the discourse communities in which teachers are immersed. This suggests that teachers learn from policy rather than passively absorbing and implementing some uniform, fixed vision of policy. Drake et al. (2001) argue that teachers' learning depends, in part, on the organizational arrangements and the norms of the schools in which they work. Whereas some organizational arrangements and social norms can create incentives and opportunities for teachers to learn, others can constrain learning and change, they argue. They point out that what and how teachers learn is also shaped by and situated in their identities as teachers and learners. In this regard, they posit that teachers' responses to instructional reform practices differ, from one teacher to another, given their diverse identities as learners.

Further, Helsing (2007), Spillane et al.(1996) and Cohen and Ball (1990) highlight that instructional policies are filtered through teachers' knowledge and beliefs about teaching and learning and academic subjects, and through their established practices. Helsing points out that teachers combine their practical knowledge about students, instructional techniques, classroom management and school structures with theoretical forms of knowledge (subject matter, psychology, etc) and their personal identities, values, beliefs and history. In relation to instructional reform efforts in the USA, Cohen and Barnes (1993) argue that policy-makers often employ 'didactic approaches' of teaching whereby they primarily tell teachers what to do rather than generating discussion on how to revise classroom practice. This may

result in a lack of clarity on instructional change, and influence teachers to 'make sense of new policies in the light of the old' (Cohen and Ball, 1990, p. 434).

Contextual influences on curriculum implementation

Whereas the foregoing perspectives on curriculum implementation focus primarily on 'teacher' factors, another group of studies emphasizes 'contexts' in which curriculum policy making and implementation occurs and highlights ways in which these contexts influence implementation. The contexts examined include local school contextual factors, the education system where policies are designed as well as the social, political, economic and cultural contexts in which schooling is embedded.

Within the broad perspective on contextual factors, Ball (1998); Morris & Scott (2003) and Jansen (1998) focus on the relations between the education system and the broader socio-political context of the country. Morris and Scott (2003) show how the political context in Hong Kong exerts a strong influence on the nature of curriculum policy and its impact in schools. They point out that curriculum reform aimed at instilling critical thinking, independent thinking and active citizenship was fundamentally in tension with the maintenance of a colonial political system. As a result, they argue, the reform was promoted as a rhetorical slogan rather than as an agenda for change. In conclusion, they observe that the policy was symbolic in that it promised great changes in teaching and learning but in reality did little to disturb prevailing practices.

Jansen (1998) examines the political environment in which curriculum reform is initiated and argues that the OBE curriculum in South Africa was enacted as a political response and so it did not sufficiently attend to modalities of change at classroom level. Ball (1998) recognizes the importance of local politics, culture and tradition and the process of interpretation and struggle entailed in translating generic ideas and ideals into practical policy ideas and institutional practice. He argues that, in policy making and implementation, policies do not easily change existing power and cultural practices.

Another group of studies (Moore, 2005; Muncey et al., 1999; Powell, 1999; Maes, Vandenberghe & Ghesquiere, 1999; Spillane, 1999; Elmore, 1996 and Bowe, Ball & Gold, 1992) focus specifically on the local school contexts in which teachers work, showing how factors operating at this level influence teachers' curriculum implementation efforts. Bowe et

al. (1992), Muncey et al. (1999); Powell (1999); Maes, et al. (1999) and Squires (1999) examine the local contexts of implementation from a micro-political interactionist perspective. They suggest that social structures and micro-politics within schools define possibilities and limits for teachers' actions and so shape their efforts to enact curriculum policy ideas. Squires argues that institutionalization of a new curriculum has social dimensions, given that it occurs within the social structure of the classroom, school, district and state. She elaborates:

In building social structures to support reform, the problems of classroom implementation are nested in school implementation, school implementation is nested in district support, and district support is nested within a context set by the state. This systemic reform means assisting teachers, schools, districts, and states to confront the impact of ripples from the social changes that curricular change generates (1999, p.158).

Muncey et al. (1999) suggest four conditions of a school's social structure that are necessary to sustain and support curricular innovations: open discussion about the curriculum ideas, sensitivity to local contexts, support for teachers and administrators in their change efforts and continued dialogue between schools and reformers. They argue that, although an individual teacher's learning and professional development is paramount, these are supported by opportunities, structures and norms within an organization. Further, Maes et al. (1999), Squires (1999) and Sieburth (1992) examine relationships between the education system, school level and classroom contexts and call for complementarity between these levels as a condition for enhancing curriculum implementation. Sieburth highlights a need to show greater sensitivity to the total context of education during curriculum reform in developing countries, emphasizing that curricula should not be perceived in isolation, but should rather be seen as part of a whole spectrum of related factors.

Benavot & Resh (2003, 2001) and Darling-Hammond, (1990) examine how both systemic and local school contextual factors interact to influence teachers' curriculum implementation efforts. Darling-Hammond argues that the ways in which teachers and other school actors encounter and interpret policies is partly a function of the educational context in which policy operates. This context, she argues, is beset with local considerations for resources, student needs, community expectations for schools, and competing priorities and ideologies as well as a variety of constraints imposed by existing policies. She suggests that existing policies may pose a direct or indirect obstacle to the pursuit of new policy intentions. She argues that,

because of variation in school contextual circumstances, 'local agencies must *adapt* policies rather than *adopt* them' (p. 41, original emphasis).

Darling-Hammond (1990) highlights tension between progressive instructional reforms and contextual demands relating to the curriculum such as pressures to cover content and the demands of examinations. She points out that teachers take on instructional strategies that align with the type of performance elicited by public examinations, particularly when this assessment provides a basis for important decisions about students and schools. In this case, immediate pressures of instruction win out over change initiatives. Benavot & Resh (2003) examine patterns in curriculum implementation within and across schools in Israel. They make a distinction between macro-level factors relating to structural and institutional characteristics of national education systems and meso-level factors relating to community and local school characteristics and highlight how variations in curriculum patterns result from these factors. They argue that a centralized education system minimizes between-school variation in curriculum implementation although school level factors may generate differences across schools.

Moore (2005), Reeves (1999), Kirk and McDonald (2001) examine how factors within the local context of schools shape teachers' curriculum implementation efforts. Kirk & McDonald suggest that, '...their knowledge of their learners' needs and abilities, available resources and the obdurate, practical features of classroom life' (p.564) constitute crucial considerations in teachers' attempts to reform their practice. Likewise, Reeves shows how the time available for instruction constrained teachers' efforts to develop key concepts and skills in natural science lessons in a coherent manner. Further, she points out that inadequate physical resources, large class sizes and learners' abilities constrained teachers' efforts to enact the goals of natural science within the OBE curriculum 2005 in South Africa. In some cases school contextual factors compel teachers to adopt pedagogic approaches unique and tailored to specific schools (Jacklin, 2004; Moore, 2005). Although teachers endeavour to adapt their contexts of work to particular pedagogic purposes, Jacklin identifies a pedagogic form she terms 'repetition-led' that empties pedagogic practice of its purpose, rendering it a repetitive habituated practice.

Moore (2005) identifies 'contingent-pragmatism' as one of the ways in which teachers adapt education reforms to contextual realities. He describes contingent pragmatism as:

Those instances wherein teachers adapt or embrace teaching approaches and philosophies according to specific circumstances that may change with time or location - perhaps the circumstances of their own particular school's intake or location, for example, or the circumstances of particular pressures (2005, p.198).

Moore highlights pressures imposed by the demands of national assessment as key in teachers' responses to mandated change. He suggests that teachers may temporarily suspend elements of previously held values and philosophical or pedagogical orientations, putting these aside until circumstances change. In conclusion, he asserts that teachers' eclecticism in adopting pedagogic innovations is based on their notions of pedagogic effectiveness and that contingent pragmatism is a survival response professionally, emotionally and institutionally.

The foregoing sections have examined a range of perspectives on curriculum implementation, highlighting the main influences on teachers' responses to centrally mandated curriculum change. The following section surveys curriculum implementation studies involving progressive pedagogy.

2.3 Implementation of progressive pedagogic reforms

This section focuses specifically on literature relating to curriculum implementation involving 'progressive' or what is more commonly referred to as 'learner-centred' pedagogy¹. Much contemporary curriculum reform is informed by notions of learner-centred practice. The main interest in this section of the review is to show how teachers elsewhere have taken up progressive pedagogic approaches and what these experiences suggest for the implementation of the problem solving approach examined in this study. In chapter three, I point out that the problem solving approach, like other progressive pedagogies, adopts a 'competence' model of pedagogic practice which seeks to empower learners with high order thinking skills, including critical thinking, initiative and problem solving abilities (NCDC, 1999, 2000). Muller (1998) suggests that the global economy requires active, creative workers with critical thinking skills. In this view, the aims of the problem solving approach are not uncommon in contemporary curriculum reforms across the globe (Atkin, 1998; Brodie, Lelliott & Davis, 2002a; Mason, 2007; Singh, 2002; Taylor & Vinjevold, 1999).

¹ I use these two terms interchangeably in this thesis.

Taylor (1999) outlines the broad goals of the competence model of pedagogy on which progressive reforms are premised:

Schooling should equip learners to exhibit independence and initiative in directing their own learning. They should be able to ask questions, evaluate evidence, defend arguments, and apply their knowledge to new situations. In short, learners should acquire high order thinking skills that go beyond recall, recognition and reproduction of information, to the evaluation, analysis, synthesis, production and application of ideas (p.109-110).

In general, progressive pedagogy seeks to empower learners to take control of and responsibility for their own learning in order to develop their autonomy, creativity and initiative (Muller, 1998). Historically, ideas on progressivism date back to the beginning of the twentieth century to Piaget and to John Dewey whose experimental school in the USA was structured around children's interests (Brodie et al, 2002a).

Curriculum reforms involving learner-centred practices are associated with three interrelated aspects relating to curriculum, pedagogy and interpersonal/social relations (Brodie et al., 2002b). First, learner-centred practices promote a curriculum that is *responsive* to learners' needs, including aspects of their backgrounds and everyday knowledge; a *negotiated* curriculum and an *integrated* curriculum. It is argued that such a curriculum empowers learners, builds their self-identities and confidence and promotes social relevance (Kasanda, 2005; Koosimile, 2004; Muller & Taylor, 2000; Taylor, 1999). Relationships between school and everyday knowledge are considered to provide pedagogical 'tools' for inducting learners into the art of formal discourse and for the practical application of formal knowledge to problems in everyday life (Taylor, 1999). This two-way relationship between everyday and school knowledge is referred as a 'double-move' by Hedegaard (1998) and as 'border-crossing' by Aikenhead (1996). Despite these pedagogic and social benefits, there is a long-standing debate on the details of the relationship between formal school knowledge and everyday knowledge. I return to this discussion shortly below.

Secondly, in relation to pedagogy, learner-centred approaches are based on competence models which embrace an *emancipatory* vision in which learners take control of their own learning: they are active, creative and self-regulating (Taylor, 1999; Muller, 1998; Rowell, 1995). Direct control of the teaching and learning process is considered to 'interfere' with the 'natural' process of learning; therefore a teacher is considered a 'guide' and 'facilitator' and not a 'transmitter' of knowledge (Bernstein, 2000; Taylor, 1999; Reeves, 1999; NCDC,

1999; 2000). Learner-centred practices aim to overcome authoritarian teaching and learning practices by promoting learners' involvement in decision making processes in classrooms. Oyler and Becker (1997) invoke a metaphor of the 'rock' and 'soft place' where the 'rock' refers to traditional practices and the soft place refers to progressive ideas. These scholars observe that teacher authority has been critiqued for many generations and this has ushered us into the 'soft place' of the non-authoritarian classroom as a solace from the 'damaging pedagogies of control and indoctrination' (1997, p. 454).

This model of pedagogy has implications for the third element of learner-centred practices, that relating to the teacher-learner relationship or social relations. Unlike what occurs in typical traditional teacher-centred practices, learner-centred pedagogies emphasize symmetrical relationships between teacher and learners as well as among learners themselves. Brodie et al., (2002a) describe these ideal social relations:

Learner-centred classrooms and schools are often considered to be those where there are relationships of respect and trust between teachers and learners. Teachers acknowledge learners and their achievements, and in this way motivate them to learn and achieve. Learners should not fear teachers, as this could inhibit their learning (p.96).

Reiterating the foregoing quote, Hayes, et al. (2006) call upon teachers to ensure safety and respect in pedagogic contexts. They argue that children from marginalized backgrounds do not engage in classroom interactions as expected because they fear failure. However, these scholars emphasize that good social outcomes are associated with classroom practices that are not only socially supportive but also intellectually demanding and connected to the students' world beyond schools. While the progressive approach calls for relatively horizontal teacher-learner relations, Bernstein (1990) maintains that pedagogic relations between a teacher and learners is inherently asymmetrical, hence his use of the term 'hierarchical rules'. However, he argues that a range of communication devices can be used to 'disguise' the vertical power relations between teachers and learners.

As mentioned above, there is considerable controversy over the role of everyday knowledge in progressive curriculum reforms (Hayes, et al., 2006; Davis, 2005; Reeves, 2005; Cross, Mungadi & Rouhani, 2002; Muller, 2000; Taylor & Vinjevoid, 1999). Muller (2000), Taylor and Vinjevoid (1999) are sceptical about an obsession with everyday knowledge, arguing that most teachers are in danger of compromising the integrity of formal school knowledge,

particularly for learners from disadvantaged home backgrounds. This pessimism is premised on the view that teachers with poor subject content matter and poor professional backgrounds are unlikely to successfully 'navigate' the borders between school and everyday knowledge. Hayes et al. (2006) argue that children should not only study 'popular knowledge', but also a variety of 'powerful knowledges' that provide them with access to opportunities in the broader social context. In a similar vein, Cross, et al. (2002) caution that a side effect of progressivism is the overemphasis on learner centeredness at the expense of a critical cognitive dimension, where knowledge is left to that embedded in personal experience ignoring explicit disciplined knowledge.

Whereas proponents of progressivism call for weak boundaries between school and everyday knowledge, its critics maintain that this form of knowledge denies less privileged learners access to principled school knowledge and amounts to 'wasting' their time in school. They insist that the integrity of disciplined knowledge be maintained and disregard everyday knowledge as 'a private matter which has no place in the school curriculum' (Taylor, 1999, p.112). In addition, whereas an integrated curriculum aims to promote the interconnectedness of knowledge, Oslon and Lang (1999) argue that facilitating subject-based conceptual development while simultaneously providing links across subjects and highlighting socially relevant connections is a major challenge over looked by those calling for integration of subjects. Reeves (1999) and Koosimile (2004) highlight how teachers' attempts to integrate science and everyday knowledge results in fragmented learning and conceptual confusion.

The main contention surrounding school and everyday knowledge relationships concerns differences in the knowledge structures of the two discourses which, if not well attended to, results in conceptual confusion (Muller, 2000; Taylor, 1999). These knowledge structures are discussed in detail in chapter three. To emphasize the issue above, Kasanda et al. (2005) and Reif & Larkin (1991) point out the need to recognize differences in methods of knowledge construction in everyday and scientific domains. They argue that whereas knowledge construction and mediation is 'rule based' reasoning in science, it is 'associative thought' in everyday knowledge. As a step in the process of bridging everyday and school knowledge, scholars advocate careful 'navigation' of the boundary between the two forms of knowledge (Hayes, et al., 2006; Muller & Taylor, 1995; Taylor, 1999). Aikenhead, (1996) argues that transition between these two domains of knowledge requires 'border crossing'

which is easier when there is a match between everyday knowledge, school contexts and science domains.

On the whole, although progressive pedagogies require teachers to play a more 'covert' role than do teacher-centred practices, they nevertheless make far greater demands on the teacher (Darling-Hammond, 2005; Brodie et al., 2002b; Bernstein, 2000; Taylor, 1999; Reeves, 2005; 1999; Smerdon, Burkham & Valerie, 1999). Bernstein (2000) argues that the pedagogical principles of a competence model of practice are sophisticated and so require teachers with a strong theoretical knowledge base. However, evidence from South Africa as in other developing countries shows that the majority of teachers lack this type of knowledge base (Taylor & Vinjevold, 1999). In addition, Bernstein points out that those competence models of pedagogic practice involve a range of 'hidden costs' which are time related. Teachers must guide learners to meaningful learning, construct instructional resources, attend to individual learners or groups and cooperate with other teachers in the school to provide an integrated curriculum. Further, Smerdon, et al (1999) suggest that learner-centred approaches are time consuming because activities take a lot of time if learners are to learn from them.

Brodie, et al. (2002a) report that teacher characteristics such as prior qualifications, reflective competence, grade level, subject knowledge and competence, access to resources and support structures within schools are all implicated in their take-up of learner-centred practices. Taylor (1999) concludes that the extreme demands placed on teachers constitute the main obstacles to the successful implementation of progressivism.

Effective implementation of progressive pedagogy in which learners' individual needs and differences are addressed requires flexibility in classrooms and schools to deal with variability rather than assuming uniformity (Chisholm and Leyendecker, 2007; Darling-Hammond, 2005; Rowell, 1995). Darling-Hammond points out that, unlike transmission teaching which is straight forward, teaching for a deep understanding of knowledge that can be applied in diverse situations requires a much more complex practice from teachers. Moreover, 'active' learning situations infuse more uncertainty into the teaching process, she argues. Teachers' efforts to attend to learners' individual needs often comes into tension with traditional teaching schedules, syllabus coverage, demands of national assessments and other elements that define the schooling enterprise (Taylor & Mulhal, 2001; Darling-Hammond, 2005). These tensions ought to be addressed or else curriculum initiatives

involving progressive pedagogy are 'strangled' or, as Brodie et al (2002b) report, teachers may also take-up the 'forms' rather than 'substance' of learner-centred practices.

Scholars point out that, whereas constructivism provides a model of learning that emphasizes 'active' learning approaches, it does not provide an adequate model for teaching (Chisholm & Leyendecker, 2007; Sykes, 1990). Chisholm notes that:

Learner-centred education is more specific about the nature of learning and less specific on the pedagogies and detailed provision of outcomes in formal schooling. Its origins and ambiguities also allow a variety of different understandings that go beyond the classroom (2007, p.3).

Polarized debates about the effectiveness, merits and limitations of teacher centred and learner-centred pedagogies are beginning to converge as scholars recognize that a 'mixed' or hybrid pedagogy, incorporating elements of both pedagogic modes, is most effective for all learners (Hayes, et al., 2006; Reeves, 2005; Morais, 2002; Oyer & Becker, 1997). Oyer and Becker (1997) resist the idealist 'all-good' and 'all-bad' affinity characterizing traditional /progressivism debates and identify what they call a 'different place'. They argue that this 'different place' is not merely a middle ground between the two extremes but a place with its own identity, one which adopts desirable aspects from both the 'rock' and the 'soft place'. This view is generally consistent with the empirical work conducted within a Bernsteinian framework which shows that 'mixed' pedagogies are most favourable for learning for all children (Morais, 2002; Morais & Neves, 2001).

2.4 Progressive pedagogy in curriculum reform in Africa

This section explores the literature on implementation of progressive pedagogies in Africa. As discussed earlier, learner-centred pedagogies have gained currency in Africa as in other parts of the world. Learner-centred practices are promoted in Africa on the premise that they offer an effective antidote to teacher-centred didactic practices, associated with teacher dominance and passive learners, rote learning and the stifling of critical and creative thinking (O'Sullivan, 2004; Rowell, 1995). Curriculum 2005 in South Africa, also referred to as OBE, provides an example of curriculum reform involving progressive pedagogy. In addition to the problem solving approach in Uganda discussed in this study, other examples of curriculum reforms involving progressive pedagogy in Africa are reported in Namibia (Rowell, 1995), Botswana (Tabulawa, 1997) and Nigeria (Chisholm & Leyendecker, 2007).

Despite education reform efforts and teacher education targeting learner-centred practices, teacher-centred practices have persisted in African countries (Chisholm & Leyendecker, 2007; Brodie, et al, 2002b; Taylor & Mulhall, 2001; Rowell, 1995) as in the USA and other parts of the world (Cuban, 1993; Gore, 1995; Darling-Hammond, 2005). Gore attributes the constancy of teacher-centred practices to power relations underlying pedagogic processes:

The apparent continuity in pedagogical practice across sites and over time has to do with subtle but pervasive exercises of power relations in educational institutions and processes that remain untouched by the majority of curriculum and other reforms (1995, p.166).

She observes that, with the exception of sociological studies drawing on Bernstein's work and that of Bourdieu & Passeron (1977), educational researchers have paid little attention to the micro-level functioning of power in pedagogy. Within the African context the rigidity of teacher-centred practices is attributed to its long history, insufficient instructional resources to promote learner inquiry and the broader social and economic contexts in which schooling is embedded (Taylor & Mulhall, 2001; Rowell, 1995). In addition, some scholars suggest that the principles of progressivism are incompatible with the broader social and economic context in most African countries (Chisholm & Leyendecker, 2007; Lee & Luyx, 2005; Tabulawa, 1997; Rowell, 1995).

Drawing on experiences from South Africa and Namibia, Chisholm & Leyendecker argue that local cultural and contextual realities and capacities seem to be overlooked in legislating learner-centred practices in sub-Saharan African countries. They highlight how the broader cultural context in these countries constrains learner-centred practices along with material constraints on implementation. In addition, while progressivism promotes learner involvement through activities such as group work, Kasanda et al. (2005) argue that in contexts where adults are respected as keepers of knowledge and the young are expected to learn from their elders, teachers trying to implement learner-centred education have to break down traditional barriers and encourage learners to contribute their ideas and experiences. Likewise, learner-centred approaches encourage students to ask questions and find answers on their own. Lee and Luykx (2005) point out, however, that the norms of classroom interaction associated with this approach are often incompatible with cultural values some students learn at home.

Rowell (1995) points out that the long history of teaching and learning in Africa does not support student participation and inquiry, stifling efforts to introduce progressive pedagogies. For example, in South Africa and Namibia, the legacy of the apartheid regime with its segregated education policies heightened authoritarian teaching practices (Blignat, 2005; Rowell, 1995). Further, as discussed earlier, learner-centred practices require flexibility in instruction and curriculum frameworks. However, as Taylor and Mulhall (2001) point out, teacher flexibility in African countries is stifled by a very prescriptive curriculum that allows little room to respond to learners' individual and heterogeneous needs.

As a key element of progressive pedagogy and in pursuit of social relevance and meaningful learning experiences, relating curriculum knowledge to every day contexts in science teaching is promoted in Africa (Kasanda, et al., 2005; Taylor & Mulhall, 2001; Peacock, 1995). Relating curricular knowledge to everyday contexts is intended to allow learners to take control of their own learning, to increase their participation in class by enhancing their motivation and also to help them to determine what is to be learned (Koosimile, 2004). Curricula involving everyday contexts, also referred to as 'contextualized' science teaching, are reported mainly in the Southern African countries of Swaziland (Campbell & Lubben, 2000; Dlamini et al., 1996; Lubben, et al., 1996) and Botswana (Koosimile, 2004). However, there is inconclusive evidence of the extent to which the expectations of contextualized curricula have been realized (Koosimile, 2004; Cajas, 1998; Lubben, et al., 1996). Koosimile argues that, whereas official curriculum rhetoric emphasizes 'relevance', there are no clear pedagogical tools to help teachers to link science with out-of-school experiences. In Uganda the curriculum aims to produce citizens who are scientifically and technologically functional as a means to achieving social transformation.

As discussed in relation to the international literature, the broader context of schooling, particularly centralized education systems, poses further challenges for the implementation of learner-centred practices in Africa. Rowell (1995) argues that effective progressive pedagogy requires a shift in locus of control at all levels of the education system: curriculum administration, educational administration and governance, school and classroom levels. She points out that centralized curricula, which provide uniform content and assessment regardless of environments, come into tension with the tenets of learner-centeredness that emphasize learning experiences tailored to learners' diverse localities and communities. In conclusion, Rowell notes that it is not helpful to legislate changes in teachers' pedagogic

practices when the broader school and community contexts remain intact and unsupportive of classroom practices.

Cross, et al. (2002) raise concerns about the ‘appropriateness’ of progressive pedagogies in Africa. They observe that conversations on curriculum reform focus primarily on implementation, neglecting what they consider to be an even more significant problem: the theoretical underpinning of curriculum change itself. These scholars implicitly suggest a need to shift the debate to focus on whether we should have progressive pedagogies in Africa in the first place.

The complexities of curriculum implementation are pertinent to this study which seeks a better understanding of the intricate issues inherent in teachers’ efforts to translate official curriculum prescriptions into their classroom practice. It is hoped that evidence from implementation provides a better platform for discussing the appropriateness of the intended curriculum.

2.5 Reflection on the literature

The foregoing literature highlights the important role that teachers play in promoting or constraining implementation of curriculum policy. In spite of the differences in perspectives and variables foregrounded by various researchers, all converge on the view that curriculum implementation does not directly reflect the intentions of curriculum designers. Rather, they suggest that curriculum implementation entails varying degrees of adaptation of the policy message. The literature identifies several intervening variables that mediate teachers’ curriculum implementation efforts and processes. However, it is important for curriculum implementation research to advance beyond this level to examine the processes through which curricula get modified during implementation.

Spillane, et al. (2002) and Williams and Williams (1994) suggest the need to unpack ‘how’ curriculum policy evolves during implementation by focusing on the processes of implementation. Williams and Williams observe that in spite of the numerous studies of the effects of change and innovation in schools, these studies do not assist with understanding the process of change itself. They argue that a comprehensive understanding of the factors influencing the adoption, implementation and continuation of change is central to effective implementation of curriculum innovations. Identifying the factors that govern successful

innovation enables us to protect or introduce positive factors in the process, they suggest. Further, in view of the intricate relations between classroom practice and contextual factors, Maes et al., (1999) suggest a need to explore relations between school level factors and teacher-classroom factors, arguing that complementary relations between these two levels is necessary for effective implementation of instructional change. They refer to the former as a structural-functional perspective, and the latter as the cultural-individual perspective.

Conclusion

This chapter has surveyed the literature on curriculum implementation, drawing on experiences from Uganda, Africa and broader international perspectives. This literature converges on a common problematic of curriculum policy initiatives, particularly those relating to instructional change, persistently failing to penetrate classroom practice. In particular, it has foregrounded the challenges of implementing progressive pedagogies in African countries where these initiatives have been attempted. The chapter has shown how the current study extends the foregoing debates by addressing some under researched aspects of curriculum implementation scholarship, particularly in the developing world. The next chapter extends the empirical literature by conceptualizing curriculum implementation within a sociological theoretical framework.

CHAPTER THREE: THEORETICAL FRAMEWORK FOR CURRICULUM IMPLEMENTATION AND PEDAGOGIC PRACTICE

This chapter presents the conceptual and analytical framework for the study. This study conceptualizes curriculum implementation from a sociological perspective, drawing primarily on Basil Bernstein's theory of pedagogic discourse (1990; 1996; 2000), extended with concepts from Paul Dowling's social activity theory (1998). Bernstein's theory of pedagogic discourse provides a strong conceptual and descriptive vocabulary for pedagogic practice (Morais & Neves, 2001; Singh, 2002, Sadovnik, 1995b). Morais & Neves highlight how Bernstein's language of description provides a conceptual structure that is 'diagnostic, predictive, descriptive, explanatory and transferable, broadening the relationships studied and permitting conceptualisation at a higher level, without losing a dialectical relation between the empirical and the theoretical' (2001, p.187).

The following section provides an overview of the relevance of Bernstein's theoretical work to my empirical project, and highlights why I needed to extend the conceptual framework with concepts from Dowling's social activity theory. Two subsequent sections discuss the main concepts adopted from each of these two theories to constitute a conceptual and analytical framework for the study. Following this, I highlight how Bernstein's work has been taken up and also discuss some criticisms directed at his ideas. In the final section of the chapter, I summarize the analytical framework to highlight how Bernstein's and Dowling's concepts are operationalized in the empirical study.

3.1 An overview of Bernstein's work and its relevance for the present study

Bernstein provides a theoretical model for understanding curriculum implementation processes in terms of the theory of the pedagogic device that explains the production, distribution and reproduction of official school knowledge. The pedagogic device sets rules for the construction, distribution and transmission of school knowledge, which Bernstein refers to as 'pedagogic discourse'. The notion of 'recontextualization', which refers to reinterpretations of pedagogic discourse as it moves across the different fields of the pedagogic device, provides insight into the adaptations and transformations that characterize curriculum implementation. Bernstein's concepts of classification and framing provide a

'language of description' for pedagogic practice. These key concepts provide a common language of description for the different strands of this study, namely pedagogic prescriptions for the problem solving approach within official curriculum documents, teachers' classroom practice and teachers' accounts of classroom practice.

The theory of pedagogic discourse is part of Bernstein's larger sociological project in which he links macro-structural relations to micro-level interactional processes in pedagogic practice. This broader project examines how social relations are reproduced by cultural and specifically pedagogic practice. Bernstein is concerned with how a given distribution of power and principles of control are translated into specialized principles of communication differentially, and the consequences of this for the distribution of symbolic resources.

Bernstein's intellectual project has distinct strands which were given emphasis in particular historical periods. His earlier work in the 1970's was concerned with linguistic codes and their social origins in families (Bernstein, 1971, 1973). In the late 1970s and 1980s, Bernstein focused on modalities of elaborated codes and their institutionalisation in education (Bernstein, 1975, 1977). In the 1990s, Bernstein's work focused on the social structuring of pedagogic discourse and its realization in pedagogic practice as a relay for society's distribution of power and principles of control (Bernstein, 1990, 1996, 2000).

My study draws primarily on Bernstein's later work, particularly on his ideas on the production and reproduction of pedagogic discourse, and on pedagogic practice. Bernstein's work provides a sociological analysis of curriculum and pedagogy, working from the premise that, 'How a society selects, classifies, distributes, transmits and evaluates the educational knowledge it considers to be public, reflects both the distribution of power and the principles of social control' (1977, p.85). His concepts of classification and framing provide a language of description for curriculum and pedagogy at the macro-level of curriculum and the micro level of pedagogic practice. Classification is concerned with the organization of knowledge into curriculum and framing is concerned with the transmission of knowledge through pedagogic practices (Sadovnik, 1995). Both the macro and micro levels of curriculum and pedagogy are central to this project.

My study requires a language of description for the structure of pedagogy, the 'how' and the type of content transmitted, the 'what'. Bernstein's concepts of classification and framing

describe the structure of pedagogy, the form of knowledge and the relationship between the two. The concept of classification describes the knowledge transmitted in pedagogic processes, the 'what', but does this only in terms of its *form* and not in terms of its *content*. In order to realize the latter task, I turned to the work of Paul Dowling (1998). Dowling's (1998) social activity theory conceptualizes school subjects as 'social activities' and their instructional content as their 'practices'. Dowling describes the degree of specialization of subject content through the concepts of domains of practice and discursive saturation. In addition, Dowling describes the manner in which knowledge is distributed through the concepts of distributing strategies.

Bernstein addresses specialization of categories, such as curriculum subjects, through his concept of classification, and suggests that the strength of 'boundary' *between* categories expresses its identity and specialization. Like Bernstein, Dowling also employs the term 'classification', but recruits it differently to describe the degree of specialization of content. For Dowling, specialization does not inhere in boundaries but *within* the discourse itself, so he looks at the content of a discourse. Bernstein and Dowling have similar interests but they work from different epistemological perspectives. They are both interested in the consequences of differences in the distribution of knowledge forms and types to learners from disadvantaged backgrounds. In this regard they both examine the social implications of unequal distribution of symbolic resources.

My project examines the transmission of knowledge in a particular set of pedagogic contexts where the problem solving approach has been adopted. I examine the types of knowledge and transmission strategies that the teachers in my study associate with the problem solving approach. Together, Bernstein and Dowling's concepts provide a holistic conceptual frame and language of description for pedagogic practice covering 'what' is transmitted in classrooms and 'how' this is transmitted. These concepts enable me to describe the form of knowledge and knowledge relationships as well as the instructional content. Bernstein's conceptual vocabulary describes the organizational and interactional dimensions of classroom practice, as well as the structure or form of pedagogic discourse with reference to the degree of insulation of the *boundaries* between categories of knowledge. Dowling's concepts enable me to describe the substance of what is transmitted in terms of its specialisation and how the transmission of this form of content is effected.

Although the study draws concepts from both these theoretical perspectives, it is primarily based on Bernstein's theory. The following sections examine the key concepts I draw from Bernstein and Dowling's theories to conceptualize my study.

3.2 Concepts from Bernstein's theory of pedagogic discourse

The pedagogic device

A pedagogic device is a 'relay' or ensemble of rules and procedures by which knowledge is transformed into pedagogic communication (Bernstein, 2000). The concept of a pedagogic device answers Bernstein's own question: 'Are there any general principles underlying the transformation of knowledge into pedagogic communication, whether the knowledge is intellectual, practical, expressive, or official knowledge or local knowledge' (1996, p.39). Bernstein makes a distinction between the pedagogic device as a 'relay' or 'carrier' and its realizations (pedagogic discourse and pedagogic practice) as 'the relayed' or the 'carried' (Bernstein, 2000, p.25). He suggests that the pedagogic device provides the intrinsic grammar of pedagogic discourse through three hierarchically related rules: the distributive rules, recontextualizing rules and evaluative rules. These rules underlie the contexts for production and reproduction of pedagogic discourse.

The three rules of the pedagogic device are hierarchically arranged; recontextualizing rules are derived from distributive rules and evaluative rules are derived from recontextualizing rules. Distributive rules regulate the knowledge distributed to different social groups and by so doing specialize consciousness differentially amongst these social groups. These differences generate different orientations to meaning and pedagogic identities among social groups (Singh, 2002). Distributive rules 'mark and distribute *who* may transmit *what* to *whom*, and under what *conditions* and in so doing attempt to set the outer and inner limits of legitimate discourse' (Bernstein, 1990, p.183, my emphasis). In other words, distributive rules determine the forms of knowledge ('what') and transmission-acquisition processes ('how') made available to different groups of students through schooling.

Recontextualizing rules regulate how specific pedagogic discourses are produced; they regulate how the 'what' and 'how' of pedagogic discourse is constituted. Recontextualizing rules construct pedagogic discourse by refocusing and re-constituting the original discourse from the field of production through a process Bernstein refers to as 'recontextualization'.

The original discourse goes through ideological screens as it is delocated and relocated according to specific organizing principles to produce its new form, pedagogic discourse.

Evaluative rules construct pedagogic practice by condensing the criteria to be transmitted and acquired, 'These rules regulate pedagogic practice at the classroom level, for they define the standards which must be reached' (Bernstein, 2000, p.115). Singh describes evaluative rules as being concerned with recognizing what counts as valid acquisition of instructional (curricular content) and regulative (social conduct, character and manner) texts' (2002, p.573).

Fields of the pedagogic device

The rules of the pedagogic device operate in three fields: the production, recontextualization and reproduction fields. These fields are hierarchically related in that recontextualization cannot occur prior to production of knowledge and reproduction can not take place before recontextualization. The field of production is where new knowledge or discourse is produced, mainly through research in institutions of higher education and private research organizations. Bernstein makes a distinction between primary contexts for the production of pedagogic discourse *within* the educational system and those *without* it and notes that 'there are primary contexts and sites for the production of pedagogic discourse *external* to the educational system' (1990, p.193). Bernstein focuses mainly on sites of knowledge production within the education system.

The recontextualizing field comprises two sub fields; the official recontextualizing field (ORF) of the state and its local education authorities and the pedagogic recontextualizing field (PRF) comprising curriculum bodies, teacher education institutions along with their research and specialized publishing houses such as journals. The reproduction field is located in schools and other educational institutions where official knowledge is transmitted in pedagogic contexts. The field of reproduction, in schools, is also referred to as the 'local recontextualizing field' (Bernstein, 1990). In this view, the local recontextualizing field provides a vantage point for analyzing curriculum implementation and the teacher's role in mediating reforms as she transmits official pedagogic discourse.

Construction and recontextualization of pedagogic discourse

Bernstein suggests that pedagogic discourse is constructed by 'a recontextualizing principle which selectively appropriates, relocates, refocuses and relates other discourses to constitute its own order' (2000, p.33) and this transforms the original discourses. Briefly, the recontextualizing processes constitute the 'what' and 'how' of pedagogic discourse. The 'what' refers to categories of content and is recontextualized from intellectual fields such as physics and chemistry. The 'how' refers to the manner of transmission of pedagogic discourse entailing theories of instruction which are recontextualized from fields such as psychology. Therefore, the recontextualizing principle recontextualizes the 'what' of pedagogic discourse, the content that is taught as well as its 'how', the theory of instruction (Bernstein, 1996).

Bernstein emphasizes that pedagogic discourse is not identified with any of the discourses it recontextualizes because it is refocused according to different principles to constitute its new form as school knowledge. This implies, for example, that school physics is not identical to physics as practiced by physicists because the former is re-organized and so it loses its original form. Whenever a discourse moves from one site to another it undergoes a transformation because 'there is a space in which ideology can play': 'No discourse ever moves without ideology at play' (2000, p.32). Bernstein attributes recontextualizing processes to the ideologies of the various agents within the recontextualizing field. Recontextualizing processes within the fields of recontextualization and reproduction of official school knowledge generate 'change' at two levels:

When a text is appropriated by recontextualizing agents, operating in positions of this field, the text usually undergoes a transformation prior to its relocation...this process ensures that the text is no longer the same text...It is crucial to distinguish between, and analyze, the relations between the two transformations, at least of a text. The first is the transformation of the text within the recontextualizing field, and the second is the transformation of the transformed text in the pedagogic process as it becomes active in the process of the reproduction of acquirers (1990, p. 192-193).

In addition, Bernstein highlights how specific school contexts, and their relations with communities from which children originate influence recontextualizing processes:

However, what is reproduced in schools may itself be subject to the recontextualizing principles arising out of the specific context of a given school and the effectiveness of external control over the reproduction of official pedagogic discourse. Further, what is reproduced may be affected by the power relationships of the recontextualizing field between the school and the primary cultural context of the acquirer (family/community/peer relations) (1990, p. 199).

Influence on recontextualizing processes from school and communities constitutes part of the 'external framing' of pedagogic practice. Neves & Morais (2001) suggest that teachers may be unable or unwilling to implement the official pedagogic discourse legitimated by the pedagogic device. These scholars assert that a pedagogic device which offers more potential for recontextualizing generates more 'space' for change within pedagogic discourse and this dynamism characterizes curriculum reform processes.

Struggles and conflicts within the fields of the pedagogic device are rife, particularly between agents in the official recontextualizing field and pedagogic recontextualizing field, particularly where these two fields are strongly insulated from each other. For example, agents in the pedagogic recontextualizing field may contest the principles of pedagogic practice legitimated by the pedagogic device in relation to the theory of instruction. According to Bernstein, these struggles are over control of the principles of pedagogic discourse and its practices. Singh emphasizes that, 'incentives are huge in this struggle, for the group that appropriates and controls the pedagogic device exercises power in relation to distribution, recontextualization and evaluation of complex knowledge forms' (2002, p.577).

Jacklin (2004) and Lamnias (2000) argue that, along with features inherent in the pedagogic device, local contexts of implementation constrain the potential regulation of pedagogic practice by the official pedagogic device. This is particularly so in developing world contexts where the material and human capacities required for curriculum implementation may not be available in schools (Jacklin, 2004). In view of these contextual constraints, Jacklin cautions researchers against 'an understanding of the operations of the device as simple and mechanical, and against neglecting the historical and spatial specificity of the operation of the pedagogic device in different times and places' (2004, p.29). This study investigates ways in which the operation of the pedagogic device interacts with contextual factors to regulate pedagogic practice. This latter aspect is examined in more detail below in my discussion of the concept of pedagogic culture.

This study conceptualizes curriculum implementation as a process involving selection and reinterpretation or 'recontextualization' of the official pedagogic discourse. In this view, curriculum implementation involves 'recontextualizing processes' in the local field of recontextualization (school) and this entails space for change, or what Bernstein refers to as room for 'play'. The logic of this process suggests that teachers reinterpret official pedagogic

discourse in the context of pedagogic practice rather than 'reproducing' it in the form constituted in the official recontextualizing field. This study examines teachers' recontextualizing processes from two perspectives. First, it is examined in terms of teachers' interpretations of the problem solving approach. The study posits that this dimension of recontextualization constitutes teachers' recognition rules which provide a basis for their realization rules in pedagogic practice (Spillane, 1999, 2000; Spillane & Zeuli, 1999). Secondly, the study examines how teachers enact the problem solving approach in pedagogic practice.

By making a distinction between the two levels of recontextualization above, the study recognizes the possibility that teachers' interpretations of the official curriculum may not be fully realized in pedagogic practice, creating 'space' for further recontextualization. The gap between teachers' interpretations of the official curriculum and their classroom practice may be attributed to school contextual constraints, among other factors. Therefore this study conceptualizes curriculum implementation as comprising a vertical dimension entailing recontextualization of official pedagogic discourse and a horizontal dimension resulting from school contextual factors. The latter dimension is conceptualized through the concepts of external framing and pedagogic culture.

Further, the study constructs a parallel relation between 'recontextualizing principles' that regulate the production of official pedagogic discourse in the official recontextualizing field and principles regulating teachers' curriculum implementation processes in schools. In this view, the study seeks to understand what regulates teachers' recontextualizing processes as they enact the official pedagogic discourse in pedagogic practice. I refer to teachers' rationales for pedagogic practice as their 'recontextualizing rules/principles' and tentatively posit that these derive from the official pedagogic discourse and are mediated by the contextual influences from schools in which teachers work. Teachers' interpretations of the official curriculum policy are conceptualized as constituting their recognition rules and passive realization rules.

Pedagogic discourse

Bernstein suggests that pedagogic discourse is a cultural relay that reproduces dominant power and control relations through micro level transmission-acquisition processes. He

suggests that dominant power and control relations are realized as institutionalized forms of pedagogic communication (1996, p.19).

Bernstein defines pedagogic discourse as a rule or principle which embeds two discourses: instructional discourse and regulative discourse (1996, p.46). Instructional discourse is ‘a discourse of skills of different kinds and their relations to each other’. It entails competencies and regulates ‘*what*’ is transmitted in pedagogic practice. Regulative discourse is a discourse of order, relation and identity and for that reason it contains the norms of social conduct that underlie and regulate the form taken by the pedagogic practice. Regulative discourse entails a set of values, attitudes, and socio-affective competencies valued in particular teaching-learning contexts and it regulates ‘*how*’ knowledge is transmitted. The relation between instructional and regulative discourses is written as:

$$\frac{ID}{RD}$$

The solidus² implies that instructional discourse is embedded in regulative discourse with the latter constituting the dominant discourse. Bernstein posits that regulative discourse is dominant because it does not only set the norms of social conduct but also provides order in instructional discourse:

It is of course obvious that all pedagogic discourse creates a moral regulation of the social relations of transmission/acquisition, that is, rules of order, relation, and identity, and that such a moral order is prior to, and a condition for, the transmission of competencies (1990, p.184).

Bernstein concludes that, ‘If this is so, the whole order within pedagogic discourse is constituted by the regulative discourse’ (Bernstein, 2000, p.34). He emphasizes that pedagogic discourse is not a *discourse* or subject such as chemistry or physics but a *principle*, more specifically a *recontextualizing principle* that selects from different discourses to form its own order. ‘It is the principle by which other discourses are appropriated and brought into a special relationship with each other, for the purpose of their selective transmission and acquisition’ (1996, p.46-47). In this view, pedagogic discourse is a discourse without a discourse (Bernstein, 2000, p.32). It defines the order and content of discourses but has no content of its own.

² The line separating the numerator (ID) from the denominator (RD).

Theories of instruction constitute part of the recontextualized discourse; they determine 'how' pedagogic practice is constituted and in this sense they form part of the regulative discourse. A theory of instruction regulates the order of pedagogic practice and constructs a model of the learner and of the teacher and of their relationship and pedagogic context (Bernstein, 2000, 1990). This implies that changes in the theory of instruction potentially have consequences for the ordering of pedagogic discourse and pedagogic practice. For example, the problem solving approach constitutes a theory of instruction because it provides a model of a teacher as 'facilitator', and a learner as 'self-regulating' and defines the nature of the teacher-learner relationship. Bernstein proposes two main theories of instruction: one in which power is explicit (teacher-centred practices) and another where the teacher's power is implicit (centred on the learners). These two theories of instruction are examined in more detail in a later section.

As mentioned above, pedagogic discourse translates power and control from the macro social division of labour into pedagogic practices at the micro level. In this way, dominant power and control relations in society are reproduced through pedagogic practices. Classification and framing relations provide the means for translating power and control relations into pedagogic practice. These concepts are discussed below.

Classification and framing

Bernstein (2000) differentiates between the concepts of classification and framing; he associates classification with power and framing with control. These concepts relate macro-structural and micro-interactive levels of analysis in line with Bernstein's concern to 'recover' the macro from the micro. Bernstein associates classification with power relations in the social division of labour and relates it to structure and organization. Framing is associated with principles of control within social categories. It relates to interaction and agency.

Classification and framing translate power and control from the macro level into micro-level transmission-acquisition processes; classification translates power relations and framing translates principles of control. Power relations are relayed through the classificatory principle which establishes, legitimates and maintains boundaries between categories. Principles of control are relayed through framing relations which establish and regulate

legitimate forms of communication and social relations appropriate to the different categories (1996, p.19). In this way power and control in the broader social division of labour in society are translated into transmission-acquisition processes.

Singh observes that, despite legitimating relations of social order, 'power relations are never static or stable, rather, they are challenged, contested and negotiated in the relations of pedagogic communication' (2002, p.578). This highlights how pedagogic practice provides a viable channel for initiating change in the power relations between teachers and learners. Although control is premised on the boundary relations of power and socializes individuals into these relations, Bernstein notes that 'control is double-faced for it carries both the power of reproduction and the potential for its change' (1996, p.19). In general, power constructs relations *between* and control constructs relations *within* given forms of interaction.

At the macro-level, classification relates to the social division of labour of categories such as discourses, practices, agencies or agents. In relation to schooling, the social division of labour is made up of categories of agents (teachers and learners), categories of discourses such as school subjects and categories of institutional contexts (science laboratory, small group lesson). Framing relates to the social relations within each of the categories listed above. According to Bernstein, 'Framing at the very abstract level refers to social relations of a given social division of labour...the relay for the principle of the practices which sustain a given division of labour' (2000, p.100). Classification regulates 'what' discourse is to be transmitted as well as its relations to other discourses within a curriculum and framing regulates 'how' the discourse is to be transmitted and acquired in the pedagogic context. Classification and framing as reflected in pedagogic contexts are elaborated upon below.

Classification

At the micro level of pedagogic practice, classification relates to the structural or organizational aspects of pedagogic practice. This comprises relations between categories of discourses, spaces and agents. Classification of discourse refers to the degree of boundary maintenance between contents of different school disciplines (inter-disciplinary relations); relations within a discipline (intra-disciplinary relations) and relations between academic and non-academic knowledge. Classification between agents relates to hierarchical relations between teacher and learners and among learners. Classification of space relates to the strength of the boundary between the teacher's space and that of learners as well as the space

among learners. These classification relations are given by the degree of insulation or boundary maintenance between categories (Bernstein, 2000, p.99).

Classification is expressed in terms of its strength which shows the degree of insulation or boundary maintenance between categories; classification strength may be strong or weak. Strong values of classification (C^+) represent strong and distinct boundaries or insulation between categories while weak values of classification (C^-) represent weak or blurred boundaries between the categories. Where classification is strong the rule is to 'keep things apart' and with weak classification 'things are brought together' (Bernstein 2000). Thus with strong classification, categories develop unique and specialized identities and voices, whereas weak classification generates implicit categories with less specialized identities and voices, for example in an integrated curriculum.

Classification has internal and external values. Internal classification ($\pm C^i$) refers to relations *within* a category such as between objects, tasks and spaces between persons in a classroom. External classification ($\pm C^e$) refers to relations between different categories such as between subjects in a curriculum, between agencies such as school and community and between school and the broader school system. Below I show how the concept of classification is operationalized in my empirical research.

A key feature of the problem solving approach concerns relationships between science and other forms of knowledge. My study analyzes classification of discourse to show the extent to which teachers integrate knowledge in science classrooms as required by the problem solving approach within the Ugandan official curriculum. Classification of discourse is examined in three ways: first, the boundary between elements within science knowledge (intra-disciplinary relations); secondly, the boundary between science and other school disciplines (inter-disciplinary relations) and thirdly, the boundary between science and everyday knowledge (academic/non academic relations).

This study makes a distinction between two types of intra-disciplinary relationships within science knowledge. The first type refers to relationships between conceptual science knowledge and the knowledge relating to science procedures. The second type refers to relationships between various topics within science. The former type of intra-disciplinary relation is reflected in practical science work where particular science 'procedures' are used

to illustrate 'concepts' such as 'changes in states of matter'. The science education literature makes a distinction between conceptual science knowledge and knowledge relating to science procedures (Gott & Duggan, 1995; Miller, 1991). The latter form of knowledge is technically referred to as 'procedural knowledge' (Gott & Duggan, 1995). However, I refer to this latter type of knowledge as 'knowledge of science procedures' to differentiate this from Dowling's (1998) meaning of procedural knowledge.³ Practical work provides learners with opportunities to learn science through 'scientific processes' as a key requirement of the problem solving approach (NCDC, 2000). The other type of intra-disciplinary classification relates to relationships between various topics within science which aims to promote progressive development of concepts as these are 'recycled' and built upon across topics.

This study examines classification of space from two perspectives: classification of space between teacher and learners and classification between the spaces of learners. The study examines the boundary between the space of the teacher and that of the learners. Under the latter, I examine the arrangement of seats and use of instructional materials by the learners. The form in which space is organized in the classrooms highlights the power relations underlying the pedagogic relations between the teacher and learners and between learners. For example, seating arrangements in which learners' desks are separated from one another suggests social distance, which does not promote cooperation while blocks of seats stuck together promote cooperation, especially during group work.

This study examines classification of agents in two dimensions; classification between teacher and learners and classification between learner and learner. Classification of agents shows the power relations between teacher and learners, and between learners. In addition, classification between learners shows the degree to which the learners' individual pedagogic identities are explicitly demarcated.

The problem solving approach projects weak classification of agents at the regulative dimension where students can work together in learner-directed activities such as group work. Further weak classification between learners allows them to share ideas particularly during group discussions. At the instructional dimension, teachers are required to recognize

³ Dowling (1998) associates 'procedural knowledge' with the transmission of 'procedures' such as formulae in school mathematics without making visible their underlying principles.

and address differences in the needs and abilities of learners so as to promote their individual pedagogic identities. This suggests strong classification between learners' pedagogic identities. Weakly classified hierarchical relations between the teacher and learners deemphasize and so by so doing 'disguise' the unequal power relations in the pedagogical relationships. Such a context promotes learners' active participation in class discussions through, for example, asking questions and challenging the teacher's viewpoint where necessary.

Framing

Framing refers to the locus of control over selection of knowledge; its sequencing, pacing and evaluation criteria and social relations (Bernstein 2000). Bernstein describes framing as the 'nature of control over selection of the communication, its sequencing (what comes first, what comes second); its pacing (the rate of expected acquisition); the criteria; and the control over the social base of the communication' (2000, p.12-13). Therefore framing is about 'who' controls 'what' in the pedagogic context. Framing regulates two sets of rules: rules of discursive order or 'instructional discourse' and rules of social order or 'regulative order'. Instructional discourse refers to selection, sequencing, pacing and evaluation criteria whereas regulative discourse refers to the form of hierarchical rules regulating social order in terms of expectations about 'conduct, character and manner' (Bernstein, 2000, p.13).

Framing of selection shows who (teacher or learner) controls selection of the knowledge that is transmitted and acquired in the pedagogic context. Sequencing rules determine the progression of the transmission and pacing rules define the rate at which learners are expected to learn, the rate of expected acquisition' (Bernstein, 2000, 1990). Framing over sequencing and pacing rules shows who, teacher or learner, controls these rules.

Evaluation criteria are the rules that define what is considered a 'legitimate text' in a pedagogic context. Evaluation criteria condense the logic of pedagogic practice because they determine what counts as a 'legitimate text' within a pedagogic context. This legitimate text may be instructional or regulative, anything that attracts evaluation. To emphasise the importance of evaluation, Bernstein (1996, p.43) reminds us that, 'Any pedagogic practice is there for one purpose: to transmit *criteria*'.

Hierarchical rules define the pedagogic relationship between a teacher and learners, by providing the conditions for order, character and manner in the pedagogic relationship. Therefore hierarchical rules provide a necessary condition for appropriate conduct in the pedagogic relation. Bernstein (1990) maintains that the pedagogic relationship between teacher and learners is inherently hierarchical/ asymmetrical although this hierarchy may be 'disguised' through various communication devices. He says, 'the transmitter has to learn to be a transmitter and the acquirer has to learn to be an acquirer' (1990, p.65). These rules may be explicit or implicit. With explicit hierarchical rules, authority relations and expected conduct are immediately clear to the student. In contrast, with implicit hierarchical rules, the relationship between transmitter and acquirer is one in which power is 'masked' (Sadovnik, 1995).

Framing is expressed in terms of its strength which refers to the degree of control over pedagogic communication. Where framing is strong (F^+), the teacher has explicit control over the selection, sequence, pacing, criteria and social base of instruction, and learners have limited options over what and how to learn. Strong framing is exemplified in teacher-centred practices, or performance models in Bernstein's typology of pedagogic practices. Framing is weak where learners have 'apparent' control over pedagogic communication such as in competence or progressive forms of pedagogy. Here learners are given some options as to how they learn. Weak framing is not an expression of a loss of control by the teacher; rather it is temporary ceding of control to learners for pedagogic purposes. Weak framing reduces the emphasis and marking of boundaries, especially explicit marking of hierarchy, generating personal forms of control. In contrast, strong framing of practices marks explicit boundaries generating positional forms of control. I examine differences between these two modes of pedagogic modes under my discussion of competence and performance models.

My study examines the degree to which teachers maintain or cede control to learners in pedagogic processes, so that learners are actively involved in learning and self-regulating as required by the problem solving approach. One feature of the problem solving approach is that teachers are expected to provide learners with a relatively higher degree of control over pedagogic processes. Teachers are instructed to support learners to take responsibility for their own learning while they play the role of a 'facilitator' (NCDC, 2000). The study examines control at the level of instructional and regulative discourse.

Bernstein (2000) points out that framing values, whether strong or weak, may vary with respect to the different elements of the practice. In other words, framing over instructional discourse and regulative discourse does not always move in a complementary relation to each other. For example, strong framing of instructional discourse may be coupled with weak framing of regulative discourse. However, Bernstein highlights that, where there is weak framing over the instructional discourse, there must be weak framing over the regulative discourse. The strength of framing can also vary over the elements of instructional discourse (selection, sequence, pacing and criteria) to generate, for example, a pedagogic practice with strong framing over selection and weak framing over the other elements of the discourse.

As with classification, Bernstein makes a distinction between the internal strength of framing ($\pm F_i$) and the external strength of framing ($\pm F_e$). Internal framing refers to control over pedagogic communication within a given pedagogic context, for example, within a classroom. External framing refers to the control over communication within a particular pedagogic context from a context external to it. External controls on pedagogic practice may derive from practices of other teachers in the school, from subject heads of departments and the school administration. At school level, strong external framing inheres in practices such as centralized curriculum planning and evaluation practices and instructional supervision. Further, external framing of a teacher's pedagogic practice includes mandatory regulations by ministries of education, as well as national curriculum and examination requirements.

External framing is also expressed in terms of its strength. Strong external framing suggests that a teacher has weak control or limited options over pedagogic practice, for example where a national curriculum is implemented. Weak external framing implies that teachers have more control and discretion over aspects of instruction, such as its pacing, what to teach, and the sequencing of topics in a curriculum. This study's concern with relations between classroom practice and school contexts in relation to the national curriculum makes external framing a key conceptual tool.

Pedagogic codes

In summary, the classification principle 'regulates what discourse is to be transmitted and its relations to other discourses in a given set, for example, in a school curriculum. The principle of framing regulates how the discourse is to be transmitted and acquired in the

pedagogic context' (Bernstein, 2000, p.100). A combination of classification and framing principles generates pedagogic codes, the formula for which is expressed as:

$$\frac{E}{\pm C^{ie} / \pm F^{ie}}$$

E refers to the orientation of the discourse, which is elaborated because schooling entails elaborated codes. The solidus refers to embedding of the elaborated orientation in classification and framing values, which may be strong (+) or weak (-), internal (Cⁱ/Fⁱ) or external (C^e/F^e). Variation in the classification and framing values generates different modalities of pedagogic practice or *pedagogic modalities*. I describe and present teachers' classroom practice in terms of pedagogic modalities. These modalities show classification and framing relations over a range of relationships relating to discourse, subjects and space.

Although classification and framing is differentiated at an analytical level, there are difficulties in separating classification and framing empirically. This was evident in this study particularly in relation to the relationship between school and everyday discourses in which classification and framing were embedded and difficult to distinguish. It was not clear, for example, whether everyday knowledge recruited by learners in their spontaneous questions should be regarded as weak framing of micro-selection or as weak classification of academic/non academic knowledge. Bernstein (1996) and Atkinson (1985) recognise these difficulties and suggest that classification and framing are dialectically related at the empirical level. Although classification is prior to framing, it is 'empty' without framing which activates its power relations. Other Bernsteinian researchers have experienced similar difficulties (Hoadley, 2005; Morais, personal communication).

Specific coding orientation: recognition and realization rules

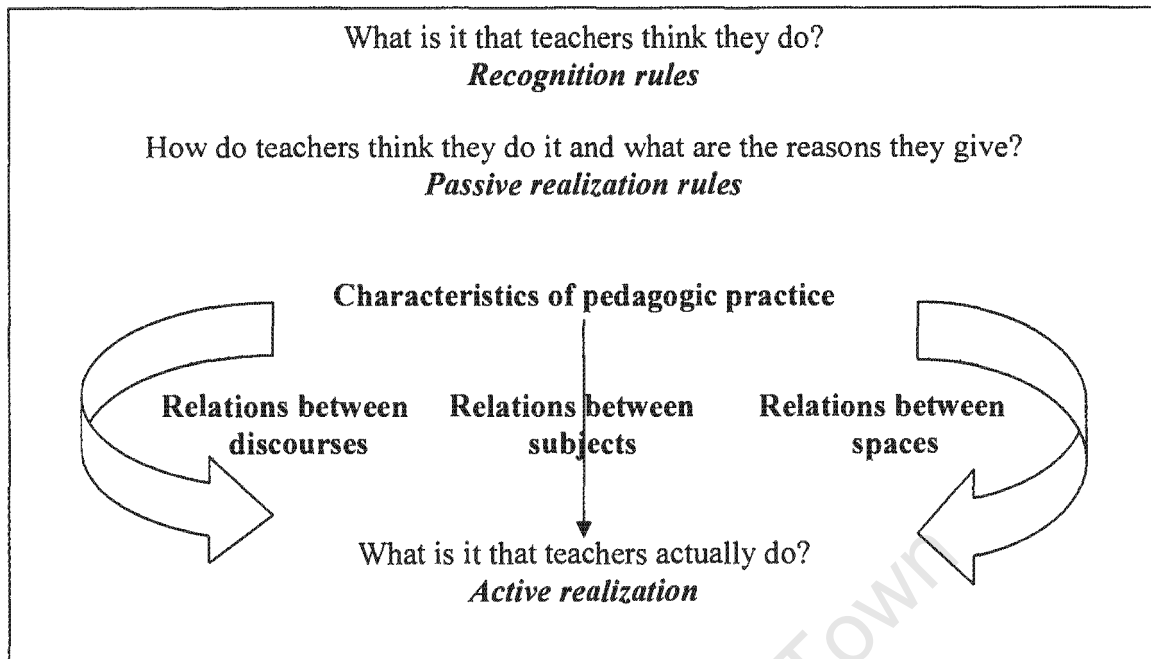
According to Bernstein, text production in a given context depends on possession of a specific coding orientation to that context. This implies that one must have recognition and realization rules to produce the legitimate text in a particular context. Recognition rules enable an acquirer to recognize the speciality of a context and provide the key to the distinguishing features of the context. Realization rules enable one to produce a legitimate text in a particular context (Bernstein, 1996). He notes that, 'Recognition rules regulate what meanings are relevant and realization rules regulate how the meanings are to be put together to create the legitimate text' (Bernstein, 2000, p.18). Morais and Neves (2001) make a

distinction between passive and active realization rules. They suggest that if a subject selects appropriate meanings but is unable to perform the legitimate text, he or she has recognition rules and passive realization rules but lacks active realization rules. When the subject performs the required text, for example, by constructing new statements that conform to the grammar of the legitimate discourse, then he or she has active realization rules.

In addition to these recognition and realization rules, the subject must possess socio-affective dispositions specific to the context, that is, appropriate aspirations, values and motivations (Morais & Neves, 2001). Both values and principles are socially acquired and become part of the subject's internal structures. In the Bernsteinian community, researchers have employed these concepts to investigate learners' acquisition of legitimate texts in pedagogic contexts (See for example, Reeves, 2005; Morais & Rocha, 2000; Daniels, 1995; Morais, Fontinhas & Neves, 1992).

Morais & Neves (2006, 2001) have used the concept of recognition and realization rules as conceptual and analytical tools for examining teachers' learning about and performance in relation to particular pedagogic practices. Here teachers are seen as learners who have to acquire a specific coding orientation (recognition rules and passive and active realization rules) in order to produce the legitimate text within a particular pedagogic approach. Morais & Neves (2006) conceptualize the ideas and representations teachers have about the characteristics of pedagogic practices in terms of recognition rules. They associate passive realization rules with teachers' ideas on how pedagogic practices are enacted as well as the principles and justifications in which they are grounded. They consider active realization rules to represent how the teachers 'actually' conduct classroom practice and produce the favourable pedagogic practice. The distinction Morais and Neves make between three rules: recognition rules, passive realization rules and active realization rules, allow them to analytically differentiate between what teachers *think* and what they *do* in relation to pedagogic practice. These relations are represented in figure 3.1 below.

Fig.3.1 Teacher pedagogic practice-specific coding orientation



Source: Morais & Neves (2006, p.148).

Bernstein (2000) associates recognition and realization rules with the concepts of classification and framing as well. He suggests that classification enables one to recognize the specific features of a context and so it enables one to know what is expected in that particular context; classification is associated with recognition rules. Framing enables one to realize or produce the legitimate text in a particular context, thus framing is linked to realization rules.

In terms of the present study, the concepts of recognition and passive realization rules are employed to conceptualize the teachers' interpretations of the problem solving approach from the curriculum documents. When teachers interpret the salient features of the pedagogic approach correctly, i.e., as described in the curriculum, they possess recognition and/or passive realization rules. When they enact the problem solving approach in ways projected in the official curriculum, they demonstrate active realization rules.

Theories of instruction: competence and performance models

Bernstein identifies two main theories of instruction: one centred on transmission and learners' performances and the other centred on acquisition and learners' shared competences. Theories of instruction based on acquisition privilege universal, general,

processes internal to acquirers; that is, what is shared: 'Such theories point to the interactional nature of the acquisition of shared competencies and so to a social unit of acquisition involving interactional relations between acquirers' (1990, p.212). These theories focus on the development of common competencies within acquirers, rather than on graded performances of a discourse to be acquired. Bernstein (1990) suggests that, in such theories of instruction, learners are actively engaged in an 'implicit facilitating practice. In theories of instruction based on the logic of transmission, emphasis is upon the explicit effective ordering of the discourse to be acquired by the transmitter' (1990, p.214). In this sense theories of instruction provide a model for an ideal teacher, an ideal learner and an ideal teacher-learner relationship and pedagogic context.

Changes in pedagogic practice usually entail a shift in the role of the teacher and learners in the pedagogic relation. Contemporary curriculum reforms seek to shift the role of the teacher from 'transmitter' of knowledge to that of 'facilitator' of learning. These pedagogic changes, associated with progressivism, emphasize that learners are 'self-regulating' so as to develop their creativity, autonomy and problem solving skills which are desirable in the global job market (Muller, 1998). As discussed in chapter five, the problem solving approach aims to alter the teacher's role from a 'transmitter' to that of a 'facilitator' and to enable learners to become self-regulating.

Bernstein's later work (1996, 2000) differentiates between performance and competence models of pedagogic practice, depending on their strength of framing and classification (code modalities). Performance models typically reflect relatively strong teacher control or strong framing over instruction while competence models give pupils more apparent control over instruction. These two models are elaborated in more detail below.

Performance models

Performance models are typically associated with strong values of classification and framing although these values may vary over the different aspects of pedagogy. Performance models emphasize the grading of learners' texts (performances), resulting in stratification of learners according to ability. Accordingly, classification between learners is strong. Evaluation emphasizes what is missing or absent in learners' texts, resulting in explicit and specific criteria (Bernstein, 2000). This pedagogic model is centred on teachers and emphasizes a visible type of pedagogy, or what is commonly referred to as 'teacher-centred' practices.

Performance models have explicit and distinct boundaries between categories of time, space and discourse. Further, performance models regulate social order explicitly through rules and positions, yielding positional forms of control.

Competence models

Competence models are premised on assumptions that competences are intrinsic to individuals and acquired tacitly in interactions. These models consider learners as 'active' and 'creative' in pedagogic processes and emphasize differences rather than deficits among learners. Competence models emphasize dispositions such as autonomy, creativity and self-regulation (Bernstein, 2000). This modality is centred on the learners, commonly referred to as 'learner-centred' practice or progressivism. Competence models are associated with an invisible type of pedagogy. Categories of time, space and discourse are blurred, yielding weak classification and framing strengths. This implies that sequencing, pacing and criteria are implicit to the learners (but explicit to the teacher). Time is weakly classified as it is not explicitly used to punctuate different activities. Learners can move freely in pedagogic spaces because of the absence of regulative boundaries on access.

Within the competence model, evaluation emphasizes what is *present* in the learners' product; therefore criteria are multiple and diffuse, focusing on developing learners' competences (Bernstein, 2000). However, although 'criteria for instructional discourse are likely to be implicit and diffuse, the criteria for regulative discourse (criteria for conduct, manner and relation) are likely to be more explicit' (Bernstein, 1996, p.60). Bernstein argues that teachers need a strong theoretical base to 'read' changes in learners' competence development. Competence models typically reflect personalized forms of control and communication that varies with the dispositions, relations and reflexivity of each acquirer. This is made possible by the absence of explicit structures and classifications in the pedagogic contexts (Bernstein, 2000). However, Bernstein (2000) does not rule out positional and imperative forms of control in competence models, 'This is not to say that positional and imperative control modes will not occur, only that these are not favoured modes' (p.47). Bernstein (1996) argues that, because competence models project learners as being 'self-regulating' and teachers as 'facilitators', positional forms of control militate against these roles.

The main features differentiating competence and performance models are summarized in table 3.1 below.

Table 3.1 Summary of features of competence and performance models

Features	Competence models	Performance models
Categories <ul style="list-style-type: none"> • Space • Time • Discourse 	Weakly classified	Strongly classified
Evaluation orientation	Presences	Absences
Control	Implicit	Explicit
Pedagogic text	Acquirer	Performance
Autonomy	High	Low/high
Economy	High cost	Low cost

Source: Bernstein (2000, p.45).

Two features of competence models: cost and autonomy, require further comment in view of their importance to this study. Bernstein suggests that, relative to performance models, the transmission costs for competence models are high because of their sophisticated theoretical base and a range of other costs:

The costs of training the teachers are likely to be high because of the theoretical base of competency models...Further; there is a range of hidden costs if the competence model is to be successful in its own terms. The hidden costs are time based. The teacher often has to construct the pedagogic resources; evaluation requires time in establishing the profile of each acquirer; and in discussing projects with groups;...establishing feedback on the acquirer's development (or lack of it) is a further time cost. Within the institution extensive interaction between teachers over the practice is required for purposes of planning and monitoring, as the structure is constructed rather than received (1996, p.62-63).

Bernstein emphasizes that, these 'hidden costs' are rarely recognized and budgeted for explicitly, rather they are charged to the commitment of individual teachers and this may result in ineffective practice or teacher fatigue. School and teacher autonomy from public regulation are key conditions for the successful implementation of competence models because pedagogic practice is dependent upon particular features of learners and their contexts. In general, competence models are less subject to public scrutiny and accountability, relative to performance models, as the products of the former are difficult to evaluate objectively (Bernstein, 2000; 1996).

Whereas competence and performance models are presented as distinct and dichotomous, these are ideal forms. In reality most pedagogic practices are characterized by a 'mix' of strong and weak modalities. Research conducted by Morais and her colleagues (Morais, 2002; Morais & Neves, 2001, Morais & Rocha, 2000) shows how mixed pedagogies are most effective for learning. Morais & Neves (2001) argue that a misconception within ardent supporters of either progressivism or traditional practices is their failure to make a distinction between instructional and regulative discourse. Whereas weak framing and classification is desirable at the level of hierarchical rules and classification of space (Morais & Rocha, 2000; Morais & Neves, 2001), it is less certainly so for instructional discourse, particularly in relation to selection and evaluation criteria.

In relation to effective pedagogic practices in science, Morais (2002) calls for weak classification of knowledge relationships, weak framing of pacing and hierarchical rules but strong framing over criteria and macro-selection. She argues that weak classification of intra-disciplinary boundaries within science inducts learners into increasing conceptual development. Bernstein's conceptualization of pedagogic practice, with his distinction between elements of instructional and regulative discourse, makes it possible to avoid dichotomies and polemic debates on teacher-centred and learner-centred practices. It permits a consideration of practices with combinations of competence and performance models to derive 'mixed' pedagogies (Sadovnik, 1995; Morais, 2002, Reeves, 2005).

Vertical and horizontal discourse

Bernstein (1999, 2000) makes a distinction between two forms of discourses; vertical and horizontal discourse. These discourses or knowledge forms differ in relation to form rather than content because Bernstein does not focus on the content of knowledge, arguing that this is contextually and historically specific (Bernstein, 1996; Singh, 2002). Vertical discourse relates to specialized symbolic structures of explicit knowledge usually referred to as official or school knowledge. This knowledge form has the following features:

A coherent, explicit, systematically principled structure, hierarchically organized as in the sciences, or the form of a series of specialized languages with specialized modes of interrogation and specialized criteria for production and circulation of texts as in the social sciences and humanities' (2000, p.157).

Vertical discourse is transmitted through explicit recontextualization and evaluation procedures in terms of space, time and actors. Horizontal discourse represents what is

commonly referred to as everyday or 'common sense' knowledge. This form of knowledge is segmentally organized and characterized by features such as 'oral, local, context-dependent and specific, tacit, multi-layered and contradictory across but not within contexts'. Bernstein defines horizontal discourse in this way: 'A horizontal discourse entails a set of strategies which are local, segmentally organized, context specific and dependent, for maximizing encounters with persons and habitats' (2000, p.157). Horizontal discourse is transmitted segmentally, usually in face to face encounters which are terminated when a competence has been mastered. Further, different segments of knowledge need not be related. For example, learning how to flush a toilet has no relation to learning how to brush one's teeth. Bernstein elaborates that 'These 'knowledges' are related not by integration of their meanings by some coordinating principle, but the 'knowledges' are related through the functional relations of segments or contexts to the everyday life' (2000, p.158-159).

Differences between vertical and horizontal discourse are pertinent to my study in view of the prominence given to the relevance and application of school knowledge to everyday life issues in the national curriculum. The present integrated science syllabus on which this study is based reflects strong relationships between vertical and horizontal discourses in themes such as 'science in human activities and occupations' among others.

Pedagogic culture

Under the discussion of the concept of a pedagogic device, I argued that the effectiveness of this device is limited by local contextual factors operating at the school level particularly in less developed world contexts. That discussion brings into focus the possibility that pedagogic practice may be regulated by factors that do not derive from the rules of the pedagogic device and its realizations through pedagogic discourse. Elaborating on these 'non-discursively' regulated contextual influences on pedagogic practice, Jacklin (2004) suggests that Bernstein's account of pedagogic practice as regulated by macro-social structure considers the 'context of pedagogic practice as a product of that practice'. She elaborates:

Yet what is underdeveloped in his work is the relation of pedagogic practice to the school as an institution, and specifically to those features of the school that are not derived from the pedagogic device and the form of the discourse that it recontextualizes (p.40).

Jacklin acknowledges how Bernstein's (2000) work introduces means to address this hitherto underdeveloped influence on pedagogic practice through the concept of pedagogic culture. Bernstein provides an initial conceptual frame for the relationship between the overall institutional order of an agency and its transmission order in which he considers the pedagogic code underlying the latter as the 'contained' and the organizational order the 'container'. The 'container' refers to management of the agency in relation to administration of staff and resources, their relation to each other and its external responsibilities and interests. The 'contained' refers to the transmission and its social relations. In this formulation Bernstein recognizes the possibility of a dual relationship between a school's pedagogic code and its institutional order and he proposes the concept of 'pedagogic culture' to conceptualize these relations:

Thus we need to have a concept whose relations are dependant upon the pedagogic code but which also regulates the code. This concept would embrace the fundamental regulation of the *mode of being* of the agency. I propose the concept of pedagogic culture. We can now also consider the inter-relations between the pedagogic culture and the pedagogic code. Pedagogic culture is the mode of being of the agency's social relations as they cope with its bias, shape, stability and economy (2000, Pg. 24, original emphasis).

Bernstein notes that shape and stability are intrinsic to code modality but bias and economy are not, yet all four components regulate the agency, attending to its internal and external demands. In this view, the concept of pedagogic culture embraces both discursive and non-discursive aspects within a school, the latter including economic aspects such as responsiveness to 'marketisation' and other external biases of a political nature. On the whole, the concept of pedagogic culture provides a holistic conceptual frame for relating pedagogic practice to institutional contexts in which it takes place.

My study draws on the concept of pedagogic culture to differentiate the influence of external framing on classroom practice from influences from other non-discursive factors falling outside symbolic concerns. The main interest is to highlight the degree to which organizational frameworks influence classroom practice and, through this, the teachers' recontextualizing processes.

The preceding sections discuss how pedagogic discourse is constructed, distributed and transmitted through the operation of the pedagogic device. I have argued that the concept of pedagogic culture provides a productive means of highlighting how school contextual factors

influence operations of the pedagogic device in local school contexts. I have also discussed how concepts of classification and framing provide theoretical resources for describing the internal logic of pedagogic practice, showing 'how' pedagogy unfolds in classrooms.

Take-up and criticism of Bernstein's work

Bernstein's theoretical work has been employed in diverse ways in conceptual and empirical work, within the sociology of education, in the sociological analysis of curriculum and pedagogic practice, in sociolinguistics and in gender studies. In chapter two I discuss the Bernsteinian studies undertaken within the field of curriculum change and implementation. Below, I highlight some of this work, focusing particularly on pedagogic practice. Bernstein's key concepts of classification and framing have been employed in studies of science education and teacher education through action research methodology primarily by Anna Morais and her colleagues at the sociological studies of the classroom (ESSA) project at the University of Lisbon in Portugal (Morais et al, 2005; 2004; 1999; 1996; 1992; Morais & Neves, 2001; 2006; Morais, 2002; 1996) and in the sociology of knowledge and pedagogic practice (Sadovnik, 1995a; 1995b). In Norway, Riksaasen (1999) has employed Bernstein's work in a study of teacher education. Daniels (1995, 2001) has examined acquisition of recognition and realization rules by learners in schools with specific coding orientations.

In South Africa, Bernstein's work has been drawn on to study cultural reproduction through schooling (Hoadley, 2005), achievement of learners from low social class backgrounds (Reeves, 2005; Bolton, 2005) and teacher education (Ensor, 2004). It has also been employed to study specific pedagogic modalities such as problem-centred mathematics education (Davis, 2005), craft pedagogy (Gamble, 2004) and in conceptualizing relations between pedagogic practice and local school contexts (Jacklin, 2004). In conceptual work in the sociology of knowledge and schooling, Bernstein's concepts have been employed in Muller (2000), Muller & Taylor (1995), Muller (1998) and Taylor, Muller and Vinjevold (2003). This outline is not exhaustive but provides some indication of the diverse application of Bernstein's ideas.

Bernstein's work is mainly employed by a community of researchers who have worked with him as colleagues and as PhD students. These scholars have recruited more 'disciples' into

the Bernsteinian research community. Bernstein (1996; 2000), Sadovnik (1995) and Singh (2002) highlight the main criticisms of Bernstein's intellectual project.

Initial critiques were directed at Bernstein's work on restricted and elaborated language codes. His explanations were perceived as depicting working class learners in a 'deficit' mode. In response, Bernstein explains that he sought to explain and therefore account for differential achievement in schooling processes between children from high and low social class backgrounds.

Further, Bernstein's ideas have been seen as being too abstract and his writing and language code as 'very impenetrable' (Sadovnik, 1995a). Singh reports that Bernstein's writing is described as being, 'white, male, middle-class grand narratives that constituted disadvantaged students as the deficit other' (2002, p.571), while purporting to empathize with difficulties of working class learners in schools.

Bernstein's sociological theory draws largely on Durkheimian structuralist ideas and symbolic interactionists, providing a sociological lens for understanding the structure and processes of schooling (Sadovnik, 1995b). This approach is criticised as projecting a deterministic view rather than providing transformative potential with regard to inequalities in education. However, Bernstein (1996) shows that his concepts of power and control are double-edged, in that they explain the social basis of symbolic forms and relations but also carry transformative potential. A case in point is the concept of framing which derives from principles of control. Although framing translates principles of control from the social division of labour at macro level into transmission-acquisition processes at the micro level of classroom practice, framing may give rise to resistance and change in established power and control relations between categories.

It has also been argued that Bernstein's ideas remained largely at the conceptual level, lacking empirical grounding. Bernstein (1996, 2000) went to great lengths to explain how various aspects of his work have been empirically tested mainly by his PhD research students. Bernstein (1996; 2000) argues that these criticisms reflect a misinterpretation of his work, resulting from his ideas being taken out of its broader context. He points out that, although his theoretical project was developed progressively, his critics considered his ideas as being terminal rather than as work-in-progress.

3.3 Dowling's social activity theory

Dowling (1998) developed his social activity theory as a language of description for the sociological analysis of a scheme of school mathematics textbooks. Social activity theory analyses practices within activities in terms of their degree of specialization. Dowling's focus on specialization is premised on the view that every activity specializes its practices and regulates 'what can be said or done or meant' within it (p.131). School mathematics constitutes the 'activity' in Dowling's empirical project, and the content of school mathematics comprises its 'practices'. In the present research, school science constitutes the 'activity' and school science content, its practices. Dowling describes specialization of 'practices' in terms of domains of practice and discursive saturation. These concepts are discussed below.

Domains of practice

Dowling makes a distinction between four domains of practice: esoteric domain, public domain, expressive domain and the descriptive domain. These domains vary in terms of specialization of content and forms of expression. Dowling employs the concept of classification to analyze the degree of specialization of content and forms of expression within the domains of practice. He draws on Bernstein's concept of classification in conceptualizing his version of classification, citing Bernstein's argument that the strength of insulation creates 'space in which categories become specific' (1990, p. 23). The degree of specialization of the domains is described as being strongly or weakly classified.

The esoteric domain refers to the region of an activity which is most strongly specialized relative to other activities. Its content and forms of expression exhibit the strongest classification and it constitutes the regulating domain for the activity. Dowling suggests that the esoteric domain 'lights upon' external practices, 'recontextualizes' part of their elements and brings these into an activity to form three other domains with weakly classified practices at the level of expression or content. By recontextualization, Dowling means the 'subordination or partial subordination of the forms of expression or contents of practices of one activity to the regulative principles of another' (1998, p.136). Dowling's notion of recontextualization draws on Bernstein's (1990) 'recontextualizing rules', which regulate construction of pedagogic discourse. Dowling employs the concept of 'gaze' to metaphorically refer to how one ideology 'views' another. Bernstein's 'recontextualizing

rules' de-locate and relocate other discourses to form pedagogic discourse. Likewise, Dowling's 'gaze' recontextualizes content and ideological expressions from the recontextualized activity and subordinates them to the organizing principles of the recontextualizing activity. In other words, an activity can 'recruit' content or forms of expression from other activities and use these as resources for realizing its purposes.

The public domain is one of the three domains formed through the recontextualizing gaze of the esoteric domain. The public domain has low levels of specialization of either forms of expression or content; it has the appearance of non-specialized practices or everyday knowledge. The public domain is therefore weakly specialized relative to the esoteric domain; however it is still subject to the regulating principles of the esoteric domain to some extent. An example of a public domain task in school mathematics, Dowling's area of specialization, would be; 'two children are given six eggs to share equally, how many will each one get?' This format contains mathematical content but it is expressed with a non specialized form of expression using words rather than numerical symbols and adopting eggs and children as non-specialized 'signifiers' of numbers. In this example, eggs and children (which are non-mathematical elements) are recontextualized to give expression to mathematical content. A specialized form of expression for the foregoing example would be; 'Solve, $x = 6 \div 2$ ', where both the content and form of expression are mathematical.

Dowling's public domain resembles Bernstein's horizontal discourse or everyday 'commonsense' knowledge (Bernstein, 1999). However, Dowling conceptualizes the public domain as comprising less specialized content 'within' a school discipline whereas Bernstein considers everyday knowledge as being external to school knowledge. Dowling emphasizes that the public domain is not external to the practice:

I should emphasize, at this point that the public domain is not external to the practice; it comprises practices which have been or are being recontextualized from other activities (Dowling, 1998, p.136).

Dowling argues that the public domain is a crucial component of the practices of an activity because it is the domain through which 'apprentices' enter the activity. Dowling's conceptualization of the public domain as a 'portal' to an activity resonates with Bernstein's argument that aspects of everyday knowledge can be used as resources for inducting learners into school knowledge (Bernstein, 1996).

In addition to the public domain, two other domains of less specialized practices are formed through the recontextualizing 'gaze' of the esoteric domain; these are the expressive domain and descriptive domain. The two domains recruit either non-specialized forms of expression or non-specialized settings which are described in specialized terms. The expressive domain combines non-specialized forms of expression with specialized content. Non-specialized forms of expression are recontextualized to give expression to specialized content. An example of expressive domain practice within a science lesson is presented below. This extract is taken from a transcript of a lesson observed in this study. The communication occurred at the beginning of a practical activity in which 'changes in states of matter' were demonstrated.

Extract 3.1

- T: (*The teacher holds a container with water and shows it to the class*). What is in this container?
L: Water.
T: What state of matter is water?
L: Liquid.
T: Yes, liquid (*Then he holds up a wax candle*). What is this?
L: A candle.
T: Good, and what state of matter is a candle?
L: Solid.
T: Very good, it is a solid.

Water and the wax candle, both non specialized forms of expression are used to 'signify' or 'express' liquids and solids. The *descriptive domain* is constituted by recontextualization of non-specialized sites whose contents are described with specialized forms of expressions. The 'gaze' of the esoteric domain may recontextualize non-specialized settings or sites whose features are described in terms of specialized expressions. For instance, food substances on a restaurant menu can be described with specialized terms such as sodium chloride (NaCl) for table salt. Here specialized forms of expression from the esoteric domain are imposed upon a non specialized setting. The descriptive and expressive domains constitute the link between the esoteric and public domains whereas the public domain provides a 'portal' into the esoteric domain. Dowling points out that because expressive and descriptive domains are weakly classified at the level of content or forms of expression, the regulative principles of the esoteric domain cannot be made fully explicit within these domains.

Discursive saturation

Dowling suggests that, in addition to domains, practices also vary in terms of the level of discursive saturation. Discursive saturation refers to 'the extent to which regulation of the practices of an activity are explicitly available' (1998, p.161). The element of 'discursive' refers to the extent to which an activity can be fully regulated and sustained at the level of explicit language. Activities with a high discursive saturation (DS^+) and low discursive saturation (DS^-) maximize and minimize, respectively, the extent to which the regulating principles of the activity are discursively regulated. Dowling points out that there is always an excess of the 'material' over the 'discursive' because no practice is fully realized within discourse. Therefore the difference between DS^+ and DS^- activities is in the extensiveness of the excess of the non-discursive over the discursive, that is to say, the extent to which the regulation of the practice lies within or outside the linguistic.

The degree of discursive saturation determines the extent to which utterances within an activity can be abstracted from their immediate context of production, through symbolic significations. Dowling notes that all practices are, to some measure, context dependent because discursive saturation can never be complete; however activities with high DS^+ exhibit a relatively higher degree of context independence and generalization than do DS^- activities. DS^- activities are associated with relatively more context-dependence or localization. DS^- activities such as 'manual' practices in everyday life are characterized by implicit regulating principles; they are consequently less specialized discursively, rendering utterances in the activity context-dependent and particularized. School disciplines also vary in their levels of discursive saturation. A discipline such as mathematics has a higher level of discursive saturation than arts and crafts, given that the former discipline is discursively regulated to a greater extent, than the latter which encompasses ostensive practice as well as tacit knowledge.

School science comprises both discursive and non-discursive practice. Discursive practice elements comprise conceptual science knowledge including its basic concepts, principles, definitions and taxonomic criteria. The non-discursive aspects cover procedures such as those undertaken in experiments and other practical science work. This suggests that the regulating principles of school science are expressed both discursively and non-discursively, potentially reflecting a hybrid practice of high (DS^+) and low (DS^-) discursive saturation.

My study employs the concept of domains of practice to describe the degree of specialization of the different types of knowledge within the science curriculum (themes, topics) as well as that distributed in the lessons. At the level of the curriculum, my study employs the concept of domains of practice to differentiate between curricular topics entailing primarily esoteric domain knowledge from that entailing public domain knowledge. For example, a theme such as 'matter and energy' which covers basic science (physics and chemistry) knowledge comprises primarily esoteric domain practice. In contrast a theme such as 'science in human activities and occupations' covers both esoteric and public domain practice.

Within the lessons, I am interested to see how the different knowledge types are recontextualized. Accordingly I will examine the degree of specialization of content and forms of expressions within science lessons. At primary school level basic science knowledge covers primarily descriptive terms aimed to introduce learners to the specialized science lexicon. In this regard, teachers emphasize specialized forms of expression as a way of apprenticing learners into the practices of the science. One of these instances is exemplified in extract 3.1 above.

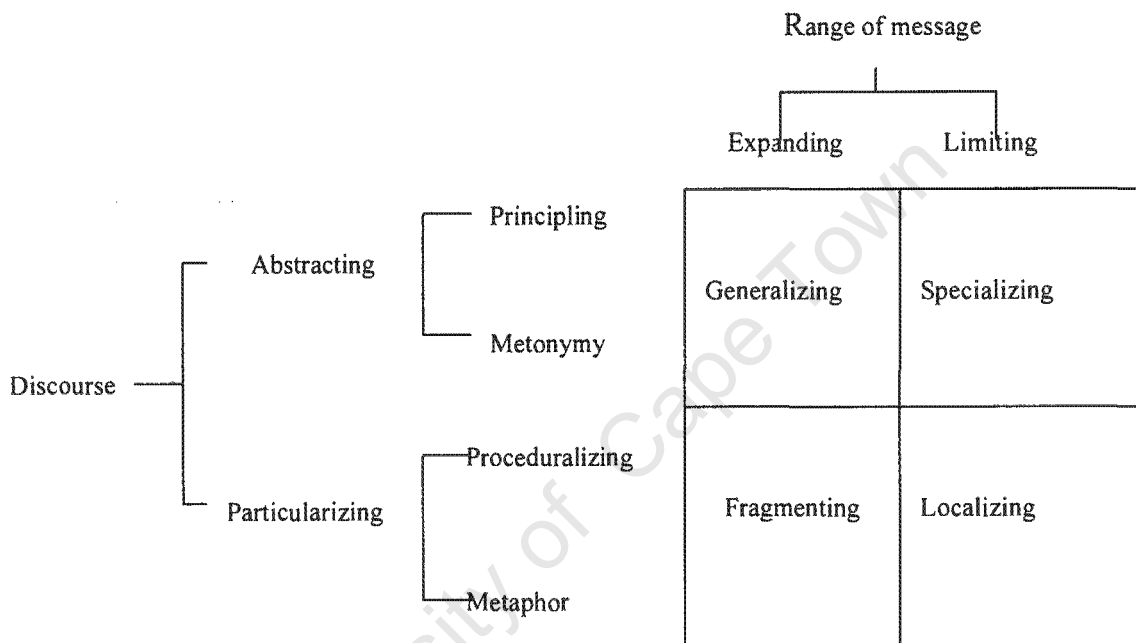
Distributing strategies

Dowling suggests that activities are reproduced by texts and by pedagogic texts in particular. A text refers to 'an utterance (linguistic and/or non linguistic) or a set or sequence of utterances made within the context of one or more activities' (1998, p. 131). A pedagogic text is an utterance or set of utterances within the context of a pedagogic relationship. Dowling says that every text constructs 'authors' and 'readers' and these correspond to 'authorial voices' and 'reader voices', respectively. In an interactional context such as the pedagogic process, the transmitter and acquirers can each 'authorize' and 'read' a text. Within a pedagogic text the authorial voice corresponds to the subject position (transmitter) and reader voices correspond to the subordinate/acquirer positions (learners). Texts are material or empirical instances of the activity.

Dowling makes a distinction between the structural and textual levels in his language of description. Practices and positions are at the structural level of the language whereas message and voices exist at the textual level. Pedagogic texts constitute the textual level of an activity. The practices of an activity are inscribed into a pedagogic text as *message* and the positions are reflected as *voices*. Distributive strategies are the *textual strategies* which

reproduce the features of activities in pedagogic contexts. In other words, the message containing the practices of an activity is distributed to acquirer voices who are potential 'recruits' into the activity. Acquirer voices 'receive' and 'read' the message, metaphorically speaking. Fig 3.2 below outlines Dowling's distributing strategies.

Fig.3.2 Dowling's distributing strategies



Source: Dowling, 1998, p. 147.

Distributing strategies are broadly differentiated into those relating to the discourse (abstracting or particularizing strategies) and those relating to the range of message distributed (generalizing, fragmenting, specializing and localizing strategies). Dowling describes the discourse as being 'abstract' or 'particularized' and the range of the message as being 'expanded' or 'limited'. Abstracting strategies realize the discourse as context-independent whereas particularizing strategies realize the discourse as largely context dependent. Dowling (1998) distinguishes between discourse as principled and proceduralized:

The general quality which distinguishes principled from procedural discourse is that the former exhibits connective complexity, whereas the latter tends to impoverish this

complexity, minimizing rather than maximizing connections and exchanging instructions for definitions (p.146).

A principled discourse exhibits connective complexity through abstract concepts such as definitions, principles and taxonomies. Principling through the use of definitions and taxonomic classifications 'facilitates the expression of the regulating principles of a DS+ practice, such as school mathematics' (p.146). Dowling argues that, because principles cannot be fully realized outside the esoteric domain, principling must involve an esoteric domain message. Principling, as the opposite of proceduralizing, 'abstracts' a discourse from its context, facilitating development of context-independent meanings. Where examples are used as elaborating instances within principling strategies, their abstract properties are made explicit so that the context-dependence of the message is minimized.

Proceduralizing as the opposite of principling, 'weakens the connective complexity of discourse' presenting it as fragmented and particularized (Dowling, 1998, p.146). Proceduralizing strategy places emphasis on the 'how' of procedures, rather than the 'why' or discursive principles underpinning the procedures. For example, Dowling suggests that formulae in school mathematics are 'signifiers' for particular mathematical principles, therefore instructional strategies that emphasize formulae, without making explicit the mathematical principles signified, proceduralize the discourse. In this case mathematical understandings are not 'abstracted' from the procedures undertaken in the formula. Focusing on procedures rather than principles particularizes the message, increasing its context dependence. Dowling considers proceduralizing of content a limiting strategy in relation to the range of message distributed.

For purposes of this study, it is important to distinguish between Dowling's concept of 'proceduralizing' as an instructional strategy and the knowledge of science procedures as a specialized form of principled discourse in school science. Dowling's 'proceduralizing' refers to a distributing strategy while 'knowledge of science procedures' refers to the form of discourse. Knowledge of science procedures embodied in practical science work may or may not be 'mechanically' undertaken and so it does not necessarily 'proceduralize' and impoverish the complexity of science knowledge. Thus science 'procedures' do not entail a proceduralizing strategy when they are underpinned by specialized conceptual knowledge.

Distributing strategies expand or limit the message distributed to learners; what Dowling refers to as 'voices'. Expanding strategies broaden the message via the range of esoteric domain topics and recontextualized public domain settings, whereas limiting strategies effect the narrowing of message in terms of topics and settings. Generalizing strategies '*expand*' and '*abstract*' messages from their local contexts thereby reducing the context dependence of meanings. Fragmenting expands the range of message although this is realized as an incoherent collection of settings or topics lacking connective complexity. The esoteric domain is realized as segmental and the public domain as an incoherent collection of settings regulated by public domain rather than esoteric domain values. A number of lessons in this study were based on topics in which the animal kingdom was classified into sub categories on the basis of certain criteria such as exterior physical features or method of reproduction. One of these lessons covered the topic of worms, in which the teacher asked learners to suggest examples of the different subgroups of worms, as well as their descriptive names. At no point in the lesson did this teacher indicate how the sub groups were categorized. This exemplifies fragmenting.

Specializing is the construction of an abstract message with respect to a specific esoteric domain topic or public domain setting. Specializing strategies were exemplified in the lessons I observed in cases where teachers abstracted the message by highlighting definitions and other taxonomic criteria, say the characteristics of birds, but where the message was restricted to a particular topic. No references were made to how the concepts were applicable in other topics. In these cases, teachers distributed an abstract esoteric domain message within a limited range of a topic. Localizing entails the distribution of a particularized message. Localizing limits the range of a message by '*localizing*' it to a particular public domain setting and also through the exclusion of an esoteric domain message. Extract 4.3 in chapter four exemplifies a localizing strategy. Another example of a localizing strategy is in provided in extract 7.7 in chapter seven.

Dowling argues that a particular combination of domains of practice and distributing strategies position learners in specific ways within an activity. Esoteric domain text facilitates abstracting of the discourse and promotes an apprenticed voice whereas public domain text promotes a dependent reader voice through its context-dependent message. The pedagogic process through which objects (learners) are recruited into an activity can be conceptualized as a form of 'apprenticeship' into the practices of a particular discipline.

Pedagogic texts construct a hierarchy of positions with transmitters as the *subjects* of an activity and the acquirers as the *objects* to be recruited into the activity. In terms of positions, transmitters (teachers) occupy the transmitting position and acquirers (learners) occupy the ‘acquiring position’. Learners occupy a hierarchy of ‘acquiring positions’ which may vary according to age, ability or career advancement. These acquiring positions may be *apprenticed* positions or *dependent* positions.

Apprenticeship into the activity requires the ‘apprentice’ to be recruited into the esoteric domain of practice within which reside the regulating principles for the activity. This is realized through what Dowling calls ‘visible pedagogic action’ which establishes clear links within the esoteric domain of an activity. Acquirers positioned in the dependent position are marginalized and denied access to the regulative principles of the esoteric domain because they are not considered potential subjects for recruitment. Further, restriction to the public domain denies the dependent position access to the regulative principles of the activity given that these reside in the esoteric domain. Where the esoteric domain message is introduced, the dependent position is not given access to the connective complexity of the practices. In general, the lack of access to the regulative principles of the activity perpetuates learners’ dependence on the teacher.

My study describes how knowledge is distributed in the ‘problem solving lessons’ in terms of the concept of distributing strategies. This provides insight into teachers’ recontextualization of the problem solving approach in relation to knowledge. The following extract exemplifies a generalizing strategy taken from one of the lessons I observed.

Extract 3.2

- T: That is where now I go back, we have seen how sound is produced by vibrations, then we have these musical instruments (*The teacher points to the chalkboard*) musical what?
- L: Instruments
- T: All musical instruments you see are all sources of what?
- L1: Are all sources of sound
- T: Are all sources of sound. Now when you look at this musical instrument (*The teacher lifts up one type of instrument*) this one is also another musical instrument (*points at another instrument*). This is another (*points to other types of musical instruments*). You find that you have different types and they have different names. The way this one produces sound is quite different from the way this one does (*holds up a wind instrument*) therefore there is a need to group them. We have already said that sound is produced whenever an object does what? (*The teacher points to the word ‘vibrate’ on the chalkboard*)
- L: Vibrates
- T: Whenever an object does what?

- L: Vibrates
 T: Then in this case, what vibrates matters a lot, are you getting me?
 L: Yes
 T: For example this one and this one and this one (*holds up three different instruments*) are three different instruments and they make different...
 L: Sounds
 T: It can be musical or noisy sound. Okay, it can be musical or noisy...
 L: Sound
 T: But as far as musical instruments are concerned there is a way we look at them. Whenever an object vibrates that is sound generally, eeh that is sound generally. When we look at these ones, the way we are playing it is quite different, this time I am not going to use my fingers but will use my mouth (*blows the wind instrument and asks*). What have I done?
 L: Blown
 T: I have blown the instrument (*The teacher lifts up a drum*). Am I going to blow this one?
 L: No
 T: What am I going to do?
 L: Drum
 T: (*Teacher beats the drum*) I am going to hit it, are you getting me?
 L: Yes

The teacher employed a generalizing strategy by ‘abstracting’ the esoteric domain message from particular instances and ‘expanding’ it by showing how it applies in diverse contexts. He abstracted a general rule by suggesting that sound is produced whenever vibrations occur and expanded this rule by demonstrating vibrations with different musical instruments. After this instance, the teacher moved on to explain and illustrate the media that vibrate to produce sound in different musical instruments. Examples of the other strategies are presented in the analysis in chapter seven.

Within South Africa, Dowling’s work has been taken up to describe initial teacher education practices; classroom practice in primary and secondary schools and recruitment of prior learning in a University labour law course (Ensor, 1999; Breier, 2003; Hoadley, 2005).

3.4 Analytical framework

This section presents the analytical framework in which I operationalise theoretical concepts discussed above as a language of description for the salient features of the problem solving approach. This framework adopts a common language to describe the approach in the curriculum documents, classroom practice and teachers’ accounts of practice. Bernstein’s concepts of classification and framing provide the means to describe pedagogic practice, and in this way they constitute part of the ‘language of description’ for this study. Dowling’s concepts of domains of practice and distributing strategies extend the language of description by providing means to describe the type of content transmitted in pedagogic processes, the

'what' of pedagogy. Table 3.2 below summarizes the conceptual categories adopted from the theoretical framework to examine the key features of the problem solving approach.

Table 3.2: A summary of the conceptual categories adopted in the analytical framework

Conceptual & analytical categories	
Interactional dimension Framing of discursive rules: Selection Sequencing Pacing Evaluation criteria Framing of hierarchical rules: Forms of communication Forms of control	framing relations + - Fi
Organizational dimension Classification of pedagogic space Between teacher and learners Between learner and learner Classification of agents Teacher and learner Learner and learner	classification relations + - Ci
Classification of discourse Classification between science topics Classification between science concepts & procedures Classification between science and other subjects Classification between science and everyday knowledge	classification relations + - Cie
Types of pedagogic activities Whole class teacher-led instruction Group work activities Practical science work by demonstration or group work	Lesson activity types
Domains of practice Esoteric domain, public domain, descriptive domain & expressive domain	Strength of classification of content & forms of expression (weak or strong) Discursive saturation High or low (DS+/DS-)
Distributing strategies Generalizing, specializing, fragmenting & localizing	

Conclusion

This chapter has discussed how curriculum implementation is conceptualized within a Bernsteinian framework. Further, the chapter has discussed relevant concepts from Bernstein's theory of pedagogic discourse and Dowling's social activity theory and shown how these inform the conceptual and analytical framework for the study. The following chapter addresses the design and methodological aspects of the study.

CHAPTER FOUR: RESEARCH DESIGN AND METHODOLOGY

This chapter addresses the design and methodological aspects of the study. The first section discusses the rationale for the research design and describes the study sample of schools and teachers. The second section describes the data collection strategies and analysis procedures. The chapter concludes by discussing the limitations of the study and the strategies undertaken to address validity threats.

This study's focus on teachers' recontextualizations of official curriculum policy in particular school contexts present an intricate set of issues best undertaken within a qualitative research paradigm. I opted for a case study design so as to investigate a small number of teachers and schools in some depth. In the following section, I discuss my rationale for employing the case study design and multiple case studies in particular.

4.1 Rationale for a case study approach

Yin (2003) suggests that the case study is a preferred strategy for investigating real-life events in their natural settings because it captures both the phenomenon (the real-life event) and its context (the natural settings). The case study design was therefore well suited to explore the intricate relationships between teachers' recontextualizing processes and the school contexts in which they work. The 'context' for curriculum implementation in this study extended beyond local school contexts to include the district and national education system levels, covering the different levels of what Bernstein calls the official pedagogic device (Bernstein, 2000).

Further, Yin suggests that 'Case studies are preferred when "how" and "why" questions are being posed, when the investigator has little control over events and when the focus is on a contemporary phenomenon within some real-life context' (2003, p.1). In this view, the case study design was appropriate for investigating how and why teachers recontextualize the problem solving approach in particular ways.

Multiple cases

Case studies cover either a single case or multiple cases. I opted for multiple cases that highlight variation in two features of schools: level of academic performance and class size.

These cases capture extreme ends of the class size and academic performance continuum so as to illuminate contrasts in curriculum implementation processes across schools. Class size and academic performance as criteria for selecting schools are theoretically significant to the study. The problem solving approach as a competence model of pedagogic practice (Bernstein, 2000) or 'learner-centred' pedagogy is best employed in small sized classes where learner participation and individual attention can be maximized. I used school size as proxy for class size given that these are positively correlated. Therefore the study explores the extent to which variation in class sizes across schools influences teachers' pedagogic practice and ultimately their curriculum implementation efforts. Academic performance on the national primary leaving examination (PLE) is a key feature that differentiates schools in Uganda and the Kampala district in particular. The study aims to explore the extent to which differences in academic performance within schools are reflected in teachers' pedagogic practices and curriculum implementation processes.

Studies involving multiple cases are considered to provide more compelling evidence than single case studies. This is attributed to the theoretical replication in multiple cases which strengthens the validity and confidence of findings (Yin, 2003; Miles & Huberman, 1994). Similarities in findings from multiple cases are less attributable to 'chance' than those from single cases. For example, similarities in pedagogic practice in schools with similar class sizes and academic performance in this study strengthen the association between school contextual factors and curriculum implementation processes. However, focusing on multiple cases of schools and teachers rather than a single case meant that I sacrificed some depth for the sake of covering breadth, a defensible 'trade-off' (Maxwell, 1996, p.72).

This study aims to describe how the teachers selected for this study recontextualize the problem solving approach. In doing this, the study does not claim to represent these teachers' typical ways of teaching nor does the classroom practice of these teachers' represent the practices of other teachers in their respective schools. Instead, the lessons represent an example of the teachers' notion of how a problem solving pedagogy should be enacted, as will be discussed more fully below.

4.2 Introduction to the cases: schools and teachers

Selection of schools

This study was conducted in the urban and peri-urban surroundings of Kampala, the capital city of Uganda. Kampala is located in the central part of Uganda on the northern shores of Lake Victoria. I used class size and academic performance of schools as criteria for selecting schools and grade level for selecting teachers. I purposively selected eight schools and sixteen teachers of science, two from each school. Maxwell (1996) suggests that purposeful selection is where particular settings, persons or events are selected deliberately in order to provide important information to answer one's research questions. I selected two schools from each of the following four categories of schools: large class size and high academic performance, small class size and high academic performance, high class size and low academic performance and low class size and low academic performance.

There were four high performing schools and four low performing schools. Alpha, Bethel, Ebenezer and Fahimu primary schools were selected in the high performing category. Alpha and Bethel are large schools whereas Ebenezer and Fahimu are small schools. Canaan, Ddembe, Gonzaga and Harambee were selected as low performing schools. Canaan and Ddembe are large schools and Gonzaga and Harambee are small schools. These particular schools provided some heterogeneity to highlight the ways in which school contextual factors influence teachers' recontextualizing processes.

Schools were selected with the help of an official in the district education department using records of student enrolment and performance in PLE, the national primary leaving examinations. Six of the eight schools were government owned public schools, popularly referred to as 'UPE schools', following implementation of UPE in 1997. Ebenezer and Fahimu, the small, high performing schools, were the only privately owned schools in the sample. I had planned to use only government owned schools but found that none of the government schools in the geographical location of the study met the criteria of small class sizes and high academic performance. Inclusion of the private schools usefully provided further heterogeneity to the research schools.

All government schools were adequately resourced with text books and classrooms provided through the national Schools Facility Grant (SFG). However, a poor culture of maintenance, coupled with large student enrolments in the large schools was reflected in the poor

condition of the physical infrastructure in some schools. The UPE programme is not implemented in the private schools; therefore these schools charge tuition fees and other charges determined by the school governing bodies. Because of these charges, private schools generally serve the more affluent population.

Table 4.1 below provides a summary of key information about the selected schools. Class size is influenced by learner: classroom ratio as well as teacher: learner ratio.

Table 4.1: Summary of key information on the research schools

School	School ownership	Academic performance	Student enrolment	Average class size	No. of teachers	Teacher: learner ratio
Alpha	Govt	High	2398	+100	67	1:36
Bethel	Govt	High	2093	+100	50	1: 42
Ebenezer	Private	High	465	30	32	1:15
Fahimu	Private	High	950	45	30	1:32
Canaan	Govt	Low	1800	+100	43	1: 42
Ddembe	Govt	Low	1081	+100	18	1: 60
Gonzaga	Govt	Low	300	43	07	1:43
Harambee	Govt	Low	150	20	07	1: 21

Selection of teachers

A total of sixteen teachers of science were selected from the eight schools; two teachers from each school. The teachers were purposively selected from primary five (P.5) and primary six (P.6) because the pedagogic approach on which the study focuses is particularly emphasized for the upper primary classes (NCDC, 1999, p.131). With the exception of one teacher discussed below, I excluded primary seven (P.7) teachers because they are usually under immense pressure to prepare learners for the PLE written at the end of the year. Teachers were selected with the help of school head teachers in consultation with the science heads of department. Where schools had more than one science teacher in the selected classes, particularly in multi streamed schools, I opted for teachers with longer experience at the school as these were likely to be more conversant with the school's instructional culture.

It was not possible to select two teachers from P.5 and P.6 at one of the schools, Gonzaga, because of the manner in which the teaching load was allocated among the science teachers at that school. Gonzaga had only two teachers of science; one teacher taught the lower primary classes, primary three and four, and the other taught primary five, six and seven. Rather than observe the same teacher in two classes, I decided to include both teachers in the study. I observed one teacher in P.4 and requested the second teacher to teach either a P.5 or P.6 lesson. However, on the appointed day, he informed me that he had decided to teach a

P.7 class because he believed that the topic that was scheduled for this class was more suitable for the problem solving approach than what was planned for the other two classes.

The following section provides more details on the selected schools and teachers. I present these according to the four types of schools: large high performing schools, small high performing schools, large low performing schools and small low performing schools. I have excluded some details about the schools in order to conceal their identity, particularly for readers in Uganda.

Large high performing schools

Alpha and Bethel were selected as large high performing schools. Alpha was established in the 1950's and Bethel in the 1960's. They are both located within a five kilometre radius from the city centre. In 2005, when data was collected, Alpha had 2398 learners and 67 teachers and Bethel had 2093 learners and 50 teachers. Both schools had average class sizes of about 100 learners. These schools have a long history of high academic performance at the PLE which has persisted despite an assumption that high enrolment from UPE would adversely impact on learning outcomes. Both schools had large compounds with large adequately furnished classrooms, and well maintained buildings. However, toilet facilities were inadequate for the high student enrolment, having been designed for a much smaller population.

Alpha and Bethel were originally established to provide education for the children of colonial government expatriates. After independence, the schools were taken over by government but attended by learners from relatively high socio-economic status (SES) backgrounds, particularly the children of upper and middle class professionals and civil servants. Following the implementation of UPE, many parents of high SES removed their children from these schools and enrolled them in private schools because they expected the quality of learning to deteriorate due to the increased enrolment. The student composition of Alpha and Bethel is now mixed, comprising children of mid-level professionals and children from low SES backgrounds. Both schools serve learners mid-day meals funded by contributions from parents. Although parents are not compelled to pay for school lunch under UPE policy, parents at both schools opted to do so.

Asiimwe and Sakwa taught at Alpha primary school. Asiimwe taught P.6 and had been at the school for seventeen years, his total teaching experience. He held a diploma in primary education. Sakwa taught P.5 and had twenty years' teaching experience all spent at Alpha. He had a diploma in primary education. Both Asiimwe and Sakwa taught only science.

Kulaba and Nekesa taught at Bethel primary school. Kulaba taught science and arts and crafts in P.6 and had taught at Bethel for all thirteen years of his work experience. Kulaba had a diploma in primary education and had recently completed a Bachelor of Arts degree. Nekesa taught science and physical education in P.5 and had been at Bethel for all seventeen years of her teaching experience. She had a diploma in primary education. All teachers at Bethel were required to teach one of the 'minor' non-examinable subjects such as arts & crafts, physical education and music in addition to one of the 'major' examinable subjects; English, mathematics, science and social studies.

Small high performing schools

Ebenezer and Fahimu are the two small high performing schools in the sample. Both schools are privately owned and are relatively 'young', having been established in the early 1990's. In 2005, Ebenezer had a student enrolment of 465 learners, 32 teachers and two streams per class with an average of 30 learners each. Fahimu had 950 learners, 30 teachers and two streams per class with an average of 45 learners each. Both schools have a record of high academic performance at the PLE. These schools serve learners from high SES home backgrounds because they charge high school fees. Both schools are housed in very neat and well maintained buildings with large sized well furnished classrooms, administration offices, computer rooms, libraries, school halls and adequate well maintained toilet facilities. Both schools provide break and mid-day meals for the learners.

Musaali and Erone taught at Ebenezer. Musaali taught science in P.5 and P.7 and had fourteen years' teaching experience, four of which had been spent at Ebenezer. He had a diploma in primary education. Erone taught science in P.5 and P.6 and was also head of the science department. In 2005, he had twenty years' teaching experience and had spent three years at Ebenezer. He had a diploma in primary education. Both Erone and Musaali taught only science.

Bogere and Kabi taught at Fahimu primary school. Bogere taught science in P.6 and had been at the school for all ten years of his teaching experience. He had a diploma in primary education. Kabi taught science in P.5 and had seven years' teaching experience, three of which had been spent at Fahimu. He also had a diploma in primary education. Both teachers taught only science.

Large low performing schools

Canaan and Ddembe were selected from the pool of low performing large schools. Both schools were among the oldest in the sample; Canaan was established in the 1930's and Ddembe in the 1940's. Both schools are located in the peri-urban outskirts of Kampala, within a radius of ten kilometres from the city centre. In 2005, Canaan had a student enrolment of 1800 learners and 43 teachers. Every class had three streams with an average of 100 learners each. Ddembe had an enrolment of 1081 learners and 18 teachers. Each class had two streams with an average of 100 learners each. Both schools had a record of low academic performance which was exacerbated by high student enrolment and by some UPE policies, particularly automatic promotion. Automatic promotion allows children to progress to subsequent classes regardless of whether they meet the necessary academic requirements.

Canaan is housed in a very large compound with many buildings whereas Ddembe has a small compound consisting of two blocks of old buildings. Classrooms were very crowded at both Canaan and Ddembe with four to five learners sharing a desk. In some classes, learners performed tasks squatting and wrote while supporting exercise books on their laps and knees. Children attending both schools came from low income families headed mainly by manual labourers, low-level factory workers and low rank officers in the armed forces. School lunch was provided for learners whose parents had opted to pay for it. Some learners carried packed lunches and a considerable number were reported to spend the school day without any meal.

Malongo and Weere taught at Canaan Primary school. Malongo taught science in P.6, she had eighteen years' teaching experience and had spent nine years at Canaan. In addition, Malongo was the senior woman teacher in charge of the social welfare of female students. She had a diploma in education. Weere taught science in P.5. He had nineteen years' teaching experience which had all been spent at Canaan. He was the senior teacher in charge

of the teachers' social welfare and also patron of the environmental education club. Weere had a diploma in primary education. Both teachers taught only science.

Bwogi and Opio taught at Ddembe primary school. Bwogi taught science in P.6 and P.7. She had thirteen years' teaching experience and had spent eight years at Ddembe. She headed the science department and had a diploma in primary education. Opio was in his third year at Ddembe but had a total work experience of twenty three years. He had a diploma in primary education and had embarked on a part-time Bachelor of Education degree programme at the time of data collection. Both teachers taught only science.

Small low performing schools

Gonzaga and Harambee were selected from the pool of small low performing schools. Both schools were located within a radius of five kilometres from the city centre but in close proximity to slum areas. Gonzaga was established in the 1940's and Harambee was established in the 1950's. Gonzaga had a student population of 300 learners and seven teachers. Each class had one stream with an average of 43 learners each. Harambee had an enrolment of 150 students and seven teachers. Each class had one stream with an average of 20 learners each. Classrooms at both schools had adequate furniture with excess desks piled at the back of some classrooms at Harambee.

The physical infrastructure at both schools was in poor condition with paint peeling off walls and leaking roofs. The compounds were very small, without fences and criss-crossed by several foot paths. The physical environment was not conducive to learning because of frequent disruptions from nearby car washing bays and markets. Although both schools had benefited from the Schools Facilities Grant (SFG) and each had a block of new classrooms, these were generally poorly maintained. Relative to the other six research schools, Gonzaga and Harambee were under staffed with only seven teachers each, therefore each teacher taught two or more subjects. The small number of teachers at these two schools was attributed to the government policy of allocating resources according to student enrolment.

Both schools were attended by children from the surrounding slums, most of whom were reported to be orphans looked after by relatives. The academic performance of these two schools was the lowest in the sample. Teachers and head teachers complained about the very low competencies of learners which they attributed to their lack of mastery of the English

language and to the general poverty of the learners. Most learners reported to school without basic items such as pens and exercise books and spent the school day without meals because none of the parents at these schools paid the optional school lunch contribution nor provided packed lunches for the learners.

Ssesanga and Nambuya taught at Gonzaga primary school in 2005. Ssesanga taught science and mathematics in P.5, P.6 and P.7. He had thirty three years' teaching experience, the longest among all teachers in this study and had spent fifteen years at Gonzaga. He was head of the science department and was also in charge of the school's instructional resource centre. Ssesanga had a diploma in education. Nambuya taught science and English in P.3 and P.4 as well as Mathematics in P.3. Nambuya had seventeen years' teaching experience of and had spent five years at Gonzaga. She had a certificate in primary education.

Acom and Suubi taught at Harambee primary school. Acom taught science in P.6 and P.7 in addition to social studies in P.7. She had fifteen years' teaching experience, three of which had been spent at Harambee. She was head of the social studies department and had a diploma in primary education. Suubi taught science and English language in P.4 and P.5. She had thirteen years' teaching experience and had spent ten years at Harambee. She had a diploma in primary education.

The basic qualification for primary school teachers in Uganda is a certificate in primary education. This is a two years' professional training programme provided after four years of ordinary level secondary education.⁴ Most primary school teachers in Uganda have moved one or two ranks above this basic requirement, having upgraded to diploma and bachelor levels. This trend is reflected in the qualifications of teachers in this study. Table 4.2 below summarizes key information about the teachers.

⁴ This is equivalent to grade ten in South Africa.

Table 4.2: Summary of information about teachers

Teacher	School	Science Class	Highest level of training	Teaching experience (Years)	Subjects Taught	Other Positions
Teachers from high performing schools						
Asiimwe	Alpha	P.6	Diploma in educ	17	Science	N/A
Sakwa	Alpha	P.5	Diploma in educ	20	Science	N/A
Kulaba	Bethel	P.6	Bachelor of Arts	13	Science and Arts & Crafts	N/A
Nekesa	Bethel	P.5	Diploma in educ	17	Science & Physical educ	N/A
Erone	Ebenezer	P.6	Diploma in educ	20	Science	HOD science
Musaali	Ebenezer	P.5	Diploma in educ	14	Science	N/A
Bogere	Fahimu	P.6	Diploma in educ	10	Science	N/A
Kabi	Fahimu	P.5	Diploma in educ	07	Science	N/A
Teachers from low performing schools						
Malongo	Canaan	P.6	Diploma in educ	18	Science	Senior woman teacher
Weere	Canaan	P.5	Diploma in educ	19	Science	Environment Club patron, senior teacher
Bwogi	Ddembe	P.6	Diploma in educ	13	Science	HOD science
Opio	Ddembe	P.5	Diploma in educ	23	Science	N/A
Nambuya	Gonzaga	P.4	Certificate in educ	17	Science, Maths & English	N/A
Ssesanga	Gonzaga	P.7	Diploma in educ	33	Science & Mathematics	HOD Science
Acom	Harambee	P.6	Diploma in educ	15	Science & Social Studies	HOD Social Studies
Suubi	Harambee	P.5	Diploma in educ	13	Science & English	N/A

4.3 Data collection

Data sources

Consistent with case study research with its multiple sources of evidence (Yin, 2003), I collected data from a range of sources. Multiple sources of data limit systematic biases inherent in specific methods, strengthening the validity of findings through triangulation (Yin, 2003; Maxwell, 1996). Data sources in the study included classroom observations, teachers' interviews, head teachers' interviews, direct observation of school facilities and non-participant observation in meetings (staff, departmental and academic committees). I also had informal conversations and interaction with teachers in staff rooms and in the school compounds. In addition, I held a key informant interview with a curriculum specialist

at NCDC, the national curriculum development unit and analyzed curriculum policy documents.

Pre-lesson observation meeting with teachers

Prior to the fieldwork, I contacted the Kampala district education department and the school head teachers for authorization to conduct fieldwork. My first meeting with the teachers was an informal one aimed at initiating research relationships and establishing rapport with them. I used this meeting to introduce myself, the purposes of the study and the nature of teachers' participation in it and also to allay concerns about the study. Because the study focuses on the implementation of official curriculum policy, teachers may have perceived it as evaluating their practice in some way. I emphasized to each teacher that the research sought to understand how they employ the problem solving approach, for purely academic purposes, and did not seek to evaluate their practice. I sought their consent to participate in the study and assured them that their true identities and that of their schools would be concealed by using pseudonyms. After getting their consent, I requested each teacher to prepare and teach one science lesson using the 'problem solving approach' in the best way possible and on a topic they felt would demonstrate the approach best. Following this, we set the most convenient dates and times for the lessons.

Classroom observations

I observed a total of sixteen science lessons, one per teacher, over a period of six months from January to June 2005. My decision to observe one lesson per teacher was based on the purpose of the study as well as my practical knowledge of the setting. This study describes how teachers employ a particular pedagogic approach, the problem solving approach, so as to inform an account of their recontextualizations of curriculum policy. The study focuses on teachers' 'best practice' in relation to a particular pedagogic approach rather than describing their 'typical' pedagogic practices. Typical pedagogic practice was however explored in the subsequent interviews so as to contextualize the lesson observation data. Critical incidents in the lessons provided a spring board to explore general instructional issues in the school.

My practical knowledge of the research setting alerted me to possible resistance from schools to longer classroom observation on two accounts. First, classroom based research in Uganda is still in its infancy; therefore teachers are not accustomed to researchers observing their lessons for extended periods of time. Second and more important, the intensity of work

and the pressure that teachers in the study area operate under pose a challenge to classroom research. Teachers' accounts in this thesis confirm that pressure to cover content-heavy syllabi before examinations constrains their classroom practice considerably. The duration of lessons varied, with single lesson periods ranging between 40 to 60 minutes and double lessons taking 80 minutes. Although the official lesson period lasts 40 minutes and a double one 80 minutes, some schools, particularly private ones, have 60 minute lesson periods.

All the lessons were video recorded by an assistant while I sat at the back of the classroom and took notes covering as much of what was going on in the lesson as possible. I noted critical incidents that were of theoretical and empirical significance to the study. These incidents provided themes for discussion in the subsequent interviews with the teachers.

Interviews with teachers

I held an interview with each teacher after the lesson observation. The interviews provided opportunities to reflect on the lessons using the critical issues which I had noted as entry points for the discussions. The interviews focused on three key aspects; firstly, I sought to understand why teachers enacted the problem solving approach in particular ways, focusing on their rationales for classroom practice. Questions were framed around specific incidents that occurred in lessons relating to theoretically relevant issues such as pacing and knowledge relations, among others.

Secondly, the interviews sought information relating to the school's general instructional culture. Beginning from specific issues observed in the lessons, I asked teachers questions relating to curriculum planning and assessment, relationships between administration and teachers and among teachers as well as other relevant contextual issues. I also asked teachers about their academic and professional training. Thirdly, the interviews examined teachers' interpretations of the problem solving approach focusing on their perceptions of its key features, pedagogic benefits and limitations as well as their general experience in using the approach in their schools. The interviews also explored how factors within the broader education system influenced teachers' pedagogic practice in general and their efforts to take up the problem solving approach in particular. All interviews were audio-recorded and each took on average one hour.

Interviews with head teachers

I held an interview with each of the eight school head teachers. These interviews aimed to collect school contextual data relating to historical background, administrative and management structures, staff and student profiles, resources, instructional cultures and policies and general institutional ethos and culture. All the interviews were audio-recorded and each took one hour on average.

Interview with curriculum specialist

I held a semi-structured key informant interview with the curriculum specialist in charge of primary school science at the NCDC. This officer provided background policy information on the new curriculum generally and the problem solving approach in particular. This included an historical account of the current curriculum reforms in Uganda, the origins and rationale for the problem solving approach as well as its key features and pedagogic principles. I also inquired about the dissemination process for the new curriculum including teachers' in-service preparation and support. The interview was audio-recorded and lasted about 45 minutes.

Analysis of curriculum policy documents

I analyzed key curriculum policy documents comprising the primary school curriculum (1999) focusing on the integrated science syllabus and its accompanying teachers' guide as well as the main science text books recommended for the classes I observed. I also reviewed the Education Policy Review Commission Report and the Government White Paper on Education to provide contextual information on the education policy framework more generally.

Direct observations

I sat as a non-participant observer at the following meetings: two science department meetings; one at Alpha and another at Bethel, an academic committee meeting at Bethel and staff meetings at Alpha, Bethel, Canaan and Harambee, one at each school. The purpose of attending meetings was to get a general sense of how these meetings were organized as well as the issues discussed therein so as to provide insights into how power and control relations within the school context articulated with teachers' classroom practice. I was not able to attend meetings in the rest of the schools because there were none scheduled in the field work period and the timing of some meetings coincided with classroom observations at other

schools. However, this did not affect the overall validity of the findings because I inquired about the structure, frequency and content of meetings in the interviews with the teachers and head teachers. I also had informal interactions and conversations with teachers in all the schools either in staff rooms or within the school compounds. Table 4.3 below summarizes the types of data, data sources and collection strategies and indicates these against the specific research questions they addressed.

Table 4.3 Summary of data sources and collection strategies

Specific research question	Type of data needed	Source of data	Data collection strategy
How do teachers enact the PSA in pedagogic practice?	Teachers' pedagogic practice	Classroom observations	Video-recording Class observation notes
Why do teachers employ the problem solving approach in particular ways?	Teachers' rationales for pedagogic practice	Teacher interviews	Audio-recording
What do teachers interpret as the main features and pedagogic benefits of the problem solving approach?	Teachers' interpretations of key features & pedagogic benefits of the problem solving approach	Teacher interviews	Audio-recording
In what ways do school contexts influence teachers' recontextualizing processes?	School contextual data	Interviews with head teachers Interviews with teachers Direct observation Staff & departmental meetings Informal conversations with teachers	Audio-recording Direct observation Field notes
What mode of pedagogic practice does the official curriculum project through the problem solving approach?	Policy on the problem solving approach Background information on the curriculum	Curriculum policy documents Interview with curriculum specialist	Review of documents Audio recording

4.4 Data analysis procedures

Classroom observations and teachers' interviews constitute the bulk of the data presented in this thesis. This section explicates the analytical procedures employed to transform information from classroom observations and interviews into data. These procedures are informed by the theoretical framework presented in chapter three. In this view, the analysis is 'biased' towards a particular theory (Brown and Dowling, 1998, p.89), in conformity with the general methodological approach in the Bernsteinian research community (Bernstein,

2000; Morais & Neves, 2001; Singh, 2002). Bernstein (2000) calls for explicit theoretical models and analytical procedures summarized in his concepts of ‘languages of description’ which he defines as follows:

Briefly, a language of description is a translation device whereby one language is transformed into another. We can distinguish between internal and external languages of description. The internal language of description refers to the syntax whereby a conceptual language is created. The external language of description refers to the syntax whereby the internal language can describe something other than itself (pg.132).

The internal language of description relates to the relevant theoretical concepts informing a study. The theoretical framework presented in chapter three constitutes an internal language of description for this study. The external language of description relates to a model by which the internal language is activated to determine what ‘counts’ as data and its principled ‘reading’ (Bernstein, 2000, p.133). The following sections provide an account of the data analysis procedures highlighting how the external language of description for the study developed through dialogic relations between theoretical concepts and empirical data.

The following table summarizes the theoretical concepts which informed the analysis of data.

Table 4.4 Summary of theoretical concepts informing data analysis

Research issues	Type of data	Relevant theory & Theoretical concepts	Coding strategy
Relative control of teacher and learners in pedagogic processes Knowledge relationships	Classroom observations	Bernstein’s theory of pedagogic discourse Classification & framing	Coding instrument
Instructional content & its transmission Degree of specialization Instructional strategies for transmitting content	Classroom observations	Dowling’s (1998) social activity theory Domains of practice & Distributing strategies	Nvivo soft ware
Teachers’ interpretations of the problem solving approach in curriculum policy	Teacher interviews	Bernstein’s theory Recognition and Realization rules	”
Teachers’ rationales for practice	Teacher interviews	Bernstein’s theory Classification & framing	”
School contextual influences on recontextualizing	Teacher interviews Head teachers’ interviews Direct observations	Bernstein’s theory External framing Pedagogic culture	”

Preparing the data sets

The initial step in the analysis entailed preparation of the data texts through transcription of the video and audio-recordings of the lessons and interviews. I transcribed the lessons with the aid of an assistant. I reviewed all the completed transcripts for accuracy by comparing them with the video and audio recordings. I subsequently read the transcripts a number of times to derive a general sense of what was going on in the lessons and interviews, what Maxwell calls 'contextualizing the analysis' (1996, p.79). I formed initial impressions about the data which I noted down as memos in the texts.

Analysis of the classroom observations

The lesson constituted the unit of analysis for the classroom observation data. The analysis of classroom observations focused on two aspects. The first part of the analysis examined three aspects; the relative control of teachers and learners in pedagogic processes, social relations between teacher and learners and among learners and relationships between science and other forms of knowledge. With regard to knowledge relationships, I considered relations within science knowledge (intra-disciplinary relations), relationships between science and other school subjects (inter-disciplinary relations) and relations between science and everyday knowledge (academic/non-academic relations). This part of the analysis involved a characterization of the structure of pedagogic discourse in terms of Bernstein's concepts of classification and framing. These concepts were operationalized through a coding instrument whose development is described in some detail below.

In the second part of the analysis, I examined the degree of specialization of instructional content transmitted in the lessons and the types of instructional strategies employed in its transmission. These two aspects were analyzed in terms of Dowling's concepts of 'domains of practice' (esoteric domain, public domain, descriptive domain and expressive domain) and 'distributing strategies' (generalizing, specializing, fragmenting, localizing). I used the Nvivo software for qualitative data to code lessons for domains of practice and close reading of the texts for distributing strategies.

Developing the coding instrument

I developed a coding instrument for the classroom observation data using the two key theoretical concepts of classification and framing. In this view, the coding instrument constitutes the 'external language of description' for analysis of the structure of pedagogic

practice. The general methodology used to operationalize the concepts of classification and framing into the coding instrument follows the work of the sociological studies of the classroom (ESSA) project at the University of Lisbon in Portugal. However, the scheme was tailored to the purposes of this study. The instrument covers conceptual categories for pedagogy offered by the theory, including its organizational and interactional dimensions. The organizational features cover: classification of discourse (intra-disciplinary, inter-disciplinary and academic/non academic relations); classification of spaces (teacher-learner and learner-learner) and classification of agents (teacher-learners and learner-learner).

Interactional features covered indicators for framing over the discursive rules (selection, sequencing, pacing and evaluation criteria) and hierarchical rules. Each conceptual category had a number of empirical indicators, with an overall total of 30 indicators for the entire instrument. The indicators focused on salient elements of pedagogic practice in the context of the problem solving approach and its empirical realizations. The indicators were extended and modified continuously until the instrument was capable of coding the full range of lessons. Therefore the instrument evolved through several cycles, highlighting the dialogic relations between the theoretical concepts and the empirical data.

Utilizing conventional Bernsteinian symbols, I assigned each indicator a value on a four point scale ranging from the weakest framing and classification values (F^- / C^-) values to the strongest values (F^{++} / C^{++}). I assigned C^- / F^- a value of 1; F^- / C^- a value of 2; F^+ / C^+ a value of 3, and F^{++} / C^{++} a value of 4. An example of one of the indicators under the discursive rule, evaluation criteria, is shown in fig.4 below. A copy of the full coding instrument is attached in appendix A.

Fig 4.1: An indicator for evaluation criteria on the coding instrument

Indicator	F^{++}	F^+	F^-	$F--$
Handling of learners' responses to questions	The teacher accepts all responses given by the learners. S/he elaborates correct answers and shows why some answers are incorrect. The teacher provides the missing text or s/he guides the class to build up incomplete responses.	The teacher accepts correct and incorrect responses. S/he elaborates correct responses and shows why some responses are incorrect.	The teacher accepts only correct responses, which s/he elaborates briefly and rejects incorrect responses without further elaboration.	The teacher accepts correct responses but does not elaborate these further. S/he ignores incorrect responses without further elaboration.

Using a copy of the instrument for each lesson, I highlighted the corresponding strength of framing and classification under the different indicators of each conceptual category. The following extract exemplifies an empirical instance coded as F⁺⁺. The incident, taken from Asiimwe's lesson, took place during the correction of a class exercise.

Extract 4.1

T: How is music different from noise? (*Short pause*) How is music different from noise? Iga?
 Iga: Music is organized while noise is not
 T: Is not? Is that so? If it is not, then what is it?
 Iga: Then it is not organized
 T: If it is not organized, now you are changing
 Iga: Which is disorganized...?
 T: Eeh, so the answer is disorganized?
 Iga: Music is organized while noise is disorganized
 T: Music is organized what now? Sarah
 Sarah: Music is an organized sound while noise is disorganized sound
 T: It is organized, when you talk of music it is organized what?
 P: Sound
 T: It is organized what?
 P: Sound
 T: While this noise is the sound that is disorganized. Now how is sound produced? Yes Iga?
 Iga: By vibrations
 T: Is that the way we train you to answer questions? Are questions answered like that? Iga?
 Iga: Sound is produced by vibrations of objects

Asiimwe expected learners to express their answers in grammatically complete sentences. The extract shows how he pointed out what was missing in Iga's initial response and then elaborated the correct aspects of the answer. He finally guided the class to build up the incomplete answer.

Fig 4.2 below shows one of the indicators for hierarchical rules showing the form of control employed to regulate learners' conduct.

Fig 4.2: One of the indicators for hierarchical rules on the coding instrument

Indicator	F+ +	F+	F-	F--
Control of learners' conduct	Teacher employs imperative control all the time. S/he admonishes learners when they make mistakes and may also use physical punishment.	The teacher employs positional control most of the time. S/he sets rules of conduct and reminds learners about the rules when they digress from the expected conduct.	The teacher uses positional and personalized control. S/he sets rules for conduct and in some cases s/he gives learners reasons why they should follow the rules.	The teacher employs personalized control all the time. Whenever, learners digress s/he explains to them the consequences of their conduct to themselves and the rest of the class.

The following extract exemplifies an instance coded as F+ showing strongly framed hierarchical rules.

Extract 4.2

This communication took place in Suubi's class

T: Now let us get the uses of these leaves from here (*Pointing at the textbooks*).

L: (*Learners begin reading from the textbooks*)

T: NO, don't read loudly, read quietly and you get the answer.

P: (*Learners are reading with some reading a bit loudly*)

T: This one has just come; don't disturb your friends (*Teacher points at the late comer who is inquiring from*).

The extract shows how Suubi reminded the learners about the expected rules of procedure. This instance exemplifies strongly framed hierarchical rules (F+), reflecting a positional form of control.

Some indicators were only applicable for particular lessons therefore the number of indicators coded for each lesson varied according to the structure of activities in the lessons. For example, lessons involving practical science work demonstrated by teachers were not coded for indicators relating to group work activities. The non-applicable indicators were marked as 'NA'. I summarized the overall coding for all the indicators of pedagogic practice for each lesson on a sheet. An extract from the summary sheet showing evaluation criteria for one lesson is shown in figure 4.3 below.

Fig 4.3: Sum total for all indicators for evaluation criteria

Indicators	F ⁺⁺	F ⁺	F ⁻	F ^{..}
Exposition of content		F ⁺		
Conduct of practical work	NA			
Instructions for tasks	F ⁺⁺			
Correction of class exercises	F ⁺⁺			
Presentation of group work		F ⁺		
Handling of learners' verbal responses	F ⁺⁺			

Following Hoadley (2005), I derived an average for each classification and framing relation (selection, sequencing, etc) by summing up the values for the coded indicators and dividing this sum by the number of indicators coded as illustrated below. In the example above, the lesson was coded for five indicators under evaluation criteria and one indicator was not applicable to the lesson. The average value for evaluation criteria was derived by summing up the coded indicators as follows: $3F^{++} \times 4 + 2F^{+} \times 3 = (3 \times 4) + (3 \times 2) = 12 + 6 = 18/5 =$

3.6. I used this average value as the overall strength of framing for evaluation criteria. In this case the overall average value, 3.6, indicates very strong framing (F⁺⁺). The full results for coding for each of the sixteen lessons are provided in appendix B.

Instructional content and transmission strategies

The previous analytical procedures focused on the organizational and interaction structure or the 'how' of pedagogy. This section considers the instructional content or 'what' was transmitted in the lessons, focusing on the degree of specialization of the science knowledge and the instructional strategies employed to transmit content. The analysis drew on Dowling's concepts of domains of practice and distributing strategies because these aspects could not be described in terms of Bernstein's concepts of classification and framing. Bernstein focuses on the 'boundaries' between knowledge rather than the 'content' or semantic substance of knowledge. He describes these boundaries in terms of 'classification'. As discussed in chapter three, Dowling also employs the concept of classification but uses it to refer to the degree of specialization of content.

Because the analytic procedures for instructional content are conceptualized within a different theoretical and methodological framework, Dowling's (1998) social activity theory, they differ from what was used for analyzing the structure of pedagogy. Dowling proposes content analysis and quantification strategies as the key analytical approaches for content and distributing strategies. He recommends a semiotic analysis of pedagogic texts via detailed reading to determine the 'denotations and connotations incorporated in a text' (p.180). Content and its form of expression are incorporated in pedagogic texts (such as lesson transcripts) in the denotations and connotations referred to in the preceding sentence.

Dowling (1998) suggests that an 'activity' (such as school science) is reproduced by texts and in particular, by pedagogic texts. He defines a text as 'an utterance (linguistic and /non-linguistic) or a set or sequence of utterances made within the context of one or more activities' (Dowling 1998, p.131). The lesson transcript in this case constitutes the empirical 'pedagogic text' which was analyzed via a close reading. Dowling suggests that 'pedagogic texts' are empirical instances or 'events' of pedagogic activities. Activity, the structural level of Dowling's language of description, is accessed through texts which exist at the level of events.

Following Dowling, I analyzed lesson transcripts to determine the strength of classification of content and forms of expression within science lessons. The type of content and forms of expression denote the degree of specialization of school science knowledge. I used the broad categories of science knowledge such as physical and natural science to determine specialization of content. I quantified the proportion of utterances falling under each of the four domains of practice; (esoteric, public, descriptive and expressive) by running a character counter using the Nvivo software. The distribution of utterances in the different domains provided a coarse measure of the degree of specialization of knowledge transmitted in the lessons. A high percentage of utterances in the esoteric domain suggests that knowledge is more specialized whereas a higher percentage of text falling under public domain suggests less specialization in relation to school science.

I also included character counts for utterances directed at controlling learners' conduct its proportion in the pedagogic text is analytically significant to the study. For example, it allows one to compare the proportion of the lesson text devoted to transmission of content with that utilized for regulating conduct. These utterances that focus on what learners should do but which do not transmit instructional content, for example utterances relating to expected conduct such as 'speak louder' or 'keep quiet'. A summary of the character counts for all the lessons is presented in a table, an extract of which is shown in table 4.5 below. The full results of this analysis are presented in table 7.1 in chapter seven. CC stands for character count of utterances and (%) refers to the percentage of the overall pedagogic text covered by each domain.

Table 4.5: An extract from table showing character counts and percentage of utterances in lesson transcripts

	Esoteric domain CC& (%)	Public domain CC& (%)	Descriptive domain CC & (%)	Expressive Domain CC & (%)	Regulation of learners' conduct CC & (%)	Total CC& (%)
Lesson type one						
Asiimwe	18,614 (79.6)	-	2,911 (12.5)	166 (0.7)	1,681 (7.2)	23,374
Kulaba	10,853 (73)	-	246 (1.7)	-	3,774 (25.4)	14,873
Nekesa	13,706 (50.8)	2,813 (10.4)	5,117 (19)	-	5,328 (19.8)	26,964
Sakwa	12,441 (74.6)	-	436 (2.6)	1,891 (11.3)	1,902 (11.4)	16,670
Ssesanga	8,364 (80.8)	-		-	1,989 (19.2)	10,353

I examined the instructional strategies used to transmit content in the light of Dowling's concept of distributing strategies: generalizing, specializing, fragmenting and localizing. The analytical procedures for distributing strategies were less structured in comparison to those used for content analysis. I reviewed entire lesson transcripts to identify the different ways in which content was transmitted using Dowling's definitions for each distributing strategy to derive its empirical indicators.

The extract below provides an example of transmission of content through a localizing strategy. Localizing transmits a particularized message focusing on a specific setting; it provides details on the setting of activities, for example, through pictures and photographs as well as narratives of personal experiences. Localizing strategies project learners into the public domain by identifying them with specific experiences. The following extract taken from Acom's group work lesson on the topic 'effects of alcohol in society' exemplifies localizing. Acom was elaborating points presented by one of the groups on the effects of alcoholism on families.

Extract 4.3

- T: How does alcohol lead to loss of employment? Yeku, when you drink too much, how does it lead to loss of your employment? (*Silence*) Eeh, Yeku how does it lead to loss of employment, when you see your uncle, and other relatives drinking too much it will lead to loss of employment, but how? Eeh.....Yes
- Yeku: Because your knowledge will be destroyed
- T: The knowledge will be destroyed aha, Yeku said when you drink too much, and the knowledge will be destroyed. Apart from knowledge, what other things can lead to loss of employment. Kawa...? Matayo...? Who is talking there? We are asking how too much drinking can lead to loss of employment? Can you close that book there; you had enough time with it. How can this drinking too much bring loss of your employment...eeh if your relatives drink? Yeku told us that it destroys knowledge that is used at work
- L: (*A learner says something inaudibly*)
- T: Speak up, put up your hands and tell us. That is why I was telling you to add more points on these ones here (*Pointing to blackboard*). Now Ann is telling us good answers but she does not want to put up her hand. Aha can you tell us?
- Ann: Causes accidents
- T: This also causes accidents because when they are drunk they over speed, the speed is too much leading to accidents and death. If you are walking along the road he hits you and he may also die. This employment here, if somebody drinks until very late, can he wake up and go to work?
- L: NO.
- T: You can't wake up to go. So the next day he will also miss work until at the place of work they say so and so should be removed from work. This one can lead to loss of job. What about the breakage of the family, you have seen in that picture, can we see in that picture on page 91 what is happening in that picture?
- L: (*Learners look at the picture in a text book*)
- T: What is happening there?

- Yeku: The father is caning the mother
 L: *(The rest of the class together with the Acom laugh at Yeku's answer)*
 T: The father is caning the mother. Now if that is your mother, will you feel happy?
 L: No
 T: That is the bad effect of drinking; caning the mother when the children are watching their mother being caned. You can't come back from drinking everyday and beat a woman - that will lead to breakage of the family.

The extract shows an emphasis on specific examples of the adverse effects of alcoholism drawn from incidents within the local context of the learners. Further, Acom identified learners with positions within the public domain setting of a family by asking them 'how they would feel if their mother was caned'. Dowling suggests that such identification of learners with a specific public domain setting of a family constitutes a localizing strategy. These aspects provide indicators for localizing strategies outlined above. The rest of the transcripts were examined in the same way by referring to Dowling's definitions and indicators for each distributing strategy. I identified the most prevalent strategies used in each lesson. The full results of this analysis are presented in table 7.2 in chapter seven.

Analysis of interview data

This section describes the analytical procedures for interview data. Kvale (1996) suggests that the theoretical basis of an investigation provides the context for making decisions about how interviews are analyzed. '...the analyst's theoretical conceptions of the subject matter influence how he or she analyzes the interviews' (p.206). The analysis of interviews was informed by the theoretical framework for the study although its analytic procedures were less structured than those employed for analyzing lessons.

Coding of interviews

I coded interview data electronically using the Nvivo computer software programme with its capacity to code, categorize, store and retrieve data texts. An initial step in the analysis of the interviews was a close reading of each transcript a number of times to get general impressions about the data. I inserted these ideas into the text as memos. Following this, I coded each transcript by assigning labels referred to as 'free nodes' against data segments in the text. Free nodes were derived from the same conceptual categories used for coding classroom data; they included concepts such as pacing, evaluation criteria and intra-disciplinary relations. Other free nodes were derived from the actual words and themes (in vivo) emerging from the interviews. An example of a coded interview transcript showing the free nodes is provided under appendix

C. I categorized some free nodes into broader conceptual categories, referred to as ‘tree nodes’, where possible. For example, I grouped all components relating to discursive rules together; likewise I grouped all free nodes relating to knowledge relations together. This simplified comparisons within and across different interview transcripts because I could retrieve and compare data segments labelled with the same free or tree nodes from all the interviews or sets of interviews.

The data derived from teachers’ rationales for pedagogic practice were related and categorized according to the aspects of classroom practice they related to such as pacing. Therefore the conceptual categories for these aspects of the interview data were similar to those used in classroom observation data. For example, interview data relating to the influence of centralized curriculum planning practices on teachers’ practice was coded as ‘external framing’. Similarly, teachers’ rationales for using particular instructional strategies for transmitting content was coded and categorized under the concept of ‘distributing strategies’. In this way interview data was analyzed and described in the same theoretical framework as the classroom data, drawn from Bernstein’s and Dowling’s theories.

Below, I illustrate how I operationalized the concept of pedagogic culture to analyze interview data relating to relationships between classroom practice and the organizational framework of schools, including its curriculum and instructional monitoring practices and other management practices. I want to differentiate the influence of external framing on classroom practice from influences from other non-discursive factors. In the extract below, the head teacher of Alpha describes his monitoring and supervision strategies for instruction:

I ensure that I move to every corner of the school to know what is where, I move into the classroom to see the teachers physically teaching. When I identify a problem, then I see how we go about it. But specifically where I move into the classrooms to see the teachers teaching I [would] have informed those teachers that I will be coming to see them. Yes, I sit there, see the whole lesson throughout, then after that we discuss. I say there is this, there is this; I have seen this and this. They are now used to it.... When I am in for that lesson, I will have to look at the pupils books, I will have to look at how you prepare. I will have to look at whether your preparation rhymes with the scheme of work and how you actually deliver to the children, I do all that in that particular lesson.

Here we see how strong external framing at the level of the school relates to teachers’ classroom practice, operationalized empirically through the school’s curriculum and instructional monitoring strategies operating at the organizational management level. My

interest is the degree to which organizational strategies such as the one described above influence classroom practice and, through this, the teachers' recontextualizing processes. Some of the school's influences on classroom practice did not originate from the official pedagogic discourse entirely; instead these were driven by other economic and political imperatives, which Bernstein refers to as 'marketisation'. In particular, head teachers of private schools in this study reported challenges relating to reconciling the interests of parents with the requirements of the Ministry of education.

In response to these external demands, schools develop strategies to enhance academic excellence, and by so doing shape pedagogic practice in particular ways. The following extract exemplifies some of the strategies developed by Fahimu primary school, taken from the head teacher's interview.

One of the things that we have put in place is making sure that every teacher is accountable for what he does...Everybody must be accountable and teachers have that competitive spirit in them. When they look at a class or subject being done better than his or hers, he feels a challenge and they put in a lot of effort to make sure that they improve their performance. But also we have a system of giving homework, daily homework.Then we have midterm exams which we give to the children to evaluate their performance. We also have what we call topic evaluation exercises. After the teacher has taught a topic, we evaluate to see whether the children have really understood it. This is done in upper school, mainly from P.3 upwards, because that is when we think that the children have a lot of content they have to retain. Another strategy is actually analyzing results, because when we teach and you don't evaluate and analyze the results you never know where your weakness is. But we do tests then we analyze the results the children have got so that you get to know which subject is performed worst, which one is performed best, which topics were done worst and why and then we lay strategies to improve.

Although the strategies highlighted above potentially improve classroom practice, particularly in terms of strengthening framing of evaluation criteria, not driven by the requirements of the pedagogic discourse. They may in fact be in tension with the official curriculum. They are also motivated by what Bernstein refers to as 'a bias of marketization' (2000, p.24), aiming to improve the school's public image. According to Bernstein, these school management strategies and their articulation with the pedagogic code constitutes part of pedagogic culture.

Analysis of the official curriculum documents

I analyzed the official curriculum documents, focusing particularly on the integrated science syllabus and its accompanying teachers' guide so as to derive information on the pedagogic principles entailed in the problem solving approach, what Bernstein calls a 'theory of instruction' (2000). In relation to theories of instruction, the pedagogic prescriptions for the problem solving approach in the curriculum documents are associated with features of a competence model of pedagogic practice. Despite the general orientation towards competence theory of instruction, some guidelines for pedagogic practice in the teachers' guide suggest strong framing, particularly over evaluation criteria and macro-selection of content. I analyzed the salient features of the pedagogic approach and described these in terms of the concepts of classification and framing as operationalized in the analytical framework for this study.

I provide two examples of how I interpreted the curriculum policy texts in terms of theoretical concepts. One of the key features of the problem solving approach suggests that teachers cede some control over instruction to learners so that learners take responsibility for their learning (self-regulating role) as teachers facilitate them. This feature is derived from the following guideline from the teachers' guide to the integrated science syllabus, 'Treat learners as responsible beings. Let them take charge of their learning as you provide the necessary guidance and facilitation' (NCDC, 2000, p.138). In terms of Bernstein's theoretical concepts, this pedagogic prescription is described as 'weak framing' over the discursive rules of micro-selection, sequencing and pacing and hierarchical rules.

Another curriculum guideline reads, 'Ensure that learners always know what to do, when and how to do it, difficult tasks and unclear instructions often depress learners other than motivating them' (NCDC, 2000, p. 137). This guideline suggests that teachers provide learners with explicit criteria for producing expected texts, emphasizing strongly framed evaluation criteria. Therefore, whereas the general theory of instruction for the pedagogic approach suggests weakly framed and classified practices at the instructional and regulative levels, Bernstein's theoretical concepts allowed a finer delineation within these two broad dimensions of instruction to generate a delicate analysis of the policy documents.

4.5 Validity concerns

This section addresses measures to ensure validity and the steps I took to address potential threats to validity. Ultimately validity addresses rigour in research procedures; the credibility, trustworthiness and integrity of the claims researchers make (Yin, 2003; Ensor & Hoadley, 2004; Morse, et al., 2002). Morse, et al, (2002) suggest that strategies and mechanisms for ensuring rigour be 'woven into every step of the inquiry to construct a solid product' (p.9). In relation to classroom practice, Ensor & Hoadley (2004) discuss the need for explicit languages of description open to verification by readers. Likewise, Kvale (1996) advises researchers to explicitly outline the different steps of the analysis process and where possible, present examples of the material used for interpretation of an interview. He refers to this as 'laying cards on the table for inspection' (p.209). This makes it possible for readers to retrace and check the steps of the analysis using the researcher's perspective on the data. He also suggests that researchers make explicit their perspectives and intentions for the analysis. I have described the theoretical framework informing this study and outlined the purposes and procedures undertaken in the analysis of data. In this way, I have 'laid my cards on the table for inspection'.

Maxwell (1996; 1992) identifies three types of validity that are instructive to this study: descriptive validity; interpretative validity and theoretical validity. Descriptive validity relates to the factual accuracy and completeness of an account. In this regard, incomplete and inaccurate descriptions of data pose a possible threat to validity. This study employed video and audio-recording instruments. These recordings were transcribed verbatim so as to provide accurate records of classroom practice and teachers' accounts. These were supplemented with lesson observation notes and field notes. The account of teachers' recontextualizations includes simple statistics such as percentages and numbers to provide a quantitative measure of some findings.

Maxwell observes that descriptive validity 'is by no means independent of theory, even if this theory is implicit or common sense' (1992, p.282). The analytic procedures in this study are informed by an explicit theoretical framework described in chapter three. Although I approached data collection with a set of theoretical expectations, the open data collection instruments (video and audio technology) generated unstructured information. It is in the

analysis stage that particular concepts were employed to provide the criteria or 'recognition rules' (Bernstein, 2000) for what was theoretically relevant for the study.

Maxwell (1996) refers to validity issues during the interpretation of data as *interpretive validity*. He suggests that the main threat to interpretive validity inheres in 'imposing one's own framework or meaning rather than understanding the perspective of the people being studied and the meanings they attach to their words and actions' (p. 89-90). As discussed above, this study interprets data in the light of an explicit theoretical framework therefore it does not claim to represent participants' perspectives in a completely 'neutral' way. Maxwell's perspective on interpretive validity differs from that suggested by Kvale (1996) who calls for researchers to recontextualize what informants say in a specific conceptual context. He calls on researchers to 'go beyond what is directly said to work to structures and relations of meaning not immediately apparent in a text' (p.201). This requires a certain distance from what is said, achieved by a methodical or theoretical stance. Kvale's approach to interpretive validity is consistent with that adopted in this study. Kvale (1996) suggests using multiple interpreters and explication of analytical procedures as two ways of controlling researcher biases in the interpretation of interviews.

Maxwell identifies another type of validity which he terms *theoretical validity*. This validity refers to theoretical explanations of what is going on in the phenomena described. Theoretical validity has two dimensions; the validity of the concepts themselves as applied to the phenomena, and the validity of the postulated relationships among the concepts (Maxwell, 1992). The first dimension is associated with what is commonly referred to as 'construct validity' whereas the second corresponds to 'explanations' developed by a researcher. The most serious threat to the theoretical validity of an account, according to Maxwell, is not paying attention to discrepant data, or not considering alternative explanations or understandings of the phenomena one is studying (1996, p.90). Although this study is conceptualized on the basis of an explicit theoretical framework, I have tried to acknowledge, as much as possible, alternative explanations to those offered by the theory. I have done this particularly with respect to 'unexpected' findings that are inconsistent with the theory, particularly in regard to the association between physical organizational forms in the classroom and the underlying power relations.

Researcher bias and reactivity are two further threats to validity cited by Maxwell. Because this study is based on an explicit theoretical framework, I cannot claim, as researcher, to have approached data collection and analysis with a 'neutral and open mind' so as to eliminate biases. However, to counter selective data collection that fits into existing theory, I employed open and unstructured data collection instruments, using video and audio recording.

Reactivity as a validity threat relates to the influence of a researcher on the individuals studied; for example, teachers' classroom practice in this case. In this study, reactivity posed a serious potential threat particularly with the use of video-recording technology. However, given the difficulty of eliminating the actual influence of the researcher in qualitative research, Maxwell (1996) advises that one needs to understand and use reactivity productively. Heeding Maxwell's advice, I used reactivity productively by asking the teachers to display their 'best practice' in using the problem solving approach. This did not pose a threat to the findings because this study does not aim to describe 'typical' ways of teaching where reactivity would distort typicality. Prior to the classroom observations, I reassured the teachers that the research did not aim to evaluate their practice but to understand what they would see as a good example of the problem solving approach. I minimized all possible 'trappings' associated with evaluation by, for example, not asking for lesson plans and schemes of work, preferring to inquire about these issues in the interviews where necessary.

In addition, I tried to maintain a non-evaluative stance during the interviews. I avoided discussing with teachers what the pedagogic approach entailed prior to the lessons and when a couple of teachers sought my views on what the approach entailed, I informed them that I was more interested in their perspectives.

4.6 Limitations of the study

The main limitation of this study is associated with case study research in general and this relates primarily to the degree of external generalization of findings (Yin, 2003; Coffey & Atkinson, 1996). Yin (2003) makes a distinction between internal and external generalizability. He suggests that internal generalizability refers to the generalizability of a conclusion within the setting or group studied and external generalizability refers to generalization beyond a particular setting or group. In general, this study like all case study research is limited in terms of external

generalization. This study's main contribution is towards the development of a theoretical model for curriculum implementation that can be extended to other cases. The study's theoretical claims relate to ways in which school contexts interact with curriculum policy to influence pedagogic practice. In this view, the study provides theoretical insights into curriculum implementation processes rather than providing empirical generalizations regarding teachers' pedagogic practice and curriculum implementation processes in the research schools generally.

Maxwell (1996) points out that internal generalizability is a crucial aspect of qualitative research because the descriptive, interpretive, and theoretical validity of the conclusions all depend on their internal generalizability to the case as a whole.

Conclusion

This chapter has outlined the design and methodology aspects of the study and acknowledged the limitations of the study in relation to empirical generalization. The chapter describes the various analytic processes employed to translate information into data; opening these procedures to the readers' interrogation. Validity concerns in the research have been addressed primarily by providing an explicit theoretical and analytic framework or 'languages of description', transparency in analytic procedures as well as leaving room for alternative explanations to the findings and conclusions made.

CHAPTER FIVE: THE MODALITY OF PEDAGOGIC PRACTICE PROJECTED IN THE OFFICIAL CURRICULUM

This chapter presents an analysis of the official curriculum to establish the projected modality of pedagogic practice. It describes the main features of the problem solving approach projected in the official curriculum documents. These features of pedagogic practice provide a point of reference for the analysis of the teachers' recontextualizations from the official curriculum in the subsequent three chapters. The first section of this chapter introduces the curriculum texts and the subsequent sections examine the main features of the desired pedagogic practice in the light of the analytical frame work presented in chapter four.

5.1 The official curriculum texts

The data presented in this section is based on the integrated science syllabus which is part of the *Uganda primary school curriculum: syllabi for primary schools, volume one* (NCDC, 1999) and the *Teachers' guide to the Uganda primary school curriculum, volume one* (NCDC, 2000). I have not included these texts in the appendices as part of the evidence for analysis because they are very bulky. However, below I provide a general sense of the texts which were analyzed, accompanied with illustrative extracts where necessary. In addition to the curriculum texts relating specifically to science, I examine the general guidelines for teaching and learning prescribed for the present national curriculum. These guidelines, included in the introduction to each of these two documents, contextualize the pedagogic prescriptions for the problem solving approach in the broad aims of the present curriculum.

The general introduction section in the *Uganda primary school curriculum, volume one*, (1999) comprises eleven pages. It outlines the national aims of education, the aims and objectives of primary education, the structure and content of the curriculum, the recommended time allocation for lessons in each of the school subjects, as well as the assessment and evaluation rubrics. The general introductory section in the *Teachers' guide to the Uganda primary school curriculum, volume one* (NCDC, 2000) comprises five pages of text outlining the rationale and organization of the document and guidelines for effective teaching and learning with an emphasis on active learning approaches, self-regulating

learning, integration of knowledge and adjusting teaching to learners' needs and learning styles, among other strategies.

The integrated science syllabus text

The general introduction text in the science syllabus comprises ten pages of text and is subdivided into six sections. The first section provides the rationale, aims and objectives of the integrated science subject. The second section outlines the instructional content in the syllabus showing its themes, topics and an outline of content under each topic. The third section sets out the time allocation for teaching highlighting the number of periods and time for lessons for each grade level of school. The fourth section outlines the attainment targets for each class level. The fifth section discusses the recommended pedagogic modes for teaching science and outlines a list of instructional modes and learning activities, with reference to their pedagogic value in science education in the context of Uganda in particular. Section six provides guidelines for assessment and evaluation in science.

The main bulk of the science syllabus document, totaling 80 pages, provides details on instructional content under the different themes and topics for all the seven classes of primary school, P.1 to P.7, stipulating the duration of lesson periods allocated to each topic as well as the general and specific objectives for each topic. The syllabus provides information under the title 'hints' giving specific guidelines for teaching particular topics. Some of the hints indicate where knowledge is cross-referenced with other science topics, with other school subjects and with everyday life issues and give recommendations for particular activities. For example, a hint for the topic 'alcohol in society' reads: 'The teacher should put a lot of emphasis on effects of alcohol on human health especially of young people' (NCDC, 1999, p.195). A copy of the guidelines for teaching one science topic is provided as appendix D.

Teachers' guide to the integrated science syllabus

The text from which data was derived in this document is organized into five sub sections. The first section is a general introduction showing the rationale for learning science and the structure of the curriculum document. The second section provides guidelines for teaching science, highlighting the recommended instructional methodology and activities and their epistemological background in cognitive development theories. The third section provides guidelines for the 'scientific processes' of learning science, outlining its purpose and the recommended activities for developing this mode of learning. The fourth section focuses on

strategies for motivating learners to learn science in the manner recommended in the foregoing sections. This section describes conditions likely to promote a favorable social and intellectually stimulating environment in the classroom.

The rest of the document, comprising 101 pages, provides a detailed outline of each topic, showing the main ideas, background areas for the concepts, an outline of recommended activities and instructional materials, and guide lines for assessment. A copy of the foregoing guidelines for one of the topics is provided as appendix .E.

Interview with curriculum specialist

The curriculum texts were supplemented by information from a key informant interview with a science curriculum specialist based at NCDC, Uganda's national curriculum development unit. This official, who was the chair person for the primary science panel at the time the field work was conducted, had participated in developing the present curriculum. The curriculum specialist provided background information relating to the problem solving approach and he also clarified some issues arising from reading the curriculum texts. Extracts from this interview are presented to inform the analysis of the curriculum texts.

Aims of the integrated science syllabus

The integrated science syllabus recommends the problem solving approach as a major instructional mode for teaching science:

The new integrated science syllabus is designed to provide pupils with the opportunity to learn science by doing, giving priority to problem solving over other approaches (NCDC, 1999, p.126).

This emphasis reiterates the general goals of primary education and the specific aims of the integrated science syllabus shown below. The first aim below relates to the broad goal of primary education and the second is a subject level aim.

1. To develop the abilities of pupils to use the problem-solving approach in various life situations (NCDC, 1999, p.x)

2. To develop in the pupils life-skills and to use problem-solving approaches in various life situations particularly of a scientific or technological nature (NCDC, 1999, p.129).

5.2 Pedagogic prescriptions for the problem solving approach

This section analyzes the main features of the problem solving approach as defined in the official curriculum. The teachers' recontextualizations in the subsequent chapters are examined in the light of these pedagogic prescriptions. Analysis of the curriculum documents was not a straight forward task as the pedagogic prescriptions were not systematically arranged but embedded in the policy rhetoric. As mentioned in chapter one, the three main features of the problem solving approach relate to lesson structures emphasizing activity based instruction, the role of the teacher and learners in pedagogic processes and relationships between science knowledge and other forms of knowledge. I examine each of these features below, drawing evidence from the official curriculum texts.

Framing of discursive and hierarchical rules

One of the key features of the problem solving approach relates to the relative control of teachers and learners in pedagogic processes. In order to promote the learners' active roles, teachers are discouraged from exerting direct control over pedagogic processes. The teacher's role is that of 'guide' and 'facilitator'. The following pedagogic prescription captures the essence of the roles of the teachers and learners in pedagogic processes.

Treat learners as responsible beings; let them take charge of their learning as you provide the necessary guidance and facilitation (NCDC, 2000, p.138).

Discursive rules

The official curriculum envisages weak framing over the discursive rules of micro-selection, sequencing and pacing but strongly framed macro selection and evaluation criteria. The aim is to 'motivate' learners to take responsibility for their own learning so as to be self-regulating. Teachers are advised to give learners some options within a range, highlighting weakly framed selection. Weakly framed micro-selection is intended to address the learners' individual preferences and requirements as reflected in the following guideline.

Provide an assortment of contents, concepts and activities that appeal to the variety of tasks and interests present in the class (NCDC, 2000, p.138).

This guideline highlights the distinction between strongly framed macro-selection, where the teacher selects an assortment of contents, materials and activities and micro-selection where learners select from the given options. This implies that the curriculum recommends strongly framed macro-selection but weakly framed micro-selection.

Although the official curriculum expects learners to take an active role in pedagogic processes, teachers are required to provide learners with explicit criteria for producing legitimate texts. This implies strong framing of evaluation criteria as suggested in the following guidelines:

Ensure that learners always know what to do and when and how to do it. Difficult tasks and unclear instructions often depress learners other than motivating them (NCDC, 2000, p.138).

Research shows that when learners know the goals or reason for the lesson, they are more likely to successfully complete that lesson. What the goals do is to focus attention on the task at hand. Knowing the task, learners can direct their attention to what is to be learned (NCDC, 2000, p.x).

The second guideline above argues that learners need to know what is required of them if they are to actively participate and take responsibility for their learning. This implies that the criteria of knowledge are not left to learners to decide.

Hierarchical rules

Treating learners as 'responsible beings who are able to take charge of their own learning' (NCDC, 2000, p.138) requires weakly framed hierarchical rules where the rules of conduct, manner and relations are left implicit to the learners. Weakly framed hierarchical rules encourage learners to actively participate in pedagogic activities because the teacher's authority is 'masked', making it easier for learners to engage in self-directed activities such as discovery learning, asking questions and, where necessary, even challenging the teacher's viewpoint (Bernstein, 2000; Morais,2002). In order to motivate learners to actively participate in learning, teachers are required to provide a socially supportive learning environment:

Make the environment in which the learners are immersed pleasant and supportive for the learning of science (NCDC, 2000, p.137).

Be well prepared for all lessons, energetic and enthusiastic in what you are going to teach (NCDC, 2000, p.137).

The macro-structure of lessons

In order to realize the projected roles of teachers and learners described above, the official curriculum requires teachers to provide learners with opportunities to actively participate in pedagogic processes. Teachers are advised to give activity based instruction priority over other modes of instruction:

The teacher is encouraged to make teaching-learning activity based... The teacher will be required to encourage learners' creative abilities by involving them in the learning activities based on their relevant experiences, learning capacities and interests. Although the teacher should take great initiative in the choice of methods and activities, emphasis should be put on those which encourage learners to learn science by "**doing**" (NCDC, 2000, P.132, original emphasis).

In summary, research on learning and remembering shows that learners learn and remember at different rates, all things being equal, according to the degree that the learners are involved in the lesson. The more learners actively participate, that is, cooperate and share in the lesson, the more they learn and remember because they are focusing attention on a task (NCDC, 2000, p.x).

Active learner participation implies that the structure of the science lessons should facilitate weakly framed micro-selection, sequencing, pacing and hierarchical rules. It is expected that the active involvement of learners in pedagogic processes develops their initiative and creativity as vital ingredients of the problem solving competence. In addition, activity based instruction aims to minimize passive forms of learning associated with the previous curriculum. Further, it is argued that activity based instruction would enable learners to apply knowledge in new ways, particularly in everyday life. The latter issue suggests weak classification between academic school knowledge and everyday knowledge. The curriculum specialist elaborated on the background to activity-based instruction:

The origin of that [activity based instruction] was the evaluation of the previous syllabus. It was found that children had the knowledge, they could even write very good answers in their examinations and so on, but once out of school you could not see them practise what they had just written. So the question was what was wrong? Is it because the knowledge is more emphasized in book form and the teacher is just guiding children to go through it without necessarily understanding and *doing it* in a *participatory manner* - what could be the problem? And of course out there in the community there was a similar cry that the children after going to school can not do anything but according to exams they were scoring marks. So we got into a compromise position where both the knowledge and the practice are evident to improve upon the teaching such that it is more through *practical approach* which is referred to as '*by doing*' - *involving the children in doing whatever they are learning about* (My emphasis).

Activity based instruction is described in the phrase, 'learning science by **doing**' which is premised on the argument that, 'Science is a '**doing subject**', therefore it should be learnt through active participation' (NCDC, 2000, p.136, original emphasis). Activity based instruction is underpinned by constructivist views that argue that processes are 'vehicles' by which children develop conceptual tools (Gott & Mashiter, 1991). The curriculum documents reiterate these constructivist principles by emphasizing the notion of 'learning by

doing' and by encouraging teachers to engage learners in activities that draw upon their prior learning experiences.

Classification of agents

This study examines classification of agents in terms of two dimensions: classification between teacher and learners and classification between learners. Further, the study makes a distinction between classification of agents with respect to pedagogic identity and the classification of agents in relation to hierarchical relations relating to, for example, ability, social status, gender and social class.

Classification of agents (teacher-learners)

The official curriculum prescribes weak classification between the pedagogic identities of the teacher and the learners. This is reflected in the guidelines relating to the 'facilitating' role of the teacher and the 'self-regulating' role of learners. Activities such as group work provide learners with opportunities to act as 'teachers' to themselves and their peers, suggesting weak classification between the pedagogic identity of 'teacher' and 'learner'. Weak classification between the pedagogic identities of the teacher and the learners assumes weak classification of hierarchical relations between teachers and learners. In other words, it is easier for the learners to take responsibility for their own learning and become self-regulating when the power relations between teacher and learners are relaxed. However, as Bernstein (1990) argues, the inherently asymmetrical teacher-learner relation can only be 'disguised' by communication devices.

As discussed above, the *Teachers' guide* recommends that teachers provide a pleasant social atmosphere in science classrooms. This type of social climate provides room for 'masking' the power relations between teachers and learners as envisaged in the official curriculum. Weak classification between the teacher and the learners with respect to hierarchical relations requires simultaneous weakening of framing of hierarchical rules. These correlations show how classification and framing are embedded empirically.

Classification of agents (learner-learner)

Teachers are expected to identify and address the individual learning needs of learners. This suggests strong classification between the individual pedagogic identities of learners.

Know the learners well: their names, strengths, weaknesses, ambitions, goals, values and anxieties (NCDC, 2000, p.137).

Effective teaching adjusts to the learners' needs and learning styles...All learners do not come to the classroom with the same level of maturity, intellectual gifts or skill development. Adjusting is literally providing for individual differences, which means adapting and fitting learning to the needs and learning styles of learners. Learning styles refer to the learners' preferences for seeing, hearing, or participating in the lesson. Adjusting is finding alternative ways of appealing to different learning styles (NCDC, 2000, p. x).

The emphasis on activities such as group work where learners 'share, discuss and report findings' (NCDC, 2000, p.132) suggests weak classification between the hierarchical relations between learners in terms of gender, ability and social class. Symmetrical social relations among learners facilitate equal participation and sharing of ideas, particularly during group discussions.

Classification of space

Weak classification of teacher-learner space and learner-learner space is reflected in activities such as group work and other learner-directed activities. In activities such as group work, learners work together in a common space and also share instructional materials, highlighting weak classification of learner-learner space. This implies that learners' space has to be organized in a manner that promotes collaboration, perhaps by arranging desks in stacks rather than in rows. Although learners are self-regulating, they require some guidance from the teacher as discussed above. This implies that the teacher should be able to move into the learners' space to guide groups and individuals, highlighting weak classification of teacher-learner space. Weak classification of space weakens power relations between the teacher and learner and between learners and their peers. In addition, weak classification of space requires a weakening of framing of hierarchical rules (Morais, 2002). These two examples demonstrate internal coherence between the concepts of classification and framing.

Classification of discourse

The third feature of the problem solving approach relates to a requirement that science is taught in an integrated form. Integration is sought firstly within the science syllabus itself (intra-disciplinary relations), secondly, between science and other subjects in the school curriculum (inter-disciplinary relations) and thirdly, between science and non-academic everyday knowledge. This suggests that the curriculum projects weak classification of the

intra-disciplinary boundaries between elements within science, the interdisciplinary relations between science and other subjects and the interdiscursive relations between academic science and everyday knowledge. I examine each of these discursive relations below.

Intra-disciplinary relations

As mentioned in chapter three, this study examines intra-disciplinary relations from two perspectives: first, it examines relationships across different science topics and secondly, the study examines relationships between conceptual science knowledge and the 'knowledge of science procedures'. With regard to intra-disciplinary relations across science topics, teachers are instructed to reiterate and build upon previously taught science concepts. Under a column termed 'preview of topic', the *Teachers' guide* highlights concepts which teachers are expected to build upon in each topic of the syllabus. This knowledge is mainly drawn from preceding topics covered within the class and in previous classes.

The science syllabus provides teachers with 'hints' on the suitable points and concepts for cross-references across science topics. For example, one of the 'hints' provided under the topic 'components of the environment: soil' for primary five science reads as follows:

The teacher is required to develop this topic from what the pupils learnt about soil in primary three and four. But the teacher should not repeat what the pupils already know (NCDC, 1999, p.183).

The spiral structure of the science syllabus enables the eight content themes to be taught progressively within and across the different grades of primary school, promoting intra-disciplinary relationships. 'This spiral approach enables the teacher to make reinforcement of the key concepts, skills and attitudes as the learner's capacities expand' (NCDC, 1999, p. xi).

The second dimension of intra-disciplinary relations is reflected in scientific processes provided in practical science work such as experimentation. Here science concepts are demonstrated, tested and verified through specific procedures, suggesting weak classification between conceptual knowledge and the knowledge of science procedures. Scientific processes constitute specialized forms of activities which reflect the methods used by practicing scientists to construct and validate knowledge (Haigh, 2005; Osborne, 2002; Atkin, 1998; Miller, 1991). Teachers are instructed to create opportunities for learners to learn science through scientific processes:

Science as a way of arriving at facts or knowledge should be presented to learners in a manner that provides them with the opportunity to learn it through scientific processes (NCDC, 2000, p.137).

The Teachers guide identifies nine different types of activities that facilitate scientific processes, three of which are listed below:

- Observations to gather information about things or problems under investigation
- Experimentation- where learners design and plan experiments to test their hypothesis. This includes taking necessary measurements.
- Making sensible interpretation of what is observed and measured

The teachers' guide outlines the following as examples of activities that provide learners with opportunity to learn science 'by doing':

Problem solving, making discoveries, projects, experimentation, field trips, demonstrations, mediated learning and any other methods which lead learners into activities such as making observations, collecting data, reporting findings and sharing experiences during discussions (NCDC, 2000, p.132).

Scientific processes are intended to enhance learners' capacity to think in a logical manner as part of their problem solving competencies. This is premised on the view that scientific processes reflect a logical and systematic approach to knowledge construction. I asked the curriculum science specialist to clarify the essence of the scientific processes and their role in the problem solving approach. He responded as follows:

At the back of our minds when we were preparing this syllabus, we thought that even if the syllabus gives the teacher the basic starting point, there could be some problems which may interest a class which may not necessarily be here. We think that through this kind of approach [scientific process], whether it is in the syllabus or it has occurred in the community, the child should now be able to relate the kinds of steps he or she has been using to solve that other problem which is classroom oriented to the outside oriented problem. So at the back of our minds we were not confining the child to only what may exist in the classroom, it could be outside.

Scientific processes are, therefore, expected to develop the learners' capacity to apply the scientific approach to solving problems in everyday life. This aim should not be conflated with learning about everyday problems as an end in itself as some contemporary progressive curriculum reforms suggest.

Inter-disciplinary relations

The official curriculum requires teachers to relate science knowledge with knowledge in other school disciplines. All the syllabi for the primary school curriculum are prepared in an

integrated manner. Integration is sought both within the individual subjects and across the subjects. The *Teachers' guide* emphasizes that:

No subject should stand alone in the school curriculum because they are all part of the learner's whole experience of becoming educated and functional in his or her environment (NCDC, 2000, p.xi).

This guideline suggests weak classification between science and other school subjects (weakly insulated inter-disciplinary boundaries). It is argued that weak classification of knowledge across subjects provides learners with meaningful learning experiences in which they view knowledge as holistic rather than as fragmented and disjointed (NCDC, 1999). To promote the desired integration across subjects, suitable areas for linking science concepts to other school disciplines such as mathematics and social studies are pointed out in the syllabus. For example, under the topic of measurement, the syllabus points out that, 'The teacher should relate this topic closely with what is taught in mathematics on measurement' (NCDC, 1999, p. 174).

Relations between science and everyday knowledge

The science syllabus emphasizes that the teachers should relate learning experiences to the lives of learners as much as possible and to reduce the emphasis on learning science merely for passing examinations:

The teacher as much as possible should closely relate learning experiences to the life of learners; in the first place, we science teachers should note that science can be related to every aspect of life, it is an important subject. It deals with phenomena, ideas and activities. The teacher should put more emphasis on and aim at enabling the learners to acquire and apply relevant knowledge, skills and positive attitudes for purposeful improvement of the environment, to use in the betterment of the learners' and communities living conditions (NCDC, 1999, p.134).

Use interesting strategies such as solving real community problems and including activities which are relevant to learners' experiences (NCDC, 2000, p.137).

Tell learners the usefulness, in future, of what they are learning now-utility of science (NCDC, 2000, p.137).

These pedagogic prescriptions suggest weak classification between academic school knowledge and everyday knowledge, drawing attention to the issue of relevance emphasized in the education policy rhetoric and the curriculum documents. For example, it is explained that the themes on 'health education' and 'population and family life education' aim to enable learners to apply basic scientific knowledge, skills and positive attitudes so as to

'keep themselves and those they live with in the community in healthy life styles and improve the quality of life' (NCDC, 1999, p.135).

The science curriculum specialist emphasized the role of the problem solving approach in developing the learners' abilities to apply knowledge and skills in everyday life:

The problem solving approach, well people want to look at it very differently but I think the principle remains the same-Can we start by helping the child to know there is a problem and then can we help the child to chart out a process of solving it, the different stages of solving it. Can we provide what can facilitate the child to do that? Can the child relate... if the problem sounds so academic in the class, can we relate it to the child's life out side the class? Can the child see the relevance of that problem to some life problem in the community, can the child go on even to do others [solving problems] probably using similar approaches? So the major thing here is perhaps to help the child see the problem, see the relevance of solving it, see the way to solve it, and probably continue to use the similar approach in solving even other problems that may not have come up in the class. And I think more importantly we would like them to relate what they learn to life outside in the community. So it is like an application, relevancy issue.

To facilitate application of scientific knowledge to everyday living, the integrated science syllabus adopts a thematic approach that integrates basic science concepts with health education, environmental education and population and family life education. This knowledge is provided under eight themes outlined in table 5.2.

Furthermore, the rubrics of assessment place emphasis on the application of previously acquired knowledge to new contexts. Teachers are instructed to assess the learners' ability to 'apply known knowledge and skills in problem solving contexts, 'Whenever possible, items can be set to test pupil's skills in problem solving. This will require the candidate to think and reason out solutions from learnt knowledge and skills' (NCDC, 1999, p.136). The syllabus provides the criteria for the allocation of marks to question items relating to four Teachers are advised to allocate 40% of the total marks in science examinations to the 'ability to apply knowledge', 20% to 'factual recall of knowledge', 30% for 'comprehension' and 10% for 'deductive/inductive' reasoning.

5.3 Summary of the projected modality of pedagogic practice

The pedagogic prescriptions for problem solving approach portrayed in the section above are associated with what is generally referred to as learner-centred practices in conventional education discourse. These learner-centred approaches are closely associated with

Bernstein’s competence model of pedagogic practice (2000, 1996), although it reflects some elements of a ‘mixed’ pedagogy. The pedagogic prescriptions discussed above emphasize features associated with competence models, namely, that learners are active, creative and self-regulating as the teacher provide a ‘facilitating’ role. Table 5.1 below summarizes the foregoing features to highlight the desired modality of pedagogy projected in the national curriculum.

Table 5.1: A summary of the projected modality of pedagogy within the national curriculum

Pedagogic feature	Framing	Classification
Lesson structure (Activity based instruction)	Weakly framing over micro selection, sequencing and pacing (F ⁻)	Weakly classified power relations (C ⁻) between learners in group work activities. Weak classification of space (C ⁻) <ul style="list-style-type: none"> • Teacher-learner space • Learner-learner space
The roles of teacher and learners in pedagogic processes <ul style="list-style-type: none"> • Teacher as a ‘facilitator’ • Self-regulating learners 	Weakly framing over micro selection, sequencing and pacing (F ⁻) Strong framing of macro-selection of curricular knowledge (F ⁺) Strong framing of evaluation criteria (F ⁺⁺) Weak framing of hierarchical rules (F ⁻)	Classification of agents <i>Instructional level</i> Strong classification of learners’ pedagogic identities (C ⁺⁺) Strong classification of teacher/learners’ pedagogic identities (C ⁺⁺) <i>Regulative level</i> Weak classification of power relations between teacher – learners, and learner-learner at the regulative level (C ⁻) Classification of space Weak classification of space (C ⁻) <ul style="list-style-type: none"> • Teacher-learner space • Learner-learner space
Knowledge relationships <ul style="list-style-type: none"> • Intra-disciplinary • Interdisciplinary • Academic/non-academic 		Classification of discourse <ul style="list-style-type: none"> • Weak classification of intra-disciplinary relations (C⁻⁻) • Weak classification of inter-disciplinary relations (C⁻) • Weak classification/framing of academic/non-academic relations (C^{e-} / F^{e-})

Types of instructional content in the science syllabus

Domains of practice

The curriculum prescribes a specific selection of instructional content provided under eight themes presented in table 5.2 below. Some curricular themes comprise predominantly physical and natural science knowledge which is associated with esoteric domain of practice. These include the themes of ‘matter and energy’, ‘environment’ and the ‘world of living things’. Themes such as ‘science in human activities and occupations’ and ‘human health’ include hybrid or integrated science knowledge comprising both esoteric domain practice and public domain practice. In this regard, the degree of specialization of knowledge varies across the different themes of the science curriculum.

Discursive saturation

Discursive saturation tells us about the degree to which knowledge is made explicit in language. The knowledge prescribed in the science syllabus includes a range of knowledge with high discursive saturation (DS+), low discursive saturation (DS-) and hybrid discursive saturation (DS+/DS-). Concepts such as the classification principles for living things reflect high discursive saturation (DS+). However, some of the aspects of science knowledge reflect low discursive saturation (DS-). This is particularly so with practical science work where knowledge is expressed through experimental ‘procedures’ employed to illustrate concepts. For example, a concept such as ‘changes in states of matter’ may be demonstrated practically to show the processes of ‘evaporation’ and ‘condensation’. Emphasis on ‘scientific processes’ by the official curriculum suggests inclusion of science knowledge with low discursive saturation.

Distributing strategies

The curriculum documents do not specify the instructional strategies for distributing knowledge under the problem solving approach. Therefore it is not possible to describe the projected distributing strategies beyond what is presented under the desired mode of pedagogy. In this view, choice of distributing strategies is subject to the teachers’ discretion which is associated with their recontextualizing of what is deemed ‘best practice’ in relation to the problem solving approach.

CHAPTER SIX: MODALITIES OF PEDAGOGIC PRACTICE

The following three chapters present the empirical findings on the teachers' recontextualization of a 'problem solving approach' in science. This chapter and chapter seven present the classroom observation data focusing, respectively, on the form of pedagogy and types of instructional content reflected in the lessons. Chapter eight constructs an account of why teachers employed the problem solving approach in particular ways, drawing on the teachers' interviews. The description of pedagogic practice in this chapter informs an account of how the teachers enacted their interpretations of the problem solving approach as a particular way of teaching and learning science in relation to: first, the types of lesson structures employed; second, the roles of the teachers and learners in the pedagogic process; and third, the relationships between science and other forms of knowledge.

The chapter identifies patterns in the implemented curriculum and relates these to the pedagogic prescriptions for the problem solving approach outlined in chapter five. The analysis draws on Bernstein's concepts of classification and framing. In chapter three I discussed how classification and framing define the power and control relations within transmission-acquisition processes. These power and control relations are reflected in the organizational and interactional aspects of pedagogic contexts. The sections that follow present the classroom data showing how teachers enacted the three features of the problem solving approach in pedagogic contexts.

6.1 The lesson structure

This section analyzes the teachers' pedagogy in relation to types of lesson structures employed. There were three broad categories of lessons varying in relation to the activities around which instruction was structured, these were:

- Three lessons in which practical science work was demonstrated by the teacher.
- Six lessons structured around group work activities undertaken by learners.
- Seven lessons comprising whole class teacher- led expositions.

Demonstration lessons

The three lessons in this category involved practical science work demonstrated by the teachers. These lessons were taught by Musaali, Sakwa and Ssesanga. In general, teachers introduced the lessons and provided an overview of the activities to be demonstrated. Following this, the teachers called learners to the front of the classrooms where they stood or sat and watched the teacher demonstrate the activities. During the demonstrations, teachers instructed learners to observe particular aspects of the activities and through teacher questioning, interpretations and conclusions were drawn from the activities. The practical activities provided learners with an experience of the 'scientific processes' of learning science which reflected a specialized form of 'learning by doing'.

Group work lessons

This category comprises six lessons which were taught by Acom, Bogere, Kabi, Malongo, Kulaba and Weere. All the lessons incorporated group work activities undertaken by learners. Although there was some degree of variation in the extensiveness of various pedagogic activities, particularly teacher expositions, the lessons had a fairly similar structure encompassing three distinct phases: in the initial phase, a brief review of the previous lesson was undertaken and the new topic introduced. This was followed by teacher exposition of the main concepts and the setting of group tasks with accompanying instructions. The group activities and report back sessions were undertaken in the subsequent phase and finally teachers recapitulated the salient concepts covered and gave class exercises.

Acom, Kulaba, Malongo and Weere supplemented the learners' group activities with extensive teacher expositions of content along with question and answer sessions. In contrast, Bogere and Kabi utilized the greater part of their lessons for the group activities and consequently their content expositions were very brief. Group sizes ranged from three groups of four learners each in Acom's class to over fifteen groups of six learners in Kulaba's class. Less than one quarter of Malongo's class participated in three role-plays which comprised between four to six learners each. Group work lessons provided learners with opportunities to engage in discussions and co-construction of knowledge with their peers. They searched for information in resource texts or from natural specimens such as plants; they also discussed and presented their findings to the class for evaluation.

Teacher-led expositions

The seven lessons in this category were taught by Asimwe, Bwogi, Erone, Nekesa, Nambuya, Opio and Suubi. These lessons comprised whole class teacher-led expositions of content interspersed with oral questioning. In general, teachers began instruction by reviewing the previous lesson's work through questioning and then introduced the day's topic. In two of these lessons, teachers instructed learners to read sections from course textbooks as they elaborated upon the texts. In all but one class, learners took down lesson notes or did class exercises in the final phase of the lesson.

6.2 Teacher and learner control over pedagogic processes

This section examines the degree to which the teacher maintained or ceded control of selection, sequencing, pacing and evaluation of knowledge. I also analyze the social order underlying pedagogic processes and thereafter examine relationships between science and other forms of knowledge. The analysis shows similarities in pedagogic form across lessons in relation to selection, sequencing, social order and inter-discursive relations between science and other school disciplines. However, there were differences between lessons in terms of pacing, evaluation criteria, intra-disciplinary relations, and in the relationships between science and everyday knowledge. I considered lessons generally similar if thirteen or more lessons of the sixteen lessons were coded as strongly and very strongly framed (F^+/F^{++}) or classified (C^+/C^{++}) on the same conceptual category such as selection. The common pedagogic features are presented first and followed by features which differentiated lessons.

Chapter four provides a detailed discussion on the coding of lessons for classification and framing of pedagogic discourse. Each of the sixteen lessons was coded for the different conceptual categories of pedagogy on the lesson coding instrument. The results from the coding of classification and framing for all the sixteen teachers are recorded on a summary sheet which can be found in appendix B. Below I provide an extract from the summary sheet showing the results of coding for one teacher.

Table 6.1: An extract from the summary sheet showing the results of coding for one teacher.
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Conceptual category	Average value for each conceptual category	Strength of classification / framing
Selection	3.66	F++
Sequence	3	F+
Pacing	2.66	F+
Criteria	4	F++
Hierarchical rules	2	F-
Intra-disciplinary	2	C-
Inter-disciplinary	4	C++
School/everyday relations	3	C+
Classification of space	4	C++
Classification of agents	3	C+

Table 6.2 on the following page provides a summary of the strength of classification and framing for all the sixteen lessons.

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Table 6.2: Summary of classification and framing values for all the lessons

Lesson type	Selection	Sequence	Pacing	Evaluation Criteria	Hierarchical rules	Intra Discip. 1	Intra Discip. 2	Inter Discip.	Academic & Everyday relations	Classification of space (T/L)	Classification of space (L/L)	Classification of agents	Activity type
Lesson type one													
Kulaba	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺	C ⁻	-	C ⁺⁺	C ⁺	C ⁻	C ⁻	C ⁻	Group work
Nekesa	F ⁺⁺	F ⁺	F ⁺	F ⁺⁺	F ⁻	C ⁻	-	C ⁺⁺	C ⁺	C ⁺⁺	C ⁺⁺	C ⁺	Teacher-expo
Asiimwe	F ⁺⁺	F ⁺⁺	F ⁺	F ⁺⁺	F ⁺	C ⁻	-	C ⁺	C ⁺	C ⁺	C ⁺	C ⁺⁺	Teacher-expo
Sakwa	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺	F ⁺	C ⁺⁺	C ⁻	C ⁺⁺	C ⁺	C ⁺	C ⁺	C ⁺	Demonstration
Ssesanga	F ⁺⁺	F ⁺⁺	F ⁺	F ⁺	F ⁺⁺	C ⁺	C ⁻	C ⁺	C ⁺⁺	C ⁻	C ⁺	C ⁺	Demonstration
Lesson type two													
Bogere	F ⁺⁺	F ⁺⁺	F ⁻	F ⁺	F ⁺	C ⁺	-	C ⁺⁺	C ⁺⁺	C ⁻	C ⁻	C ⁻	Group work
Erone	F ⁺⁺	F ⁺⁺	F ⁻	F ⁺⁺	F ⁻	C ⁻	-	C ⁺⁺	C ⁻	C ⁺	C ⁺⁺	C ⁺	Teacher-expo
Kabi	F ⁺⁺	F ⁺⁺	F ⁻	F ⁺⁺	F ⁺	C ⁺⁺	C ⁺	C ⁺⁺	C ⁺	C ⁻	C ⁻	C ⁺	Group work
Musaali	F ⁺⁺	F ⁺	F ⁻	F ⁺⁺	F ⁺	C ⁻	C ⁻	C ⁺⁺	C ⁻	C ⁻	C ⁺	C ⁺⁺	Demonstration
Malongo	F ⁻	F ⁺	F ⁺	F ⁺	F ⁺	C ⁻	-	C ⁺⁺	C ⁻	C ⁻	C ⁻	C ⁻	Group work
Acom	F ⁺⁺	F ⁺⁺	F ⁺	F ⁺	F ⁺	C ⁺	-	C ⁺⁺	C ⁻	C ⁻	C ⁻	C ⁺	Group work
Weere	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁺	F ⁺⁺	C ⁺	-	C ⁺⁺	C ⁻	C ⁻	C ⁻	C ⁺	Group work
Lesson type three													
Bwogi	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁻	F ⁺⁺	C ⁻	-	C ⁺⁺	C ⁻	C ⁺	C ⁺⁺	C ⁺	Teacher-expo
Nambuya	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁻	F ⁺	C ⁺	-	C ⁺	C ⁻	C ⁺	C ⁺	C ⁺	Teacher-expo
Opio	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁻	F ⁺	C ⁺	-	C ⁺⁺	C ⁻	C ⁺	C ⁺	C ⁺	Teacher-expo
Suubi	F ⁺⁺	F ⁺⁺	F ⁺⁺	F ⁻	F ⁺⁺	C ⁺⁺	-	C ⁺	C ⁺	C ⁺	C ⁺	C ⁺	Teacher-expo

Key

Intra-discip.1 – Intra-disciplinary relations between science topics

Intra-discip.2 – Intra-disciplinary relations between conceptual science knowledge and 'knowledge of science procedures'

Classification of space (T/L) – classification between teacher and learner space

Classification of space (L/L) – classification between learner/learner spaces

Teacher-expo – teacher-led exposition

Similarities in pedagogic form across lessons

This section examines the four features which were largely similar across all the sixteen observed lessons, these are: selection, sequencing, social order; and the interdisciplinary relationship between science and other school subjects.

Selection

The analysis shows very strong framing of selection in all but one of the sixteen lessons observed. Teachers selected the topics, content, activities and instructional materials in fifteen lessons on their own; therefore learners were not given any options or latitude to select any of the foregoing aspects. In the group work lessons, teachers selected content and activities at the start of lessons and also selected salient concepts during the reporting sessions. Within the practical science lessons, teachers selected salient aspects of the practical activities and instructed learners to focus their observations on these. Given the diversity and scope of what can be observed in practical activities, Millar (1991) and Brooks et al (1989) argue that one needs a selection of what to 'see' and this selection is guided by the theories we hold about the things we observe. In this case, the teachers selected what they considered to be conceptually significant to their respective lesson topics. The following extract from Bogere's lesson exemplifies very strongly framed selection which typifies 93% of the sixteen lessons observed.

Extract 6.1

At the start of the lesson, learners are seated quietly and as Bogere walks into the classroom they all stand up and greet him.

- T: Sit down. Now yesterday we looked at groups of invertebrates, what were these invertebrates we looked at yesterday? Yes (*points at a learner*)
- L1: Arthropods
- T: (*Bogere notes the response on the blackboard*) what did we say arthropods are? (*Repeats the question after waiting for a response in vain*)
- T: Kaddu, what are arthropods?
- T: Yes Martha?
- L2: Arthropods are animals with jointed legs and segmented bodies.
- T: Arthropods are animals with jointed legs and segmented bodies, why do we call these animals invertebrates? , why do we call these animals invertebrates? , Mukasa?
- L3: We call them invertebrates because they don't have backbones
- T: They don't have... (*Learners ec ho 'ba ckbones'*). Now arthropods, this group of invertebrates has some other small groups falling under that very big group of arthropods and these groups include insects (*writes the lesson topic 'Arthropods' on*

blackboard then writes insects, myriapods , arachnids , crustaceans as learners mention them), they include.....Yes (points at a learner)

L4: Myriapods

T: Yes, who can give us another group? Yes Kaddu?

L5: Arachnids

T: Another group?

L6: Crustaceans

T: That is good, now in our groups we shall look at each group of arthropods, we have four groups, members of group one put up your hands (*Group one members raise their hands*). Group one you will discuss the insects. Group two will discuss the myriapods; group three will work on the arachnids and group four on the crustaceans. (*Bogere writes group numbers against the four groups of arthropods*). I am giving you books but they shall be given out by the group leaders. (*Bogere picks up a heap of text books and gives them to the group leaders who in turn distribute them to group members*).

Now get the books and I want you to open page 17 of M.K, open page 17 and comprehensive science open page 40. Are we all there? (*Bogere moves around the classroom distributing sheets of writing paper to the groups*). Now in our groups, we shall discuss the following on each group of arthropods (*He writes the tasks on blackboard*) we shall discuss in our groups the characteristics of each group of arthropods and number two we shall list down examples of each group of arthropods. Now we can begin, you are free to open the page on which your group is. Arthropods begin on page 17 in M.K books and page 40 in the comprehensive books. The chairperson asks questions as the secretary writes down whatever is discussed.

Extract 6.1 shows how Bogere selected the topic and outlined the scope of content to be covered therein. He also selected learners' activities and allocated a particular task to each of the four groups. Further, Bogere selected the resource materials (textbooks) and indicated the pages on which to find the relevant information for the tasks. Bogere did not incorporate learners' micro-selection of content beyond the scope he prescribed for the groups. For example, during the reporting session, one group presented findings that exceeded the scope of their assigned tasks. Bogere acknowledged the extra work but declined to incorporate it into the discussion, saying, 'Yes they went as far as reproduction but we want all the examples of insects, all those animals, all those arthropods with these three characteristics'. The degree of teacher control over selection reflected in Bogere's lesson was reflected in fourteen other lessons.

I did not observe any unsolicited learner interventions in the teachers' exposition of content or demonstrations in any of the sixteen lessons. Learners only interrupted the teachers' communication to seek clarification on instructional tasks. This was not surprising, given that in Ugandan primary classrooms teachers usually devote a special time of the lesson to learners' questions. Accustomed to this practice, learners

normally wait and ask their questions at the opportune time rather than ‘interrupting’ the teacher’s communication. Moreover learners’ questions were generally within the scope of the topics taught except in one incident, in Nekesa’s lesson, where a learner asked a question beyond the planned content scope. In this particular case, Nekesa addressed the question briefly and informed the class that the concept would be elaborated further under a subsequent topic. The paucity of unprompted communication from learners can also be examined in relation to the power and control relations between the teacher and learners. In my opinion, strongly framed hierarchical relations evident in most classrooms constrained learners’ spontaneity. Morais (2002) and Riksaasen (1999) associate learners’ spontaneous communication with social relations between teacher and learners. Morais suggests that weakly framed hierarchical rules give children confidence to question, discuss and share ideas. Likewise, Riksaasen argues that weak framed hierarchical relations strongly influence students’ spontaneous questions.

Despite the dominance of very strongly framed selection amongst the other lessons, Malongo’s lesson reflected weakly framed selection. Although, like other teachers, she selected the topic and the general activities for the lesson, Malongo gave learners some options in selecting activities, procedures and materials for the role plays. Each group was allowed to select an ‘accident’ to role-play from a collection of common accidents. Further, groups were not provided with materials for the role-plays; each group improvised materials from what was locally available in the classroom. These included items such as sticks, handkerchiefs, pieces of cardboard, plastic cups and plates. In addition, learners volunteered to participate in the role-plays as the three groups could not accommodate the entire class of ninety learners. Malongo’s lesson demonstrates relatively weaker framing over micro-selection for the reason that learners were given the opportunity to select within a range of options.

Malongo’s lesson was coded F⁻ and the other fifteen lessons were coded F⁺⁺ for selection. The structure of these lessons did not influence selection to any degree given that it was similarly very strong across the three types of lesson structures. In terms of the problem solving approach, very strong framing of selection implies that teachers are still in direct control of learning emphasizing the role of ‘transmitter’

rather than the projected ‘facilitators’ of learning. The pedagogic identity of learners as ‘self-regulating’ also remained largely unattained.

Sequencing

Sequencing defines the order of transmission of knowledge within pedagogic processes. This study examines sequencing from two perspectives; the first section considers micro-sequencing of knowledge and activities within the lesson as a whole. The second section looks specifically within particular science activities to show the internal order of the processes or steps therein. The latter aspect of sequencing was particularly evident in practical science activities where a specific sequence of procedures was essential to realize expected outcomes from the activities.

The analysis shows very strong sequencing within thirteen lessons (81%) and relatively more flexible sequencing in three lessons. In general, teachers adhered to a particular sequence of instruction throughout the lesson; therefore learners’ contributions that potentially altered this sequence were addressed briefly or deferred to appropriate times in the lesson. For example, while examining the classification of sounds in Asiimwe’s class, a learner gave an answer which was beyond the scope of the discussion at that point. Asiimwe deferred the contribution to a later stage of the lesson saying, ‘Before that, we are coming to that, but before that there is something else we go to first’.

Extract 6.1 also shows that Bogere regulated the sequence of instruction, he reviewed the previous work, set the tasks and prompted the class to move on to subsequent steps, ‘now get the books...’, ‘now we can begin’ and so on. This pattern was recurrent throughout the lesson. At the beginning of the group presentations, he determined the sequence of presenting findings, saying, ‘Now we are beginning with the characteristics, please listen’. As the group reporters presented findings, Bogere wrote these on the chalkboard and cued the reporters to subsequent steps by, for example, saying, ‘Can you look at the examples?’ He also emphasized to a group reporter, who preferred to write the findings on the chalkboard by herself, to follow the set sequence of presentation. He said: ‘She says she wants to write for herself, I will also rest at least ...but observe you are beginning with characteristics’.

In addition to the general sequencing of instruction in the lesson, sequencing within the practical work lessons is analyzed in relation to the steps internal to the scientific processes around which activities were structured. The analysis shows that activities in all four practical lessons were tightly structured around a sequence determined by the internal structure of the processes. For example, while demonstrating how to make temporary magnets, Ssesanga adhered to a particular sequence of procedures outlined in a textbook. He reminded a learner who was demonstrating part of the activity to adhere to the specified guidelines saying, 'Here it says put a nail on a table don't you see here in the diagram'. It is evident that adherence to the sequence of activities within the macro-structure of activities was necessary to ensure the expected outcomes from practical work.

The structure of the lessons did not seem to influence sequencing, given that it was teacher controlled across all lessons in the three lesson structures. One would have expected a bit more flexibility within group work lessons. However the analysis shows that selection within these lessons was also teacher controlled. Given the tight control of activities by the teachers, group work did not provide as much room for learners' self-regulation as prescribed by the science curriculum policy documents. This data resonates with Brodie et al (2002a)'s research in South African classrooms, where they found teachers implementing outward 'forms' of learner-centred pedagogy without realizing the 'substance' underlying the pedagogy. The data reflects Jacklin's (2004) characterization of pedagogic practice as convention-led whereby practices are adopted as a 'convention' rather than being directed at fulfilling particular instructional ends. In this study, an outward 'form' of group work was enacted although this did not enable the 'substance' of fostering learners' self-regulation. This dissonance is also reflected under classification of space.

Thirteen lessons were coded as very strongly framed (F++) whereas three were coded as strongly framed (F+) for sequencing. The three lessons with relatively weaker sequencing were taught by Musaali, Malongo and Nekesa. These teachers occasionally relaxed sequencing and revisited previous steps to accommodate their learners' needs when necessary as exemplified in the following extract from Musaali's lesson.

Extract 6.2

The class had just observed an activity illustrating the processes of evaporation and condensation then Musaali's co-teacher asked learners some questions about the processes.

- Co-T: So now I am asking you another question, according to what the teacher has explained what made the gas to turn into the liquid?
(Waits for a response in vain and repeats the question). Discover, what is it?
- L: *(Silence)*
- Co-T: *(The co-teacher repeats the question)*
- L: *(A learner mentions condensation in a very low tone)*
- Co-T: I heard someone around here say something.
- L: *(There is silence as learners seem to have failed to get the correct response).*
- Co-T: I am going to do it for you again *(Lifts up a tin with cold water)* Now see, is this one here also evaporation?
- L: No
- T: Watch properly.
- Co-T: *(Pours cold water into the pan and feels it)* this is cold water
- T: Touch and see, those near.
- L: *(some learners put their hands into the water to feel its temperature)*
- T: Now watch *(Musaali places small pan over boiling water and raises it up and cleans its bottom part)* Do we have water droplets here? *(Pointing to the small pan)*
- L: No
- T: Okay, so what do we have inside here? *(Musaali points inside the small pan).*
- L: Water
- T: What kind of water?
- L: Cold water
- T: Again
- L: Cold water
- T: Now watch *(places the small saucepan over the saucepan of boiling water)*
- L: *(Learners are observing)*

Musaali and the co-teacher repeated the activity and slowed its pacing until learners recognized the difference between evaporation and condensation.

Musaali and his co-teacher repeated the activity after noticing that learners were unable to answer a question. Here, the order of transmission was altered to accommodate the learners' productions, that is, their inability to produce the legitimate text. In another incident, at the beginning of the lesson, Musaali revisited the previous day's work in some depth after learners failed to correctly answer one of the questions he asked about the work. Nekesa also sequenced instructional activities flexibly and altered the order to accommodate learners' needs and interventions. For example, prior to dismissing the class for break, she remembered that she had not given the class an opportunity to ask questions. She called for questions which extended well into break time because some required considerable elaboration of concepts. In addition, Nekesa postponed note-taking to the subsequent lesson when she realized that the available time was insufficient.

On the whole, Malongo, Musaali, and Nekesa's lessons demonstrated relatively more flexible sequencing than the other thirteen. In general, this evidence suggests that pedagogic processes were strongly regulated by teachers and were not sufficiently flexible to accommodate learners' needs, interventions and productions. This also implies that learners' self-regulation as required by the problem solving processes remained largely unattained.

Inter-disciplinary relations between science and other school disciplines

This subsection examines the extent to which the teachers related science to other school disciplines as required by the problem solving approach. The analysis shows that the boundary between science and other school disciplines was very strong in twelve lessons suggesting that teachers did not relate science knowledge to that in other school disciplines. Teachers did not make explicit links to other subjects even where these were obvious. For example, Asiimwe's lesson on sound energy provided considerable relations with music; however these linkages were implicit rather than explicitly declared to the learners. This may be partly attributed to the fact that music is optional and largely provided as a co-curricular activity. In this sense, Asiimwe, like the other teachers, considered music to be a 'minor' subject, but he used an assortment of musical instruments which he reported to have borrowed from the music department.

In spite of the dominance of strongly classified relations between science and other school subjects, Nambuya, Ssesanga and Suubi weakened the boundary between science and English language to some extent. This aimed to develop learners' reading competencies. These teachers instructed learners to read texts aloud as they intervened to correct pronunciations and also to simplify the meaning of texts. For example, Suubi instructed her class to read sections of texts from the course books as a form of comprehension exercise; she told them to paraphrase the points, saying, 'Use your own words'. Gonzaga, where Nambuya and Ssesanga taught, required teachers to integrate reading activities in all school subjects so as to improve the learners' reading competencies. This requirement may partly explain why both Nambuya and Ssesanga asked learners to read texts aloud.

Four lessons (Nambuya, Ssesanga and Suubi and that of Asiimwe) were coded as strongly classified (C+), whereas the other twelve were coded as very strongly classified (C++). These findings suggest that science knowledge was strongly insulated from that in other school subjects. This form of knowledge structure emphasises 'collection' codes rather than the 'integrated' code projected by the problem solving approach as well as that legitimized by the integrated science syllabus.

Social order

This section examines the power and control relations between teachers and learners in the classrooms. This study examines social order in terms of three conceptual categories: framing of hierarchical rules, classification of agents and classification of space. The empirical realizations of each of these features are examined below.

Hierarchical rules

Hierarchical rules relate to the rules of manner, conduct and relations in the pedagogic relationship. These rules may be explicit or implicit given the degree of framing. I analyzed the strength of framing of hierarchical rules by looking at the form of control teachers employ to regulate learners' conduct and the form of communication between the teacher and the learners. Imperative forms of control exemplify very strong framing of hierarchical rules (F++). Here teachers use verbal admonishments or physical punishment to control learners' conduct, highlighting authoritative forms of control. Imperative control is exemplified in the following communication, taken from Suubi's lesson. Suubi admonished a learner who came to the class 30 minutes late.

- T: You are late! Tell us why you are late. Where do you stay?
L: (*The latecomer keeps quiet but some learners respond*) Lubaga road.
T: Lubaga road? Okay sit.

Suubi did not give the learner an opportunity to explain why he was late; he was simply reprimanded, demonstrating that the teacher's authority rather than the learner's interest was at stake here. Here we see authoritative communication relations emphasizing the power relations between the teacher and the learners. Such verbal reprimands portray imperative control based on authority.

Positional forms of control reflect strong framing of hierarchical rules (F+). Positional control is based on a defined 'position' or ground rules aimed at defining the expected code of conduct as illustrated in the following communication taken from Nekesa's lesson. There had been some disagreement over the spelling of the word 'anopheles' prior to this.

- T: What do you do when you are not sure of the spelling? What do you do? Yes?
L₁: When the spelling is wrong you should put up your hand.
T: You should put up your hand? Yes (*points to another pupil*)
L₂: Check in the dictionary
T: Exactly, check in the dictionary, you should check in the dictionary, get your dictionaries and check.

In personal control forms, control is 'personalized' and the interests of the learners are considered; for example, learners are told the consequences of their behaviour for themselves or the rest of the class. This is exemplified in the following communication taken from Nambuya's lesson. The class was doing a class exercise and Nambuya was encouraging them to consult one another

- T: Whatever you don't understand ask, clear. Eeh don't just keep quiet. You are not doing a test; ask your friend that where are the uses of flowers? Assist one another on your desk, clear?
L: Yes
T: You can understand better from your fellow pupils more than from a teacher do you know that?
L: Yes

Nambuya provided a reason for the desired conduct by explaining to the learners the consequences of consulting one another.

The analysis shows that hierarchical rules were very strongly framed across the majority of lessons; ten lessons were coded F⁺⁺, four were F⁺ and only two were coded F⁻. A majority of the teachers (fourteen out of sixteen) employed the positional form of control expressed through rules defining the expected code of conduct. Bernstein (1990) suggests that positional control works to 'clarify, maintain and repair boundaries' (p.83), relying on the positional status of teacher and taught (Atkinson, 1985, p.150). Positional control is exemplified in the following rules that Weere set for his class before they went for an outdoor activity.

I want us to go outside and we look at some of these systems we have talked about. I want us to move quietly and we are going to move in a line and I am going to begin with this row (*points to the row closest to the door*).

Positional control was further evident in the code of conduct within lessons. Learners raised their hands and waited for authorization before answering questions. They also spoke one at a time; consequently 'chorus answers' were discouraged. In addition, learners stood up to address teachers as a sign of respect as illustrated in extract 6.1 where Bogere's class stood up to greet him. Learners were also expected to seek permission from the teacher before going out of the classroom. Some of these rules were not announced in the lessons because by grade five and six most learners had already been socialized into the expected conduct through school and class 'rules'. Teachers did not provide learners with reasons or consequences for the expected conduct.

Where learners produced unacceptable conduct, thereby transgressing the set rules, teachers reinstated the rules to remind them of the expected conduct. For example, whenever learners responded to questions in unison teachers reminded them to raise their hands. Likewise, at the beginning of Nambuya's lesson, the class spontaneously stood up and started singing as part of their classroom culture. As they sang, one learner cued the rest to 'dance', 'clap' and eventually 'sit down'. After the class had sat down one learner shouted 'clap' but Nambuya reminded her of the rule: 'when you sit you have finished'. This incident demonstrates how the learner's spontaneity was subordinated to a defined code of conduct.

Further, although teachers 'appeared' to cede control to learners for a while during group activities, they set explicit rules for conduct and moved around groups emphasizing the desired behaviour. For example, Bogere encouraged group members to 'speak up' and later informed them that, 'You are free to talk because it is a discussion'. Kabi expected learners to adhere to a defined code of conduct during the group activities; before each presentation he instructed group 'reporters' to mention their names and reminded those who deviated from this sequence to, 'say your name first'. At the end of the lesson learners stood up spontaneously and speaking in unison thanked Kabi saying, 'Thank you teacher for your service your service is appreciated' and moved out of the class in two straight lines. These incidents exemplify an explicit and formal code of conduct suggesting strongly framed hierarchical rules. Learners' behaviour was strongly regulated allowing them little room for spontaneity and self-regulation.

While positional forms of control were dominant, Nekesa and Erone employed more personalized forms of control, whereas Nambuya used both positional and personal control although the former was more dominant. Although Nekesa provided explicit rules of conduct, she used local proverbs to justify why the expected conduct was desirable; for example, she informed the class that, 'one does not borrow salt from a neighbour every night' to highlight the need for all learners to have basic requirements for the lesson. To emphasize the need for learners to sit still and concentrate on the activity at hand, she used the analogy of 'a machine in a factory cutting off one's hands'. Atkinson suggests that personal control is less overt and 'a matter of negotiation and influence rather than power and status' (1985, p.150). Nekesa also related to her class in a warm and affectionate manner; for example, she rewarded one of the learners with money 'for a sweet' for correctly answering a difficult question and hugged her as well. Despite the large class size of 113 learners, she addressed learners by name most of the time and the whole class as 'children'.

Likewise, the social climate in Erone's class was warm, relaxed and flavoured with a sense of humour and an informal style of communication. Erone frequently asked the class to clap for learners who answered questions correctly which motivated others to participate in some way. When learners responded to questions inaudibly he emphasized to them the need to speak audibly, explaining that he too addressed them audibly. To emphasize this, he said something softly and asked the class to repeat what he had said. When they failed to do so, he told them to speak loudly so that, 'they all share like market vendors'. Later on, a learner answered a question rather softly and Erone remarked that, 'Now you are talking stereo' and implored him to 'speak to the class like Vanessa'. He also jokingly remarked to a learner who had been quiet through most of the discussion, 'Yes Brenda, eeh good morning' as the rest of the class giggled with laughter. At the end of the lesson, Erone told the class to 'talk to feathers' which implied doing prior reading on the topic. Here, we see how Erone de-emphasized his hierarchical position and status through an informal style of communication.

Control was more variable within Nambuya's lesson; she employed both positional and personal forms of control at different stages of the lesson. Although positional control was more dominant, Nambuya also exercised personal control by explaining

to learners why particular forms of conduct were desirable. For example, she instructed the class to 'sit upright and not bend over' and also 'to keep their books in an upright position'. She explained this as necessary to ensure good handwriting: 'so that the letters don't bend with you'. By revealing to learners the consequences of their conduct these teachers demonstrated that the learners' personal interests rather than the teachers' position or rules per se were at stake in complying with the expected conduct.

The analysis shows the dominance of 'closed' communication across lessons; teachers initiated and dominated communication and learners only contributed when invited to do so through questions or group discussions. On no occasion did learners interrupt the teacher's communication spontaneously except when seeking clarification of tasks. In general, any form of unauthorized communication among learners was considered 'noise' and disruptive of learning. Further, most teachers pointed at learners to draw their attention. This can be partly attributed to the fact that field work took place during the first term of the school year and teachers had not yet mastered the learners' names, particularly those teaching large classes. Nevertheless, Suubi was quite authoritative and harsh in her communication with learners; she shouted at those who made mistakes and also referred to learners in an impersonal manner as 'others' or 'this one' as shown in the last line of the extract below.

Extract 6.4

One of the learners had been called to the front of the classroom to show the class the different parts of a simple leaf. As she pointed out the different parts Suubi intervened as follows:

- T: All of you have seen the mid rib?
L: Yes
T: Another one, other parts? Speak louder, we don't hear.
L: *(The learner continues demonstrating but speaks rather softly)*
T: You can shout louder than that.
L: Leaf blade
T: Leaf blade, show us the leaf blade and you have to talk louder than that.
T: Others their eyes are this way now read those parts.

Later on in the lesson, Suubi remarked to a learner who answered a question inaudibly, 'Louder, louder, we don't hear, another one, if you want to talk, speak loudly, louder, if you talk, speak loudly' and moved on to the next learner. Like

Suubi, Musaali's voice was relatively strong and occasionally harsh. When learners made mistakes, he frequently pinched them and in one incident he pulled a learner's ears while marking his work.

In general, a combination of positional forms of control and closed communication between teacher and learners demonstrated that social order in the classrooms observed limited the degree to which the learners could take charge of their learning and be self-regulating. On the whole, control was regulated by an explicit code of conduct which gave learners little room for options. Bernstein (1996) argues that the economy of performance models makes the use of personalized control less favoured as these modes entail lengthy communication.

Classification of agents

Classification of agents relates to the power relations underlying the pedagogic relationship between teacher and learners and between learners and their peers. This study examines classification of agents from two perspectives (teacher- learners and learner-learner).

Classification of agents relates to social relations between teacher and learners and among learners and their peers. These relations reflect the power relations defining the pedagogic identity of the teacher and learners as well as the degree of differentiation among the learners' pedagogic identities. Bernstein (1996; 2000) suggests that classification between transmitters and acquirers is inherently strong because of the high status of the transmitter in the pedagogic relation. Therefore differences in teacher-learner relations reflect relative strengths within strongly classified relations. Classification of the teachers' and learners' pedagogic identities was evident in the distribution of tasks and the explicitness of the boundary between the teacher's status and that of the learners.

Classification of teachers' and learners' pedagogic identities was strong, portraying the teacher as 'author' and 'regulator' of instructional and regulative tasks. This was particularly evident in the set up and management of group activities where teachers set rules for managing instructional activities and also assigned specific roles to group 'chairs' and 'secretaries'. Extract 6.1 shows how Bogere allocated roles to the group

chairs and secretaries; 'The chairperson asks questions as the secretary writes down whatever is discussed'. He also set rules for distributing books to group members, 'I am giving you books but they shall be given out by group leaders'. This pattern of distributing tasks and materials was evident in other group work lessons. Acom and Weere selected leaders for the groups as well. Because teachers organized group activities in detail, learners were not given much room to regulate their activities flexibly.

Classification of agents (learner-learner) is examined in relation to ability (pedagogic identity) and in relation to social relations such as gender and social status in the classroom such as group leaders and class prefects. The majority of the teachers did not differentiate between the learners' pedagogic identities; they addressed learners as groups rather than as individuals. This highlights weak classification of learners with respect to ability. However, some of the group work lessons provided learners with opportunities to act as 'teachers' to their peers, reflecting strong classification between learners with respect to social positions in the classroom. This was particularly evident in Bogere's class where some group leaders 'instructed' group members who listened attentively and raised hands and waited for turns to contribute.

Classification of space

Classification of space reflects the power relations underlying the relationships between the teacher and learners and among learners themselves in the use of teaching and learning space. In this study, classification of space is examined through the organization of seating arrangements of the teacher and learners within the classroom. I describe classification of space from two perspectives: classification between the teacher's and the learners' space and classification between the learners' spaces. Classification of space was visible in the arrangement and use of the teacher's and learners' pedagogic space. Organization of space varied according to the lesson activity type as well as the physical size of the classrooms.

The teachers' space was clearly demarcated from that of the learners with a desk at the front of the classroom. Learners' desks were arranged in rows facing the front, although this arrangement was adjusted to suit the activity structure of the lesson when necessary. Within the teacher-led exposition lessons, the teacher's space was

clearly demarcated from that of learners, showing strong classification. Most teachers instructed the class from the front of the classroom, although a few moved into the learners' space to supervise and mark class work. This was particularly evident in the whole class teacher-led lessons of Asimwe, Erone and Suubi. Nekesa, who also taught a whole class teacher-led lesson, remained at the front of the classroom throughout the lesson because, as she later explained in the interview, she believed that teachers' movements within the class distract learners. Within the practical lessons, classification between teacher and learner spaces was weaker for the duration of the demonstrations which were all held at the front of the classrooms. Learners gathered around the table to watch the demonstrations after which they returned to their space. The group activity lessons reflected very weak classification (C--) between the teachers' and learners' space. Teachers moved around the classroom supervising groups as they worked, and learners' group presentations took place in the teachers' space.

In general, classification of learner-learner space varied according to the structure of the lessons, which in turn influenced learners' seating arrangements. Learners' spaces were strongly classified with desks arranged in columns facing the front in the teacher-led and demonstration lessons. The large schools had very crowded classrooms with four to five learners sharing a desk. Desks had been arranged in stacks to cope with the limited space in Kulaba and Weere's classrooms. Here classification between learners' space appeared 'weak'. However, this was more apparent than real because the organization was undertaken in response to space limitations. Grace (1995) suggests that the constraints of space in crowded urban classrooms give the notion of boundary not only a symbolic significance but also a material and functional one. The seating arrangements in Nambuya and Suubi's classes were gender segregated; boys and girls sat at separate desks, highlighting strong classification between learners' spaces. Classification between the spaces of learners was weaker in the group work lessons because seating plans were arranged to facilitate interaction among learners. In the teacher-led and demonstration lessons, classification between learners' seating arrangements was stronger.

Although there was 'weak' classification between the learners' seating spaces within the group activities, this was not necessarily associated with interaction among

learners. For example, in Acom's group work lesson, two boys and three girls sat at separate desks and worked independently on the group task. Similarly, Nambuya only encouraged learners to work in concert with their peers after noticing that some were having difficulty with the tasks. Prior to this, learners had been working independently. In Bogere's class, interaction between group leaders and members was asymmetrical; the leaders assumed the role of 'teachers' and 'instructed' the rest of the group members. Some group members raised their hands and waited to be selected before speaking; this seemed to reproduce the general teacher-learner pedagogic and social relations reflected at the broader level of the classroom.

On the whole, weakly classified teacher- learners' space, and learner- learner space did not necessarily imply weakly classified hierarchy and social interaction. In this regard, evidence from this study contradicts that from other Bernsteinian studies (Morais et al 2005; Morais, 2002; Morais & Neves, 2001; Hoadley, 2005), which associate weak classification of teacher-learner space with weakly framed hierarchical relations between teachers and learners. Weak classification of teacher-learners' space did not necessarily result in less hierarchical relations in this study because some teachers moved around the classroom primarily to reinforce a hierarchical social order. Emphasis on a particular code of conduct clearly demarcates the teacher's position and status as 'transmitter' rather than the anticipated role of 'facilitator'. In general, learners were not given the opportunity to regulate themselves. Bernstein (1996) suggests that positional control militates against the role of a transmitter as 'facilitator' and the acquirer as self-regulating.

Pedagogic features differentiating lessons

The analysis shows substantial differences among lessons in relation to four pedagogic features: these include pacing, evaluation criteria, relationships within science knowledge (intra-disciplinary relations) and classification between science and everyday knowledge. To highlight the differentiating features the lessons have been categorized into three groups that are broadly similar in relation to these issues. The lesson groups are: lesson type one, lesson type two and lesson type three. However, the boundaries between the three lesson types reflect a continuum with some similarities between adjacent types. For example, there are strong

commonalities between lesson types one and two in relation to evaluation criteria and intra-disciplinary relations. Likewise, some lessons within types two and three are very similar with respect to school and everyday knowledge relationships. In view of these similarities, some lessons within adjacent lesson types are described together to avoid repetition. Table 6.3 highlights the characteristics of the four pedagogic features in each lesson type. The column on the extreme right shows the structure of each lesson.

Table 6.3 Lesson types and their differentiating characteristics

Lesson type	Pacing	Evaluation criteria	Intra-disciplinary relations (Topics)	Intra-disciplinary relations Concepts & Procedures	Academic & everyday relations	Lesson structure
Type one						
Kulaba	F ⁺⁺	F ⁺⁺	C ⁻		C ⁺	Group work
Nekesa	F ⁺	F ⁺⁺	C ⁻		C ⁺	Teacher-expo
Asiimwe	F ⁺	F ⁺⁺	C ⁻		C ⁺	Teacher-expo
Sakwa	F ⁺⁺	F ⁺	C ⁺⁺	C ⁻	C ⁺	Demonstration
Ssesanga	F ⁺	F ⁺	C ⁺	C ⁻	C ⁺⁺	Demonstration
Type two						
Acom	F ⁺⁺	F ⁺	C ⁺		C ⁻⁻	Group work
Bogere	F ⁻	F ⁺	C ⁺		C ⁺⁺	Group work
Erone	F ⁻	F ⁺⁺	C ⁻		C ⁻	Teacher-expo
Kabi	F ⁻	F ⁺⁺	C ⁺⁺	C ⁺	C ⁺	Group work
Malongo	F ⁺	F ⁺⁺	C ⁻		C ⁻	Group work
Musaali	F ⁻	F ⁺⁺	C ⁻	C ⁻	C ⁻	Demonstration
Weere	F ⁺⁺	F ⁺	C ⁺		C ⁻⁻	Group work
Type three						
Bwogi	F ⁺⁺	F ⁻	C ⁻		C ⁻	Teacher-expo
Nambuya	F ⁺⁺	F ⁻	C ⁺		C ⁻⁻	Teacher-expo
Opio	F ⁺⁺	F ⁻	C ⁺		C ⁻⁻	Teacher-expo
Suubi	F ⁺⁺	F ⁻	C ⁺⁺		C ⁺	Teacher-expo

Lesson type one

Type one lessons reflected strong framing and classification values emphasizing a 'visible' form of pedagogy and strongly insulated knowledge boundaries. These lessons reflected strongly framed pacing, very strong framed evaluation criteria and strong classification between science and everyday knowledge. However, type one lessons portrayed weak intra-disciplinary boundaries within science knowledge. The lesson structure did not appear to influence the classification and framing values, given that all three activity types are represented in the lesson type. In the following

sections, this group of lessons is described in relation to pacing, evaluation criteria, intra-disciplinary knowledge relations and science and everyday knowledge relations.

Pacing

Pacing relates to the rate at which learning is expected to occur; this is referred to as the 'expected rate of acquisition' (Bernstein, 1990, p.76). This analysis makes a distinction between the pacing of instruction which relates to the actual speed or pace of instruction and framing of pacing which relates to 'who controls the expected rate of acquisition'. Whereas Bernsteinian analyses mainly consider framing of pacing, this analysis examines both aspects; pacing and framing of pacing. This decision is premised on the analytic significance of differences in the speed of instruction across the three lesson types particularly between lessons types one and three.

Lesson types one and three differed considerably with respect, firstly, to the pace at which learners undertook tasks and secondly in relation to the manner in which teachers accommodated differences in learners' abilities and rates of progression. Differentiation in pace among learners is particularly crucial in the problem solving approach where it is seen as key in recognizing their individual pedagogic identities. The pedagogic prescriptions for the problem solving approach examined in chapter five highlight the need for teachers to adjust instructional activities in ways that are responsive to differences in learners' abilities and rates of progression. Recognizing learners' individual rates of progression suggests a variation in the pace of instruction according to the composition of learners in a particular classroom.

The analysis shows that pacing ranged from strong to very strong framing in lesson type one. Instruction was conducted at a generally fast pace; teachers set time limits on learners' activities and implored them to work fast. The following extract from Kulaba's lesson provides an example of the very strong framing of pacing characteristic of lesson type one.

Extract 6.5

Here Kulaba was giving instructions for group activities prior to and during the activities.

- T: Write the various parts that you can see from that flowering plant, you are not writing in the book but on the paper. You discuss and come up with an answer from the whole group. I am giving you five minutes to do that.
- L: *(Group activities begin).*
- T: *(Kulaba moves around the groups).* You must agree on the various parts that you see, you observe the plant very well. *(Kulaba moves to the front of the classroom)* Have you finished?
- L: *(There are mixed responses of 'yes' and 'no' from the class)*
- T: Which group has not finished?
- L: *(Some groups raise their hands)*
- T: I add you some two minutes *(after the two minutes elapsed Kulaba reminds the groups to complete the tasks)* Can you wind up? *(He moves around the classroom a bit).* Now can you pay attention this way last group we are waiting for you to give us the attention. Now can you mention the various parts that you have observed in the various groups?

This extract shows how Kulaba specified the duration for the group tasks and even when he extended the time he explicitly indicated how long the extension would be. It was evident that pacing was strongly regulated by the defined lesson time frames and so teachers endeavoured to complete the planned work within that time. Similarly, Sakwa exerted pressure on learners to complete work so that he could mark it. As soon as the class exercise commenced, he moved around the classroom looking for completed work which he quickly marked by ticking or crossing without further comment.

Among the three lessons coded as strongly framed (Asiimwe, Nekesa, Ssesanga) pacing was generally strong but relaxed in some instances when it was necessary to address specific learning needs. For example, Asiimwe allowed learners adequate time to respond to questions and also revisited previous steps when it was necessary to correct misconceptions or to enable learners to build up answers. He also relaxed pacing while marking the class work in order to explicate evaluation criteria to individual learners and to the rest of the class where he found common mistakes. Asiimwe's actions demonstrate the close relationship between relaxed pacing and the explication of evaluation criteria. Despite the strong pace of instruction, learners in these classes completed the assigned tasks within the allocated time.

Evaluation criteria

In this section, I analyze the extent to which teachers provided learners with explicit rules for producing expected texts. I examine evaluation criteria in relation to the degree of explicitness of criteria within content expositions, instructions for learners' tasks, the handling of learners' verbal responses, along with how and whether class exercises were corrected. Learners' productions encompassed oral and written texts; the former included oral responses to teachers' questions and group reporting while the latter included class exercises. The lesson structure determined whether learners' productions were included and evaluated within the lessons. Teacher-led expositions and demonstration lessons had few learner productions and most were oral responses to teachers' questions. In contrast, group work lessons provided more opportunities for the evaluation of learners' productions given their lesson structure. Given the similarities in evaluation criteria in lesson types one and two, both lessons types are presented under this section.

Table 6.2 shows that these two lesson types reflected strong and very strongly framed evaluation criteria (F+/F++). Questioning sessions provided an opportunity for teachers to evaluate learners' productions through the triadic structure of 'question-answer-evaluation'. The analysis shows that teachers in lesson types one and two provided very explicit criteria within questioning sessions. They took time to explore the learners' responses; they elaborated correct responses, showed why some responses were incorrect and also pointed out missing texts in responses. In these ways, criteria for producing acceptable responses were made 'visible' and explicit to learners. Bernstein (2000) suggests that pointing out what is 'absent' in the learners' texts specifies and clarifies expected rules and allows learners to produce legitimate texts. The following extract shows how Erone elaborated one of the correct responses.

Extract 6.6

The class was looking at the characteristics of birds

Zaake: They have eyes with an extra membrane.

T: Clap for that one (*Learners clap*) Yes they have eyes with an extra membrane, which can be withdrawn or drawn to cover the eye when the bird is flying so that it protects it from excess wind. Now if you are running against the wind what will happen? (*Learners giggle as Erone demonstrates running against wind*). So there are many characteristics that enable a bird to cope with flying against the wind, one of them is

presence of a 'nic' membrane on their eyes so their eyes are protected against the force of wind.

Erone elaborated the response to show how the extra membrane enables birds to cope with the force of wind in the course of flying. Further, these teachers provided explicit criteria by pointing out missing texts and misconceptions in the learners' responses as exemplified in the following extract from Asiimwe's lesson.

Extract 6.7

- T: (*Asiimwe hits three different drums*) I have drummed, now how does this drum produce sound?
- L: (*Silence*)
- T: Because we have seen generally all instruments or sound is produced whenever an object vibrates, but now we are coming to a drum, yes (*Points at a learner*)
- L1: It produces sound when it vibrates,
- T: But there is something missing (*hits one of the drums*) Isaac?
- Isaac: By beating
- T: By beating okay I am now beating (*hits the drums again*) aha?
- L1: By drumming
- T: By drumming you are drumming but.....
- L2: When you hit it, it vibrates then sound is produced
- T: What vibrates?
- L2: The skin on it
- T: It is the skin that does what? (*Hits two different drums*) The smaller the drum...what do you want to say?

Following this Asiimwe elaborated the concept further. He asked the class to identify the various media which vibrate to produce sound in different musical instruments.

Asiimwe pointed out a missing text in learner L1's response after which he solicited contributions from the class to build upon the incomplete response. He also reminded the class about a general rule, 'we have seen generally all instruments produce sound when they vibrate' and instructed them to focus on a particular medium that vibrates in drums. Asiimwe also pointed out potential ambiguities in learners' texts. In one of the incidents, Asiimwe asked the class to identify a pipe capable of producing the highest frequency of vibrations on a musical instrument. In response to this question, one learner stated the answer as, 'the last one'. Asiimwe showed how the answer was ambiguous, saying:

Which one? And that is the biggest problem you have when you are answering questions because now when you tell me the 'last one', for me this one can be the last one or this one can be the last one. (*Asiimwe explains while pointing at pipes at opposite ends of the instrument*) Now which one do you mean? Please that is how you always make mistakes that which one and you say the last one.

Following this, Asiimwe asked another learner who stated the correct answer as 'the last one, which is the smallest'. This form of emphasis on recognition rules was also evident in Nekesa's approach of revising a class assignment. For example, after an elaborate explanation of the differences between an 'embryo' and 'germinal disc' she cautioned learners against confusing the two terms. She said:

Now be very attentive, one time they will cross your work in the exam, they will show you something big like this (*illustrates on the chalkboard*) and you will call it a germinal disc and when it is small like a dot you will call it an embryo, that is wrong. What is called the germinal disc is this small part, are you getting me? Know when to use the word germinal disc and when to use embryo.

Nekesa transmitted explicit criteria for recognizing the specificity of these particular concepts and thus provided learners with rules for producing legitimate texts subsequently.

Furthermore, teachers ascertained whether learners could justify their responses by giving reasons 'why' or showing 'how'. This ensured that learners did not simply guess or recall facts, rather that they understood the scientific principles underlying their answers. This type of question also exposed potential errors in the learners' responses which were subsequently corrected. The following extract exemplifies how Weere used this type of questioning.

Extract 6.8

The class was outdoors examining different poultry systems.

- T: Now look this way everybody, look on this side look at me. Since you have already seen the other method, what system are these other chickens using? (*Weere points at some chickens which are moving around the poultry unit*).
- L2: Free range
- T: Give me a reason why you think this is a free-range system?
- L2: Because they are looking for food.
- T: Aha, what else makes you know that these ones are using the free range?
- L3: Because they are moving on their own.
- T: Yes they are being left to move freely by themselves. Why do you think are the disadvantages of this system? (*The deep litter system*)
- L1: It is expensive.
- T: Correct, the system is expensive, it is expensive. Who can give me a reason why this one is expensive? Why is this system ... 'Lwaaki eyo sistimu etwala sente nyingi?' [*The Luganda translation for the previously asked question*] Why? Who can give us the reason?
- L2: The birds can use a lot of energy.
- T: Now we should try and look at this one before we look at yours. Why is it expensive? Why is this method expensive? (*Lwachi zitwala sente nyingi?*) That is what I am saying.

- L1: Because you have to buy the food.
 T: Correct, you have to buy the food. And food costs what? Money food costs what?
 L: Money.

In the practical lessons, Musaali and Sakwa asked *why* questions to help learners interpret the observations made in the light of scientific concepts and principles. For example, Musaali asked his class why the surface that was placed above the boiling water became wet. This question formed a platform for explaining the processes of evaporation and condensation.

Framing of evaluation criteria was also evident in the way teachers set up, supervised and corrected learners' productions. Class exercises constituted the main learner production in the teacher-led and demonstration lessons whereas group tasks were the key learner productions in group work lessons. Asiimwe, Erone, Musaali and Ssesanga gave class exercises and Nekesa revised a previously done class assignment. These teachers provided learners with explicit criteria for undertaking tasks. For example, Ssesanga wrote the instructions on the chalkboard and instructed learners to read them as he elaborated upon the requirements for each question. Likewise, prior to group activities, teachers wrote instructions on the chalk board and elaborated upon them as illustrated in extract 6.1 from Bogere's lesson. These teachers also moved around the class helping individual learners or groups. When they found common mistakes they clarified the issues to the entire class as exemplified in the following extract from Asiimwe's lesson.

Extract 6.9

- T: Pens down everybody, pens down everybody, pay attention and look here (*points to the chalkboard*) Are you paying attention?
 L: Yes
 T: Sarah, I have corrected that thing twice but you are still making the same mistake. When you say sound is a form of energy, even heat is a form of energy; therefore are you saying that heat can be sound? The form of energy is different who can put it better?
 L1: Sound is a form of energy which is formed whenever an instrument vibrates
 T: Which is produced whenever an instrument vibrates, Apio are you paying attention?
 Apio: Yes
 T: Stand up and tell us, what is sound?
 Apio: Sound is a form of energy that is produced whenever an object vibrates.
 T: By vibrations whenever an object vibrates, pay attention don't just sit. (*Asiimwe writes correct answers against the questions on the chalkboard*).

In this extract, Asiimwe explicated the evaluation criteria by pointing out a recurring mistake in Sarah's work and explained why her answer was wrong. Similarly, after noticing that some learners were having difficulties in the class exercise, Musaali revisited and elaborated the concepts of physical and chemical changes further. In addition to pointing out common mistakes to the whole class, Asiimwe and Musaali also wrote correct answers in the exercise books of learners. Further, Asiimwe, Musaali, Nekesa and Ssesanga revised the exercises by systematically reviewing each question, pointing out correct and incorrect texts and writing correct answers on the chalk board. They finally instructed the learners to make corrections in their exercise books. In so doing these teachers provided learners with explicit rules for producing legitimate texts. The reporting sessions in the group work lessons provided opportunities for evaluating learners' group tasks. During these presentations, teachers intervened to elaborate concepts further, to correct misconceptions and also to point out missing texts in each report. This is illustrated in the following extract from Kulaba's lesson.

Extract 6.10

A group reporter was presenting findings on the functions of various parts of a flowering plant and in this particular case the functions of the stem and flowers were being presented.

- T: Any other function you have come up with? Yes.
- L2: Store food for the plant.
- T: Like which ones? (*Kulaba notes the function on the chalkboard but adds the word 'some' and underlines it as he reads it out loud*) we say some stems not all stems, and you have given us an example of what?
- L2: Sugarcane
- T: What else have you come up with? What was the other part? Flowers (*writes the point on chalk board and selects another response*). Yes
- L2: Helps plants to pollinate.
- T: How important is that one to a plant? Yes Okia?
- Okia: It becomes a fruit
- T: The flower?
- L2: Ovary
- T: It is the ovary, which is part of the flower so we can't say the whole flower does that. Yes Kagwa?
- Kagwa: Flowers help plants reproduce
- T: Yes it helps the flower carry out reproduction (*notes the point on the board as he says it out loud*). Of course later we shall look at pollination of flowers and fertilization and see where pollination takes place. That's where we have the.... (*Briefly points out aspects that will be handled under pollination*) is that okay?

The extract shows that as group reporters read out findings, Kulaba noted the points on the chalkboard and commented on their validity. He elaborated upon some concepts; asked questions about the points raised and corrected misconceptions in the findings. Similarly, after each role play, Malongo asked each group to justify why they had performed particular 'first aid' procedures. For example, she asked one of the groups why they had tied the leg of the accident 'victim' with sticks. She also drew the learners' attention to possible omissions in the first aid procedures. This pattern was observed in the report back sessions for the rest of the group work lessons. The structure of the lesson did not seem to influence framing of evaluation criteria in lesson types one and two because criteria were similarly strong in all three lesson activity types.

Intra-disciplinary knowledge relations

As discussed in chapter five, this study examines two types of intra-disciplinary relationships within science; these are the relationships between science 'procedures' and science concepts and relationships between science topics. Lessons in lesson types one and two with similar intra-disciplinary relations are presented together under this section.

Relations between conceptual science knowledge and knowledge of science procedures

Table 6.3 shows that only four lessons covered practical science work and all these lessons are under lesson types one and two. Three of the four practical lessons (Musaali, Sakwa and Ssesanga's) reflected a weak boundary between science conceptual knowledge and the knowledge relating to science procedures. These three lessons were coded as C- . Weak classification between these two types of science knowledge was reflected as the teachers interpreted and synthesized observations from the practical work in light of the relevant science concepts. This is exemplified in the following extract taken from Ssesanga's lesson.

Extract 6.11

Ssesanga was correcting a class exercise on the practical work demonstrated in the lesson

- T: Now we did the experiment we saw what happened there. What happened to the nail in the single and divided touch method? When we are touching using this method here (*Gestures the magnetization procedure*) what happened to the nail? The nails here, (*Picks up the nail*) what happened to it?
- L1: The nail became magnetized
- T: The nail became magnetized so we should write here (*Writes on the chalk board, the nail became...?*)
- L2: Became
- T: The nail became magnetized. So this nail became magnetized, so we tested to see whether it was magnetized by using the small nail seeing whether it will attract them so we saw that it attracted the small nail it means the nail was..?
- L: Magnetized
- T: So number two, what happened to the nails when they were put near a magnet? Now we put one nail near a magnet these two nails here (*picks a nail and places it on the magnet*) now after removing one nail and you put it to the small nails what did we notice... they attracted the small nails isn't it? So what did we notice?
- L3: The nail was magnetized
- T: So what did we conclude there? That the nail was magnetized, so that was what we call the induction method (*Ssesanga writes the phrase 'induction method' on the chalkboard and underlines it*). When you put a magnetic material near a magnet it gets magnetized so that is known as the induction method.

The extract shows that Ssesanga systematically recalled what was 'done' and 'observed' in the demonstration and then interpreted these in light of conceptual knowledge on magnetism. Likewise, Musaali interpreted the main aspects observed and described these as 'evaporation' and 'condensation', he also explained how these processes illustrated changes in the states of matter. These two examples show that observations provided the 'empirical evidence' for the interpretations and conclusions arrived at. The validation of knowledge on the basis of a chain of empirical evidence provided learners with some experience of the 'scientific processes' practicing scientists engage in 'doing' their work.

In contrast to the three lessons above, Kabi's lesson reflected a strong boundary (C+) between science procedures and the conceptual knowledge on the topic. Although the practical work was based on the topic 'melting' the activities focussed primarily on the science process skills of observation, measurement and recording as shown in the following instructions.

Extract 6.12

- Light a candle and let it stand.
- How many colours can you see on the flame?
- Identify the colours on the flame
- Smear four balls of vaseline on the nail and on the stick
- Heat the end of the nail and stick and observe
- What is happening to the vaseline on the nail and stick?
- How many minutes has ball one taken to melt?
- Which ball has melted last?

During the group presentations, Kabi did not comment on the validity of the findings reported. After all the groups had presented, he concluded the lesson as follows;

T: Now all your answers are very correct. (*Kabi points out similarities and differences in the answers across the six groups and notes that some groups had not identified a third colour – black*). Next time observe properly there was colour black there. Now when you put the balls on to the stick and melt how many minutes did it take on the ball and on the stick? You had the stick and nail, but you gave only one for the nail. So next time it cannot be the same because when you are heating the nail it can not be the same as the stick.

T: Now apart from vase line, can you tell me any other things that can melt?

L: A candle

T: Any other

L: Ice

T: Thank you, any other?

L: Metal

T: So thank you very much

L: You are welcome

T: Now collect that work, group leaders collect that work I am going to mark it.

Kabi focused on the observations of the activity but he did not examine their conceptual significance resulting into a strong insulation between the ‘procedures’ undertaken and their ‘conceptual’ significance. It would have been conceptually meaningful to explain why, for example, the four ‘balls’ of vaseline melted at different time intervals. In addition, an explanation of the differences between the melting processes on the nails and sticks would have been useful. Kabi later explained that he planned to examine the relevance of the activity in the subsequent lesson because of the limited time of the lesson. Although Kabi’s plan was laudable, this lesson demonstrates ‘fragmentation’ in the scientific process of validating knowledge on empirical evidence.

Musaali, Sakwa and Ssesanga’s lessons were coded C-, suggesting weak classification between the science ‘procedures’ and conceptual knowledge whereas Kabi’s lesson was coded C+ implying strong classification between the type knowledge types. All

four practical lessons were under the same theme, 'matter and energy'. This suggests that the type of curricular content influenced the viability of providing 'scientific processes' mandated under the problem solving approach.

Relations between science topics

Three lessons under lesson type one reflected weak intra-disciplinary boundaries between science topics and two had strong boundaries. The two strongly classified lessons (Sakwa and Ssesanga's lessons) are discussed under lesson type two. Table 6.3 shows that six of the seven lessons with weak intra-disciplinary relations were under lesson types one and two. The analysis shows that these six teachers began lessons by briefly reviewing the previous lesson's work and showing how the current lesson extended the previous one and by so doing these teachers provided logical sequencing and continuity of knowledge. Reviewing the previous lesson's work at the start of lessons is a conventional way of introducing lessons in Ugandan schools, therefore some teachers do it in a manner reflecting what Jacklin (2004) describes as convention-led practice. However, these teachers linked the new lessons to the previous ones in purposeful ways. Further, these teachers employed knowledge from other science topics to explain concepts within the lesson as illustrated by Erone in the extract below. He was teaching about the external features of birds.

Extract 6.13

- T: Now when we were learning about friction, we said that there are ways of reducing friction on those bodies that move through air and through water, what is that way of reducing friction on bodies that move through air or water? Yes Kato?
- Kato: Streamlining.
- T: Yes, streamlining. Clap for that one (*learners clap for Kato*). So birds' bodies are streamlined, (*writes the word 'streamlined' on the chalkboard*). You see they look like a stream, what do we mean by streamlined? (*Erone comments that someone is gesturing but can't put it in words*).
- L: Streamlined means their bodies have sharp sharp ends.
- T: What ends?
- L: The front end
- T: Only the front end? A body that is streamlined means it is pointed in front and also at the behind. If you look at an aeroplane, is the behind part large?
- L: No.
- T: It is this kind of nature (*Erone sketches an illustration of the stream lined shape on the chalkboard*) like a spear. So they have streamlined bodies. Do you have another one? We have not finished the lesson, I have said we have finished with characteristics of birds, but if you have another one, add. Yes.

Weak classification of the intra-disciplinary boundaries between science topics was facilitated by the spiral structure of the science syllabus which allows progressive teaching of themes within and across all the primary school grades. Therefore teachers of C- lessons revisited and built upon concepts introduced in earlier classes. This enabled them to provide learners with a broad and inter-related structure of knowledge. Musaali drew on the concepts of mass and weight of matter taught in a prior class to explain the difference between physical and chemical changes in the states of matter. Likewise, Malongo used the concept of blood circulation to show how interruption in supply of blood causes the accident of fainting. Teachers frequently reminded learners that some concepts had been introduced in previous classes so they were 'just building on' or 'doing revision'. In addition, Kulaba, Malongo, Nekesa and Asiimwe also showed learners how the current lessons would be built upon subsequently. For example, in extract 6.10, Kulaba pointed out how the functions of flowers would be built upon in subsequent topics on 'pollination'.

Five of the seven lessons (71%) with weakly classified intra-disciplinary boundaries (C-) were based on the physical and natural science themes, 'matter and energy' and 'the world of living things'. This suggests that weak classification of knowledge across topics was partly linked to the type of content within these two themes. Vertical knowledge structures within natural and physical science provides room for integration to generate increasing abstractions of principles and theories (Bernstein, 2000). Further, table 6.3 shows that 86% of the lessons (six out of seven) with weakly classified intra-disciplinary relations had strong or very strongly framed evaluation criteria. This relationship is consistent with findings which demonstrate that strong intra-disciplinary knowledge relations generate deep conceptual development and effective science learning (Morais, 2002; Morais, Neves & Pires, 2004).

Relations between science and everyday knowledge

All the five lessons in lesson type one were strongly insulated from everyday knowledge. Asiimwe, Nekesa, Sakwa, Kulaba's lessons were coded as strongly classified (C⁺) and Ssesanga's very strongly classified (C⁺⁺). These teachers maintained a strong boundary between science and everyday knowledge and only weakened it momentarily to illustrate abstract concepts with everyday contexts or

materials. For example, despite Kulaba's topic on flowering plants drawing on learners' everyday knowledge of plants he emphasized the scientific perspective of the plants rather than the everyday contexts of farming. He only incorporated everyday knowledge by illustrating scientific plant categories of monocotyledonous and dicotyledonous plants with examples of common crops in the learners' environment such as maize, beans, millet. Likewise, Asimwe and Nekesa used everyday examples to illustrate science concepts whereas Sakwa incorporated everyday contexts largely through materials employed as 'carriers' for concepts within practical work. On the whole these four teachers recruited everyday knowledge as a resource and 'portal' into science knowledge. Ssesanga's lesson on magnetism was very strongly classified from everyday knowledge; it was coded as C⁺⁺ because no efforts were made to relate science to everyday knowledge at all.

In general, the boundary between science and everyday knowledge in lesson type one was very strong. Science knowledge was accorded a high status relative to that of everyday knowledge which was only recruited as a resource for learning science. Except for Nekesa's lesson, all the lessons examined under this section were based on the specialized science themes, 'matter and energy' and the 'world of living things'. Although Nekesa's lesson topic, 'hatching and rearing of chicks' was based on an integrated science theme, 'science in human occupations and activities', she taught content relating to biological aspects of reproduction and did not teach about poultry 'rearing'. The science syllabus did not include the aspect of hatching; it only considered rearing of poultry. This implies that Nekesa extended the scope of the topic to include the biological aspects of the topic, highlighting weak external framing of macro-selection.

Apart from Ssesanga, the other four teachers in lesson type one taught in the two large high performing schools (Alpha and Bethel). It can be tentatively argued that the instructional cultures of these two schools promote the configuration of pedagogic features reflected in lesson type one. Strongly framed evaluation criteria can be linked to the culture of high achievement emphasized by the high performing schools. Further, the strong pace of instruction in lesson type one may also be attributed to the pressure to cover prescribed syllabi contents so as to prepare learners for the national

public examinations. These aspects are discussed further under section 8.2 in chapter eight.

Lesson type two

Weakly framed pacing constitutes the distinctive pedagogic feature exclusive to lesson type two; all four lessons with this feature are located in this group. Given that lesson type two was the mid group on the continuum, lessons in this type have commonalities with lesson types one and three. In particular, type two lessons are similar to lesson type one in relation to evaluation criteria and intra-disciplinary knowledge relationships. Similarly, some type two lessons are similar to type three lessons in terms of very weakly classified relations between science and everyday knowledge. The following sections elaborate the pedagogic features of this lesson type.

Pacing

The analysis of pacing in lesson type two shows a continuum of framing strengths ranging from very strongly framed pacing in Acom and Weere's lessons, strongly framed pacing in Malongo's lesson to weakly framed pacing in four lessons. I briefly comment on the three strongly framed lessons and then examine the four weakly framed lessons in detail. Weere and Malongo's pacing rules were similar to those in lesson type one whereas Acom's class pacing was similar to that in lesson type three. These lessons are described under the two respective lesson types. The remaining section examines the four lessons with weakly framed pacing; these were taught by Bogere, Erone, Kabi and Musaali. These four teachers paced instruction in ways that accommodated learners' abilities and productions. They allowed learners to proceed with tasks at their own pace without exerting undue pressure on them. They neither allocated time limits to activities nor reminded learners to speed up. Instead they first ascertained if all learners had completed tasks before moving on to subsequent steps, as exemplified in the extract below taken from Bogere's lesson.

Extract 6.14

Group activities had been going on for about ten minutes and Bogere was moving around the class talking to different groups as they worked.

T: Are we through yet?

L: *(Learners respond in unison)* No

After five minutes Bogere moved around the classroom and inquired again if learners had completed the task.

T: I think we have finished, have we finished?

L: *(Learners respond in unison)* Yes

T: Now chairpersons of the respective groups are you ready to present your findings? I think you are all ready? Can we have chairperson group one come forward and present your findings.

Bogere inquired whether groups had completed their tasks and when he found that they were not yet ready, he extended the activity for a further five minutes. He moved to the report back session only after establishing that all the groups were ready.

Teachers weakened framing over pacing so as to explicate evaluation criteria to learners and also to differentiate between different learners' paces. This was particularly evident as teachers marked and corrected class work and also within question sessions. For example, Musaali marked the class exercise at a relaxed pace, spending considerable time moving from one learner to another addressing their particular needs. At one point, after noticing common mistakes in the exercise, Musaali stopped marking and drew the attention of the class in order to elaborate some concepts. Further, teachers relaxed pacing during questioning sessions to probe learners' responses, allow longer 'wait' time and also to clarify concepts. The latter aspect is exemplified where Musaali repeated the practical activity after learners failed to answer a question correctly. These incidents suggest that teachers relaxed pacing so as to explicate criteria by pointing out errors and missing texts in learners' productions. Erone accommodated differences between learners' pacing by giving extra work to those who completed tasks before the rest of the class. The foregoing incidents demonstrate that these four teachers recognized and accommodated learners' rates of progression. The fact that all four lessons reflected strongly framed evaluation criteria supports the empirically recognized relationship between weakly framed pacing and explication of evaluation criteria (Morais, 2002; Hoadley, 2005; Reeves, 2005).

Evaluation criteria

Lesson type two reflected strong to very strong framing of evaluation criteria; four lessons were very strongly framed and three were strongly framed. These lessons have been described under lesson type one given that the two lesson types had similar framing strengths.

Intra-disciplinary knowledge relationships

Type two lessons reflected classification strengths ranging from weak classification, strong classification, to very strongly classified intra-disciplinary knowledge relations. This section examines only the strongly classified lessons in lesson types one and two. These include Acom, Bogere, Kabi and Weere's lessons in lesson type two and Sakwa and Ssesanga's lessons in type one. Type two lessons reflecting weak intra-disciplinary boundaries (C-) have been described under lesson type one. In addition, this section only examines intra-disciplinary knowledge relationships between science topics because the aspect relating to classification between science procedures and concepts is covered under lesson type one.

Four teachers began lessons by reviewing the previously covered work as exemplified in Bogere's lesson in extract 6.1. However, apart from reviewing previous work, these teachers did not utilize or refer to concepts from other science topics in the rest of the lesson. These four lessons are coded C⁺. Kabi and Sakwa did not review the previous work nor did they employ concepts from other science topics at all. These two lessons were coded C⁺⁺. Strong classification between science topics reflected in Acom and Weere's lessons can be partly explained by the horizontal knowledge structure characterizing the integrated science topics these two teachers taught. I will elaborate on this aspect under lesson type three. Although the content transmitted in Kabi and Bogere's lessons provided room for strong intra-disciplinary relations (C-) with other science topics, these teachers maintained strongly insulated intra-disciplinary boundaries (C+) in their lessons. In this view, Kabi and Bogere's instructional strategies accounted for the strong intra-disciplinary boundaries more than the type of content taught.

Relations between science and everyday knowledge

Table 6.3 shows a continuum of classification values ranging from very strong to very weakly classified boundaries between science and everyday knowledge. Lessons reflecting very weak classification between science and everyday knowledge are described under lesson type three. This section considers lessons with weak classification and strong classification from everyday knowledge.

Three lessons (Erone, Musaali and Malongo's lessons) were weakly classified from everyday knowledge and coded (C⁻). Although these lessons are all coded as weakly classified, the teachers employed everyday knowledge for different purposes as illustrated in the examples that follow. Musaali and Erone employed everyday experiences, materials and examples to introduce or illustrate abstract concepts. Here everyday knowledge served as a pedagogic resource or 'means' to induct learners into science knowledge. Extract 6.6 shows how Erone used analogies from everyday phenomena to explain how birds are adapted to their habitat and life style. Likewise, Musaali referred to the freezing process in refrigerators to illustrate the change in the state of matter from liquid to solid. He also referred to the water cycle to illustrate the processes of evaporation and condensation in nature as shown in the following extract.

Extract 6.15

Musaali had just demonstrated activities illustrating the processes of evaporation and condensation

- T: Now as we are doing this, observe this space here over the water. And as we wait for droplets to form under the bottom I want you to be thinking about something in our daily lives, in nature, where this kind of thing occurs naturally, in nature naturally! Just think? Just watch, where in nature do we have droplets like this forming naturally, in nature? Kate have you discovered?
- Kate: Yes
- Co-T: (*Holds pan over steam and asks*) in nature when does this kind of process occur?
- Kate: Water cycle
- Co-T: Water cycle?
- T: In nature, in real life, in life, in our life? You think, think!
- Co-T: When does this process occur in nature, naturally, it is not even man made, this one here is man made, but the other one is naturally?
- L1: In the morning
- T: This one is nearer, only that he has not got it completely.
- L2: Rainfall.
- Co-T: Again
- L2: Rainfall
- Co-T: That's right – very good. Clap for that one. It is exactly like this (*gestures*). The water from the ground surface evaporates like this vapour and when it reaches up it forms

droplets like this (*points at apparatus*) that collect together and form nimbus clouds that fall as rain. Thank you very much. Are we together?

This extract demonstrates weakening of classification and framing between science and everyday knowledge. It is weakly framed in relation to micro selection because learners were encouraged to offer their narratives from everyday life. This instance exemplifies the embedding of classification and framing empirically.

Everyday knowledge was also introduced to explain 'perplexing' occurrences in everyday contexts. For example, a learner in Erone's class inquired why bats are not electrocuted when they perch on 'live' electric wires and another asked why birds do not immediately die after their heads are chopped off. Erone drew on science knowledge to explain these perceived 'anomalies' thereby demonstrating how the physical and natural world is propelled by science principles. Whereas Musaali and Erone recruited everyday knowledge into specialized content, Malongo introduced specialized science as a resource to improve an everyday practice of first aid. Malongo substantially employed concepts on the biological functioning of the body to explain and justify why certain procedures for first aid are necessary and why some common practices are harmful. Malongo's lesson consequently reflected relatively stronger classification from everyday knowledge relative to other lessons under the same theme.

Kabi's lesson was strongly classified from everyday knowledge and coded (C⁺). Although the practical work covered in this lesson (see extract 6.12) appeared like an 'everyday' process of melting, the activity focused solely on the scientific skills of accurate recording and measurements and so it specialized the everyday practice. However, Kabi utilized common materials including candles, pieces of sticks and vaseline to illustrate the processes of melting; these materials served as 'carriers' for the processes demonstrated. Bogere's lesson was very strongly insulated from everyday knowledge (C⁺⁺) because he did not incorporate everyday knowledge into his lesson at all.

The influence of curricular content types on the classification strength of lessons is best demonstrated by relations between science and everyday knowledge. Lessons

with strongest classification strengths were under the specialized science themes, 'matter and energy' and the 'world of living things' and weakest classification was primarily reflected in integrated science lessons. However, two lessons covering integrated science knowledge reflected a relatively strong boundary between science and everyday knowledge which demonstrated the key influence of teachers' instructional strategies on their recontextualizing processes. These two lessons differed from four other lessons covering integrated themes because the latter lessons transmitted integrated themes as essentially everyday knowledge.

Lesson type two comprised pedagogic features best described as a mix of those in lesson types one and three as it combined features with strong and weak framing and classification values. Weakly framed pacing coupled with strongly framed evaluation criteria may be attributed to the relatively smaller class numbers in four of these lessons. This made it possible for teachers to address learners' individual learning needs. Further, a combination of weak pacing and strongly framed evaluation criteria reflected in this lesson type resonates with findings from other Bernsteinian studies (Morais, 2002; Morais and Neves, 2001; Reeves, 2005; Hoadley, 2005) which show that weak pacing promotes strong evaluation criteria. The structure of lesson type two did not 'appear' to influence the framing and classification values of the lessons as all three lesson structures were represented in the lesson type. This is similar to what was found in lesson type one.

Lesson type three

This lesson type shows a combination of weakly classified and framed pedagogic features. Table 6.3 shows that these lessons were very weakly framed in relation to evaluation criteria but very strongly framed in relation to pacing. The lessons also reflected very weak classification between science and everyday knowledge although they showed strong classification of intra-disciplinary relations.

Pacing

Pacing rules in lesson type three differed across the different elements of instruction and in relation to instructional activities. The distinction made between pacing of instruction and framing of pacing is explicitly demonstrated in this lesson type. The teacher-led aspects of instruction were paced at a fast rate whereas learners' tasks

were paced very slowly. However, the analysis shows strongly framed pacing because teachers did not recognize and accommodate differences in the learners' pace of learning or adjust pacing to accommodate their productions. In general, pacing was adjusted to the pace of the slowest learners who were the majority in these classes rather than *all* the learners.

Instruction was generally paced at a fast rate, particularly within content expositions and questioning sessions. These teachers elaborated concepts very fast and moved on without ascertaining if learners were following. For example, Nambuya punctuated her exposition with a frequent 'clear?' which attracted a unison response, 'Yes' from the class. Likewise, Suubi terminated an activity before learners could complete it and moved on to another, saying, 'Can you stop writing and we now look at uses of leaves to plants, can you look here'? In addition, Suubi implored a learner who was demonstrating something to the class to speed up, saying, 'Hurry, hurry up, do it in one minute and we do another thing'. These incidents show that these teachers were more concerned to complete the planned work than to ascertain if the learners had correctly realized the expected texts. Because these teachers did recognize learners' progress with productions in pacing instruction, these lessons reflected weakly framed evaluation criteria. On the whole, evaluation criteria were left implicit as teachers 'rushed' through instruction as elaborated further below.

Questioning sessions were paced at a fast rate. Teachers intervened with correct answers when learners failed to respond to questions immediately therefore learners were given very short 'wait' time. Further, teachers moved on to subsequent steps even where learners failed to produce expected texts rather than adjusting pacing or sequencing to provide remedial help. The following extract from Bwogi's lesson exemplifies strongly paced instruction during a question session.

Extract 6.16

Bwogi had solicited questions from the learners on the work that had just been covered in the lesson

- L1: Are earthworms dangerous to man?
T: Yes we said that.
L2: What is the use of suckers?
T: They suck digested food (*Bwogi briefly elaborates this aspect*)

- L3: Do worms kill?
 T: *(Silence)*
 L3: When you become anaemic, if they suck your blood and it is over in your body can you die?
 T: Yes you have to die because blood is over. You learnt about the importance of blood in P.5. *(Bwogi asks learners to mention the uses of blood)*
 L4: Do worms have intestines?
 T: Do worms have intestines, do worms have intestines?
 L: No
 L5: What is the use of a hookworm?
 T: They are not useful but harmful, let me summarize, can you give me the groups of worms?
 L6: Roundworms
 T: Another name for roundworms?
 L7: Nematodes
 T: Another group of worms?
 L8: Earthworms
 T: Can you give me examples of tapeworms? How are tapeworms dangerous to you?
 L9: Suck our blood
 T: Get your books and write something.

This extract shows how Bwogi did not give learners sufficient time to respond to questions, nor did she ascertain whether learners had exhausted their questions before moving on to the next activity. This form of pacing was recurrent in the other three lessons in this group. Although teachers paced instruction very fast, the learners' activities were paced at an extremely slow speed, particularly in Opio, Nambuya, and Suubi's classes. For example, Opio's class used forty minutes of a one hour lesson completing a simple class exercise which required filling a few blank spaces in the lesson notes. These teachers did not differentiate pacing to accommodate mixed ability classes as learners' activities were paced according to the abilities of the slowest learners in the class to the neglect of the faster ones. Consequently a substantial number of learners in these classes completed work and sat idle waiting for others to complete while teachers moved around the class marking. In Nambuya's class, learners initially sat quietly but eventually got unsettled and disruptive. She had to intervene to restore order. As the noise progressively increased, she remarked, 'Some of you are talking when you have not finished'. Opio and Nambuya alerted learners to speed up after noticing other teachers standing by their doors waiting to take over the lessons. Acom, whose lesson falls under lesson type two, paced her learners' activities in a similar manner to the teachers in this lesson type.

Evaluation criteria

Lesson type three reflected weak to very weak framing of evaluation criteria implying that teachers did not provide learners with explicit criteria for producing expected texts. Evaluation criteria are examined in relation to setting and marking of class work and questioning sessions which were the main learner productions for this group.

All the teachers gave class exercises but these mainly comprised short questions or texts with blank spaces requiring single words or phrases. In general, teachers gave brief instructions before tasks, for example Opio told his class, 'Now you are going to fill in a word, okay'. Nambuya gave more elaborate instructions. She asked learners to read out aloud the questions from the chalk board as she clarified upon what was required. Although these teachers moved around the classrooms during the exercises, they did not intervene to help individual learners nor did they clarify rules to the class. In this regard, the criteria for producing texts remained implicit to the learners. When they found mistakes in learners' productions, they simply restated the requirements of the tasks in a general form that was not helpful. For example, Opio remarked to learners who had failed to produce the expected texts, 'Don't you know the advantages number two, three and four, where are the answers; fill in the answers'. To other learners he said, 'Where are the answers for number one, two and three, you were the ones giving me the answers? Write them in your books, disadvantages'. Likewise, Bwogi remarked, 'Some people are waiting for me to come before they fill in'.

These teachers made no attempt to explicate and clarify the rules for producing expected texts even when it was obvious that learners were unable to proceed with tasks. For example, despite several attempts at repeating instructions for the class work, learners in Suubi's class seemed uncertain of how to proceed with tasks. Shortly after one of the tasks had begun, Suubi moved around the class and noticed that some learners had not yet started working which prompted her to repeat the instructions. She said:

Who has started drawing, some of you look like you have not understood. Do you know how to draw? I want you to draw a simple leaf and name its parts, but first write leaves, then write parts of a leaf and its uses then draw a simple leaf.

In this case, Suubi did not explicate the rules for producing the required texts by clarifying to learners *how* to go about the task; she simply repeated *what* they should do. Suubi kept referring the learners to the textbook saying, 'Everything is there in the book'. This was an implicit 'clue' to the learners. Although it was clear that learners had failed to produce what was expected of them, Suubi did not adjust the selection or sequencing of the knowledge nor elaborate the required texts to address this need. The implicit evaluation criteria in Suubi's lesson were partly attributed to very thin content exposition that did not transmit expected criteria. Prior to the task referred to above, the class had read a section from a textbook describing simple and compound leaves, but Suubi did not elaborate on the text thereafter. Given the low level of English language proficiency in Suubi's class, it is likely that they did not comprehend the meaning of the text and so they were unable to produce texts based on the text.

Further, although teachers gave class work and some marked it in class; none of them revised the work in the lesson so as to rectify errors and by so doing explicate rules for producing legitimate texts. Although teachers may have revised the work in subsequent lessons, the time lag between lessons implies that learners did not get timely feedback on their productions.

With regard to questioning, this group of teachers did not explore learners' responses to show the basis for legitimate texts; they merely accepted or rejected learners' responses without providing explicit criteria for doing so. For the most part, they repeated or briefly commented on correct answers and ignored incorrect ones without showing why or providing missing texts. Because teachers did not reveal why responses were correct or incorrect, criteria for producing legitimate texts remained implicit to the learners. The following extract from Opio's lesson illustrates how these teachers handled learners' responses.

Extract 6.17

The class was discussing the advantages and disadvantages of the different systems of keeping pigs.

- T: Now what do you think are the advantages of the extensive system, yes (*points at a learner*).
- L1: Pigs cannot eat things of people

- T: She is saying pigs cannot eat people's crops; we go to another, yes another advantage, yes, behind.
- L2: They cannot be easily knocked by cars
- T: They can't be done what?
- L2: They cannot be easily hit by cars
- T: Very good they can't be hit by cars, good, there yes?
- L3: *(Responds inaudibly)*
- T: Louder
- L3: They cannot be sick
- T: They cannot be sick, she says they can't be sick, is that right?
- L: No
- T: They can't get diseases also, any other, Tendo?
- Tendo: They can't be stolen by people
- T: They can't be easily stolen by people or they can't be killed by some people, why, because they are in a fence, Oguti?
- Oguti: They cannot be attacked by wild animals
- T: Good, they can't be attacked by wild?
- L: Animals
- T: Those are advantages. Is there any advantage you are forgetting? Yes *(Points at a learner)*

The discussion later moved to the advantages of the intensive system of rearing pigs

- L4: They cannot be attacked by outside animals
- T: They cannot be attacked by outside animals, right. Yes *(points at a learner)*
- L5: They cannot be attacked by diseases
- T: He is saying they cannot be attached by diseases is that right?
- L: No
- T: Thanks for trying but that is not right just keep trying till you are right

Opio asked the class to decide whether responses were correct and he accepted their verdict without further elaboration. His comment that a learner should 'just keep trying till you are right' implied that the learner's further attempts were to be realized on trial and error basis; this highlights the implicitness of rules for producing the legitimate text. Opio's sole attempt at elaborating correct responses in the extract above was when he commented on Tendo's answer. He did not discuss the validity of correct answers from the perspective of school science nor everyday knowledge. The fact that Opio accepted learners' responses without further elaboration could be partly attributed to the very weak boundary between science and everyday knowledge in the lesson. Perhaps Opio expected learners to be familiar with the issues and hence he did not see the need for further elaboration. Like Opio, Nambuya repeated correct responses and instructed the class to do the same. However in a few cases she illustrated the answers with examples. In general, Nambuya asked very few questions therefore it is not possible to examine how she responded to incorrect or half

responses. Typically, Bwogi asked questions and after a few unsuccessful attempts from the class, she intervened to provide the correct answers as exemplified in the extract below.

Extract 6.18

- T: What other name can you give the flat worms, what name can you give to flat worms, flat worms, flat worms? Yes Fred?
- L1: Round worms
- T: Well tried but it is not the right answer
- L2: Segmented worms
- T: No, no, yes (*points at a learner*)
- L3: Nematodes
- T: He says nematodes, no but well tried. Another name for these flat worms is what we call plyty-helminthes (*writes the term on the chalkboard*). All of you
- L: Plyty-helminthes

Although Bwogi indicated some responses as being incorrect, she did not show why this was the case, therefore the criteria for evaluating the responses as incorrect remained implicit to the learners. A closer scrutiny of the type of questions in Bwogi's extract above also shows that most required recalling the scientific names for the worms; therefore learners' responses were given in a 'trial and error' manner, a form of guess work. Implicit criteria in lesson type three were exacerbated by strongly paced questioning sessions where teachers did not sufficiently explore learners' responses so as to explicate the rules for producing acceptable texts. Further, these teachers did not provide sufficient 'wait' time to give learners an opportunity to respond to questions, neither did they probe or rephrase questions for clarity. When the learners took some time to respond to questions, these teachers quickly intervened to give correct answers and moved on to subsequent questions. This directly contrasts weakly framed pacing in lesson type two where teachers relaxed pacing within questioning sessions to explicate criteria for expected responses. This lends further support to the association between weakly framed pacing and explicit evaluation criteria in addition to effective learning in general (Morais, 2002).

Framing was slightly stronger in Nambuya and Bwogi's lessons which were both coded as F⁺ whereas Opio and Suubi's lessons were very weak framed (F⁻). The structure of type three lessons 'appears' to influence evaluation criteria in this lesson type given that all lessons were teacher-led and all had weakly framed criteria. This

may be associated with the fact that teachers in these four lessons did not sufficiently provide for and evaluate learners' productions. When these lessons are compared to the lessons with explicit criteria in the same low achieving schools, (Acom, Malongo, Weere and Ssesanga), it becomes clearer how teachers' efforts to explicate criteria as well as provision for learner productions influenced evaluation criteria. Acom, Malongo and Weere evaluated learners' group productions during the reporting sessions while Ssesanga corrected the class exercise in the lesson. The structure of group work lessons allowed teachers to evaluate learners' productions so as to explicate the rules for producing legitimate texts.

Intra-disciplinary knowledge relations

Type three lessons did not cover practical science work, so it is not possible to analyze relationships between science procedures and concepts. Therefore the section examines intra-disciplinary relations between science topics.

Opio and Nambuya's lessons reflected strongly classified intra-disciplinary relations (C+) and Suubi's lesson was very strongly classified from other science topics (C++). These three teachers did not utilize concepts from other science topics apart from revising the previous lesson's work. Suubi did not refer to other science knowledge at the start of the lesson nor within the lesson. This suggests that knowledge was presented independent from the general body of science knowledge. However, Bwogi's lesson reflected weakly classified intra-disciplinary relations (C-). Bwogi utilized concepts from other science topics considerably. For example, she utilized the concept of parasites to explain how worms cause hookworm anaemia in man. She also referred to the concept of 'true insects' while explaining why a particular type of worms is classified as 'true worms'. On the whole, Bwogi's lesson topic (worms) provided room for integrating concepts across topics under the broad theme 'The world of living things'.

The nature of intra-disciplinary knowledge relations in lesson type three can be explained by both the type of topics taught as well as the teachers' instructional strategies. Whereas both Bwogi and Suubi taught topics from the same specialized science theme (The world of living things), Bwogi's lesson reflected weakly classified intra-disciplinary relations (C-) whereas Suubi's lesson reflected strong classification

(C⁺⁺). The other type three and type two lessons with strong intra-disciplinary classification (C⁺) were based on integrated science themes. Strongly classification across topics in the latter lessons can be partly attributed to the horizontal knowledge structures (Bernstein, 1999) within the integrated themes ('science in human activities and occupations' and 'human health') which do not support integration across themes. These integrated science themes are structured around particular issues in health and socio-economic aspects of society. Consequently these are linked in a segmental manner that does not allow progressive concept development and integration through general principles as it is in hierarchical knowledge structures.

Relations between science and everyday knowledge

This section examines the four lessons in this lesson type as well as two others from lesson type two given their similarity in relation to this aspect. In four of these lessons, science knowledge was very weakly classified (C⁻) from everyday knowledge, one lesson reflected weakly classified (C⁻) relations. Only one lesson, that taught by Suubi, reflected strong classification from everyday knowledge. The following extract from Acom's lesson illustrates very weak classification between science and everyday knowledge characteristic of lesson type three.

Extract 6.19

Acom was elaborating findings presented by one of the groups on the effects of alcohol on a family. Some of the points the group had presented were; 'violence and criminal behaviour in homes', 'loss of employment' and 'loss of respect and dignity'.

T: Aha I am going to ask you. How does alcohol lead to loss of employment? Yeku, when you drink too much, how does it lead to loss of your employment?

L: *(Silence)*

T: Eeh, Yeku how does it lead to loss of employment when you see your uncle, your relatives drinking too much it will lead to loss of employment, how? Eeh..Yes?

Yeku: Because your knowledge will be destroyed

T: The knowledge will be destroyed aha, Yeku said when you drink too much the knowledge will be destroyed. Apart from knowledge, what other things can lead to loss of employment Hawa? , Mark? Who is talking there? We are asking how can too much drinking lead to loss of employment? Can you close that book there; you had enough time with it. How can this drinking too much bring loss of your employment if your relatives drink? Yeku told us that it destroys knowledge that knowledge you use at work. This employment here, if somebody drinks until very late, can he wake up and go to work?

L: No

T: You can not wake up to go and so the next day he will also miss work until at the place of work they say so and so should be removed from work. This one can lead to

loss of job. What about the breakage of the family, you have seen in that picture, can we see in that picture on page 91 what is happening in that picture?

Yeku: The father is caning the mother (*Some laughter from the class after Yeku's response*)

T: The father is caning the mother, now if that is your mother, will you feel happy?

L: No

T: That is the bad effect of drinking, caning the mother when the children are watching their mother being caned. You can't come back from drinking everyday and beat a woman that will lead to breakage of the family.

This extract shows how the boundary between school science and everyday knowledge is so weak that one can not easily differentiate the two discourses. This group of lessons covered topics relating to: 'effects of alcohol abuse', 'economic importance of flowers' as well as different 'systems of livestock keeping'. As discussed in chapter five, these integrated science themes are intended to promote the application of basic scientific knowledge in everyday life, particularly to address population and family life issues as well as health and environmental concerns. However, the analysis of these four lessons shows that they all transmitted essentially everyday knowledge devoid of basic scientific knowledge. Teachers based discussions on the common everyday knowledge and experiences within the local Ugandan context. Acom's topic had potential entry points for introducing specialized science knowledge, for example, through the effects of alcohol on the functioning of the body, however these links were not exploited. The lesson focused entirely on social and economic consequences of alcohol rather than its effects on the body. In general, the integrated science themes transmitted a form of contextually 'relevant' science curriculum.

Although Suubi and Bwogi's lessons reflected a stronger classification from everyday knowledge relative to the foregoing four lessons, they were similar in the manner in which they employed and foregrounded everyday knowledge. At the end of each lesson, these two teachers blurred the boundary between specialized science knowledge and everyday life by showing the application of science concepts in everyday life. Suubi cautioned her class against keeping plants in bedrooms arguing that the plants' transpiration processes at night are incompatible with man's respiration. Likewise, Bwogi cautioned her class against eating half cooked meat as shown in the following extract.

Extract 6.20

Bwogi had asked the class how man gets infected with tape worms and after a few unsuccessful attempts she gave the correct answer as follows.

- T: Okay we get these tape worms through eating half cooked meat, half cooked ...
L: Meat
T: Most of you enjoy muchomo (*muchomo is the Luganda equivalent for roast meat*), you enjoy what?
L: Muchomo
T: The pork which they have just warmed, the beef which they have just warmed and you just eat mmh?
L: Yes
T: But please you must be careful as you eat that half cooked meat some of you not only eat muchomo but when they bring meat that is the time you start complaining of stomach ache then you run to the toilet all the time, you run to the toilet all the time.

Following this, Bwogi asked the class to suggest ways of guarding against tapeworm infection and after some contributions she concluded the discussion as follows.

- T: Make sure when they bring meat at home however anxious you are to eat the meat, however hungry you are to eat the meat make sure you cook it ...? (*Learners echo 'well'*) If you are to roast it make sure it is well roasted, not just warming and once it changes the colour you say yes it has changed the what? (*L: colour*) And you say let me stop and eat, no you have to make sure you prepare it very
L: Well

Teachers of lesson type three utilized science knowledge as a *resource* for improving the quality of everyday living in contrast to lesson types one and two where everyday knowledge was employed exclusively as a *'portal'* into school science. Therefore, everyday knowledge was accorded a relatively higher status in lesson type three than it was in types one and two.

Distribution of lesson types across school contexts

Table 6.4 shows the distribution of the three lesson types across the different schools and some key demographic features of the schools.

Table 6.4 Distribution of lesson types across schools

Teacher	School name	School type	Student population Size	Class size	Academic profile
Lesson type one					
Asiimwe	Alpha	Public	2398	67	High
Sakwa	Alpha	Public	2398	76	High
Kulaba	Bethel	Public	2093	109	High
Nekesa	Bethel	Public	2093	113	High
Ssesanga	Gonzaga	Public	300	26	Low
Lesson type two					
Bogere	Fahimu	Private	950	40	High
Kabi	Fahimu	Private	950	55	High
Erone	Ebenezer	Private	465	30	High
Musaali	Ebenezer	Private	465	25	High
Malongo	Canaan	Public	1800	90	Low
Weere	Canaan	Public	1800	62	Low
Acom	Harambee	Public	150	12	Low
Lesson type three					
Bwogi	Ddembe	Public	1081	104	Low
Opio	Ddembe	Public	1081	84	Low
Nambuya	Gonzaga	Public	300	40	Low
Suubi	Harambee	Public	150	19	Low

Table 6.3 shows that all the eight lessons (100%) taught in the high achieving schools fall under lesson types one and two. In contrast, all four lessons in lesson type three were taught in low achieving schools. Only one of the lessons in low achieving schools, that taught by Ssesanga's lesson, falls under lesson type one. Further, lessons from particular schools were under the same lesson type. For example, Erone and Musaali taught at Ebenezer, Bogere and Kabi both taught at Fahimu and both Malongo and Weere taught at Canaan. This suggests that the pedagogic features in lesson type two were reinforced by the instructional cultures of these three schools. Strongly framed evaluation criteria reflected in lesson types one and two can be explained by the emphasis on academic excellence in the high achieving schools where these lesson types were taught. Conversely, slow pacing of learners' tasks in type three lessons can be explained by the need to accommodate less competent learners attending the low performing schools. The instructional cultures of these schools reflected a 'repair' form of pedagogy characterized by relaxed pacing of learners' activities.

Further, weakly framed evaluation criteria in lesson type three reflect the low achievement profile of the schools where they were taught. Bernstein (1990) suggests that certain strategies are developed as a remedial measure for 'less able' learners;

these include: relaxed pacing, reduction in the quantity and/or quality of content provided. These features are reflected in the pedagogic features of lesson type three; for example, slow pacing of learners' tasks in all four lessons, less content scope in Opio's lesson and the low complexity of work in Suubi's class. In the post-observation interview, Suubi explained that the lesson was based on a topic meant for P.4, a grade lower than the class she taught.

Conclusion

This chapter has examined teachers' pedagogic practice in relation to the three main features of the problem solving approach. Table 6.2 shows strong framing over the discursive rules of selection, sequencing across all the lessons and strongly framed pacing among the majority of the lessons. Evaluation criteria varied across lesson types which were strongly correlated with school achievement profiles; framing was strongest in high achieving schools and weakest in low achieving schools.

The teacher's power and status was distinct and clearly marked from that of learners regardless of the physical form of the classroom organization and activity forms. For example, despite weak classification of 'physical' space between teacher and learners and among learners in group work lessons, the 'social' space between them remained strongly classified and distinctly hierarchical. This suggests that social relations between teacher and learners are not yet supportive of learners' self-regulation although some changes in instructional 'forms' within the problem solving approach have been effected.

Discourse relations in these lessons were greatly influenced by the type of curricular content taught although this was further mediated by the teachers' instructional strategies. In general, the natural and physical science themes such as 'matter and energy' reflected more weakly classified intra-disciplinary relations than the integrated science themes such as 'science in human activities and occupations'. This may be explained by differences in the knowledge structures of specialized science and integrated science, the former being hierarchical and the latter horizontal knowledge structures. The hierarchical knowledge structure allows generalization through progressive abstractions and the integration of meanings. In contrast, horizontal knowledge structures generate 'segmental' knowledge relations.

Further, the analysis shows differences in the form of relationships foregrounded between science and everyday knowledge across the two school contexts. In general, teachers in the high achieving schools maintained a strong boundary between the two discourses and only recruited everyday knowledge as a pedagogic resource for learning science knowledge. This suggests a higher 'status' accorded to school science knowledge which may explain why one teacher (Nekesa) in this context extended the scope of the integrated science topic on poultry-keeping to incorporate specialized content. In contrast, where specialized science topics were taught in the low achieving schools, teachers emphasized its application to the learners' everyday life. This indicates an emphasis on the utility of science knowledge beyond the school context.

The configuration of pedagogic features in each lesson type suggests an association between the instructional cultures of particular schools and the teachers' recontextualizations of the problem solving approach. However, similarities in some pedagogic features, shown earlier, suggest common influences on teachers' recontextualizing processes emanating from the broader education system and societal context in Uganda. These broader systemic and societal influences are reflected in teachers' accounts discussed in chapter eight.

CHAPTER SEVEN: INSTRUCTIONAL CONTENT AND TRANSMISSION STRATEGIES

This chapter continues with the analysis of classroom observation data by examining the type of knowledge transmitted in science classrooms. The previous chapter examined relationships between science and other forms of knowledge in terms of three features: first, it examined relationships between various topics in science and relations between science concepts and procedures; secondly, the analysis considered relationships between science and everyday knowledge and thirdly it examined relationships between science and other school disciplines. This chapter's analysis extends Bernstein's concept of 'classification of discourse' by moving from a focus on 'boundaries' to consider the instructional content 'within' the discourse. Instructional content relates to 'what' is classified; that is, the internal substance of a discourse or subject. The chapter examines discourse in relation to the degree of specialization of pedagogic content and the instructional strategies employed to transmit content in pedagogic contexts. This part of the analysis examines teachers' recontextualizations of the problem solving approach in relation to types of science content and transmission strategies. In other words, it highlights the types of content and transmission strategies that teachers associate the pedagogic approach with.

The analysis draws on Dowling (1998)'s concepts: domains of practice and distributing strategies. Dowling draws on Bernstein's concept of classification, but adapts it to constitute his version of classification that he employs to analyze the degree of specialization of instructional content. Dowling's version of classification refers to the '*content*' of the discourse whereas Bernstein's classification refers to '*boundaries*' of discourse.

The chapter analyzes the degree of specialization of instructional content in the three lesson types identified in chapter six. Specialization is described in terms of domains of practice and discursive saturation. The analysis examines the instructional strategies teachers employ to distribute knowledge in the three lesson types as well. These instructional strategies are described in terms of Dowling's categories of distributing strategies; generalizing, specializing, fragmenting and localizing.

7.1 Types of instructional content

This section examines the type of instructional content transmitted in the science lessons in relation to its degree of specialization.

Overview of instructional content types and distributing strategies

The analysis in chapter six showed that lessons were similar in relation to four pedagogic features and they were differentiated in terms of evaluation criteria and pacing of learners' activities. With regard to discourse relations, lessons were differentiated in terms of intra-disciplinary relations and relationships between science and everyday knowledge. Three lesson types were identified in relation to the differentiating features. This chapter examines types of instructional content and its mode of transmission within the three lesson types.

I carried out a content analysis to quantify the proportion of text falling under each of the four domains of practice as a coarse measure of the degree of specialization of knowledge within science lessons. Using the Nvivo qualitative analysis computer software, I quantified the text in each domain through a character count of utterances. Table 7.1 shows the character count and percentage of utterances in the four domains of practice as well as utterances directed at regulating learners' conduct.

Table 7.1 Character counts and percentage of domains in lesson transcripts

	Esoteric domain CC& (%)	Public domain CC& (%)	Descriptive domain CC & (%)	Expressive Domain CC & (%)	Regulation of learners' conduct . CC & (%)	Total CC& (%)
LESSON TYPE ONE						
Asiimwe	18,614 (79.6)	-	2,911 (12.5)	166 (0.7)	1,681 (7.2)	23,374
Kulaba	10,853 (73)	-	246 (1.7)	-	3,774 (25.4)	14,873
Nekesa	13,706 (50.8)	2,813 (10.4)	5,117 (19)	-	5,328 (19.8)	26,964
Sakwa	12,441 (74.6)	-	437 (2.6)	1,891 (11.3)	1,902 (11.4)	16,670
Ssesanga	8,364 (80.8)	-		-	1,989 (19.2)	10,353
LESSON TYPE TWO						
Acom	-	13,166 (64.8)	1,080 (5.3)	-	6,079 (29.9)	20,325
Bogere	2,966 (54)	-	-	-	2,531 (46)	5,497
Erone	9,081 (64.7)	781 (5.6)	1,857 (13.2)	1,801 (12.6)	2,312 (16.5)	14,031
Kabi	151 (3.7)	49 (1.2)	-	489 (12.1)	3,339 (82.8)	4,028
Malongo	4,967 (11.4)	29,701 (67.9)	5,390 (12.3)	-	3,669 (8.4)	43,727
Musaali	7,856 (55.5)	67 (0.5)	740 (5.2)	3,319 (23.5)	2,161 (15.3)	14,143
Weere	1,211 (7.4)	11,958 (72.8)	311 (1.9)	-	2,955 (18)	16,435
LESSON TYPE THREE						
Bwogi	15,426 (62.2)	4,657 (18.7)	1,369 (5.5)	1,540 (6.2)	2,660 (10.7)	24,807
Nambuya	357 (3.5)	6,160 (61)	300 (3)	-	3,279 (32.5)	10,096
Opio	-	8,284 (78.7)		-	2,237 (21.2)	10,521
Suubi	7,602 (53.8)	1,113 (7.9)	-	-	5,419 (38.3)	14,134

Note: CC stands for character count and the figures in brackets show the percentage of pedagogic discourse constituted by character counts in each cell.

The distribution of utterances in the different domains reflects the degree of specialization of content and forms of expressions in the lessons. A high percentage of utterances in the esoteric domain suggest that knowledge was more specialized whereas a higher percentage of text falling under public domain suggests less specialization in relation to school science. Descriptive and expressive domains provide useful pedagogic resources to link the public and esoteric domains. For

example, the expressive domain employs non-specialized materials as ‘means’ for expressing esoteric domain concepts and processes. This was particularly useful where teachers improvised common materials to illustrate concepts in practical science lessons. The following sections examine the degree of specialization of instructional content and distributing strategies in the three lesson types.

Table 7.2 below provides an overview of the key features of instructional content within the three lesson types.

Table 7.2 Specialization of content and distributing strategies in lessons types

Teacher	Classification strength (Content)	Classification strength (Expressions)	Major domain of practice	Degree of discursive saturation	Distributing strategy
Lesson type one					
Asiimwe	strong	strong	esoteric	DS+	generalizing
Kulaba	strong	strong	esoteric	DS+	generalizing
Nekesa	strong	strong	esoteric	DS+	generalizing
Sakwa	strong	strong	esoteric	DS+/DS-	specializing
Ssesanga	strong	strong	esoteric	DS+/DS-	specializing
Lesson type two					
Erone	strong	strong	esoteric	DS+	generalizing
Bogere	strong	strong	esoteric	DS+	specializing
Musaali	strong	strong	esoteric	DS+/DS-	generalizing
Kabi	strong	strong	esoteric	DS- /DS+	specializing
Malongo	weak	weak	public	DS/DS-	localizing
Acom	weak	weak	public	DS+	localizing
Weere	weak	weak	public	DS+	localizing
Lesson type three					
Nambuya	weak	weak	public	DS+	localizing
Opio	weak	weak	public	DS+	localizing
Suubi	strong	strong	esoteric	DS+	fragmenting
Bwogi	strong	strong	esoteric	DS+	fragmenting

The table shows that the three lesson types are not strongly differentiated in terms of content types but strongly differentiated in relation to distributing strategies. In general, lesson type one comprised only strongly specialized science knowledge whereas the other two lesson types incorporated both specialized and non-specialized knowledge. Further, whereas all lesson types covered esoteric domain knowledge, its transmission in lesson types one and three differed significantly. Teachers in type one lessons employed generalizing and specializing to distribute esoteric domain knowledge, whereas fragmenting strategies were employed to transmit the same type of knowledge in lesson type three. As the transitional group, lesson type two has

commonalities with lesson types one and three in relation to content types and distributing strategies.

7.2 Lesson type one

This lesson type one has five lessons whose teachers, classes, lesson topics and curricular themes are shown in table 7.3 below.

Table 7.3 Instructional content in lesson type one

Teacher	Class	Lesson topic	Curricular theme
Asiimwe	P.6	Sound energy	Matter and energy
Kulaba	P.6	Flowering plants	The world of living things
Nekesa	P.5	Hatching and rearing of chicks	Science in human activities and occupations
Sakwa	P.5	Finding volumes of objects	Matter and energy
Ssesanga	P.7	Ways of making magnets	Matter and energy

Degree of specialization of instructional content

Domains of practice

Table 7.2 shows that lesson type one is constituted by strongly classified content and forms of expression typical of the esoteric domain of practice. The lesson content comprised physical, natural and biological science knowledge involving definitions and taxonomic classifications and criteria for matter, plant and animal kingdoms. This is strongly specialized science knowledge. Dowling (1998) suggests that the esoteric domain is the region with the highest degree of specialization and one in which the regulating principles of the activity reside. The regulating principles of school science were embodied in abstract concepts such as definitions, principles and taxonomic classification criteria. Strongly classified forms of expression were evident in the descriptive terms that teachers introduced to 'apprentice' learners into a specialized science lexicon. Extract 7.1, taken from Kulaba's lesson, exemplifies the type of content and forms of expressions in lesson type one.

Extract 7.1

Kulaba began the lesson by instructing learners to carefully examine bean seedlings they had planted a week prior to the lesson after which he asked them to name the group of plants the bean seedling represented. A number of suggestions were given including leguminous plants, monocotyledonous, dicotyledonous and flowering plants. Kulaba selected flowering plants as the correct answer.

T: Now all your contributions have been good but I think Angela has given us the correct answer that I wanted. What you have before you is a flowering?

- L: Plant.
- T: And today we are going to look at flowering plants (*writes heading on the chalkboard*). Now in P4 you also learnt about flowering?
- L: Plants.
- T: And you looked at the characteristics of flowering plants and they must have told you what flowering plants are. So what do you think these flowering plants are? What are they? Why do we call the plant that is before you a flowering plant?
- L1: Plants that bear flowers.
- T: Yes, these are plants that bear flowers and by means of ...? (*Some learners shout 'spores' and others 'seeds'*). Not spores but seeds, because when I was telling you to plant, I told you to plant what?
- L: Seeds.
- T: Meaning that these plants were to grow from those seeds that you planted. Now they also bear flowers; that is why they are called flowering plants, though these ones (*holds up one of the plants*) have not yet reached the stage of flowering, but you will see the flowers when it comes to that stage. You will see them having those flowers and those flowers are used for reproducing. Is that okay?
- L: Yes.
- T: So flowering plants are plants that reproduce by means of seeds and they bear what? Flowers, that's why they are called...,?
- L: Flowering plants.

After introducing flowering plants, Kulaba instructed learners to examine the structure of a bean seedling in groups following a set of guidelines. He later asked groups to mention their findings as he outlined these on the chalkboard. He finally reviewed the points emphasising particular features of the flowering plant. Following this, Kulaba distributed bean seeds to the class and instructed them to remove the seed coat (testa) from the seed and separate it into two parts.

- T: Now I hope every group has seen those two separate parts? Those are what we call cotyledons. What do we call them?
- L: Cotyledons.
- T: Again.
- L: Cotyledons.
- T: And for this particular plant we have, (*holds up one of the bean seeds*) it has got two cotyledons. That is why you have been able to separate them. And when it germinates, the two cotyledons move up above the ground (*points at the cotyledons*). Is that okay?
- L: Yes
- T: Now monocotyledonous plants, these one have got one cotyledon and when it germinates, it remains below the what?
- L: The ground
- T: Can you give some examples of plants that have got two cotyledons? Yes
- L1: Beans.
- T: We have beans, what else?
- L2: Groundnuts.
- L3: Soya beans
- L4: Maize
- L: (*several learners protest the example of maize*)
- T: Is maize a dicotyledonous plant, does it have two cotyledons?
- L: No
- T: How many does it have?
- L: (*Learners respond in unison*) One
- T: Okay can we have examples of monocotyledonous plants?
- L5: Maize

- T: Yes, you (*points to learner*).
- L6: Millet
- T: We have millet. All those have got one cotyledon and they are called monocotyledonous plants and those with two cotyledons are called dicotyledonous plants. So what we are looking at is a flowering plant that has got two cotyledons. Is that okay?
- L: Yes.
- T: So flowering plants are divided into two groups, we have those with one cotyledon and those with two cotyledons (*pointing to respective part of the illustrations on the chalkboard*). Then flowering plants have two major parts, one that grows above the ground – the shoot system and that which grows below the ground – the root system. Then of course we have other parts that we mentioned earlier and those parts have got various functions.

The extract shows a number of definitions and taxonomic classification criteria and categories for flowering plants. Flowering plants were defined as ‘plants that reproduce by means of seeds and they bear flowers’ and within these, smaller sub groups were identified. Kulaba also introduced specialized descriptive terms such as cotyledons, monocotyledonous plants and dicotyledonous plants to describe sub groups of flowering plants. The content exposed various plant classification criteria. For example, after classifying the bean plant as a flowering plant, Kulaba examined ‘why’ the bean plant is considered a flowering plant and by so doing he exposed the taxonomic criteria for classifying plants.

Further, the extract shows that Kulaba referred to the abstract taxonomic criteria to evaluate the validity of learners’ texts. For example, when one learner (L4) suggested that maize was an example of dicotyledonous plants, the rest of the class immediately disapproved the answer. Kulaba intervened and drew attention to the abstract criteria by questioning whether a maize plant met the criteria of dicotyledonous plants. He asked whether maize seeds have two cotyledons like other dicotyledonous plant seeds. These taxonomic criteria are part of the regulating principles of school science and in this example, they ‘regulated’ the classification of plants into the categories of dicotyledonous and monocotyledonous. Like Kulaba, other teachers in this lesson type exposed definitions and classification criteria in relation to sound energy, magnetism, matter and the biological development of eggs. Furthermore, teachers in lesson type one emphasized that learners adopt specialized forms of expression, highlighting the imperative of a discourse-specific language. One of these instances is exemplified in the following extract from Kulaba’s lesson.

Extract 7.2

This communication took place during a group report back session. One of the group representatives was presenting findings on the functions of the various parts of a flowering plant, in this particular the functions of leaves and roots.

- L: Leaves have breathing organs for plants.
T: Breathing organs for the plant, so what is that function?
L1: Respiration.
T: So leaves enable plants to carry out respiration (*Kulaba writes the point on the chalkboard*). Aha is there any other group that came up with a different function of the leaves. Yes Nakazi? (*Silence*) Okay can we now go to the roots, roots, yes Mandu?
Mandu: Roots suck water and mineral salts from the soil.
T: Yaa, he is saying the roots absorb water and mineral salts (*Kulaba writes the function mentioned paraphrasing it with the word 'absorb' rather than 'suck'. He then turns to the class*). Now I want to correct one mistake, eeh, you find some people writing that roots suck water from the soil. They don't suck; they don't get a straw and suck like this (*Kulaba gimmicks sucking*) but they only do what? (*Pointing to the word 'absorb' on the blackboard*)
L: Absorb.

Kulaba modified learners' answers from public domain forms of expressions such as 'having breathing organs for plants' and 'roots sucking water from the soil' to specialized expressions. He introduced terms such as 'respiration' and 'absorb' as specialized descriptions for the foregoing everyday expressions. He also cautioned learners against using public domain expressions as these introduced ambiguity in science texts. In general, such descriptive terms introduced learners to the scientific lexicon, a specialized form of expression. Strongly classified forms of expression are a key feature of esoteric domain practice.

When teachers introduced specialized descriptive terms, they instructed learners to repeat the terms a number of times so as to perfect pronunciations. For example, in extract 7.1, Kulaba introduced the term 'cotyledons' and instructed learners to repeat it twice. This practice was recurrent in all lessons covering esoteric domain content. Descriptive terms such as 'homoeothermic', 'photosynthesis', 'vertebrate animals', 'oviparous animals' and 'condensation' were introduced to describe natural processes, as well as common plants and animals, in scientific terminology. The dominance of specialized descriptive terms in these lessons covering esoteric domain knowledge may be attributed to the fact that primary school science 'apprenticed' learners to its discourse-specific vocabulary as a foundation for subsequent study.

In general, lesson type one covered the most strongly specialized science knowledge among the three lesson types. This content comprised both conceptual knowledge and practical science work. The dominance of esoteric domain content in this lesson type suggests that the teachers in this group associated the problem solving approach with strongly specialized science content. This was evident in Sakwa's decision to select a topic on 'measurement of volume', esoteric domain content, in place of an integrated science topic (poultry systems) which was scheduled at that time.

Discursive saturation

This subsection examines the degree of discursive saturation of lesson type one to determine the degree to which the regulating principles of school science are explicitly made available in the lesson content. School science comprises practice with high discursive saturation and low discursive saturation. The former comprises conceptual science knowledge, including its basic concepts, principles, definitions and taxonomic criteria. The latter covers procedures undertaken in practical science work. This suggests that the regulative principles of school science are expressed both discursively and non-discursively and therefore potentially reflect a hybrid of high and low discursive saturation.

Dowling (1998) suggests that the regulating principles of practices with high discursive saturation (DS+) are explicitly expressed through definitions, principles and taxonomic criteria. With regard to practices with low discursive saturation (DS-), he suggests that 'activities whose practices exhibit low discursive saturation are characterized by implicit regulating principles' (Dowling, 1998, p.139). Dowling suggests that specialization of such DS- practices is at the level of the non-discursive; this may be through 'skills' or tacit rules.

Discursive saturation within lesson type one varied according to the type of science content transmitted, whether conceptual knowledge or practical science work (knowledge related to procedures). In other words, these knowledge types determined whether the regulating principles were expressed discursively or non-discursively. Three of the five type one lessons covered conceptual science knowledge and two lessons comprised a hybrid of conceptual knowledge and procedures. The latter aspects involved science practical work. Kulaba's lesson, part of which is shown in

extract 7.1, exemplifies conceptual science knowledge. The three lessons covering conceptual knowledge reflected a high degree of discursive saturation (DS+) evident in definitions and taxonomic classification criteria for matter and plants. Extract 7.1 shows various definitions and taxonomic classification criteria and categories for flowering plants. These definitions and classification criteria, explicitly expressed in Kulaba's pedagogic text, embody part of the regulating principles of school science.

The two practical science lessons in this group (Sakwa and Ssesanga's lessons) exhibited a hybrid of high discursive saturation and low discursive saturation (DS+/DS-) because they incorporated both conceptual science knowledge and scientific procedures. The discursive aspects that covered the definitions and properties of magnetism and volume reflected high discursive saturation (DS+). The practical aspects involving procedures relating to magnetization processes and measurement of volume reflected low level of discursive saturation (DS-) because these aspects were expressed in 'actions' and not with words entirely. The following extract from Ssesanga's practical lesson exemplifies instructional content comprising a hybrid of high and low discursive saturation.

Extract 7.3

The class was examining three ways of making temporary magnets and the learners had read a section from a textbook showing these different procedures. One learner (Musa) was chosen to take part in the demonstration with Ssesanga.

- T: Now you are going to carry out this experiment. In the picture it says put a metal rod or a nail, I am going to refer to one nail here. It says put a nail on a table (*Ssesanga gives Musa a nail and he places it on the table*) Move the magnet as shown here. (*Referring to the instructions in a textbook*) What is the movement? Place your nail there. (*Ssesanga demonstrates to Musa the procedure of magnetizing the nails*). Move it from there, how many times?
- L: Ten
- T: Ten times or more so do that (*instructing Musa*). This is much stronger (*hands him a magnet*) Strike ten times and we see what will happen.
- L: (*Musa magnetizes the metal as the rest of the class observes*)
- T: Slowly, so how many times? (*Asks Musa*) Touch the nail (*instructing Musa*) can't you see here in the diagram, touch the nail with the magnet. (*Ssesanga demonstrates this aspect*) Like that mmh have you seen? (*Rest of class is now giggling*) Continue, how many times are those? Are you counting or not?
- L: (*The class counts from one to ten as Musa magnetizes the nail*)
- T: Okay now remove the nail and try to put the nail near these things [iron filings]
- L: (*Musa takes the nail close to the iron filings but nothing happens*) Nothing
- T: Okay try this (*Ssesanga gives Musa another nail*)

- L: (*Musa places the magnetized nail close to another nail and the latter is attracted and lifted off from the table*)
- T: Are we okay?
- L: Yes
- T: What is happening eeh?
- L: (*Inaudibly*)
- T: What has happened to the nail?
- L1: It has been (*inaudible*)
- L2: It has attracted the nail
- T: It has attracted the ...?
- L: Nail
- T: Okay so we are saying that the nail has been magnetized, the nail has been what?
- L: Magnetized
- T: Now the second one let us do the second one, the electrical method.
(*Ssesanga demonstrates the second procedure of making magnets*)
- T: So the nail has been magnetized isn't it? So that is another way of magnetizing, of making a magnet. That is one of the ways of making a magnet. So one is made by using touch methods and another is made by using the electrical method. Now there is another third method which we are going to see.

This extract highlights an emphasis on the 'procedures' of magnetism much more than 'concepts'. However, at the end of each procedure, Ssesanga indicated the descriptive names for the procedures as 'touch methods' and 'electrical methods' of magnetization. The knowledge in this pedagogic text is expressed through 'actions' or 'procedures' as well as in language. The latter aspects covering the descriptive science terms reflect high discursive saturation. This extract differs from Kulaba's text in extract 7.1 which focuses entirely on concepts.

On the whole, lesson type one covers esoteric domain science knowledge characterized by strongly classified content and modes of expression; this implies strong specialization. Its discursive saturation ranged from high (DS+) to hybrids of high and low (DS+/DS-) depending on the type of science knowledge covered. Dowling (1998) suggests that abstract concepts such as definitions and taxonomic classifications criteria 'abstract' a message from the immediate context of production rendering it context-independent. Further, he suggests that specialized forms of expression reduce ambiguity in texts and this increases the context independence of message. In general, the instructional content and modes of expression in this lesson type have strong potential for application across diverse contexts. Application of science knowledge in diverse contexts is consistent with the aims of the problem solving approach.

Transmission of content

This section examines the strategies teachers employed to transmit knowledge in lesson type one. Table 7.2 shows that this group of teachers distributed esoteric domain knowledge through generalizing and specializing strategies. Three teachers employed generalizing strategies for the most part of their lessons whereas two teachers employed specializing strategies predominantly. Generalizing 'abstracts' and 'expands' the range of an esoteric domain message through principling and metonymy. Principling highlights the abstract regulating principles of the esoteric domain through principles, definitions and taxonomic classification criteria whereas metonymy renders the articulation between the signifying elements of the esoteric domain visible by, for example, showing the relationships between different elements within a topic or across topics.

Generalizing extends the range of the esoteric domain message across a wide range of topics or recontextualized public domain settings. This may be undertaken by applying the 'abstracted' principles across a range of cases, for example by showing how the law of gravity controls different physical processes in everyday life. Like generalizing, specializing 'abstracts' an esoteric domain message but limits its range to a specific topic or recontextualized public setting. In other words, specializing employs principling and metonymy to abstract the esoteric domain message as undertaken in generalizing. However, specializing limits the range of the message by restricting it to specific topics or settings. I will examine specializing strategies under lesson type two where similar strategies are employed; this section considers generalizing.

Generalizing strategies

The teachers 'abstracted' the esoteric domain message by providing definitions, principles and taxonomic classification criteria for matter as well as for plants and animal kingdoms. Further, these teachers established links or metonymic chains between different elements of esoteric domain knowledge. They also established metonymic chains between esoteric domain science and everyday phenomena by illustrating how abstract concepts are expressed and applied in everyday life. Therefore, through principling and metonymy, these teachers pulled the message away from particularistic features to focus on generalizable properties. Dowling

suggests that generalizing expands the range of the abstract message across esoteric domain topics and recontextualized public domain settings. These teachers extended the range of the message by applying the abstract definitions, taxonomic criteria and principles to an expanded range of phenomena and contexts. They also extended the range of the message by using the abstract properties and criteria to categorize particular instances into broad categories. Further, these teachers extended the range of the message by using the general concepts in diverse ways within the lesson and by so doing ‘opened up’ the message further. They also distributed content in multiple ways which enabled learners to ‘read’ the message in diverse ways. The following sections exemplify generalizing strategies using instances from Kulaba and Asimwe’s lessons.

Exposition of abstract definitions and taxonomic criteria

These teachers exposed and elaborated various basic concepts, definitions and classification criteria for matter, energy, plants and animals. For example, extract 7.1 shows how Kulaba began the lesson by asking learners to suggest the general category of plants which the bean seedling represented. Here, Kulaba abstracted the message away from a particular case, the bean plant, to a focus on a general category of flowering plants. After identifying the bean plant as a flowering plant, Kulaba asked the class ‘why’ the bean plant is classified a flowering plant. Through this question, he exposed the taxonomic classification criteria for plants and explained that plants are divided into flowering and non-flowering plants on the basis of criteria such as their means of reproduction. He also explained that flowering plants are further subdivided into dicotyledonous and monocotyledonous plants on the basis of the number of cotyledons seeds possess.

Kulaba provided various definitions of flowering plants and their sub categories. For example, he said, ‘So flowering plants are plants that reproduce by means of seeds and they bear flowers’ and pointed out that, ‘That is why they are called flowering plants’. This definition highlighted the taxonomic classification criteria for plants in a general abstract statement. Likewise, Asimwe differentiated between natural and artificial sounds indexing the ‘source of sound’ as the abstract distinguishing feature. These teachers referred back to the abstract properties whenever there was disagreement over the examples suggested for the different classification categories.

This is exemplified in extract 7.1, where an example of dicotyledonous plants was contested. This suggests that examples were only acceptable so long as they met the abstract properties. Dowling suggests that abstracting strategies highlight the abstract properties within examples. He says, 'Where exemplars are used their abstractive properties will be made explicitly available. In this way, the metaphorical relationships between exemplars are reduced metonymically, so that the context dependency of the message is reduced' (1998, p.146-147).

Application of general principles to diverse instances

These teachers extended the range of the message by applying the abstract definitions, criteria and principles to a diverse range of instances foregrounding generalizing. This highlighted how these universal concepts embraced several particulars. For example, after introducing the definitions and classification criteria for flowering plants, Kulaba asked learners to suggest examples of dicotyledonous and monocotyledonous plants. He also asked the class to suggest examples of plants which store food in their roots after one group reported that some plants store food in roots.

Likewise, after defining sound energy, Asiimwe extended the range of this concept by asking the class to suggest examples of sounds. He also asked learners to suggest examples of the various categories of musical instruments after showing how these are differentiated according to the medium that vibrates to produce sound. Asiimwe extended the range of the abstracted message by employing the definition of sound to elaborate other aspects of the topic. For example, he emphasized and extended the general principle in the definition of sound that states that 'sound is produced when objects vibrate' to explain how musical instruments are classified. He asked the class to suggest the various media that vibrate in a range of musical instruments he had brought to class. When some learners suggested incorrect examples, he reiterated the general principle in the definition saying, 'We have seen that generally sound is produced whenever an object vibrates, now when we come to a drum what vibrates?' Asiimwe expected learners to apply this general rule to the different musical instruments, highlighting its application across a range of instances.

Categorizing particulars into broad categories

These teachers also extended the range of the abstract message by moving from particular instances of concepts to broad categories. For example, extract 6.10 in chapter six shows that Kulaba categorized the different parts of the plant structure reported by groups into the shoot and root systems and in so doing he generated broad categories from particulars. Similarly, Asimwe explained that sounds are categorized into broad groups on the basis of their source. He applied this criterion to group the different examples of sounds that had been suggested by the learners into two broad categories: natural sounds and artificial sounds. Asimwe also grouped various examples of musical instruments into three categories: percussion instruments, wind instruments and string instruments. Further, he later asked the class to categorize the various examples of musical instruments represented in a textbook into these three categories. These broad categories incorporated specific examples but transcended them, foregrounding a universal application of an abstract message. The metaphorical relations between examples were minimized by highlighting the abstract classification criteria uniting them.

Abstraction through metonymic links within and between esoteric domain topics

Dowling suggests that generalizing abstracts the message by metonymically linking concepts within and across esoteric domain topics, strengthening intra-disciplinary relationships within and between science topics. The analysis in chapter six shows that lesson type one reflected strong intra-disciplinary relations. Through these strong intra-disciplinary relations, teachers extended the range of the esoteric domain message by highlighting its application across science topics. This was undertaken in three main ways: firstly, by teachers reviewing previous lessons and contextualizing these into general curricular themes; secondly, by employing concepts from other topics to elaborate concepts within lessons and thirdly by showing how concepts were extended in subsequent topics. In these ways, teachers provided metonymic chains and articulation between the signifying elements of the esoteric domain, highlighting how concepts related to the general school science discourse.

Multiple transmission strategies

Teachers of type one lessons distributed concepts in a variety of ways. They employed teacher exposition, ostensive demonstrations, group tasks, graphical

representation and concrete manipulation. This provided learners with different ways of 'reading' the message distributed. Further, multiple ways of distributing knowledge provided a better understanding of concepts which increased instructional density. For example, Kulaba distributed the message through group tasks, content exposition and elaboration, through questioning and graphic representation. Kulaba instructed learners to plant bean seeds a week prior to the lesson. During the lesson, learners worked in groups and examined the structure of the bean plant and by so doing they concretized the abstract concepts. Kulaba elaborated and extended concepts further as learners presented group findings. Further, Kulaba summarized the main features of the plant structure on a chart which he displayed. He asked learners to identify the different parts from the chart. He also recapitulated and summarized the main points of the lesson time and again and by so doing he consolidated the main concepts covered. He finally instructed the class to draw the structure of the flowering plant in their note books and name its main parts. These multiple ways of presenting concepts deepened conceptual development of the esoteric domain message.

The analysis highlights the interplay between distributing strategies adopted in these lessons and two pedagogic features of the lesson type identified in chapter six. First, the abstracting strategy of metonymy, which is a dimension of generalizing, promoted strong intra-disciplinary relations between science topics, highlighting the application of general principles across the esoteric domain of practice. In other words, metonymic links across topics made visible the connective complexity and articulation within the esoteric domain of school science and by so doing accentuated its general application. Secondly, generalizing strategies 'appear' to correlate and hence facilitate explication of evaluation criteria. Dowling associates generalizing strategies with 'visible' pedagogic action and suggests that apprenticeship into an activity (such as school science) takes place through visible pedagogy that renders the regulating principles of the activity visible. Thus the 'visibility' of the regulating principles promoted explication of criteria. This association is highlighted by the fact that lessons that employed generalizing reflected very strongly framed evaluation criteria.

7.3 Lesson type two

This lesson type covers seven lessons. The key features of this group of lessons are shown in table 7.4.

Table 7.4 Instructional content in lesson type two

Teacher	Class	Lesson topic	Curriculum theme
Bogere	P.6	Arthropods	The world of living things
Erone	P.6	Birds	The world of living things
Kabi	P.5	Melting	Matter and energy
Musaali	P.5	Changes in states of matter	Matter and energy
Acom	P.6	Effects of alcohol in society	Human health
Malongo	P.6	First aid for accidents	Human health
Weere	P.5	Poultry systems	Science in human activities & occupations

Degree of specialization of knowledge

Table 7.2 shows that lesson type two covered both esoteric domain and public domain content. Four lessons were predominantly esoteric domain and characterized by strongly classified content and forms of expression. This suggests strong specialization. These four lessons were similar to lesson type one in relation to domains and discursive saturation. Three lessons in this group cover public domain practice characterized by weakly classified content and expressions which suggests low specialization. These three lessons are similar to two of the lessons in lesson type three. In view of these similarities, this section does not present the degree of specialization of knowledge for this lesson type independently. The degree of specialization of esoteric domain content has been described under lesson type one and public domain content is examined under lesson type three.

Transmission of knowledge

This section examines the instructional strategies employed to transmit content in this lesson type. This group of lessons employed three types of distributing strategies. Esoteric domain knowledge was transmitted through generalizing and specializing strategies whereas localizing strategies were employed to transmit public domain knowledge. Generalizing strategies were exemplified in lesson type one and localizing strategies are described under lesson type three. This section examines specializing.

Specializing strategies

Specializing strategies were employed to transmit esoteric domain knowledge primarily in four lessons; two in this lesson type (Bogere and Kabi) and two in lesson type one (Sakwa and Ssesanga). Specializing, like generalizing, abstracts the esoteric domain message through definitions, principles and taxonomic classification criteria. Both generalizing and specializing are abstracting strategies. However, they differ in relation to the range of the message distributed. Specializing distributes a limited range of message, for example, by focusing on a specific topic or setting, whereas generalizing extends the range of the message by showing its application across a wide range of topics and settings.

This group of teachers abstracted the esoteric domain message by providing definitions and classification criteria and stating abstract concepts. For example, Ssesanga defined and examined the properties of magnetic materials and also demonstrated three different procedures for making temporary magnets. Likewise, Sakwa provided definitions and basic concepts on volume and also demonstrated different procedures for measuring volume. While these teachers abstracted the esoteric domain message through these definitions and procedures, the range of the message was restricted to specific topics which limited it relative to generalizing strategies. The following section exemplifies specializing in Bogere's lesson.

Bogere's lesson was based on the topic 'arthropods' which is a sub group of invertebrate animals. He introduced the lesson by reviewing the previous day's work on arthropods and through questions he briefly examined what arthropods are and why they are classified as invertebrates. The message was abstracted through a definition and a classification criterion for invertebrate animals. He defined arthropods as 'animals with jointed legs and segmented bodies' and he also pointed out that 'invertebrates are animals without a backbone'. Through a brainstorming session, the class identified four sub groups of arthropods. Bogere abstracted the esoteric domain message by exposing the definition and classification criteria for these four sub categories of arthropods.

Further, Bogere divided the class into four groups and instructed each group to identify characteristics and examples for one sub group of arthropods. Through the

group tasks, the abstract message (classification criteria) was extended by employing it to identify suitable examples. During the group reporting session, Bogere reiterated and emphasized the abstract taxonomic criteria whenever groups presented inappropriate examples of the different sub groups of arthropods. One of these incidents is exemplified in the following extract.

Extract 7.4

One of the groups was presenting group findings on 'arachnids', one of the four sub groups of arthropods. The group reporter read out the findings as Bogere wrote these on the chalkboard.

- L: They have four pairs of legs; they have two body divisions namely cephalothorax and the abdomen. They do not have compound eyes but have a number of single eyes; they have no wings.
- T: There is one which is missing out. Oh it is here (*Bogere points to the point on the chalkboard*).
- L: They feed on insects.
- T: Now can we have the examples?
- L: Spiders
- T: Are these arachnids? Are these arachnids?
- L: No
- T: Do they have four pairs of legs?
- L: No
- T: Do they have two body parts?
- L: No
- T: Thank you

The abstract properties of arachnids were used as a yardstick for assessing the suitability of the examples suggested by this group. Bogere also corrected misconceptions relating to classification criteria in other group presentations. For example, he clarified that 'some' rather than 'all' insects have wings. Similarly, another group reported that 'myriapods sting their enemies and coil when they sense danger'. Bogere clarified this point by saying that these characteristics applied to some rather than all myriapods. Further, Bogere restricted the message to the specific topic under consideration as he did not incorporate concepts covered from other topics so as to highlight metonymic chains across esoteric domain topics. This message was restricted in range relative to that distributed through generalizing. There is a clear difference between Bogere's lesson and the preceding lessons where teachers extended the range of message by employing it in diverse ways in the lesson.

Dowling considers specializing a limiting strategy because it distributes the message within a specific esoteric domain topic or recontextualized public domain setting. He argues that specializing restricts reader ‘voices’ to particular aspects of the discipline which subordinates them in relation to the general practices of the activity. Table 6.2 in chapter six shows that four lessons, those taught by Bogere, Kabi, Sakwa and Ssesanga, reflected strongly classified intra-disciplinary relations. This section has shown that the same lessons employed specializing strategies. The association between specializing and strongly classified intra-disciplinary relations suggests that teachers did not relate topics so as to make visible the metonymic links across science topics. In this way, they restricted the application of the message to the specific topics taught and this limited the range of the message. Further, three of the four practical science lessons employed specializing. This suggests that the distributing strategy employed was partly influenced by the type of knowledge transmitted.

7.4 Lesson type three

Lesson type three comprises four lessons. The lesson types, teachers, topics and themes for this group of lessons are shown in Table 7.5 below.

Table 7.5 Instructional content in lesson type three

Teacher	Class	Lesson topic	Curriculum theme
Bwogi	P.6	Worms	The world of living things
Suubi	P.5	Leaves	The world of living things
Nambuya	P.4	Uses of flowers to man	The world of living things
Opio	P.5	Systems of keeping pigs	Science in human activities and occupations

Degree of specialization of content

Domains of practice

As shown in Table 7.2, two of the type three lessons cover esoteric domain content and the other two lessons cover public domain content. The esoteric domain content has been described under lesson type one and is not repeated here. This section examines the two type three lessons covering public domain content (Opio and Nambuya’s lessons) and three type two lessons covering public domain knowledge. These five lessons covered content relating to livestock and poultry rearing systems, primary health care and the economic importance of flowers to man. These lessons reflected weakly classified content and forms of expressions. Extract 7.5, taken from Acom’s lesson, exemplifies text from this group of lessons.

Extract 7.5

The text is taken from a group report back session. Yeku, a 'reporter' for one of the groups, was presenting findings on the effects of alcoholism on families. Some of the adverse effects Yeku reported included 'aggressiveness', 'violence of drunkards', 'destruction of household property', 'misuse of family funds' and 'family neglect'. When he mentioned 'self neglect', Acom refuted the point as follows.

Yeku: Self neglect

T: Self neglect?

Yeku: Many alcoholic appear dirty and shabby

T: Aha, we shall cut you short there; can that one be in a family? When I drink and I become shabby is that a problem to me or to the family?

L: To you

T: Aha so that point should be for these people here (*pointing to the group that worked on effects of alcohol on an individual*) Can you go to the next one?

Yeku: Family neglect

T: How?

L: Alcoholism leads to misuse of funds and this may lead to family neglect. (*Yeku fails to pronounce a word, this prompts Acom to inquire about the issue*)

T: What word is disturbing you? (*Acom moves closer to Yeku to read the word*)

T: Oh, misuse of funds. This one is family neglect, aha next?

Yeku: It can lead to misuse of funds and lack of food in the family and children not able to go to school

T: Aha, have you finished?

Yeku: Yes

T: This one said it leads to? (*Acom points at the phrase 'misuse of funds' on the chalkboard*). How can misuse of funds become a problem in the family, misuse of funds, how do drunkards misuse money? Tendo, you are busy laughing, how do these drunkards misuse money? Yeku you said how, how do they misuse funds? Back benchers don't sleep be awake. How do these drunkards misuse funds, how?

Yeku: They use it to drink alcohol

T: Aha they misuse this money to drink alcohol instead of buying food, paying school fees and doing other things in the family. If the month is ending today before the next week ends, there will be no money. Why, because this man or woman had already spent money in drinking. And they have their groups when you don't have money and others have, they say there is no problem all of us will drink, and tomorrow if another one has money they use it all for booze. That is why we said it leads to misuse of funds, you find there are no school fees, and no money to take the child to hospital, there is no food, no clothes so these problems affect a family. Family neglect is similar to what we have just discussed; when someone is drunk he will not mind about the family. Then destruction of things how? How do they destroy things, a drunkard, Mukasa-how do they destroy things in the house like the table, how do they destroy?

Acom moved on to elaborate the different ways in which drunkards destroy property in the homes.

This extract foregrounds public domain knowledge rather than esoteric domain concepts and categories. For example, informal 'drinking groups' are common in the urban slums where the majority of learners in Acom's class reside. Such drinking groups frequently pool funds to support joint drinking sprees that often result in

misusing family funds as suggested in Yeku's group presentation. Further, clustering the effects of alcoholism into 'individual', 'family' and 'society' reflects public domain categories rather than specialized scientific taxonomies. These public domain categories were used to evaluate learners' productions. For example, in the extract above, Acom challenged Yeku's suggestion that 'alcoholics appear shabby'. She questioned the validity of this point and asked whether appearing shabby affects a family, 'Can that one be in a family, when I drink and I become shabby is that a problem to me or to the family?' Here, the pedagogic text was regulated by public domain values rather than abstract science principles. This incident contrasts the instances where Kulaba and Bogere referred to abstract classification criteria when learners suggested incorrect examples of dicotyledonous plants and arachnids.

This group of lessons focused primarily on public domain knowledge and backgrounded esoteric domain knowledge. This is exemplified in Acom and Nambuya's lessons shown in extracts 7.5 and 7.7, respectively. These lessons reflected a low degree of specialization because they were regulated by public domain values rather than abstract scientific principles. For example, in extract 7.5 Acom recruited specialized science knowledge to elaborate the adverse effects of alcoholism briefly in two incidents. First, she explained that alcohol interferes with the transmission of impulses to the brain which makes it difficult for drunkards to balance and hence their frequent staggering. Secondly, she explained that excessive alcohol intake damages body organs such as the liver and the brain. The rest of the effects were analysed from the perspective of public domain knowledge. Dowling (1998) suggests that the regulating principles of a DS+ activity cannot be fully expressed outside the esoteric domain of practice. This is evident in the absence of definitions and other abstract concepts within these lessons. Exclusion of esoteric domain message constrains 'apprenticeship' into an activity because it denies access to the regulating principles of the activity which reside in the esoteric domain.

Further, type three lessons reflected weakly classified forms of expressions. Because the lessons transmitted public domain knowledge, there was little room to introduce descriptive terms which reflect the specialized science lexicon. For example, in Opio's lesson, learners' utterances were constructed in everyday language. Phrases such as 'pigs being sick', 'pigs eating things of people' were used. Similarly, in

Acom's lesson, a learner suggested that excessive alcoholism results in unemployment because 'someone's knowledge is destroyed'. Whereas such colloquial expressions were permissible in type three lessons, extract 7.2 shows how Kulaba discouraged learners from using everyday language to describe specialized concepts.

In general, this group of lessons transmitted less specialized science knowledge reflected by weakly classified content and forms of expressions. This type of knowledge is highly particularized and context-dependent and so it cannot be unambiguously interpreted outside immediate local contexts in Uganda. Although this type is highly relevant and meaningful to learners' immediate contexts, it has relatively less potential for application in diverse contexts in comparison to esoteric domain knowledge. Type three lessons reflected high discursive saturation (DS+) because pedagogic texts were easily expressed in language.

Transmission of knowledge

This section examines the strategies employed to transmit knowledge in type three lessons. It also includes three lessons covering public domain knowledge in lesson type two which employed transmission strategies similar to those in this lesson type. This group of lessons employed fragmenting and localizing strategies. Fragmenting was employed to transmit esoteric domain message and localizing was employed to transmit public domain knowledge. Fragmenting transmits an extended range of message; however the message is distributed 'segmentally', therefore it lacks coherence and articulation with the general practices of an activity. Dowling points out that fragmenting 'realizes the esoteric domain as segmental rather than articulated', (Dowling, 1998, p.149) given that fragmenting does not highlight the regulating principles of the esoteric domain. Localizing transmits a particularized message which is restricted to a particular public domain setting. These strategies are exemplified further below.

Fragmenting

Bwogi and Suubi employed fragmenting strategies to distribute an extensive range of esoteric domain message. These lessons emphasized specialized descriptive names

and examples of worms and leaves but did not highlight the abstract properties and criteria used to generate the examples. The message was therefore particularized to the examples rather than being abstracted through abstract principles. Further, because the message was presented in a fragmented manner, it lacked coherence and articulation with the general body of esoteric domain science. This 'masked' the connective complexity of the esoteric domain. This strategy is exemplified in Bwogi's lesson described below.

Bwogi's lesson covered the topic of 'worms' which is a sub group of invertebrate animals. She transmitted an expanded range of descriptive terms, specialized names and definitions for various categories of worms. Although Bwogi highlighted different taxonomic categories of worms, she did not expose the abstract criteria underlying these categories. Bwogi began the lesson by briefly reviewing the previous lesson on snails after which she introduced the topic of 'worms' and pointed out that worms are a sub group of invertebrate animals. Following this, Bwogi asked learners to suggest a definition for worms, and after five unsuccessful attempts she defined worms as 'long, thin soft bodied animals'. After providing a brief description of worms, she then moved on to examine the different categories of worms as follows:

Extract 7.6

- T: Now let us look at the different groups of worms; (*Bwogi writes the topic on the chalkboard*) they are divided into three groups. Who can tell me the groups? Yes (*points to a learner*).
- L1: Tapeworms
- T: He says tapeworms, mmh well tried. Yes (*points to another learner*)
- L2: Flat worms
- T: And by the way you must be remembering this, you did it in P.5. We have the flat worms; all of you say flat worms.
- L: Flat worms
- T: Flat worms
- L: Flat worms
- T: What other name can you give the flat worms, what name can you give to flat worms, flat worms, flat worms? Yes Fred?
- Fred: Round worms
- T: Well tried but it is not the right answer
- L3: Segmented worms
- T: No, no.
- L4: Nematodes
- T: He says nematodes, no, but well tried. Another name for these flat worms is what we call plyty-helminthes, all of you
- L: Plyty-helminthes
- T: Plyty-helminthes

L: Plyty-helminthes

Although Bwogi explained that worms are categorized into three groups, she did not highlight the abstract taxonomic criteria underlying the categories. After identifying the three groups she inquired about the specialized names for the worms. While describing the different categories of worms, Bwogi also pointed out that segmented worms are ‘true worms’, just like some insects are considered ‘true insects’. Although she explained why some insects are classified as ‘true insects’ she did not make it explicit why segmented worms are considered ‘true worms’. Because the classification criteria were not made explicit learners suggested examples for the three groups of worms in a ‘trial and error’ manner. Learners responded to questions in this manner in the rest of the lesson. Later on, Bwogi asked the class to define segmented worms. Learners’ attempts to define this type of worms ranged from describing their physical characteristics or their habitat to their economic importance to man.

After describing the three groups of worms, Bwogi displayed a chart and asked learners to identify the different examples of segmented worms but none of the learners was able to do so. Bwogi employed questioning as the main instructional strategy which she interspaced with brief periods of exposition. She also illustrated the structure of the different worms on the chalk board and a chart. Further, she distributed some specimen of worms for the class to examine. The learners were given an exercise to name the various groups of worms covered. Although Bwogi distributed a wide range of message, the various definitions, specialized names and examples of worms were incoherently linked. Dowling suggests that providing examples devoid of their abstract properties particularizes the message and renders it context-dependent.

Fragmenting as exemplified in Bwogi’s lesson contrasts the abstracting strategy employed in two other lessons (Erone and Bogere’s lessons) that covered classification of animals as well. These teachers emphasized the abstract classification criteria as illustrated in extract 7.4 where Bogere questioned a particular example of arachnids suggested by a group ‘reporter’. In contrast, Bwogi presented the examples without highlighting their abstract classification criteria, thus the examples were related ‘metaphorically’ or ‘segmentally’. Dowling argues that fragmenting strategies

do not facilitate effective apprenticeship into the practices of an activity because they do not give access to the regulative principles of the activity.

Localizing strategies

Localizing strategies were employed in the five public domain lessons; two of these are in lesson type three and another three in lesson type two. These lessons and the respective teachers are shown in table 7.2. These teachers employed localizing strategies to distribute public domain message particularized to local contexts. These teachers foregrounded the particular contexts in which practices are situated, highlighting Dowling's point that localizing elaborates a particular instance. They emphasized the details of the sites of practice rather than abstract scientific concepts and principles. These teachers localized the message through narratives and role-plays about particular public domain settings; they elaborated stories citing their personal experiences as well as learners' experiences. They also used pictures and photographs to highlight details of the settings and issues discussed.

Dowling suggests that pictures provide the reader with a 'visual code of presence' which signifies the physical presence of a viewer. In other words pictures highlight 'what the context would look like if the reader was there'. He argues that the visual code of presence projects learners into a highly localized public domain setting with which they are identified. Dowling suggests that iconic modes of signification such as photographs and pictures are particularly suitable for localizing strategies because they assert the reality and significance of public domain settings. He contrasts iconic modes of signification with indexical and symbolic representations that are preferred in generalizing strategies. He argues that the latter modes of representation alienate readers from the public domain setting by minimizing local details of the setting.

Localizing is exemplified in Nambuya's lesson on the 'uses of flowers to man'. Nambuya localized the message by foregrounding how flowers are used in the Ugandan context. She started the lesson with a brief review of the previous lesson that covered 'parts of a flower'. After this she instructed learners to read a section on 'uses of flowers to man' from a text book as she elaborated salient points in the reading as shown in the following extract.

Extract 7.7

- L: People sell flowers and get money
T: Stop there a bit. Do you see those people? How many people pass in town? (*A few learners raise their hands*) Don't you always see people selling flowers?
L: Yes
T: Yeah they sell them and get money and that is what helps them at home like buying food. So you can sell them and get?
L: Money
T: Mmh... (*Nambuya prompts learners to resume reading*)
L: Some flowers are used to make perfume.
T: Yeah some are used to make perfume. Look at that woman perfuming her armpits (*gimmicks application of perfume*), have you seen the perfume?
L: Yes
T: Some of you see your mothers using them at home and some of you bring tins here and we always keep them here and you take them in the evening. (*Nambuya prompts the class to resume reading*)
L: People use flowers on coffins in funerals to show love and respect for the dead.
T: Look at that picture of the coffin. (*Referring to a picture in a textbook*) Most of us these days at least every home has lost a person. We always see people using them, they buy them already made from the shops or they pick them and put them on the coffin. (*Nambuya flips through the book*) Can you continue next page 31 page 32, flowers are used....?
L: Flowers are used to show love. Some people present flowers as gifts to their loved ones.
T: Yeah some people give flowers as gifts to their...?
L: Loved ones
T: We have been reading for you this book PIASCY⁵, we were telling you during PIASCY clear?
L: Yes
T: A girl can love a girl and a boy and a boy can love each other. I have been explaining to you and you acted outside there clear? Even outside the school community people can love each other clear?
L: Yes
T: So some people can present flowers as gifts to their friends clear?
L: Yes

Nambuya particularized the message by localizing each of the uses of flowers that were highlighted in the textbook to learners' familiar experiences and contexts. She emphasized details of learners' experiences at school, for example, by referring to the PIASCY lessons and drama. She also referred to specific uses of flowers in the learners' homes and community. Nambuya used pictures and photographs to illustrate particular ways in which flowers are used, for example that relating to perfume. These pictures localized the message by providing excessive details about the setting in which flowers are used. Dowling suggests that excessive contextual details localize message by celebrating a particular context rather than esoteric domain principles.

⁵ PIASCY is a local school project in Uganda designed to provide learners with HIV/AIDS messages.

Localizing is also exemplified in Opio's lesson where he particularized the message by foregrounding learners' personal experiences rather than esoteric domain principles. In one incident, Opio asked learners whether pigs' milk is consumed by man. Although most of the learners responded with a unison 'no', one learner deferred and said, 'Some people drink it'. Opio asked this learner if he had ever taken the milk himself and the learner said he had never done so. Here Opio particularized the message to the personal experiences of the learners and by so doing limited the range of the message. Likewise, Acom asked her class to suggest what was happening in a picture that showed a drunkard man beating a woman. One learner suggested that 'the father was caning the mother'; this particularized the message to a family context. Following this, Acom asked the class, 'Now if that is your mother, will you feel happy?' Dowling argues that identification of learners with public domain settings in the manner Acom did, projects them into a highly localized public domain setting.

Localizing may be undertaken metaphorically or procedurally with the former elaborating incidents within a particular local context as shown in the preceding examples. Localizing procedural strategies are exemplified in the role plays on first aid in Malongo's lesson. The role-plays aimed to 'skill' learners in the procedures for administering first aid for common accidents in the local community. In the course of discussing the appropriateness of procedures demonstrated in the role-plays, Malongo evaluated learners' decisions in light of the specific local setting in which the 'accidents' occurred. For example, in one incident, she asked learners whether it was prudent to transport an accident victim from 'Kalangala' to 'Mulago' referral hospital when there were other health centres in the former location (Kalangala is located on an island within lake Victoria over 50 km away from Mulago hospital situated within Kampala city). Here, Malongo localized the message to the local setting of the 'accident', backgrounding a general principle that accident victims require immediate help through first aid.

On the whole, teachers of type three lessons distributed a particularized message through localizing and fragmenting strategies. Dowling suggests that fragmenting 'interrupts' apprenticeship into the practices of an activity because its regulating principles are not made explicit to learners. With regard to the problem solving approach, fragmenting and localizing strategies limit application of knowledge to

diverse contexts because meanings are particularized and context-dependent. The choice of distributing strategies was partly attributed to the type of curricular content taught. For example, localizing was employed to transmit public domain content in both lesson types two and three whereas esoteric domain content was transmitted through fragmenting. This suggests that teachers' pedagogic choices were partly influenced by the type of content transmitted.

Conclusion

The three lesson types were less differentiated in terms of instructional content than they were in relation to distributing strategies, where stronger differentiation was evident. For example, esoteric domain knowledge was covered in all three lesson types and public domain knowledge was reflected in both lesson types two and three. Teachers implementing a national curriculum have limited control over the type of knowledge transmitted in classrooms, the 'what' of instruction. In contrast, teachers have relatively more control over 'how' they transmit knowledge through the distributing strategies employed.

This may explain the strong differentiation of distributing strategies across lesson types, particularly lesson types one and three, which are positioned at extreme ends of the continuum. In terms of school contexts, these differences suggest that teachers in high performing schools employed generalizing and specializing strategies and teachers in the low performing schools adopted fragmenting and localizing strategies. Further, there was evidence that distributing strategies employed were partly determined by the type of curricular content covered in the lesson types. This is evident in the extensive use of generalizing and specializing strategies in esoteric domain lessons, (lesson type one and two) while localizing strategies were primarily utilized in public domain lessons. Nevertheless, the fact that two teachers taught type three lessons distributed esoteric domain content through fragmenting shows that teachers' pedagogic choices also influenced the choice of distributing strategies. This provides further evidence for the association between teachers' pedagogic choices and school instructional cultures evident in chapters six and eight.

Differentiation of distributing strategies across schools has implications for children's positioning with respect to knowledge. Dowling (1998) suggests that particular

combinations of distributing strategies position learners differently in relation to the practices of an activity; school science in this case. Abstracting strategies such as generalizing and specializing are associated with the apprenticed 'voice' (learners) whereas particularizing strategies (fragmenting and localizing) position acquirers as dependent 'voices'. The apprenticed 'voices' master the practices of an activity whereas dependent 'voices' are denied access to the regulating principles of an activity. This suggests that learners' pedagogic identities are framed, in part, by the distributing strategies teachers employ to transmit knowledge. Distributing strategies position learners as 'apprentices' or 'dependants' therefore their pedagogic identities are constructed in ways that may or may not align with identities sought under the problem solving approach. For example, apprenticed learners have more potential for self-regulation having mastered the 'privileged repertoire' or regulating principles of school science. In contrast, learners who are 'dependants' have low potential for self-regulation as their dependence on teachers is perpetuated by being denied access to the regulating principles of school science, a key element in apprenticeship. Abstracting strategies facilitate development of context-independent meanings whereas particularizing strategies promote context-dependent meanings.

CHAPTER EIGHT: TEACHERS' INTERPRETATIONS OF THE PROBLEM SOLVING APPROACH AND RATIONALES FOR PEDAGOGIC PRACTICE

Drawing on interview data, this chapter constructs an account of the teachers' interpretations of the problem solving approach, focusing on what the approach entails and *why* they enacted it in particular ways. Chapters six and seven describe the teachers' recontextualizations of the problem solving approach in pedagogic practice; this chapter builds on the previous analyses to provide an account of *why* teachers recontextualized the problem solving approach the way they did. In other words, the chapter provides teachers' recontextualizing rules that guided their selections from the official curriculum and the constitution of their pedagogic practices. The analysis in this chapter also examines the degree to which teachers' recontextualizing processes were mediated by organizational and instructional cultures in their schools. This contributes to an understanding of the factors influencing the implementation of the problem solving approach.

First, I examine teachers' descriptions of the problem solving approach, focusing on its salient features and pedagogic worth in teaching and learning science. Secondly, I analyze teachers' accounts of *why* they enacted the problem solving approach in particular ways. Thirdly, I examine the extent to which the instructional cultures in the research schools influenced teachers' enactment of the problem solving approach.

8.1 Teachers' interpretations

Descriptions of the problem solving approach

This section examines what teachers interpreted the problem solving approach to be and involve. The main interest in exploring these interpretations is to establish the degree to which teachers recognized the pedagogic principles of the approach. In other words, had teachers acquired the recognition rules for producing the legitimate text in relation to the projected curriculum? I asked teachers to describe the main features of the problem solving approach.

On the whole, teachers described the problem solving approach in three main ways: in relation to the degree of learner participation in pedagogic processes; in relation to the

structure of lessons, where they associated the approach with particular types of pedagogic activities and in relation to the application of knowledge to everyday life concerns. These views are elaborated further below.

Teachers interpreted the problem solving approach as entailing more learner involvement in pedagogic processes. Thirteen teachers (81%) emphasized this as the key defining feature of the pedagogic approach. For example, Bogere described it as an approach where, 'the learners do *more of the job*'; Acom said, 'learners are the *main players* and the teacher just guides them' and referred to teacher centred pedagogy as, '*the thinking of long ago, of the teachers of long ago*'. Asiimwe said, 'It used to be teacher centred; now it is child centred where *a child is involved in almost each and everything*'. These teachers demonstrated awareness of the prominence of learner-centred practices in contemporary discourse of education, including a shift in the pedagogic role of the teacher from 'transmitter' to 'facilitator' of learning. Several teachers described the problem solving approach as being 'learner-centred' or 'child centred', in line with the general rhetoric surrounding the new curriculum.

More than two thirds of the teachers (68%) interpreted the problem solving approach as literally referring to 'finding solutions to problem tasks' in the context of class exercises. Here problem solving was associated with an inductive form of learning where learners 'discover' or 'find out' solutions to given problem tasks. This perspective of problem solving was also referred to as 'discovery approaches' by three teachers: Ssesanga, Kabi and Musaali. Whereas all other teachers emphasized the learners' role in describing the problem solving approach, only Asiimwe highlighted the teacher's role; he emphasized that the approach requires teachers to address the learners' individual learning needs. Thus, he recognized the teachers' key role in 'facilitating' learning in context of the problem solving approach.

Further, a number of teachers pegged the problem solving approach to particular instructional activities: Bwogi cited the question and answer approach; Nambuya pointed out role-playing; Bogere, Kabi and Weere considered it to be synonymous with group work and Sakwa considered practical science work the key feature of the problem solving approach. These teachers associated the problem solving approach

with learner involvement in the foregoing pedagogic activities as well as in out-of-class projects and hands-on experiences with natural phenomena.

In addition, teachers associated problem solving with the application of knowledge and skills to problems and concerns within the learners' lives and society more generally. For example, Malongo altered the macro-sequencing of topics in order to teach 'first aid for accidents' because she perceived this topic to be essential for addressing an actual problem experienced by her learners. She recalled an incident where a learner fainted in class and the rest of the learners ran away in fear and argued that if they had been taught about first aid, they would have known what to do. Likewise, Erone underscored the application of science knowledge to everyday life contexts as the distinctive feature of the problem solving approach; he described this as, 'taking a lesson to the outside world'. Details of the teachers' descriptions are provided in appendix F.

This section has shown how teachers 'recognized' the 'specificity' of the problem solving approach; the next section examines their views on its pedagogic worth in science education.

Teachers' views on the pedagogic worth of the problem solving approach

One objective of the teachers' interviews was to explore their views on value of the problem solving approach in teaching and learning science. The main interest in this part of the analysis is to show the extent to which teachers recognize the pedagogic benefit of the problem solving approach as defined by the official curriculum. Morais & Neves (2001) argue that effective implementation of particular pedagogic practices is dependant on teachers acquiring the recognition rules for that context, as well as possessing the competence and affective disposition to produce the required text. Further, teachers' professional dispositions (Ensor, 2004; Hoadley, 2005) including their epistemologies (Spillane, et al., 2002; Blignaut, 2005) influence their pedagogic practices greatly. In view of this, it is imperative to examine teachers' views on the pedagogic value of the problem solving approach.

Teachers perceived the problem solving approach as beneficial in three main ways: in enhancing learners' conceptual understandings, in retention of knowledge and in the application of knowledge and skills to new situations in life. Dominance of these categories suggests that teachers perceived the benefits of the innovation primarily in terms of the cognitive perspective of learning. Few teachers mentioned the affective and social dimensions of learning as potential benefits of the approach. These teachers argued that activity based instruction generated interest and motivation in learning and that group activities, in particular, developed learners' social skills. These perspectives are elaborated further below. Although I have differentiated these pedagogic benefits in the analysis, teachers perceived them as intricately linked.

The majority of teachers argued that learner involvement through activity based instruction enhanced learners' conceptual understandings more than direct transmission of knowledge from the teacher to the learners. This was particularly associated with activities involving 'hands-on' experiences with scientific phenomena. Teachers argued that experiencing phenomena through different senses enhances understanding and memory. They explained that children understand better when they 'observe', 'touch', 'feel', 'hear' and 'smell' natural objects and phenomena. Further, teachers considered learners' active participation in pedagogic processes crucial in enhancing their mental faculties. They argued that when learners 'discover' or 'find out' things for themselves they understand and retain the knowledge better than when teachers instruct them directly. The following quotes exemplify these views:

I see it in such a way like if those children do those activities themselves they learn better. When they touch, try to observe, and identify, they understand better than the teacher just explaining on the blackboard. When you just point out the leaves they will look at those leaves but they will not know that this is a simple leaf, this is a compound leaf. But when they are touching like this, they will know that simple leaves look like this, compound leaves look like this, eeh the shapes (Suubi, Harambee P.S).

I think the children are given time to discover for themselves unlike a case where you would force them to understand certain things. Here they are discovering on their own. And if they are given time like in groups they exchange ideas and they discuss a number of things. So I think the children are given an opportunity to discover on their own and I think there they can learn better and more particularly when they are allowed to interact with what you are trying to teach them like that plant, they are trying to touch, they are trying to observe. I think there they understand better, unlike a situation where

you tell them that this is like this, this is like this. They are discovering on their own and I think it is better retained in the memory than when you would just give them ideas (Kulaba, Bethel P.S).

It helps, in fact, there they learn more, they learn better, the concepts really reach, and a child cannot even forget, by the way when you use that kind of approach, because he has involved himself he has seen and done it himself or herself (Asiimwe, Alpha P.S).

Kulaba emphasizes how group work develops learners' social skills and deepens their understanding of concepts. This highlights an association between the social and cognitive dimensions of instruction.

Further, teachers pointed out that learners' active engagement in activities promotes their interest and motivation in learning, particularly when activities are supported by a variety of instructional resources. Ssesanga exemplifies this view:

In fact if they do it by themselves, for example the other boy was demonstrating how to do the thing [magnetizing a metal] they were very happy and they were actually interested to each come and do the thing by him or herself. So that is how they learn quickly when they do it by themselves. But I should be playing a very small role for them, like how I did the demonstration, how they should do the thing, how to induce the mechanism that demonstration. But if they were to do it themselves you would see how interesting it would be.

The foregoing extracts highlight the significance of 'materiality' and 'action' within activity based instruction as resources for meaning-making in science classrooms (Kress, Jewitt, Ogborn & Tsatsarelis, 2001; Millar, 1991; Woolnough & Allsop, 1985) and also for the affective dimension of making learning 'interesting'. The latter aspect is highlighted in Ssesanga's extract as well as that of Malongo below. These perspectives resonate with the social-affective and constructivist dimensions of learner-centred pedagogy that aim to promote learners' natural abilities and interests (Brodie et al., 2002a; Hodson, 2003; Haefner & Zembal-Saul, 2004). More importantly, these views are congruent with the official curriculum argument that activity based instruction promotes learners' interests and motivation which engender effective learning (NCDC, 2000).

In addition, the teachers argued that the problem solving approach promotes the application of science knowledge and skills to problems of daily living. They explained that learners' natural curiosity to discover how things 'work' builds their

investigative skills. Commenting on the value of practical science work in particular, Ssesanga explained that when learners 'discover things on their own' their knowledge is retained in memory and they are motivated to 'keep on discovering more'. The following extracts exemplify teachers' views on the application of science knowledge and skills in everyday living:

Now since children at that age very much want to investigate and find out how things work and how things look like, how things come to exist, it gives them chance to come up with various skills like that one of observation, skills of writing and recording. The children gain all such skills during the process so they may not only find it in class, they may find such problems even in their homes, on the way, so they will not find a lot of difficulty when they are dealing with certain problems(Weere, Canaan P.S).

Eeh, its good because children find out solutions to their problems, first of all to their own problems, then may be to the problems of others. They will have to learn. Then even in class it enhances this memory; children will really memorize so that at times, before they solve problem, they remember very fast what they have to do. So it enhances that memory and then when you look at learning, it makes learning interesting (Malongo, Canaan P.S).

I think teaching becomes easier and the children get to know why they come to school. They come to solve problems actually in their future life. They learn some basic skills and these basic skills help them in life (Nekesa, Bethel P.S).

Malongo associated the application of knowledge with the extent to which relevant knowledge is memorized and recalled in problem solving contexts. Erone argued that application of knowledge to everyday life was not only important in relation to the problem solving approach, but also to science education generally. He reported that, as head of a science department, he urges teachers under his jurisdiction to relate knowledge to everyday life in order to show learners its utility. For example, he explained that his decision to 'co-teach' with Musaali was partly motivated by this cause.

I had to remind him to make children be aware of the concept that this information of evaporation and condensation also helps in the formation of rain in nature. So that one could have been left out so that is why I had to be there so that they know that in nature it occurs and then at home they use it in the preparation of 'enguuli' [a local Ugandan gin-LS] so they associate it with nature and home and then industry.

Although these teachers perceived that there are pedagogic benefits to the problem solving approach, Kabi, Malongo and Weere pointed out that it cannot be used independently. They argued that its suitability depends on the topic handled, the time

frame of the lesson, as well as the availability and adequacy of instructional resources. With regard to suitability of topics, Kabi explained that, he found the topic on 'matter', which he taught, most appropriate for practical science lessons. Coincidentally, all the four practical work lessons observed were based on the topic of 'matter'. Similarly, Malongo explained that, whereas some topics require 'basically discussion and explanation', others such as 'first aid', which she taught, required active learner involvement. According to Weere, the problem solving approach does not allow detailed concept development. For example, he described his group work lesson as just a 'brainstorming' session and planned to supplement it with teacher-led instruction in the subsequent lesson so as to elaborate concepts in detail. Table 8.1 provides a summary of the pedagogic benefits of the problem solving approach that were highlighted by the teachers.

Table 8.1 Teachers' views on the pedagogic value of the problem solving approach

Significance of PSA highlighted	Number of teachers
Enhanced understanding of concepts	11
Application of knowledge and skills to problems in everyday life	10
Easier retention and recall of knowledge (Aids memory)	09
Develops investigative or 'discovery' skills	06
Promotes interest & motivation for learning	04
Develops social skills (sharing , responsibility)	04

On the whole, the analysis in the preceding two sections shows that the teachers recognized some salient principles underlying the problem solving approach as constituted in the official curriculum. This was particularly evident in their accounts of what features differentiated the problem solving approach from other pedagogic practices as well as in their accounts of its pedagogic worth in science education. They also recognized its limitation in relation to conceptual development when employed independently. In Bernsteinian terms, these teachers 'recognized' the specificity of the pedagogic context appropriate for the problem solving approach, to a great extent. However, Bernstein suggests that possession of recognition rules is a necessary but not sufficient condition to perform the legitimate text in that context:

The realization rule is necessary to produce the legitimate text ... recognition rules regulate *what* meanings are relevant and realization rules regulate *how* the meanings are to be put together to create the legitimate text (Bernstein, 2000, p. 17-18, my emphasis).

Therefore recognition rules enable one to recognize *what* is required for a legitimate production while realization rules emphasize *how* to produce the text. Morais & Neves (2006; 2001) differentiate between passive and active realization rules, with the former relating to selection of appropriate meanings and the latter to textual production in accordance with the selected meanings. This distinction suggests that teachers as ‘acquirers’ of curriculum policy texts can possess passive realization rules by selecting appropriate meanings but remain unable to produce the legitimate text if they do not possess active realization rules. Similarly, implementing the problem solving approach in the manner envisaged by the official curriculum requires teachers not only to interpret the policy text ‘correctly’, but also to be able to implement the policy prescriptions in their pedagogic practice.

8.2 Teachers’ recontextualizing principles

This section examines teachers’ recontextualizing principles. Underlying this analysis is the assumption that teachers recontextualize the official pedagogic discourse guided by regularities derived from the prescribed curricular principles and contextual opportunities and constraints within their school environments. These curricular and contextual factors influence their decisions about pedagogic practice. Working from this premise, I analyze teachers’ accounts to examine why they enacted the problem solving approach in particular ways. This analysis is significant in two ways. First, it enables us to compare teachers’ rationales for pedagogic practice with the pedagogic principles projected by the problem solving approach in the official curriculum. Although the study explores rationales for pedagogic practice, it acknowledges that pedagogic actions are not always rationalized on the basis of an interpretation of pedagogic symbolic codes (Jacklin, 2004; Schoonmaker, 2002). Practice may be partly based on tacit knowledge. Secondly, the analysis aims to draw attention to factors accounting for differences in the implementation of the problem solving approach across the research schools.

The study recognizes that teaching and learning is a complex activity, therefore implementation of the new pedagogic approach cannot be examined independently of the general influences on pedagogic practice. These include teachers’ professional dispositions, including their subject content specializations, pedagogic beliefs and knowledge, schools’ instructional cultures and expectations and contextual conditions

within the school and society more generally. Along with their interpretations of the official curriculum, these elements mediate and hence provide additional ‘filters’ for teachers’ curriculum implementation processes.

Factors underlying similarities in pedagogic form across lessons

This section examines teachers’ recontextualizing rules relating to pedagogic features that were similar across all lessons, these are; selection, sequencing, pace of transmission, social order and inter-discursive relations. These similarities suggest that the factors underlying pedagogic practice were likely to be external to the school contexts in which teachers operated, thereby affecting teachers in a similar manner. Benavot and Resh (2003; 2001) suggest that in centralized education systems, similarities in curriculum implementation across schools are explained by macro-level factors.

Selection and sequencing

The analysis in chapter six showed strong framing over selection and sequencing, implying relatively strong teacher control over these aspects. The national curriculum provides a broad framework for pedagogic practice in Uganda, thus it externally frames macro-selection of content, activities and instructional materials as well as the macro-sequencing of knowledge. The science syllabus, like other subject syllabi, provides a detailed selection of themes, topics and content. It also outlines the sequence in which the topics are taught along with the duration of each theme in terms of the number of lessons. These detailed prescriptions allow teachers little room for flexibility in determining ‘what to teach’ as well as the ‘order’ and ‘pace’ of instruction. Therefore, the official pedagogic device, working through the centrally mandated national curriculum, exerts strong external framing on the teachers’ pedagogic practice, resulting in tight adherence to defined curricular selections and sequencing. This contributes to the strong framing of selection and sequencing across lessons and lesson types.

Teachers’ flexibility within pedagogic processes was also linked to pacing. Because teachers were under pressure to cover planned work, they rejected ‘distractions’ from learners perceived to slow down the pace of instruction. Thus pressure to complete the

official macro-selections of content required teachers to adhere to specific selections and sequencing. Centralized curriculum planning and monitoring systems in some of the research schools ensured that teachers adhered to the macro-level selection and sequencing.

The low level of teacher autonomy over instructional matters was verified during fieldwork, by teachers' reactions to my suggestion that they select topics that best demonstrated the problem solving approach. For example, Sakwa reported that he sought authorization from his subject head of department in order to teach a topic he perceived to be more 'appropriate' for the problem solving approach than what was scheduled. For Bogere, the idea of altering the macro-sequencing to select a more suitable topic was non-negotiable; he said he could only teach what was scheduled. In contrast, Malongo, Kulaba and Suubi demonstrated more autonomy over instructional matters as they altered the macro-sequencing of lessons without seeking approval from their superiors.

I will examine external framing of teachers' practice at two levels; that from the national education system level and that from the school. The analysis shows that, although teachers experienced similar pressure to cover the wide scope of the national curriculum, the manner in which different schools responded to this pressure varied. Therefore, the degree of external framing from schools varied. Teachers in high performing schools reported stronger external framing from their schools than their counterparts in the low performing schools. This was linked to the very structured school organizational cultures, centralized curriculum planning and monitoring structures that ensured uniformity in the implemented curriculum. Therefore strong external framing from these schools reinforced that from the national curriculum and ultimately shaped teachers' micro-level selection and sequencing.

The low performing schools, in particular, Gonzaga and Harambee, had less structured institutional and instructional cultures which accorded teachers relative autonomy to sequence and pace their lessons more flexibly. Acom elaborates this issue:

We find it very difficult to follow the timetable. You say, "Ah let me now finish this way and then come later". Of course if you are to follow the timetable you

find it very difficult because you are the same person here, same person there so instead of now making yourself very tired you say, "Let me finish this one", then you sit a bit and organize your lesson again then you come later. It is very difficult, this timetable, sometimes we put it up but you may not follow.

Relative flexibility in the official timetable at Gonzaga and Harambee was attributed to the smaller number of teachers at these schools which implied that each teacher taught most or all subjects per class. In general, teachers' accounts show that strongly framed selection and sequencing is attributed to the degree of autonomy teachers have over their pedagogic practice in relation to external mandates from the school and education system level.

Pacing

The analysis in chapter six shows that teacher-regulated aspects of instruction, particularly content expositions, were generally paced at a fast rate across the three lesson types. Therefore the main differences in pacing rules among the three lesson types relates to the pacing of learners' tasks. This section examines teachers' accounts relating to the teacher-led aspects of instruction. In general, teachers across the three lesson types attributed the strong pacing rules to the pressure to cover the prescribed curriculum content within defined time frames. They argued unequivocally that the science syllabus, particularly that for primary six, was very wide, compelling them to pace instruction fast to ensure its coverage. This concern is highlighted in the following extracts:

Eeh only that if again you are to consider the science curriculum, P.6 has got a lot of work mmh they piled a lot of work on P.6. P.7 has little, P.5 has little but P.6 has a lot. Even if you look at the volumes of the textbooks the ones of P.6 are bigger than these other classes. So you must really be very fast. There are topics that can even take you a full term. Eeh so you must be very fast and the children must also understand at the same time, so balancing the two sometimes is hard but we try (Kulaba, Bethel P.S).

As far as the P.6 syllabus is concerned, the thing is overloaded; there is a lot of work covered in P.6. When you look at the themes and the topics, look at the time element it is really...we are trying but it is a bit difficult to finish up the syllabus. We try but somewhere somehow it is not easy, it is too much, there is a lot of work (Asiimwe, Alpha P.S).

Teachers were also concerned about the wide range of 'minor' subjects that increased the scope of the primary school curriculum. These subjects were considered 'minor' because they are optional and not examined at PLE. The optional subjects include

French, music, arts and crafts, performing arts, physical education and Kiswahili (the regional language in East Africa). For example, Musaali reported that the high number of optional subjects offered at his school intensified teachers' work. According to Musaali, these 'minor' subjects 'interfered' with the 'normal' curriculum and so teachers had to be 'committed' so as to complete the science syllabus. He explained that, as a coping strategy, they sometimes 'neglect' the 'minor' subjects and use that time to complete the syllabus.

Erone concurred with fellow teachers that the science syllabus was wide. However, he argued that the official time for instruction is adequate but the high intensity of co-curricular activities in his school disrupts instructional time, constraining syllabus coverage. These activities include a variety of sports, swimming, girl-guides and scouts societies among other clubs. Erone argued as follows:

Time would not be an issue but I think the programs in the school are the ones that affect the time. But the timing of the lessons on the timetable is not a problem. Like now there are certain programs that will come, the other time we had a sports day. So during that issue of training children some lessons were interfered with. You know for example science is a very wide subject, very broad, so if you are not given enough time you will not finish. Because in P.6 there is a topic on cattle which can cover the whole term yet there are other topics to be taught with it in the same term. So you find that in fact those programs affect and you fail to cover it.

The high intensity of co-curricular activities at Erone's school, Ebenezer, as well as at Fahimu, is linked to the higher resource base of private schools that enables them to fund more of these activities. On the whole, these two private schools had a wider range of co-curricular activities than the six public schools in the sample.

Whereas strongly paced instruction appeared a logical option for teachers, given their concerns over the content heavy syllabus, teachers' accounts reflect its adverse repercussions on learning, and on take-up of the problem solving approach in particular. First, teachers suggested that they are too preoccupied with coverage, leaving little room to consolidate concepts. Kulaba's extract above highlights the dilemma he faces in balancing the demands of syllabus coverage and ensuring that learners understand concepts. Further on in the interview, Kulaba explained that, given the pressure of syllabus coverage, he opts for instructional modes which are not necessarily his 'ideal' option but which enable him to move fast as learners 'get ideas

here and there'. Likewise, Nekesa argued that the content heavy syllabus constrained her efforts to consolidate content because she is compelled to pace instruction faster, 'So you find that you teach what you can and in a hurry'.

Secondly, Kulaba and Nekesa's preference for instructional modes which allow them to 'rush' through the syllabus suggests that teachers opt for more teacher-directed instructional modes and shun the problem solving approach because it is considered more time-demanding. Coverage of syllabus was particularly critical in the high performing schools because excellence in public examinations is crucial to the schools' public image. These concerns on syllabus coverage suggest less potential for relaxed pacing as required by the problem solving approach.

Social order

This section focuses on teachers' rationales relating to social order. The lesson observation data reflects dominance of explicit hierarchy between teachers and learners which emphasized the teachers' role as transmitter of instructional and regulative order in the classroom. Teachers employed positional control to regulate learners' conduct; this form of control is based on explicit rules. In general, teachers justified their preference for explicit social order as necessary to enable learners to concentrate on their tasks, to control undisciplined learners and to comply with their schools' institutional cultures. Teachers' accounts highlight tensions between the social order projected by the problem solving approach and that foregrounded by the schooling system, the broader social relations in Uganda as well as teachers' own perceptions of effective class control. The following extracts are illustrative:

I give them [learners-LS] instructions or guiding rules. It is a bad teacher who always punishes a child before giving them instructions, I don't normally do that. Yeah, you have to tell them, let's say at the beginning of a term, what do we do when we enter a class, we remove books, we sing a song in the middle. I give instructions before time so that you avoid blaming, 'why are you playing'. At the beginning of the lesson, I tell them you are now going to learn and if you are a learner you empty your desks because what they have on the desks disturbs their attention. They begin fidgeting and what have you. And then when they sit you are able to see each face (Nekesa, Bethel P.S).

Okay now the value of that one [explicit rules of conduct- LS] is that you tell them to sit well, write well do this to ensure that they actually concentrate on what they are doing because, being young, when you leave them they will begin talking immediately. After writing one sentence they begin talking but

when you say "do this", one is able to concentrate, that is it (Musaali, Ebenezer P.S).

Most Ugandan teachers consider strict class control a hallmark of effective teaching; this is part of the broader instructional culture that frames teachers' practice. Teachers emphasized the crucial role of 'co-teachers' in maintaining class control. In most primary school classrooms in Uganda, a 'co-teacher' sits at the back of the classroom and monitors class control as the main teacher proceeds with instruction. In the large classes, co-teachers also assisted with other class management roles such as issuing learners permission to leave class, distributing instructional materials and attending to visitors to the class. The following extracts are illustrative:

And the presence of a teacher at the back of the class contributes to some control of discipline in class because the child knows that at the back there is a teacher; when he is trying to play around someone must be watching (Sakwa, Alpha P.S).

Usually, for example, when you are conducting group work, they come in to maintain order in the class. They always come in and help. Although yesterday she was a bit busy and she did not come in, but they always come in actually to help. Order usually is very important, eeh discipline; they always come in (Kabi, Fahimu P.S).

These extracts highlight deeply entrenched views on strong regulation as imperative for instruction. Schoonmaker (2002) and Apple (1982) suggest that social control is an important classroom dynamic.

Explicit regulation of social order and hierarchical relations was also evident in the organization of classroom tasks such as selection of group leaders. Teachers set rules of conduct and argued that these ensured that learners engaged in activities in an 'orderly' way. Acom and Weere reported that they selected group leaders with certain leadership abilities. For example, Acom said she selected those who 'could talk and express themselves', she said:

This grouping, at least their leaders are people who can at least read a bit. You have seen the group of Yeku; at least Yeku can try although with some difficulties in English. Even Sera at least she can also talk. Even those two girls can at least talk and they are active in the class when you are teaching because you cannot put someone who cannot talk at all to head a group.

In the same way, Nambuya and Suubi explained that their learners were undisciplined therefore they required strict control. Suubi employed imperative control, speaking harshly to learners who deviated from the expected behaviour. These teachers justified the code of conduct in their classrooms in terms of learners' characteristics. As explained in subsequent sections, teachers in low achieving schools defended their pedagogic practice on learners' characteristics. The fact that all four teachers cited above taught in low achieving schools highlights the articulation between factors underlying teachers' instructional decisions and their school contexts. Smerdon et al (1999) argue that decisions about methods and content of instruction are directly influenced the characteristics of students in the classroom.

Teachers' justifications for other aspects of practice highlighted their emphasis on explicit social order. This was evident where, for example, Erone and Asiimwe employed extra work as a device for regulating learners' conduct so as to keep them 'busy' and controlled. Likewise, Suubi considered activity based instruction instrumental in maintaining class control arguing that 'when learners are busy they do not disturb others'. The notion of 'occupying' learners reflects the broader context of schooling in Uganda, where learners are considered 'idle' or 'playing round' when they are not actively engaged in some form of academic activity. This notion has resulted in practices such as 'morning work', 'lunch hour work' and 'evening work', designed to keep learners 'busy'.

In general, the analysis suggests that social order in classrooms was reinforced by schools' institutional cultures. I examine two cases to demonstrate this relationship; Kabi's lesson and account exemplify an explicit social order whereas Erone's case illustrates relatively weak hierarchical rules at both class and school levels. Kabi enforced a strict code of conduct in his class, evident in practices such as queuing to enter and leave the classroom and to receive instructional materials from the teacher. Learners stood up to address Kabi and at the end of the lesson they all stood up and thanked him for his 'good service'. Kabi also emphasized that learners should control their voices and remain seated as they work. These practices mirrored the explicit organizational structure and roles and social control principles at Fahimu primary school where Kabi taught.

Fahimu promoted a particular code of conduct and identity among its learners. For example, formal lessons on 'moral education' were provided to shape learners' social relations and conduct by emphasizing particular life skills. These were supplemented by religious teachings by spiritual leaders of recognized faiths on a weekly basis. Further, Fahimu enacted a practice referred to as 'sample handwriting' whereby particular messages were written on the chalkboards of all classrooms. These messages communicated specific social issues such as 'make less noise' or 'it is good manners to say sorry' aimed to enforce a particular desirable code of conduct in the school. Sample handwriting served a dual purpose as it also aimed to develop a common hand writing style in the school. Here it is evident that Kabi's classroom practice was reinforced by Fahimu's social order.

During the interview, Kabi oscillated between supporting 'relaxed' social relations and describing a deeply entrenched code of strict social order. On one hand, Kabi supported a less structured code of conduct by endorsing learners' freedom of movement during group activities, saying, 'Here in group work we encourage them to talk, they shout they are even allowed to move from one group to another and see what is happening there'. He explained that some level of noise was inevitable, given the multiple views and discussions inherent in group work. This suggests flexibility to cede some control to learners within specified boundaries. On the other hand, Kabi emphasized the imperative of maintaining orderliness during pedagogic processes. He pointed out that learners were expected to control their voices during discussions. Despite declaring flexible pedagogic principles in the interview, classroom data shows that Kabi maintained a strict code of conduct.

Inconsistency between Kabi's views on social order and his practice may be explained by Cohen's (1990, p.323) argument that teachers do not simplistically 'shed off' their old pedagogic ideas and practices and adopt new ones. Rather, he argues that, as they reach to embrace or invent new instructional practices, they do so with their old professional selves. Thus, teachers' past experiences of hierarchical social order are reinforced by their school contexts to constrain their efforts to adopt the new pedagogic approach in the ways intended. However, as Schoonmaker (2002) argues, the complexity of classroom life may have constrained Kabi from relaxing a hierarchical social order as professed in the interview. Schoonmaker suggests that

teachers' actions are not always rationalized. She argues that teachers often adopt a utilitarian or practical view of what 'works' in a particular context rather than 'the intricate dynamics related to why particular actions or activities work and whether they are appropriate' (p.49).

Erone's lesson and account reflect less structured social relations relative to the other teachers' practices. Erone related to his learners in a friendly and informal manner, flavoured with lots of humour. Further, although his school, Ebenezer, had a hierarchical administrative structure, Erone as head of the science department considered horizontal relations with his subordinates to be an indicator of effective 'leadership'. He explained the imperative of occasionally relinquishing some of his power to teachers. The weakly framed hierarchical rules evident in Erone's lesson and account mirrored the school's culture of promoting open communication relations between teachers and learners and between learners and the administration. During the interview with him, the principal of Ebenezer reported that his school encourages learners to feel free with adults and that these open communication relations made Ebenezer 'attractive' to the public:

One of the contributing factors [attractiveness of the school] could be the atmosphere; the thought of having teachers and other employees very friendly to the children is key, so you find that the children are very free. The office is open; they can come in and tell you their problems any time. That touch between the teachers and the children I think is a very good atmosphere for normal learning, freedom of expression.

Despite the fact that Erone's classroom practice reflected open communication relations with learners as legitimated by the school leadership, he held reservations about such relations, arguing that some learners abuse the 'power' ceded to them:

Some of them come from rich parents ...sometimes a child tends to under look a teacher during the lesson...so those ones can even decide to do anything in class...and you have no say, yeah, you have no say. Sometimes you may say something but a child abuses that power from home. I have experienced one child telling a teacher, 'Do you know that even at our home we can command a soldier who is a lieutenant to go down and is caned'. So you find that when a child brings such information it scares; it has not come to hit me directly but I have heard about it.

Here we see the intricacies embedded in teacher's efforts to adopt new pedagogic styles, particularly those inconsistent with their social codes. The weakly framed

hierarchical rules highlighted at Ebenezer reinforced the personal forms of control associated with middle class homes from which the school draws its learners. These control relations contrasted with the positional and authoritarian control forms associated with working class homes. However, given that Fahimu (Kabi's school) emphasized hierarchical social relations despite being attended by learners from middle class homes, suggests that the school's social order is crucial in mediating classroom social relations. On the whole, Erone and Kabi's cases demonstrate the key role played by school context and broader social relations in shaping teachers' classroom practices and hence their take-up of new pedagogic approaches.

An emphasis on positional forms of control, reflected in the majority of the lessons, observed may also be explained by the broader social relations in Uganda, where verbal admonishments and corporal punishment are commonly employed to control children. In administering physical punishment by caning, teachers (as well as parents) commonly invoke a bible verse, 'spare the rod and spoil the child'. Schooling, a secondary form of socialization, reproduced these dominant control forms. Although none of the teachers in this study used corporal punishment, a couple of them addressed learners in harsh tones. This form of communication is consistent with studies on primary schooling in Uganda (Kabateriene, 2003; Munene et al., 1997; Carasco et al., 1996) that report high levels of verbal 'abuse' of the learners by teachers. In general, the analysis demonstrates that the power and control relations underlying social relations within pedagogic processes are not determined by particular teachers and classrooms in isolation. Instead, these are rooted in the broader contexts of schooling and society.

Inter-disciplinary knowledge relationships

This section examines how teachers accounted for the strongly classified relations between science and other school subjects identified in chapter six. In general, teachers' accounts highlighted tension between curricular prescriptions relating to integration of knowledge and contextual elements of their practice, including school instructional cultures and resource levels. Additionally, some teachers justified strong inter-discursive relations by highlighting the time demands of the national curriculum. There was also the perception that integration compromised conceptual development in subject matter. Further, teachers' professional identities and subject specializations

inclined some teachers to maintain strong inter-disciplinary boundaries. These factors are elaborated below.

Although the analysis of classroom observation data in chapter six reflects the dominance of strongly classified inter-discursive relations across lessons, some teachers pointed out potential links between their lesson topics and other school subjects' content during the interviews. For example, Erone said the topic on 'birds', which he taught, was related to 'tourism' in social studies. He also argued that integration of knowledge across subjects simplified teaching and enhanced conceptual understandings because learners got an opportunity to study concepts from different perspectives. Likewise, Asiimwe pointed out some relationships between his topic on 'sound energy' and concepts in music. This suggests that teachers recognized potential links across subjects and the pedagogic benefit of these inter-discursive relations, yet they did not explicitly provide these in the lessons observed. Inconsistency between teachers' accounts and their classroom practice highlighted tension between curricular prescriptions and the realities of classroom practice which may be attributed to two factors.

First, some teachers maintained a strong boundary between subjects and defended this with the argument that integration constrained conceptual depth. This factor exacerbated teachers' general concern that the pressure to complete official syllabi constrained their efforts to provide detailed conceptual development. In view of this concern, teachers considered integration an 'extra-burden' on their limited time. For example, Nekesa argued that by integrating agriculture with science, the current science syllabus limited conceptual development in agriculture:

When they learn things in agriculture they are able to see concepts handled at a greater depth than when everything is crowded in one subject and the teacher is rushing to complete the content.

Nekesa's argument also suggests that teachers who are accustomed to collection code curricula struggle to appreciate the benefits of integration and prefer to preserve the purity of subject boundaries. Collection code curricula rely on the 'purity' of contents and consider boundary transgressions as manifestations of 'danger' and 'pollution' (Atkinson, 1995).

Secondly, weak inter-discursive relations can be explained by teachers' professional identities, particularly in relation to subject specializations. Although basic primary school teacher training in Uganda prepares 'generalist' teachers, some schools give teachers the opportunity to 'informally' specialize in one or two subjects. This is especially possible in the large schools and better resourced schools where more staff numbers allow this form of specialization. Further, a considerable number of teachers have furthered their professional training in which they specialize in one or two subjects. Thus, some teachers consider themselves to be science 'specialists', whose priority is to 'apprentice' learners into the activity of science by distributing to them esoteric domain knowledge (Dowling, 1998). This view was evident in Erone's remark that he had successfully, 'wooed learners to pick an interest in science'. Likewise, Sakwa positioned himself as a 'science specialist' and constructed learners as potential 'recruits' into the field. This identity is reflected in his comments on the pedagogic benefits of practical science work:

Actually it is the most appropriate in teaching science because it involves children's practical touch, then the child sees what he is doing and masters it. Even in the outside world he goes on out to innovate more other better things, he innovates new skills in science and we see science move (My emphasis).

Sakwa's identity with science is reflected in his concern to 'see it move' forward. At Fahimu, specialization extends beyond subjects to topics; teachers are permitted to identify topics they feel most competent to teach so that each specializes in these.

Whereas the majority of teachers maintained strong inter-discursive boundaries, three teachers relaxed the boundary between science and English language, justifying this as an attempt to develop learners' abilities in the English literacy skills of reading, writing and speaking. As discussed in chapter six, this challenge was particularly severe in the low achieving schools of Harambee, Gonzaga and Ddembe. There has been much public outcry on the low and declining levels of English literacy skills among primary school learners in Uganda, especially after the implementation of UPE (Read & Enyutu, 2004; UNEB, 2003). Low levels of English literacy have adversely affected learners' overall performance across school subjects; given that English is the official language of instruction in Uganda.

In response to these challenges, Ddembe, Gonzaga and Harambee institutionalized the practice of integrating English literacy skills into all school subjects. Teachers in these schools frequently instructed learners to read texts out aloud as they intervened to correct their pronunciations. Suubi explained that this practice, recommended by a visiting professional development adviser, allowed her to correct learners' mispronunciations. I asked Suubi why she insisted that learners report their readings from textbooks in their 'own words'. She responded as follows:

It helps them to express themselves either when they are discussing or writing on their own. Like when they are discussing in groups it helps them to make reports on their own when they are not getting the real notes from the book. I want them to learn how to express themselves.

Suubi's zeal to promote literacy skills can also be examined in the light of her professional identity. She considered English to be her 'major' teaching subject, emphasizing that she had taught science for only three years at that point, whereas she had taught English for over ten years. To emphasize her commitment to English, Suubi explained that whereas 'other' teachers were not keen on integrating reading skills in their lessons, she goes the extra mile in that direction, 'we are the ones [Teachers of English-LS] who are keen. Others don't mind about teaching reading. So you try to see that you teach reading in every lesson you go in'. In positioning herself as a specialist teacher of English, Suubi's professional identity contrasts that of Erone and Sakwa, who identified themselves with science.

The predisposition of teachers to maintain or relax subject boundaries was also associated with school resource levels. Other factors held constant, teachers teaching across subjects are likely to 'see' more links between subject contents and skills than those specializing in one subject. As discussed in chapter four, the Ugandan government allocates resources to public schools on the basis of their student enrolment levels, therefore the two small public schools, Harambee and Gonzaga, were the most poorly resourced schools in the sample. Consequently, subject specialization was not possible at Gonzaga and Harambee because these schools had few teachers, each teaching two or more subjects. In contrast, subject specialization was possible in the large public schools and the private schools like Fahimu and Ebenezer.

On the whole, although the official curriculum prescribes knowledge integration, tensions between this requirement and complexities within schools' instructional contexts and school system demands did not provide much room for teachers to integrate science with other school subjects. Taylor and Mulhal (2001) report that the rigidity of primary school curricula in developing countries discourages teachers from moving beyond their subject boundaries.

Factors underlying variation in pedagogic form across lesson types

This section examines how teachers accounted for the pedagogic features distinctive to each of the three lesson types identified in chapter six. These features include: evaluation criteria, pacing of learners' tasks, intra-disciplinary knowledge relations and relationships between science and everyday knowledge. As discussed in chapter six, these lesson types were taught in particular schools: lesson types one and two were taught in high achieving schools and type three lessons were taught in low achieving schools. Teachers' accounts relating to why they enacted the pedagogic features that differentiated lesson types are crucial in highlighting school-specific contextual influences on implementation of the problem solving approach. The following sections present teachers' rationales according to the three lesson types.

Lesson type one

The analysis in chapter six shows that lesson type one reflected strong to very strongly framed (F^+ and F^{++}) evaluation criteria and pacing; weakly classified (C^-) intra-disciplinary relations and strongly insulated boundaries (C^+) between science and everyday knowledge. This lesson type was reflected in five lessons, four of which were taught in the large high performing schools: Alpha and Bethel and one was taught in Gonzaga, a small low performing school. The following sections examine how this group of teachers justified these pedagogic features.

Strongly framed pacing rules

One of the distinctive features of lesson type one relates to the fast pace of instruction in both teachers' transmission and learners' activities. Learners' tasks were paced at a very fast rate and teachers set time limits on tasks. During the interview, I asked

Kulaba to explain his rationale for setting explicit time frames on learners' activities. He justified this practice by arguing that it helped learners 'concentrate' on the tasks. 'I think timing helps them to concentrate, so that they know that they are working at a particular rate, and that they must finish within a particular time limit'. In general, emphasis on explicit or 'visible' pedagogic structure characterized type one lessons. Ability streaming, implemented to cope with mixed ability classes in the large high performing schools, allowed these teachers to pace learners' tasks at a fast rate.

Strong pacing rules in this lesson type can also be examined in relation to the instructional cultures of the high performing schools, particularly the centralized curriculum planning and monitoring practices that exerted pressure on teachers to pace lessons fast so as to complete prescribed content. This is evident in Kulaba's perceptions that the problem solving approach was very time demanding in the context of his work environment:

That method needs when you have the time and you must go slowly but there maybe a situation, like now we are doing sports and it has taken almost a month. Next week we are doing midterm exams and the term will end within a month's time and yet you must finish all the work for first term. Now what do you do? You use such a method, you don't finish up? You must use a method where you rush. You are in a candidate class. They are looking at you; everybody is looking at you so you will see that one as a time wasting method.

Although he set explicit frames on learners' activities, it is evident that Kulaba recognized that the problem solving approach required relaxed pacing. This suggests that fast pacing rules were inconsistent with his understanding of the requirements of the pedagogic approach. This inconsistency is attributed to the broader curricula and examination requirements mediated by strong external framing from his school. In general, the schools' macro-pacing rules enforced through centralized curriculum planning and monitoring systems partly account for fast pacing in this lesson type.

Strongly framed evaluation criteria

The analysis in chapter six highlights strongly framed evaluation criteria as a distinctive feature of lesson types one and two. Teachers' rationales for evaluation criteria in these two lesson types are presented in this section. A brief recapitulation of the various ways through which these teachers explicated evaluation criteria is necessary to contextualize their justifications. Prior to tasks, these teachers provided

learners with explicit rules for producing expected texts and also clarified these during the activities where necessary. They also elaborated learners' correct texts, pointed out errors and missing texts in their productions and finally provided omitted texts. Further, these teachers explicated criteria for producing legitimate texts by assisting individual learners or groups as they performed tasks.

Teachers' rationales relating to evaluation criteria are central in understanding their general pedagogic practice because, as Bernstein (1990; 2000) argues, evaluation criteria condense the essence of pedagogic practices. Evaluation criteria were the key pedagogic feature distinguishing lessons types, particularly between high and low performing schools. This suggests that teachers' accounts relating to evaluation criteria provide insights into contextual differences between high and low performing schools. It is expected that teachers' justifications for evaluation criteria are linked to their rationalization about pedagogic practice more generally. Emphasizing the centrality of evaluation criteria in pedagogic practice, Bernstein (2000, p.28) succinctly states that, 'Any pedagogic practice is there for one thing: to transmit *criteria*' (original emphasis).

On the whole, these teachers' accounts suggest that strongly framed criteria are linked to their school instructional cultures, learners' profiles and teachers' personal theories of 'effective' pedagogy. Instructional cultures in the high performing schools emphasized academic excellence through regular evaluation and correction of learners' tests and strict adherence to national curricula and assessment system demands. Further, centralized curriculum planning and monitoring practices in these schools ensured that teachers adhered to the broader curricula and assessment requirements. Teachers reported that they were expected to provide learners with 'detailed content' so that their classes were well 'prepared' for national examinations. The teachers at Alpha and Bethel reported that they were held accountable for the academic achievement of their learners.

During interviews, I asked teachers to explain the pedagogic benefit of the instructional strategies they enacted to explicate criteria. These teachers emphasized the imperative of pointing out missing and incorrect texts in the learners' productions in order to indicate possible errors. For example, Nekesa spent one third of her lesson

correcting a previous assignment. She justified this by saying, 'You have to discuss that homework with them so that they identify their mistakes'. Likewise, Musaali and Erone wrote correct answers in the learners' exercise books as they marked the class work. Musaali explained that this practice ensured that learners got correct 'versions' of answers because some learners neglect making corrections, given their young age. Erone explained that this practice was legitimated by the school, 'so that those who can't read and write well can be helped'.

Morais (2002) suggests that when teachers write answers into the learners' books, they personalize transmission-acquisition relations by taking into account the needs of individual learners. This explicates evaluation criteria and simultaneously weakens hierarchical rules, she argues. Given that both Erone and Musaali taught at Ebenezer and the school legitimated personalized evaluation practice demonstrates how schools' instructional cultures frame teachers' pedagogic practice.

The following extracts from Kabi's interview illustrate how he justified explicit evaluation criteria:

And actually some people had failed I had to come in and help them. I think you saw me moving around to help them where possible because for example, I said 'heat the end of the nail'; some were just heating the nail. So you have to move around and say, 'please heat at the end, not the middle'.

Sometimes they give wrong answers. You have to correct them there, yeah, sometimes they go wrong. Like now I gave them a nail and a piece of stick but most of them were most interested in the nail and they did not discover what was happening to the stick...that is where they went wrong. At the end of the lesson you have to talk about it because before that the teacher has to go through the activity. I had to go through it before to discover what the pupils will come up with. So the teacher has to know actually the results not only to discover them after the lesson. So for me I knew all the details but I wanted the children to discover them by themselves.

These extracts highlight the pedagogic significance of three strategies Kabi employed to explicate evaluation criteria. First, Kabi explained the importance of clarifying to learners the rules for producing legitimate texts. In class, Kabi provided learners with guidelines for the group tasks; he wrote these on the chalkboard and instructed learners to read them as he elaborated each in detail. Further, Kabi noticed mistakes in the learners' productions as he moved around monitoring their progress. This draws

attention to the imperative of supervising learners' activities. This also suggests that weakly classified teacher-learner spaces contributed to strongly framed evaluation criteria reflected in all group work lessons. Morais (2002) argues that weakly classified teacher-learner space strengthens framing of evaluation criteria.

Secondly, Kabi underscored the pedagogic value of pointing out missing texts and errors in the learners' productions. Bernstein (2000, p. 47) suggests that an emphasis on missing texts or what is 'absent' in the acquirers' productions allows criteria to become explicit and specific and the acquirer becomes aware of how to recognize and realize legitimate texts. This aspect is critical, given that teachers in Uganda erroneously consider explicitness about incorrect answers to be a constraint on learners' confidence to participate in pedagogic processes. Consequently, some teachers avoid explicit exposition of incorrect answers, and simply 'appreciate' the learners for 'trying' and leave it at that. This aspect is discussed further below. Thirdly, Kabi points out that a teacher should have prior knowledge of the expected results of the practical activity. This suggests that teachers maintain control over the criteria transmitted to learners, highlighting strongly framed evaluation criteria.

As mentioned above, many Ugandan teachers face a dilemma of how best to point out learners' incorrect responses in a way that does not discourage them from making further contributions. This highlights tension between teachers' assumptions about the problem solving approach as a 'learner-centred' pedagogy and the appropriateness of explicit evaluation criteria. Oyler and Becker (1997) suggest that some teachers misconstrue evaluation of learners' work as damaging their self esteem and positioning the teacher as an 'arbiter'. Kulaba ably balanced these two aspects during a brainstorming session; he accepted all the contributions learners gave but eventually pointed out correct and incorrect texts. He justified this practice as follows:

Okay there is always that aspect, you are accepting children's contribution and whether it is wrong or correct so that every child feels proud of contributing and the child gets the confidence. After that you now sort out those that you feel are the correct responses. Now the child who has contributed something wrong in the first place is appreciated for having contributed instead of saying no and you leave it out; a child will get discouraged. You even discourage others from contributing knowing that their answers will be rejected straight away. But when you accept all of them then you go sorting out the most appropriate ones I think there the children will feel comfortable and confident.

This extract demonstrates how Kulaba balanced the affective and cognitive dimensions of learning, by boosting the learners' confidence to participate in the class discussion while simultaneously pointing out errors in their contributions. Smerdon et al. (1999) argue that learners' freedom in activities is facilitated where they are allowed to 'make a lot of mistakes without being chastised for being wrong'.

I asked teachers about their rationales for probing learners' responses with *why* and *how* questions. This was one of the ways teachers explicated evaluation criteria. Asiimwe justified this practice in relation to the public examination requirements:

You see the problem we now have is that the questioning technique has changed. Where these children used to write a one word answer now the situation has taken the other way round where children have to write sentences answering why, how. So if you are now teaching and again you don't probe them you are not going to arouse that reasoning ability. So if that reasoning ability is not aroused that means these children will just remain like that and these questions that require long answers, which require them to reason, will be a problem... So in fact when we give them questions here and you want only one word answers children will pass very well but you bring in why, how so that one has also forced us to change the approach and methods.

The extract demonstrates strong external framing of teachers' practice by the national examination demands. It also points to how instructional cultures of high achieving schools are driven by aspirations towards excellence in public examinations. This emphasis was also reflected in the frequent comments and references teachers in these schools made about national examination requirements.

Further, these teachers explicated evaluation criteria by elaborating learners' findings during the group reporting sessions which they justified as a way to clarify and expand concepts. For example, Weere explained that, 'Now there are some points, which were clear. But to some other groups, since they were given different areas to investigate, I had to make sure that the point is broadened'. As he elaborated the issues reported, Weere frequently code-switched between English and Luganda, the dominant local language. He explained that this aimed to simplify concepts and so enhance the learners' understandings. 'Where necessary we integrate to make a point be driven home; it is allowed'. He argued that learners understand abstract concepts better when these are translated into their local languages, particularly in cases where visual materials were lacking. Kasanda et al. (2005) suggest that code-switching

strengthens the authenticity of everyday contexts. Setati, et al (2002)'s research on code-switching practices in South African classrooms reports that, teachers employed local languages to promote conceptual understandings and allow learners to communicate their understandings better.

Teachers in the small high performing schools reported that small class sizes enabled them to address learners' needs at an individual level. Musaali enumerated the following points as benefits of teaching a class of 25 learners:

It is very easy to handle a small number; you can reach an individual child, and you can be able to attend to individual children. Sometimes you can even do the marking within the lesson...it is easier when you are marking; you can even give more work. Where you give two numbers you can find yourself giving ten because there is time for you to mark. Sometimes... you can find a situation whereby when you are free you call one by one and instead of maybe going through the whole work in class you can even do it outside maybe during break or lunchtime...You call one by one because the number is small.

The extract suggests that small classes allowed teachers to strengthen evaluation criteria by correcting class exercises within the lessons and hence they were able to provide learners with immediate feed back on their productions. It also highlights the imperative of differentiating between individual learners rather than 'communalizing' them as a group. Thus, stronger classification between learners does not only support explication of evaluation criteria to individuals, it also allows their individual pedagogic identities to be identified and developed.

Unlike Musaali and his peers with small classes, Kulaba reported that his large class size (109 learners) did not allow him to address learners' individual learning needs. I asked him how different his instruction would have been if he was to teach fewer learners than his current class:

Supervision is easy, you can reach all the children easily, you can mark all their books faster and give them feedback, and you can look at a child as a separate individual instead of looking at them as a group. You would be able to identify individual differences and maybe I would help the children better.

Kulaba recognized the imperative of providing personalized instruction as a hallmark of effective pedagogy and argued that 'the understanding of the children is not the same'. Likewise, Asiimwe's account shows that he preferred strong classification between learners as crucial in providing explicit rules for their productions. Despite

the relatively high number of learners in his class (67), he addressed learners' difficulties individually. He moved around class to mark the class exercise, and as he did this, he assisted learners individually and also alerted the class about recurring mistakes. He recognized and endeavoured to promote learners' individual pedagogic identities by providing personalized attention which he justified as follows:

So in most cases we always encourage children to use their own heads and get those answers... they first try on their own then later on friends may come in, teachers may come in... Now when I am teaching at times I collect the data from all parties, from these students then after collecting the data I know the stand of each child. You know these children have got different mental abilities so this data will help me to help them on an individual basis.

Asiimwe's arguments above are consistent with his interpretation of the problem solving approach in which he identified attending to learners' individual abilities as a key feature of the approach. However, Asiimwe addressed learners individually because his 110 minute lesson was longer than most lessons which ranged between 40 and 80 minutes. Further, there were few learner activities in Asiimwe's lesson. This freed up time to address individual learners. This is in contrast to Sakwa's demonstration lesson where more time was necessary to conduct practical work. This suggests that the lesson structure of the lesson time frames influenced teachers' capacity to attend to individual learning needs. Asiimwe's lesson demonstrates that increasing the duration of lessons makes it easier for teachers of large classes to address learners' individual needs.

On the whole, emphasis on academic excellence in the instructional cultures of high performing schools socializes teachers into practices that promote explication of evaluation criteria. Teachers' accounts foreground these practices as indicators of 'effective' pedagogy, in conformity with their implicit theories of instruction. Schoonmaker (2002) suggests that schools are powerful socialization agencies for teachers' professional development and in some cases they 'wash out' teachers' initial preparation.

Intra-disciplinary knowledge relations

Chapter six shows that type one lessons reflected weakly classified intra-disciplinary relations between science topics as well as between science 'concepts' and 'procedures'. Teachers' rationales for these intra-disciplinary relations are examined

under lesson type two, given the similarities between the two lesson groups with regard to this feature. Teachers' accounts show that those who maintained strong boundaries between different science knowledges did not do this 'purposefully' but as part of their conventional way of teaching. This may be attributed to the general pressure to pace lessons fast so as to complete the official syllabus.

Relationships between science and everyday knowledge

This subsection examines teachers' justifications for strongly classified relations between science and everyday knowledge. In general, teachers reasoned that pressure to complete prescribed curricular content constrained the degree to which they related science to everyday knowledge. Further, they argued that learners lacked contextual knowledge of integrated science themes to aid the desired integration. They also alleged that some topics were socially detestable to some learners. I elaborate these points below.

Teachers of type one lessons recognized that their lesson content was potentially useful to learners' everyday lives; however they did not explicitly highlight this relevance in both the lessons and interviews. However, when probed about the potential relevance of their lesson contents to children's everyday lives, they pointed out some benefits. For example, Asiimwe said the knowledge on sound energy would arouse learners' interests in music and that they would be able to easily differentiate between sounds made by animals and so guard themselves against danger. Inconsistency between teachers' accounts and their practice may be explained by a general concern to complete the wide scope of the national curriculum. In view of this, concern, some teachers reported that relating science to everyday life is a time-demanding task. For example, Musaali said, 'Okay the relation would be there but the allocation of these topics and the periods we are supposed to teach these children, actually the period is short'. This suggests tension between the new pedagogic approach and the demands of the broader school system.

Furthermore, some teachers suggested that they did not approve of integrated science themes, particularly when these transmitted knowledge that they considered too contextualized and socially 'controversial' in some way. For example, Nekesa explained that Muslim students usually detest the topic of piggery because it is

unacceptable to religious values in Islam. She also reported that many of her learners lacked prior knowledge of some contextual aspects of topics and this constrained effective learning:

You are talking about a poultry house. Nothing has ever been in place, so in other words there is a big gap. One may just cram what you are saying but is not getting the facts properly because he has no learning environment.

On the whole, teachers of type one lessons maintained a strong boundary between science and everyday day knowledge and only weakened it as a 'portal' into school science, justifying this with reference to time constraints.

Lesson type two

This lesson type, identified as the transitional pedagogic form, had commonalities with lesson types one and three in relation to particular pedagogic features. In view of this, teachers' rationales relating to evaluation criteria have been presented under lesson type one. This section considers only teachers' rationales relating to pacing, intra-disciplinary relations and relations between science and everyday knowledge.

Weakly framed pacing

As discussed in chapter six, all the four lessons that reflected weakly framed pacing were taught in the small high achieving schools: Ebenezer and Fahimu. This section examines how these four teachers justified weakly framed pacing. These teachers highlighted three reasons to justify weakly framed pacing: first, they emphasized the need to provide learners relative 'freedom' to learn at their pace; secondly, they pointed out the need to provide learners with sufficient time for activities so that they were able to discover more and learn better, and thirdly, they explained that they wanted to occupy the faster learners so as to minimize boredom. I elaborate these points below.

Bogere and Kabi paced learners' tasks flexibly, extending duration of tasks when necessary. Further, both teachers did not indicate the duration of tasks to learners; thus pacing rules remained 'implicit' and 'invisible' to the learners, allowing them to work at their own pace. I asked these teachers why they did not set time frames for learners' activities. Bogere responded as follows:

If you indicate it [time for tasks] to them, sometimes they may not even do what you want so you just give them freedom to do whatever they can do in that time which you have set then afterwards you stop them. If the work that you have given to them is not complete then you complete it some other time.

Bogere's emphasis that explicit time frames interfere with the learners' freedom and progress with activities suggests that he considered the quality of learners' productions to be more important than the amount of work covered in the lesson. In the same way, although Kabi had planned his time judiciously, he limited the scope of work he gave his class and he did not explicitly indicate the duration of tasks to learners. He justified this as follows:

Because of the time I did not want to give them too much because sometimes they fail to identify. That is why I decided that they identify the first and the last [time taken to melt 'balls' of vaseline] otherwise it was supposed to be in order. In such experiments usually we need enough time, when they are discovering when they are busy doing their work they need to be given enough time so usually the teacher needs to be conscious about that time... maybe five minutes to give instructions then when they are doing let them be given enough time so that they can discover. Because some of them even discover more than what you expect.

Smerdon et al. (1999) argue that more time is required if children are to learn from self-directed activities. They suggest that learners may be 'led down blind alleys before they discover a good solution to a difficult problem' (p.29). Likewise, Morais (2002) argues that successful learning is dependent on weakly framed pacing where children have some control over the time of their acquisition.

Whereas Bogere and Kabi considered the quality of learners' productions a key factor in pacing lessons, Musaali defended his flexible pacing rules by highlighting the time demands of the problem solving approach:

It is a method that requires a lot of time and preparation, it requires a teacher to continue guiding until a child understands... you have to find possible ways to ask this and ask that until you come to what you want...you are beginning from what they don't know, you have to use a lot of questions, find possible ways change this maybe the language you are using is difficult so you have to keep changing things. So it is taxing on the side of the teacher if you are not really devoted you may divert.

Musaali highlights the need for patience and flexibility and teacher commitment as crucial for this pedagogic approach, echoing the views of several other teachers and

Bernstein's (2000) argument that competence models have 'hidden' time costs usually charged to teachers' commitment.

Erone also paced his lesson flexibly, frequently stopping to ascertain if learners were ready to proceed and repeating previous steps when necessary. In addition, Erone recognized differences in learners' paces and gave extra work to those who completed their class work earlier than others. He justified this as follows:

Yeah now that one is very important because when you have these slow learners and then those fast learners. Even in copying notes they are always faster, so you don't keep them redundant because, if you keep them idle, they will become a nuisance. So your only solution is to give extra work to keep them busy until the lesson is over.

Although Erone recognized the importance of accommodating learners' different pacing rates within the lesson, it is clear that he employed extra work for regulating social order as well.

Even though all four lessons considered in this section reflected weakly framed pacing, the extracts above show that these teachers acted from different pedagogic principles. Musaali, Bogere and Kabi justified their actions in terms of the need for flexibility in attending to their learners' pacing rates and productions. In addition, Musaali considered flexibility as a requirement of the pedagogic approach. These reasons are consistent with the pedagogic principles upon which the problem solving approach is based. The curriculum emphasizes the imperative of recognizing differences in learners' abilities and progress so as to foster their individual pedagogic identities and inert competencies (NCDC, 2000). In contrast, Erone considered the 'extra' work for the faster learners as a regulative device for maintaining class control. This reason does not reflect the pedagogic principles of the problem solving approach.

Weakly classified intra-disciplinary relations

This section examines teachers' justifications for relaxing boundaries between science topics as well as between science concepts and procedures. The section examines rationales for teachers in lesson types one and two. In general, teachers considered weakly classified intra-disciplinary relations vital for promoting conceptual progression, enhancing conceptual understanding and pedagogic efficiency, particularly by reducing time and complexity of instruction. They explained that

relations across topics promoted continuity by building upon prior knowledge and that this form of progression, taking lessons from the 'known to the unknown', motivates learners and it sustains their interest in learning. Erone and Musaali's views below are illustrative:

The kind of interrelation... okay to bring the children's attention towards a lesson you must begin from what they know. Then from what they know you now drive them in the new thing. That is when they now realize that eeh so we are now having a new thing. Now as they come to the new thing that is when they now get settled from what they know other than ambushing them straight. They will just say ah we don't know, some bright ones will say we don't know that one. But if you begin from what they know that's when they will enjoy the lesson (Erone, Ebenezer P.S).

Yeah of course that one helps now...you see now like that one there is where you build on what they have already learnt like the issue of mass and weight that they learnt in P.4. So it came in that part of physical change, that these ones will not change. That one we learnt in P.4, they will be able to go and check themselves. So sometimes it even helps these children who have forgotten to go back and check their notes and know that this thing is important (Musaali, Ebenezer, P.S).

Teachers' justifications for providing strong relationships between science topics are consistent with what the official curriculum foregrounds. With regard to relationships between science procedures and conceptual science knowledge, teachers reported that the practical aspects deepened learners' conceptual understanding by allowing them to 'visualize' abstract concepts which in turn made it easier for them to 'recall' the concepts easily. Musaali elaborates this view:

Basically it helps the child; he is able to see, feel and touch, so it helps a child to remember the concept or the idea you are putting forward. Now when he comes to sit for an examination he comes with the memory.

The official curriculum legitimates practical work so as to provide learners with opportunities to experience 'scientific processes' associated with the ways in which practicing scientists work. In contrast, Musaali's argument above shows that he considers practical work primarily as a pedagogic tool to illustrate concepts rather than as an end in itself. Evidence from elsewhere (Haigh, 2005; Osborn, 2002; Millar, 1989) suggests that most teachers consider practical work to be a pedagogical tool for illustrating and enhancing conceptual understandings.

Strongly classified intra-disciplinary relations between concepts and procedures

Of the four practical lessons, only Kabi's lesson reflected strongly classified relations between sciences 'concepts' and 'procedures'. Kabi explained that he purposefully did this to limit the scope of work in order to allow learners more time to experience the skills of measurement and recording. Kabi's rationale, which highlighted the imperative of developing science process skills, is consistent with the official curriculum. Kabi's decision to restrict the scope of work demonstrates how lesson time frames regulated the structure of pedagogic activities. Although Kabi planned to cover the conceptual significance of the practical work in subsequent lessons, his lesson, nevertheless, demonstrates how limited time frames contribute to fragmented learning of practical science work. McNay (2000) cautions against too much activity with little or no content and argues that effective science education integrates process skills with significant concepts so that the two are not learnt in isolation.

Weakly classified relations between science and everyday knowledge

With the exception of two lessons, lesson type two reflected weakly classified relations between science and everyday knowledge. In general, these teachers considered everyday knowledge to be useful pedagogic resource or 'means' for learning science, particularly where everyday examples, materials and language were employed to simplify concepts. For example, Musaali explained that he introduced abstract concepts and terms through everyday language to ease learning. He said:

When a child is able to use the normal language [everyday language-LS] to identify and say the right word it actually helps the child who remembers what the thing is called. This means the child has grasped that thing properly and when you bring the scientific term now it becomes very easy, the child now relates it to the scientific term.

Musaali weakened the boundary between science and everyday knowledge as a pedagogic strategy for introducing science terms and concepts. Unlike teachers of type three lessons, who defended weakly classified boundaries between these two discourses on the notion of relevance to daily living, teachers of type one and two lessons did so to facilitate mastery of abstract science concepts. These teachers' rationales are consistent with the official curriculum, particularly in relation to the application of science to everyday life concerns. Further, these rationales highlight the view that the two-way relationship between everyday knowledge and school

knowledge provides important pedagogic tools for inducting learners into formal discourse and for the practical application of formal knowledge to problems of the real world (Taylor, 1999; Hedegaard, 1998; Aikenhead, 1996).

Lesson type three

This section examines teachers' rationale for the pedagogic features identified under lesson type three. This lesson type, taught in three low achieving schools, Ddembe, Gonzaga and Harambee was characterized by weakly framed or 'implicit' evaluation criteria, slow pacing of learners' activities, strongly classified intra-disciplinary relations and weakly classified relations between science and everyday knowledge. Before analyzing teachers' rationales, I provide an overview of teachers' perceptions of the learners attending the low performing schools as this was a key factor in justifying their practice.

On the whole, teachers in the three low achieving schools referred to above constructed their learners as 'less able' and described them as 'weak', 'slow', 'forgetful', 'dull' and 'problem learners'. Further, despite some classes having mixed ability learners, most teachers in these schools communalized all the learners as 'weak' and tailored their pedagogic approaches accordingly. Only Bwogi considered her class to be a higher ability one, relative to another stream. The following extracts exemplify how two teachers described these learners:

They select children who are in most cases... [Shakes her head in discontent-LS] Like here in our case we have dull children; those children whom you teach and they cannot get what you are teaching; we don't know what is wrong with them. So that is the problem with this place... to some extent we try to assist as you saw me, you get a chance of going to each and everybody but in most cases they are very dull (Nambuya, Gonzaga, P.S).

Even if the class is small you find that you have got very few... you can have only one child who can pick, [understand-LS] others are just there, you are just pulling them to get what you are teaching. So as a teacher if I have more than those ones I can be able to teach very well and these children learn from others (Suubi, Harambee, P.S).

These teachers had very low expectations of their learners and this attitude influenced their pedagogic practices considerably. For example, unlike other teachers in small schools, Suubi did not consider her small class size to be advantageous. She preferred

to teach a larger mixed ability class, arguing that weaker learners learn from their higher ability peers. In view of such low expectations, some teachers were generally apathetic towards their learners' learning difficulties and appeared to have 'given up' on them inadvertently. Further, Nambuya was concerned that the poor image of small low performing schools, causes the public doubt the competencies of teachers who teach there. She said, 'Most children in Kampala take them to be third world schools, may be they even think teachers who are there don't teach, I don't know'.

Teachers were also concerned that once their students 'picked up', they were transferred to better performing schools. For example, Ssesanga complained, saying, 'All my children whom I expect first grade from are being picked away by the parents; in fact I have been feeling very bad about it'. It was clear that frequent transfers of learners from the low performing schools discouraged teachers since they felt their efforts were being 'wasted'. Ease in transferring children across schools is facilitated by flexible school entry policies promoted under the UPE programme, as part of their efforts to eliminate 'unnecessary' barriers to school access.

As discussed earlier, most learners attending the low performing schools originate from low socio-economic homes situated in slums that are in close proximity to these schools. Therefore, learners initially attend the low performing schools when parents consider them to be too young to commute to the high performing schools that are farther away from the slums. However, when learners are older and able to commute to the 'better' schools, their parents transfer them there. The head teacher of Harambee reported that some parents use his school and other similar ones as 'transitional' schools for their less 'competent' children. He argued that such parents consider Harambee to be 'convenient' in terms of proximity.

These teachers cited poor reading skills as the main constraint on their learners' competencies. Suubi explained this challenge as follows:

Eeh, the language, they have the problem of language, reading; they cannot read and internalize the issues or the matter which they are reading. The problem is language mainly, they cannot... they don't understand English. Even if you are talking just like this you find a very big problem until when you say, 'Ah, let me change to Luganda', sometimes you change to Luganda and that is when they will understand you and they answer you in Luganda and yet they have to answer in English....when they are setting they do those

papers in English [public examinations-LS] so they have to practice reading English, writing English, speaking English.

In view of learners' perceived low competences, low achieving schools emphasize certain remedial practices to help develop learners' English literacy skills. For example, teachers are required to provide learners with opportunities to practise reading and writing skills in all school subjects. Further, charts showing the English alphabet were hanging above the chalkboards in Ddembe and Harambee so to help learners to identify and differentiate between letters. At Ddembe all classes were required to begin the day with reading exercises. Bernstein (1990) suggests that reading is a critical skill, particularly in visible pedagogies, because it empowers learners to engage in independent work. This background provides a context for pedagogic practice in low performing schools.

Slow pacing of learners' activities

The analysis in chapter six highlighted the very slow pace of learners' activities in type three lessons. Teachers of this lesson type justified the slow pace on learners' competences, arguing that this was one way to accommodate their low abilities. For example, in response to a comment that her class took a long time working on a simple task, Acom explained that slow learners require more time in order to learn better:

That [slow pace of learners' tasks-LS] is what we can do, these weak children. That is why we should be patient that is why we should not hurry, when you hurry you will leave very many behind. So the only thing is just to come down to their speed, slowly. And one good thing they are few. If they were to be very many it would be a lot of problems because now carrying a heap of books and very many people don't understand. But at least this one you can go slowly and those who can pick they will pick. Like now the majority picked but only those three out of twelve did not. It means these nine people have got it.

Acom highlights how relaxed pacing rules enabled her weak ability class to produce the expected text. In agreement with Acom, Suubi explained that learners at their school (Harambee) usually take long to complete tasks, she said, 'They take time to do that work, you can give work and they take even one hour and more without finishing that work'. In general, these teachers justified slow pacing as essential for remedying their learners' low competences as a form of 'repair work' (Bernstein, 1990). Relaxed pacing is a key feature of 'repair work' aimed to allow weaker

learners to 'catch up' on their grade level requirements. However, Bernstein (1990) points out that relaxed pacing limits the quantity and quality of work in terms of its scope and cognitive demand. This, he argues, ultimately stratifies low ability learners, positioning them as 'less able' (Bernstein, 1971).

Although low performing schools were mainly attended by less competent learners, some classes were mixed ability. Chapter six showed that 'faster' learners remained idle for long periods of time in Acom, Opio and Nambuya's classes, while 'waiting' for their slower counter parts. These teachers' failure to differentiate between learners' pacing may be attributed to their inability to handle mixed ability classes, as Opio suggests below:

The problem is the number is too big for the teacher to teach and to cater for every child, it becomes difficult. You may discover a child who is really weak than others. Now when you try may be to assist that other child, as you are helping these ones the others are already disturbing. So you end up maybe getting confused, other times you end up leaving work on the blackboard. But if the other one already does not know what to do so, maybe you say, 'let me give work on the blackboard and then go and see the other one', then those who have already completed their work and have nothing to do begin disturbing. So that is a very big problem we have really with these classes.

Opio's inability to handle mixed ability learners is clearly demonstrated in his perplexity about assisting 'slower' learners and simultaneously attending to the 'faster' ones. Unlike her counterparts in lesson type three, Bwogi paced the learners' tasks at a fast rate which she justified on the grounds that her class was 'brighter' than other streams:

That stream there [the one she taught] is not as weak as these other streams. Those children there are not very forgetful, their rate of understanding is not like the other stream, so the rate we go with the other streams is not the rate we move with these people and the rest. Because the other ones their ability of understanding is very far.

Bwogi's argument suggests that she recognized the importance of differential pacing for different ability levels. However, the analysis in chapter six showed that she terminated the questioning session before establishing whether learners had exhausted all their questions. Adjusting pacing to suit the ability levels of learners is laudable and resonates with the pedagogic principles of the problem solving approach. But failure to differentiate between learners' paces communalizes their pedagogic

identities in contrast to the pedagogic principles of the problem solving approach. Unlike other schools, Gonzaga and Harambee did not provide for ability streaming of classes because of the few teachers in these small schools. Opio's school, Ddembe, had multiple streams but his class had not yet been ability streamed by the time of field work.

Weakly framed evaluation criteria

Type three lessons reflected weak to very weakly framed evaluation criteria. Weakly framed criteria in these lessons were accentuated by the following practices: teachers did not elaborate learners' correct responses; they ignored incorrect responses or simply commented that these were wrong without pointing out missing texts. Further, teachers provided very brief and unclear instructions for tasks. Although all four teachers moved around the class and looked at learners' work, they did not intervene to clarify instructions or provide help even when learners' productions warranted this. Further, none of the teachers corrected the class work in the lesson although they all marked it.

To justify these practices, all four teachers drew attention to the low competence of their learners. Although these teachers blamed their woes on learners' incompetences, it was evident that in some instances they did not sufficiently explicate criteria to enable learners to produce expected texts. This perpetuated a high level of ambiguity in the lessons. For example, while Opio was writing the class exercise on the chalkboard, a learner identified a spelling error in the work. The learner walked up to Opio and pointed out the error. He corrected the mistake but he did not inform the class about it so that they rectify it as well. During the interview I asked Opio about the possibility that some learners did not see the correction and he responded as follows:

Anyway I was supposed to tell them that this is a mistake, that it wasn't supposed to be like that but I just realized later that I should have told them. Because if you just write it like this some of them might have written it like that [erroneously] I realized it later on that if you just write it there without telling them some of them may not even see and they may error and write a wrong spelling, mmh so it was in mind.

Opio explains that although he did not notify learners about the error, he had it 'in mind', highlighting implicit evaluative criteria. This suggests that Opio did not give

learners an opportunity to learn the legitimate text so as to give a correct answer in future. Explicit criteria provide learners with opportunities for self-evaluation and correction and hence increase their potential to provide legitimate texts subsequently (Nakabugo, 2004). Opio's account suggested that his pedagogic practice was generally characterized by implicit evaluation criteria. He reported that he typically corrected learners' spelling errors by indicating the abbreviation, 'sp' against them. However, such abbreviations did not communicate the intended message to learners because he reported that some learners mistook it for a complimentary comment. He reported incidents where learners inquired about the meaning of 'sp', 'So they say, "Teacher you have given me 'sp' is it very good? Others are saying it means good"'.

After he pointed out that several learners had failed the class exercise tasks, I asked Opio what could have constrained learners from realizing expected texts. He explained that they failed to 'recall' the answers because they are slow learners. When I sought his opinion on how these learners could be helped, he responded as follows:

Now those are the children who are slow learners. They needed some repeating with them together, yeah, so if you find such a child you don't have to harass. What you do, you keep quiet but you take his or her book then when everybody has finished you give them their books then you go through with them while they are filling in the right answers. If you leave it the bright ones will have got the answers right but those dull ones, slow learners, they will have nothing. So you write for the, for those ones who are slow learners otherwise if you just leave, they all write nothing... So we cater for them after the others have finished.

Opio considered it to be a form of 'harassment' to point out mistakes in the learners' work. He therefore preferred to 'keep quiet' during the lesson and provide remedial help to the weak learners afterwards, possibly out of class. Opio's stance on mistakes highlights the supposition alluded to earlier, that pointing out learners' mistakes 'discourages' them (Oyler & Becker, 1997). Opio's preference to assist weaker learners 'afterwards' suggests that he also had difficulties handling a mixed ability class. This may be attributed to his general competence in teaching. This study did not focus on teachers' pedagogic knowledge in depth; therefore it is not possible to analyze this issue further than this. However, its influence on the teachers' recontextualizing processes is acknowledged.

Weakly framed evaluation criteria in Opio's lesson and those of his counterparts can also be explained by other contextual factors. It is possible that the general pressure to cover the official syllabus contributed to his preference to 'cater' for learners out of class. He explained that he endeavours to cover the syllabus prior to examinations, and only revises difficult aspects of the work covered 'briefly' if time allows. This implies that coverage takes priority over conceptual development.

Suubi's lesson reflected very weakly framed evaluation criteria as well. During the interview, we discussed why learners failed to produce correct answers to the tasks assigned to them. Suubi explained that in her opinion the work was very simple but the learners failed to produce expected answers because they are 'too forgetful'. 'Moreover the work they did was meant for primary four', she argued. The fact that Suubi gave her class work meant for one grade lower than their current grade underscores the low expectations she had of them. When I sought her opinion on what could have been done to help learners realize the expected text, she reiterated her earlier position that the exercise was very simple so there was 'nothing' she could have done about it. However, she quickly added that she hoped some children would 'pick up' in the subsequent school term. Suubi could have been apathetic to her learners' difficulties because she did not expect much from them in the first school term. Lee, Dedrick, and Smith (1991) suggest that if students are perceived as being of low ability or unable to learn, teachers tend to lower their expectations of their own ability to teach them.

While these teachers justified their practices on the basis of learners' low competences, Ssesanga and Acom's accounts suggest that teachers' individual pedagogic styles rather than learners' competencies exacerbated implicit evaluation criteria in type three lessons. Acom and Ssesanga, whose lessons reflected explicit evaluation criteria, taught at Harambee and Gonzaga, respectively. Acom's account shows that she recognized the imperative of giving low ability learners more time to produce expected texts; therefore she relaxed pacing rules. Bernstein (1990) suggests that relaxed pacing is one of the measures employed to cope with 'less able' learners in 'repair' work.

Whereas Acom reported that her learners produced expected texts under relaxed pacing, Suubi said she 'could do nothing' about her learners' instructional difficulties. Acom adjusted pacing to suit the learners' abilities and accompanied this with other measures to explicate criteria; consequently learners were able to produce the required texts. In contrast, Opio and Suubi relaxed the pace of learners' tasks but did not accompany this with other measures for explicating criteria. This highlights the view that extra time for learning is not effective unless accompanied by explicit criteria for legitimate texts. Morais (2002, p.560) captures this argument in precisely stating that, 'Time without explicit criteria may be useless'.

Unlike the high performing schools where instructional cultures promoted strongly framed evaluation criteria, teachers' accounts show that instructional cultures in Ddembe, Harambee and Gonzaga promoted 'repair work' as a response to low levels of learner competencies. Further, these schools did not provide structured opportunities for centralized curriculum and assessment planning like the high performing schools. Some studies show that teachers who work in isolation miss benefits that derive from centralized planning and conversations (Rosenholtz, 1991; Lee, Dedrick, & Smith, 1991; Little, 1992).

Strongly classified intra-disciplinary relations

This section examines why teachers maintained strongly insulated boundaries between science topics. With the exception of Bwogi's lesson, all type three lessons reflected strongly classified intra-disciplinary relations. Teachers' accounts did not provide explicit justifications for strongly insulated intra-disciplinary boundaries, suggesting that this was not a 'purposefully' enacted feature. However, as discussed in chapter six, strongly classified intra-disciplinary relations in these lessons may be explained by horizontal knowledge structures within the integrated science themes which permit little room for integration (Bernstein, 1999). Further, in chapter seven I discussed that these lessons covered public domain knowledge that was particularized to local contexts. Integrated science themes were transmitted in a segmental manner, regulated by its functional application to society rather than in relation to conceptual development.

Bwogi, like teachers of lesson types one and two, justified weakly classified relations across science topics in terms of the benefits deriving from conceptual progression and pedagogic efficiency in teaching. She said;

That one is not bad because when you teach such a topic in one way or the other some children recall, in fact that time for them they will be revising. And even for the teacher, when teaching, at least you can refer to the previous class where it was taught, and then you build on what they learnt before. And in fact when teaching it is a bit simpler than when tackling a new topic which has never been tackled at all.

Bwogi's rationale for weakly classified intra-disciplinary relations as well as those espoused by teachers in lesson types one and two resonates with the official curriculum rationale for integrating science topics through the spiral curriculum design.

Weakly classified relations between science and everyday knowledge

This subsection analyzes teachers' justification for weakly classified relations between science and everyday knowledge. The analysis in chapter six shows that type three lessons reflected very weakly classified relations between science and everyday knowledge. In general, teachers justified these weakly classified relations on two key reasons. First, they argued that familiar knowledge motivated learners to participate in lessons because it was meaningful to them. This may be attributed to the fact that these teachers taught integrated science themes as a form of 'contextualized curriculum' focusing on familiar knowledge. Secondly, teachers argued that weak boundaries between science and everyday knowledge enabled learners to apply science to concerns in their everyday living so as to improve their livelihoods. These teachers projected everyday life as the ultimate 'end' for science knowledge.

First and foremost, teachers considered a weak boundary between science and everyday knowledge as vital for promoting the application of knowledge to daily life concerns. In particular, these teachers considered contextually relevant science knowledge to be a potential source of livelihood for learners for whom primary schooling was terminal. They also argued that most of these learners originated from disadvantaged home backgrounds where illiterate parents and relatives would benefit from school knowledge. For example, Malongo explained that learners would be

empowered to advise their relatives against using unsafe first aid practices. Weere and Bwogi's extracts below are illustrative of these views:

When you look at poultry farming, then you look at beekeeping, you go to the goats, the sheep, piggery, and this is what the government is trying to emphasize these days; to train job creators. If a child leaves P.5 when he has learnt these environmental changes; the physical, the chemical then we go to those health problems, the alcoholism. When a child understands all these you find that even in his day-to-day life he will not face problems in sickness, health problems will not be there. This family planning, if a child gets it properly even if he drops out of school, if he goes to apply that science, he can live a very very interesting life (Weere, Canaan, P.S).

Okay that one can help them about their health because they will be able to know, like for the hookworms they will know the usefulness of putting on shoes and not walking bare footed. Because they will know that if you try to walk bare footed especially where poor disposal of faeces are, automatically they will get the worms. And as they were learning that those worms can bring about hookworm anaemia they will be able to know and avoid walking bare footed. Then, these tapeworms, they will know that whenever they bring meat at home that meat should be thoroughly cooked, not just to eat it, because they don't know which animal it has come from. So at least they will be able to prevent themselves from certain diseases brought about by the worms (Bwogi, Ddembe, P.S).

Secondly, teachers reported that weakly classified relations between science and everyday life simplified instruction. They argued that everyday knowledge allowed learners to identify with their local contexts, which motivated them to participate in class discussions. For example, Opio said:

That one, especially when you are talking about the animals, you pick animals that they look at everyday, everyday, everyday. That is why many were putting up their hands because some of them have them in their homes. So when you are asking they answer what they have seen in their homes. For those ones [topics] which they are not used to, you mostly get very few responses; instead most of them just look at you. You try to ask and they think of what to say but they don't know so the response is very meagre.

Suubi asked her class to identify the local language names for the different plants and leaves that were examined in the lesson observed. She explained that this relationship with 'what happens at home' simplified concepts and facilitated learning.

Despite its anticipated benefits, application of science to everyday life was not without challenges. Malongo reported that in some cases learners did not appreciate the utility of science knowledge, particularly where it was perceived to alienate them

from their established traditional beliefs. Malongo recalled an incident where a group of girls took issue with the idea of incinerating used sanitary materials; this method had been suggested as a hygienic way of disposing such materials. These girls insisted that the practice was 'taboo' and carried a severe penalty of rendering them 'infertile'. In such cases teachers might be compelled to maintain a strong boundary between science and everyday knowledge.

On the whole, this group of teachers privileged weak boundaries between science and everyday knowledge and justified this as valuable for enriching learning and its application to everyday life. In contrast, teachers of type one and two lessons considered the relations between science and everyday knowledge to be crucial for learning science.

8.3 Schools' instructional cultures and teacher autonomy

This section examines how the instructional cultures of the research schools influenced the teachers' efforts and potential to enact the problem solving approach in the manner projected by the official curriculum. Autonomy over instructional matters is as crucial an element in enacting the problem solving approach, as other competence models of pedagogic practice (Bernstein, 2000). Some measure of autonomy over instruction allows teachers to recognize and attend to learners' individual needs and abilities so as to promote their pedagogic identities rather than focusing on accountability to external regulations. Therefore, the pedagogic approach requires weak external framing to give teachers some flexibility in instruction. However, stronger control over the evaluation criteria is vital because the problem solving approach legitimates strongly framed evaluation criteria.

The analysis shows that teacher autonomy was influenced by the organizational structures and cultures of schools. In general, more structured organizational and institutional cultures accorded teachers low autonomy over pedagogic practice. Centralized curriculum planning and monitoring practices at Alpha, Bethel, Ebenezer and Fahimu exerted strong external control over instructional matters relating to selection, sequencing, and pacing and evaluation criteria. Strong monitoring of instruction at these schools allowed teachers limited autonomy over instruction as they were expected to adhere to defined frameworks. With regard to evaluation

criteria, teachers reported that heads of departments and directors of studies vetted their question papers and marking guides. Further, teachers reported that assessment results were discussed in subject departments and academic committees so as to review learners' performance and set strategies to improve academic achievement. These practices provided the potential to realize strongly framed evaluation criteria which is one of the requirements of the problem solving approach.

In contrast, Ddembe, Gonzaga and Harambee had relatively less structured organizational frameworks and institutional cultures. Centralized curricular planning was less evident at these schools and teachers reported that subject department meetings were rarely held. In general, teachers in these schools operated largely in isolation from one another. The beginning-of-term staff meeting at Harambee that I attended discussed income-generating activities for the school and a proposed scholarship fund for orphans. And at the end of the meeting, the head teacher reminded teachers to submit schemes of work to the head teacher for record keeping.

There was variation in the degree of autonomy and potential for enacting the problem solving approach as prescribed in the official curriculum in the two groups of schools. Less structured school cultures promoted weaker external control over classroom practice which provided more room for enacting the problem solving approach. Relaxed control over sequencing and pacing allowed flexibility as exemplified in the slow pacing of learners' activities at Gonzaga, Harambee and Ddembe. More structured organizational frameworks at Alpha, Bethel, Ebenezer and Fahimu exerted stronger external framing over instruction and constrained teacher autonomy. In this case, teachers had less flexibility to adjust their practices to learners' needs as required by the problem solving approach. These schools' instructional cultures, by focusing on a 'repair' form of pedagogy, promoted slower pacing of learners' activities and by so doing responded to learners' abilities.

Bernstein (2000) suggests that external mandates provide a pivotal focus for a school's organizational order and this organizational order acts like a 'container' that 'shapes' instructional cultures in schools. In the context of the research schools, these mandates include curriculum and assessment requirements, parental expectations, as well as the schools' public image. The organizational order and instructional culture

collectively constitute the school's pedagogic culture, which provides a context for teachers' pedagogic practices. Teachers' accounts suggest that their schools' pedagogic cultures influenced their enactment of the problem solving approach considerably. Thus, the distributive rules of the official curriculum were mediated by the school's pedagogic culture to influence teachers' recontextualizing processes.

Conclusion

This chapter has shown that, in general, teachers recognized the salient features of the problem solving approach as well as its pedagogic value in science education as defined in the official curriculum. Teachers' accounts show considerable tension between the pedagogic requirements of the problem solving approach and the broad school system elements, in particular the curricular and assessment demands. Although these teachers recognized the pedagogic requirements and benefits of elements of the problem solving approach, they were unable to realize their ideal pedagogy in practice, owing to strong external framing of their work. Further, the analysis shows variation in teachers' justifications for particular forms of pedagogic practice across school contexts. Teachers in high performing school contexts emphasized accountability to the broader education system and school level mandates relating to curricular and assessment requirements as the key determinant of their practice. In contrast, in low achieving schools, teachers defended their practices in terms of the low competence level of their learners. This suggests that curricular prescriptions were adapted primarily to learners' competencies in the low achieving schools and to external curricular and assessment mandates in high achieving schools.

In general, this chapter has shown that, teachers' recontextualizing processes were mediated by their schools' instructional cultures, including opportunities and constraints therein, the demands of the broader school system, teachers' professional identities and influences from dominant social relations. The differentiated ways in which teachers justified their enactment of the pedagogic approach lends support to the view that curriculum implementation is a complex process involving adaptation rather than wholesale adoption of the policy message (Ball, 1998; Ball & Bowe, 1992; Spillane, 1999, 2000; Benavot & Resh, 2003; Blignaut, 2005).

CHAPTER NINE: SUMMARY OF THE ANALYSIS OF TEACHERS' RECONTEXTUALIZATIONS

This chapter summarizes the analysis in the preceding three chapters and presents these differently in order to highlight the main findings of the study. The analyses draw attention to commonalities and differences in the data relating to teachers' enactment of the problem solving approach, their interpretations of the official curriculum and their rationales for enacting the pedagogic approach in particular ways.

9.1 Overview of the analysis

This section outlines the different analyses undertaken in the preceding chapters and highlights the key findings from these. The first part of the study describes teachers' recontextualizations of the problem solving approach in classroom practice and in interviews. With regard to the former aspect, the study describes *how* teachers enacted the problem solving approach in science lessons. The latter aspect examines teachers' interpretations of the problem solving approach as defined in the official curriculum, focusing on its distinguishing features and pedagogic benefits. These two aspects (classroom practice and teachers' accounts) constitute teachers' recontextualizations of the problem solving approach.

The second part of the study examines *why* the teachers enacted the problem solving approach in particular ways; in other words, their rationales for pedagogic practice. This part of the study includes a particular focus on ways in which school contextual factors influenced teachers' recontextualizing processes. This part of the study provides insights on the factors influencing curriculum implementation processes and draws attention to influences inherent in particular school contexts.

The main findings from the different parts of the analysis are summarized in table 9.1 below. The table shows similarities and differences in teachers' recontextualizations of the problem solving approach.

Table 9.1 Summary of the key findings from the analysis

	Similarities across lessons	Differences across lessons , variation across lesson types
A) Pedagogic structure		
Lesson structure (chapter 6)	<ul style="list-style-type: none"> - Group work - Teacher led expositions - Practical science demonstrations 	
Control over pedagogic processes (chapter 6)	Selection , sequencing , pacing , social order (F++)	Pace of learners' tasks Evaluation criteria
Knowledge relations (chapter 6)	Inter-disciplinary knowledge relations (C++)	Intra-disciplinary relations science /everyday knowledge relations
B) Instructional content		
Type of instructional content Instructional strategies for its transmission (Chapter 7)	Domains of knowledge Esoteric & public domains	Distributing strategies Lesson types one- generalizing & specializing Lesson type two- generalizing , specializing , localizing Lesson type three- fragmenting, localizing
C) Interpretations of the problem solving approach in curriculum policy (Chapter 8)	<p>Main features More learner involvement in learning Solving 'problem tasks' in class work Application of science knowledge to everyday problems</p> <p>Pedagogic benefits Enhances conceptual understandings and memorization Application of knowledge to solve problems Develops social skills, investigative skills Motivates & interests learners</p>	
D) Rationales for pedagogic forms (Chapter 8)	Strong external framing from curricula accounting for selection , sequencing, pacing , inter-discursive knowledge relations	<p>High performing schools</p> <ul style="list-style-type: none"> - external mandates from school & education system - requirements for examinations - effective pedagogic practices as part of instructional culture <p>Low achieving schools</p> <ul style="list-style-type: none"> - low learner competencies - ineffective pedagogic practices
E) Influence of external framing from school on enactment of PSA (Chapter 8)		<p>High achieving schools (strong external framing (Fe⁺⁺)</p> <p>Low achieving schools (weak external framing (Fe⁻))</p>

The following sections present the similarities and differences in the analysis in turn, beginning with all similarities reflected in the table above. On the one hand, similarities in teachers' recontextualizations highlight the influence of macro education system factors, particularly the national curriculum and examination requirements on curriculum implementation. On the other hand, differences between teachers' recontextualizing processes across schools but similarity within particular schools suggest influence from teachers' local contexts of practice within schools and classrooms.

Similarity in pedagogic practice

All the lessons observed reflect similarities in relation to the following features: selection, sequencing, pacing of transmission (teacher-led aspects), social order and inter-disciplinary relations between science and other school subjects. These pedagogic features are all strongly framed and classified, emphasizing teachers' strong control over instruction. In all lessons, teachers selected content, activities and instructional materials, giving learners very few options. Teachers also determined the order of transmission and its pace and provided little variation in response to differences in learners' abilities and progress. Social relations were hierarchical; highlighting the teachers' status as the regulator of instructional and regulative order. Teachers employed positional forms of control to regulate social order in the classrooms; this form emphasizes adherence to established rules and positions. Further, all lessons reflected strong inter-disciplinary boundaries between science and other school subjects.

In relation to content, the analysis shows similarities across the three lesson types identified in chapter six. Esoteric domain content was reflected in all three lesson types and public domain content was reflected in both lesson types two and three. In this regard lessons were not strongly differentiated in terms of content types.

Table 9.2 Summary of similarities in pedagogic features

Pedagogic features	Framings /classification
Selection	F ⁺⁺ ;F ⁺
Sequencing	F ⁺⁺ ;F ⁺
Pacing of teachers' transmission	F ⁺
Social order	F ⁺⁺ ; C ⁺⁺
Inter- disciplinary relations	C ⁺⁺ ;C ⁺
Content types	Domains of practice
Lesson type one	Esoteric domain
Lesson type two	Esoteric domain & public domain
Lesson type three	Esoteric domain & public domain

Similarities in teachers' rationales for practice

The teachers' rationales or 'recontextualizing rules' illuminate factors underlying similarities in pedagogic practice shown above. Teachers' accounts highlight tension between the pedagogic requirements of the problem solving approach and contextual realities of their work at three levels: the macro- level of the school system, the meso-level of the schools and the micro-classroom level. Whereas the official curriculum requires teachers to cede control to learners by giving them some options in teaching and learning processes, strong regulation of teachers' work from both the national system and school levels compels teachers to maintain control over instruction. Teachers argued that they maintained control over pedagogic processes to ensure that they fulfilled the curricular and assessment demands at both school and national levels.

The national curriculum in Uganda is characterized by content heavy syllabi with a defined sequence and time frame for completing topics. This constrained teachers' efforts to provide flexibility in instruction. Further, teachers' accounts show that system level demands are reinforced by tight regulation of pedagogic practice in schools through centralized curriculum planning and assessment frameworks which set defined targets for instruction. On the whole, strong regulation of teachers' work promotes an inflexible pedagogic environment that partly accounts for strong teacher control over instruction. In addition, the teachers attributed their reluctance to relate science to other school subjects to the pressure to complete the wide scope of the science syllabus. This is reinforced by the division of teaching labour in schools which promotes subject specialization and predisposes the teachers to maintain strong boundaries between subjects.

Teachers justified an explicit code of conduct in classrooms on the premise that it ensured ‘effective class control’ and learners’ concentration on tasks; teachers considered these to be hallmarks of effective instruction. Teachers’ rationales for hierarchical social relations were generally consistent with the broader social relations in schools and society. In general, social relations in Uganda emphasise hierarchical relationships between adults and children. These are inconsistent with the requirements of the new pedagogic approach which aims to promote learners’ capacity for self-regulation. The latter requires less hierarchical social relations between teachers and learners where teachers are confident enough to cede some control to learners.

This analysis suggests that the requirements of the new pedagogic approach are generally in tension with the structure and processes of schooling in Uganda. The demands of covering the national curriculum in preparation for the public examination, PLE, written at the end of primary seven constitute a key influence on teachers’ practice from the education system level. Because these tensions originate from the macro-level of education and society, they are reflected in all the lessons across the research schools. Benavot & Resh (2003) attribute between-school similarities in curriculum implementation to macro-level factors in centralized national school systems. They argue that that the ‘shadow’ of public examinations in centralized education systems acts as an indirect but very powerful control mechanism generating greater uniformity in curriculum implementation across schools.

Table 9.3 Summary of teachers’ rationales for similarities in pedagogic practice

Pedagogic features	Main rationale
Selection F ⁺⁺ Sequencing F ⁺⁺	Centrally designed curricula, school level curriculum planning strong external framing (Fe⁺⁺)
Pacing F ⁺	Wide scope of science syllabus, short lesson time frames, intensive school programmes, strong external framing (Fe⁺⁺)
Social order F ⁺⁺ / C ⁺	Explicit code of conduct within schools Emphasis on effective class control and management practices Strong external framing (Fe⁺⁺)
Inter-discursive C ⁺⁺	Pressure to cover subject specific content Division of teaching labour in schools Strong external framing (Fe⁺⁺)

Similarities in teachers' interpretations of the problem solving approach

This section summarises the analyses of teachers' interpretations of the problem solving approach relating to its key features and pedagogic benefits. In general, teachers across the three lesson types interpreted the problem solving approach in broadly similar ways. Teachers mentioned three key features in describing the problem solving approach. First and foremost, they highlighted the aspect of more learner involvement in pedagogic processes as the key distinctive feature of the problem solving approach, associating it with learner-centred pedagogy. Secondly, teachers interpreted the pedagogic approach as being synonymous with 'solving problems' in class exercises. Thirdly, teachers highlighted the application of science knowledge to problems in everyday life as another key feature of the problem solving approach.

With regard to pedagogic benefits, teachers suggested that the problem solving approach was valuable in the following ways: that activity based instruction enhanced learners' conceptual understandings and capacity to retain knowledge; that it promoted the application of knowledge to problems of everyday life; and that learner activities generated interest and motivation in learning and also developed their social and investigative skills. In addition, teachers pointed out the limitations of the problem solving approach highlighting its time demands in relation to pressure to complete the official curriculum, its unsuitability for some topics and the tension between balancing conceptual development and ensuring adequate learner participation in pedagogic processes. In general, by showing its main distinguishing features, pedagogic benefits and limitations, teachers recognized the specificity of the problem solving approach as outlined in the official curriculum. Table 9.4 below provides a summary of the main aspects of the teachers' interpretations of the problem solving approach.

Table 9.4 Summary of teachers' interpretations of the problem solving approach

Main pedagogic features highlighted	Percentage of teachers
More learner involvement	81 %
Finding solutions to problem tasks in class exercises	69 %
Application of knowledge to every day problems	38 %
Pedagogic benefits highlighted	
Enhances understanding of concepts	69 %
Application of knowledge to everyday problems	63 %
Easier retention and recall of knowledge	56 %
Develops investigative skills	38 %
Promotes interest and motivation	25 %
Develops social skills	25 %

The foregoing sections summarize the key similarities in teachers' recontextualizations of the problem solving approach in relation to some features of pedagogic practice, their rationales for the foregoing similarities as well as similarities in their interpretations of the approach as defined in the official curriculum texts. The following sections present aspects of teachers' practice and accounts that differed across school types. These aspects are shown in table 9.1.

Differences in pedagogic practice

Differences emerged in the analysis of teachers' pedagogic practice in relation to five features; evaluation criteria, pacing of learners' tasks, intra-disciplinary knowledge relations, relationships between science and everyday knowledge and distributing strategies employed to transmit content. Three lesson types differing in relation to the foregoing features emerged. These lesson types are labelled lesson type one, lesson type two and lesson type three. Lesson type one is characterized by strong classification and framing values; lesson type two reflects a hybrid of strong and weak classification values and lesson type three is characterized by weak framing and classification values. The three lesson types constitute a continuum of pedagogic forms with lesson types one and three at both ends of this continuum displaying strong differences. These extreme ends of the continuum, lesson types one and three, are most differentiated in terms of evaluation criteria and relations between science and everyday knowledge.

Lesson type two lessons were similar to type one and three lessons in terms of particular features. All type two lessons were similar to type one lesson in relation to

strongly framed evaluation criteria and in terms of weakly classified intra-disciplinary relations to a lesser extent. Further, type two lessons had similarities with type three lessons in terms of weakly classified relations between science and everyday knowledge.

Table 9.5 provides a summary of the key differences between teachers' recontextualizations in lesson types one and three which correspond to high and low performing schools, respectively.

Table 9.5 Summary of key differences in teachers' recontextualizations

Features	Lesson type one	Lesson type three
Evaluation Criteria	- Strongly framed (F^+ ; F^{++})	- Weakly framed (F^- ; F^{--})
Pacing of learners' tasks	- Fast pacing in the large schools - 'Responsive' pacing in the small schools	- Very slow pacing and 'undifferentiated' in terms of learners' progress and abilities
Relations between science and everyday knowledge	- (C^{++} ; C^+) - Everyday knowledge as a resource 'means' to learn science	- (C^- ; C^{--}) - Everyday knowledge perceived as an 'end'
Distributing strategies	- Generalizing & specializing - Context-independent meanings	- Fragmenting and localizing - Context-dependent meaning
Rationale for pedagogic practice	- National education system mandates - School centralized curriculum planning & assessment - Emphasis on effective pedagogic practices	- Low learner competences
Organizational Framework	- Explicit roles, hierarchical administrative structures - Centralized curriculum and assessment planning & monitoring systems - Low teacher flexibility - Very strong external framing by the school (Fe^{++})	- Implicit roles, hierarchical administrative structures - Low school level control over pedagogic practices - More teacher flexibility - Weak external framing by school (Fe^{--})

The three lesson types were associated with particular schools: type one and two lessons were taught in high performing schools and type three lessons were taught exclusively in low performing schools. Correlation between lesson types and particular schools suggests that school contextual factors, particularly instructional cultures predisposed teachers to particular pedagogic practices and this influenced

teachers' enactments of the problem solving approach. This draws attention to the influence of school contextual factors on curriculum implementation.

Table 9.6 Distribution of lesson types across schools

Lesson type	Schools	Class size	Academic performance	Number of lessons
Type one	Alpha,	Large	High	02
	Bethel	Large	High	02
	Gonzaga	Small	Low	01
Type two	Ebenezer,	Small	High	02
	Fahimu,	Small	High	02
	Canaan	Large	Low	02
	Harambee	Small	Low	01
Type three	Ddembe	Large	Low	02
	Gonzaga	Small	Low	01
	Harambee	Small	Low	01

One task of this study is to examine the ways in which school contextual factors influence teachers' recontextualizing processes. In order to highlight relations between lesson types and school contexts, I focus on lesson types one and three located at the extreme ends of the continuum. Differences between teachers' recontextualizing processes in these two lesson types, associated with particular schools highlight the general pattern in curriculum implementation across schools. Lesson type two, described in detail in chapter six, portrays features of both lesson types one and three. Therefore type two lessons do not foreground the key differences in pedagogic form that I want to draw attention to in this section. Nevertheless, lesson type two portrays some unique features that suggest the influence of school contextual factors on teachers' classroom practice. I briefly comment on two key insights from type two lessons below before examining lessons types one and three in some detail in the subsequent sections.

First, all four lessons taught in the two private schools were type two lessons. These four lessons have a distinct feature of weakly framed pacing uncommon to the other twelve lessons in the sample. Weakly framed pacing coupled with the provision of explicit criteria for learners' tasks highlighted personalized forms of transmission-acquisition processes. Secondly, two other lessons in type two (Malongo and Weere's lessons) were both taught in Canaan suggesting a correlation between the instructional culture of the school and the character of lesson type two.

Lesson type one

This section presents the key features of type one lessons which were taught primarily in high performing schools. Four of the five lessons in this type were taught at Alpha and Bethel, both large high performing schools. One lesson was taught in Gonzaga primary school. The features of type one lessons presented below include the structure of the lessons, pedagogic modalities, types of content and transmission strategies and teachers' rationales for pedagogic practice. These are summarized in the table 9.7 below.

Table 9.7 Summary of key features of teachers' recontextualizations in lesson type one

School context	High performing school context
Pedagogic features	Classification / Framing
Evaluation criteria	F++ ; F+
Pacing of learners' tasks	F+
Intra-disciplinary relations	C-
Science & everyday knowledge relations	C++; C+
Content and its transmission strategies	
Types of content	Esoteric domain
Distributing strategy	Generalizing & specializing
Rationale for pedagogic practice	National and school level curricular and assessment demands.

Lesson structure

Lesson type one includes all the three lesson structures identified in the data set; two whole class teacher exposition lessons, two practical work demonstrations by the teachers and one group work lesson. Because the majority of these lessons (four out of five) are whole class teacher-led expositions and teachers' demonstrations, the macro-structure of activities placed teachers in direct control over teaching and learning processes.

Pedagogic modalities

Lesson type one portrays an 'explicit' and 'visible' pedagogic structure, emphasising strong teacher control over the transmission-acquisition process. Teachers provided explicit criteria for conducting and evaluating learners' work and set explicit time frames on learners' tasks which they tightly regulated. Further, this lesson type showed strong relations within science knowledge; both across topics and between science concepts and procedures. The latter relations were reflected in practical science lessons. Teachers maintained strong boundaries between science and

everyday knowledge and only recruited the latter as a pedagogic resource or ‘means’ to facilitate the learning of science.

Instructional content and transmission strategies

These lessons covered esoteric domain content which is strongly specialized school science knowledge. Teachers transmitted this knowledge through generalizing and specializing strategies. These strategies abstract esoteric domain knowledge from immediate contexts and by so doing promote development of context-independent meanings (Dowling, 1998). The content and transmission strategies employed in this lesson type provide potential for the application of knowledge across diverse contexts as anticipated by the problem solving approach. Furthermore, generalizing and specializing strategies position learners as ‘apprentices’ within school science. This suggests that these learners are provided with the prerequisite knowledge and skills to master science content or its ‘practices’ through the instructional strategies employed to transmit content.

Rationales for pedagogic practice

The main rationales for pedagogic practice cited by teachers in high performing schools relate to strong external framing of their practice by the national and school level requirements. Teachers’ accounts emphasized external mandates relating to national curricula and examinations as well as the relation between these mandates and school practices. In relation to the school level, teachers emphasized strong external framing of their practice by centralized curriculum planning and assessment targets and a set of practices considered generally ‘effective’ in promoting academic excellence. In addition, teachers in the small high performing schools emphasized the imperative of providing personalized forms of transmission as a key feature of instruction.

These rationales suggest that macro-level and school mandates constitute the key influence on teachers’ recontextualizing processes in high performing schools. Emphasis on ‘effective’ pedagogic practice in the instructional cultures of these high performing schools promotes the provision of explicit evaluation criteria in classrooms. Teachers attributed the strong pace of instruction to the pressure to complete the wide scope of the science curriculum. This pressure compels schools to

set defined time frames for covering the syllabi (macro-pacing) as part of the centralized curriculum planning framework.

Strong external framing from the school on teachers' pedagogic practice from the school constrains teachers' freedom to provide flexibility in instruction as required by the problem solving approach. However, emphasis on 'effective' pedagogic practices promotes teachers' ability to provide learners with explicit rules for tasks in line with the new pedagogic approach.

Influence of organizational frameworks on teachers' recontextualizing processes

High performing schools had very structured and hierarchical organizational frameworks with centralized curriculum planning and monitoring systems. The complex division of labour in these schools implies that teachers require subject department heads' consent for certain instructional matters. This results in low levels of teacher spontaneity and decision making. These contexts provide teachers little room for flexibility in pedagogic processes, a necessary condition for addressing differences in learner abilities and progress. Flexibility in instruction allows teachers to adjust micro-selection for example of materials, activities within the general theme of the lesson, and also to pace and order instruction where learners are given some options to accommodate specific learners' needs, abilities and progress.

Lesson type three

This section presents the key features of lesson type three which was taught exclusively in low performing schools. These pedagogic features include the lesson structure, pedagogic modalities, types of content and transmission strategies and teachers' rationales for pedagogic practice. These features are summarized in table 9.8 below.

Table 9.8 Summary of key features of teachers' recontextualizations in lesson type three

School context	Low performing school context
Pedagogic features	Classification / Framing
Evaluation criteria	F- ; F- -
Pacing of learners' tasks	F- -
Intra-disciplinary relations	C++
Science & everyday knowledge relations	C- -
Content and its transmission strategies	
Types of content	Esoteric domain & public domain
Distributing strategy	Fragmenting & localizing
Rationale for pedagogic practice	Low learner competence levels.

Lesson structure

All four lessons in type three were whole class teacher-led, placing teachers in direct control over pedagogic processes.

Pedagogic modalities

Lesson type three was taught in low performing schools. The lesson type reflects an 'implicit' pedagogic structure characterized by weak framing and classification values. These lessons were characterized by weakly framed evaluation criteria; teachers did not provide learners with explicit criteria for tasks, leaving a lot of ambiguity in instruction. In contrast, learners' tasks were paced very slowly resulting in very little coverage of knowledge. Although it 'appears' that slow pace of learning took cognizance of the learners' abilities and progress, extending the duration of tasks without providing explicit criteria for producing texts was ineffective in addressing the learners' progress.

Further, this lesson type had weak boundaries between science and everyday knowledge. In general, teachers emphasized the application of science knowledge to everyday life concerns portraying it as an ultimate 'end' for learning science. A close scrutiny of the knowledge relationships in this lesson type shows that in an attempt to demonstrate utility of knowledge, teachers inadvertently 'stripped off' or backgrounded science concepts and transmitted local contextual knowledge. This suggests that some teachers may have 'misinterpreted' the official curriculum principles and conflated the meaning of showing 'utility' of science knowledge (application) to everyday life with teaching exclusively contextual knowledge. Teachers in this lesson type maintained strong boundaries between science topics providing these as

independent of the general body of knowledge. In addition, this lesson type did not provide for practical science work. Weak intra-disciplinary relationships in this lesson type were both a function of the knowledge structure of the integrated science topics taught as well as teachers' instructional strategies.

Instructional content and transmission strategies

Lesson type three covered both esoteric and public domain content which was transmitted through fragmenting and localizing distributing strategies, respectively. These distributing strategies 'particularized' knowledge and by so doing foregrounded context-dependent meanings. For example, through fragmenting, teachers transmitted specialized science knowledge in a 'segmental' manner whereby its underlying principles were back-grounded. Localizing transmitted contextually specific knowledge, particularized through emphasis on excessive site details, personal experiences of the learners, teachers and local communities. In general, given their focus on particularized meanings, localizing and fragmenting strategies constrain transmission of general abstract principles that are applicable across diverse contexts.

Rationales for pedagogic practice

This group of teachers defended their pedagogic practices on the need to accommodate learners with low competence as a form of 'repair' or remedial action. For example, teachers argued that their learners required more time to learn hence the slow pacing of tasks. Because these teachers had very low expectations of the learners, they adjusted their pedagogic practices in ways that they perceived as appropriate to foster learning. They minimized the complexity of tasks even to the extent of covering work below the grade level of classes, or kept the amount of content to a level commensurate with their paces. These teachers' rationales resonate with Ensor's (1999) study where she reports that some beginning teachers she researched justified their pedagogic styles and choices on the basis of the students' abilities. Ensor reports that these teachers 'displaced' their preferred styles of teaching and adopted what they considered most 'appropriate' for the particular abilities of the learners.

Organizational frameworks and recontextualizing processes

On the whole, low performing schools had relatively less structured organizational systems, less centralized planning and fewer instructional monitoring systems than did schools in the high performing school context. Centralized planning and instructional monitoring frameworks were either lacking or generally 'dysfunctional' particularly in the smaller schools, Harambee and Gonzaga. The unstructured institutional environment accorded teachers room to implement flexible instruction particularly in terms of sequencing and pacing rules. Emphasis of the instructional cultures on providing remedial learning styles accentuated slow pacing of learning which, nevertheless, was not accompanied by explicit criteria to support learning.

The foregoing sections provide a summary of teachers' recontextualizing processes by examining the general pattern of curriculum implementation in high and low performing schools.

Conclusion

This chapter has summarized the analysis and highlighted the study's main findings from the previous three chapters. It has shown similarities and differences in teachers' recontextualizations, highlighting how these vary across high and low performing schools.

CHAPTER TEN: CONCLUSIONS

This concluding chapter provides an overview of the thesis; it highlights the lessons learnt from the study and points out its limitations. The chapter concludes with some suggestions for further research.

10.1 Overview of the thesis

This thesis aims to describe selected primary school teachers' recontextualizations of the problem solving approach, a centrally mandated pedagogic approach for teaching primary school science in Uganda. The first chapter contextualizes the study in relation to the education sector policy and curriculum reform efforts in Uganda; it introduces the problem solving approach and sets out the study's research questions.

Chapter two presents a review of literature relating to curriculum implementation, highlighting studies from Uganda and an international perspective. These studies are reviewed in relation to different theoretical perspectives including those within a Bernsteinian framework. This literature foregrounds a common argument that centrally mandated curriculum policies are seldom implemented as designed; rather these undergo transformation and adaptation during implementation. The literature suggests a range of factors to account for adaptations characterizing curriculum implementation processes, highlighting 'what' brings about these changes. In Bernsteinian terms, these changes are associated with recontextualizing processes inherent in the processes of production and reproduction of official school knowledge. However, the literature does not sufficiently address 'how' and 'why' these policies are modified during implementation. Spillane et al., (2002) point out the need to unpack the process through which curriculum policies evolve during implementation.

Further, chapter two reviews studies relating to curriculum reforms embracing a progressive pedagogy focusing specifically on experiences from African countries. These studies suggest that contextual factors within schools and the broader education system, along with influences from society social relations constrain effective implementation of these progressive reforms in Africa.

Chapter three presents the conceptual and analytical framework for the study drawn from Bernstein's theory of pedagogic discourse (2000) and Dowling's social activity theory. Bernstein conceptualizes pedagogic discourse as a macro-relay for power and control from the macro-structural level of society through the official pedagogic device to the micro-level of transmission and acquisition in classrooms. The theory of the pedagogic device and the production and reproduction of official school knowledge provides a broad framework for understanding the curriculum implementation process. The chapter discusses the notion of 'recontextualization' of official pedagogic discourse, the official pedagogic device, the key concepts of classification and framing, competence and performance models and pedagogic culture. In relation to pedagogic models, the problem solving approach follows the logic of competence models, although it features elements of a 'mixed' pedagogy. This study conceptualizes curriculum implementation as a recontextualizing process involving selection and adaptation of the official pedagogic discourse and that these processes bring about changes in the official curriculum.

Bernstein (2000) suggests that the official pedagogic device provides evaluative rules for regulating pedagogic practice. He acknowledges the influence of school contextual factors on pedagogic practice through the notions of external framing and pedagogic culture. However, Bernstein's emphasis on pedagogic discourse as a macro-relay of power and control implies that his work focuses a lot more on the 'vertical' regulation of pedagogic practice by the official pedagogic device than by school contextual factors. However, Jacklin (2004); Laminas (2002) and Bonal (1995) suggest that the effectiveness of the official pedagogic device in regulating pedagogic practices is undermined in some contexts, due to tensions within the device itself as well as due to contextual factors at the local level of implementation. This thesis suggests that Bernstein's concept of pedagogic culture provides a productive means to conceptualize the influence of school contextual factors on curriculum implementation, particularly in developing countries where regulation of pedagogic practice by the official pedagogic device is not effective.

The analytical framework adopts concepts from Bernstein's and Dowling's theories. Bernstein's concepts of classification and framing are employed to analyse the interactional and organizational elements of pedagogic practice. The concept of

framing is employed to examine the extent to which teachers cede control over pedagogic processes to learners as required by the problem solving approach. The concept of classification is employed to examine the organizational dimension of the pedagogic context including organization of space and the structure of social relations between teacher and learners and among learners. Further, the concept of classification is employed to examine knowledge relationships.

The analytic framework includes a focus on the organizational and interactional elements of pedagogic practice, shown above, as well as a focus on the 'substance' of instructional content transmitted in classrooms. Dowling's concept of domains of practice is employed to analyze the degree of specialization of science knowledge and his notion of distributing strategies is employed to examine the instructional strategies employed to transmit content.

Chapter four addresses methodological issues. The chapter describes the research design, the study sample, the data collection and analytical procedures as well as strategies undertaken to enhance validity. The chapter discusses the rationale for employing case study design, highlighting its suitability for examining complexities within pedagogic practice and its intricate relations with school contexts. The multiple case studies allow comparison of findings across four pairs of schools with similar class sizes and academic achievement profiles, strengthening the validity of the findings (Yin, 2003; Maxwell, 1996). The chapter describes how theoretical concepts (internal language of description) were operationalized into a model (external language of description) for analysis of data. This external language of description developed through dialogic relations between theory and empirical data.

Chapter five analyses the curriculum documents, the science syllabus and its accompanying teachers' guide, to highlight the salient features of the problem solving approach projected in the official curriculum. These features of pedagogic practice are analyzed and described in the light of the study's analytical framework.

Chapters six, seven and eight present the empirical findings of the study. Chapters six and seven draw on the classroom observation data to provide an account of how the teachers enacted the problem solving approach. Chapter six presents pedagogic

modalities showing the structure of pedagogic discourse. The analysis highlights similarities across all the lessons and differences across three lesson types. With regard to similarities, all the teachers maintained control over selection, organization and pacing of knowledge as well as social relations within classrooms. In addition, none of the teachers related science to other school subjects.

However, the analysis shows that teachers enacted the pedagogic approach in three distinctive forms which are labelled lesson types one, two and three. The lesson types are differentiated especially in terms of evaluation criteria and in the relations between science and everyday knowledge. Lesson type one is characterized by an 'explicit' form of pedagogy with strong values of classification and framing across the different aspects of pedagogy whereas lesson type three is characterized by weak classification and framing, particularly in terms of evaluation criteria and in the relations between science and everyday knowledge. Lesson type two is characterized by 'mixed' classification and framing. These three lesson types were taught in particular schools; type one in high performing schools and type three in low performing schools. Lesson type two comprises lesson from both high and low performing schools. Differentiation of these lesson types suggests that teachers recontextualized the problem solving approach in a continuum of ways; with lesson types one and three as distinct pedagogic forms at each end of the continuum and lesson type two as a hybrid or 'mixed' pedagogic form in the middle.

Chapter seven describes the degree of specialization of content and its transmission strategies in the three lesson types outlined above. The lesson types are strongly differentiated in terms of distributing strategies and less so in relation to instructional content. In lesson type one; teachers transmitted primarily esoteric domain science knowledge employing generalizing and specializing distributing strategies. This suggests that lesson type one transmitted abstract context-independent knowledge with high potential for application across diverse contexts. In contrast, type three lessons comprised both esoteric domain and public domain science. Teachers of type three lessons employed fragmenting and localizing strategies that transmitted context-dependent knowledge focusing on 'segmental' science concepts and local contextualized knowledge. Context-dependent knowledge has low potential for application across diverse contexts. Because contextualized knowledge appears

'relevant' to learners' everyday lives, some teachers misconstrued this as being synonymous with the application of science knowledge to everyday life. This was particularly evident in the handling of integrated science themes in low achieving schools, where teachers collapsed the boundaries between science and everyday knowledge, focusing primarily on the latter.

Chapter eight presents teachers' accounts of the problem solving approach, focusing on their interpretations of the approach as defined in curriculum policy documents and their rationales for pedagogic practice. The latter relate to the teachers' recontextualizing rules. The analysis shows that the teachers 'recognized' the main features of the problem solving approach and differentiated it from other pedagogic approaches. In general, the majority of teachers described the approach as entailing more learner involvement in pedagogic processes, emphasizing activity based instruction. They suggested that the approach improves learners' conceptual understandings, motivation and interest and their ability to apply science knowledge to everyday problems. In general, the teachers recognized the features and principles of the pedagogic approach as prescribed in the official curriculum, demonstrating acquisition of recognition rules.

With regard to rationales for enacting the problem solving approach in particular ways, all the teachers emphasized how the pressure to complete the wide scope of the national curriculum constrained their efforts to provide the flexibility in instruction required under the problem solving approach. These accounts show tension between the projected pedagogic contexts and the existing structures and processes of schooling. However, there were notable differences between the ways the teachers in the high and low performing schools responded to the strong external framing of their practice from the national system.

In high performing schools, teachers emphasized a need to conform to centralized curriculum planning and assessment targets and instructional practices developed as a response to external mandates from the national curriculum and public examinations. On the whole, teachers justified their practices in relation to their schools' pedagogic culture rather than in relation to the pedagogic principles of the problem solving approach.

Teachers in the low performing schools justified their practices primarily in relation to perceived low competences of their learners. Instructional cultures of low performing schools emphasized a 'repair' form of pedagogy, with relaxed pacing of learners' activities and the development of basic literacy skills as a response to low learner competences. Differences in teachers' rationales between high and low performing schools suggest that school contextual factors are key influences on teachers' recontextualizing processes.

The problem solving approach requires relatively high flexibility in pedagogic practice within classrooms as well as at the level of the school. This suggests that strong external control over pedagogic practice at the level of the school constrains teachers' efforts to enact the pedagogic principles of the problem solving approach. The analysis shows that the influence of school organizational frameworks on teachers' recontextualizing processes differed across high and low performing schools. High performing schools exert stronger control or 'external framing' on teachers' practice relative to their counterparts in low performing schools.

Chapter nine summarizes the data analyses presented in chapters six, seven and eight highlighting similarities and differences in teachers' recontextualizing processes. This chapter compares teachers' recontextualizing processes in high and low performing school contexts. The demands of the national curriculum in relation to content coverage, sequencing and pacing and public examinations affects all the schools. However, teachers' accounts suggest that high and low achieving schools responded to these demands differently. In general, high performing schools respond to national curriculum and examination demands in a competitive way, seeking to excel in the public examinations. In contrast, in the low performing schools, teachers and head teachers alike responded to the curricular and examination demands with relatively less pressure.

10.2 Implications of the study

The current study does not claim to provide generalizable empirical findings on curriculum implementation. Its main contribution relates to theoretical insights on curriculum implementation processes. In particular, this study provides insights on the interplay between curriculum policy and its context of implementation at three levels

of the education system; the macro-system level, school level and classroom level. This study raises issues about the curriculum implementation process in relation to articulation between envisaged curricular changes and the structure and processes of schooling at the three levels of the education system in Uganda. The key constraint to curriculum implementation for the teachers in this study relates to inconsistency between the pedagogic prescriptions for the problem solving approach and the contexts in which they work. Three dimensions of tension between the requirements of the new pedagogic approach and contexts of implementation are evident in the analysis.

Firstly, the theory of instruction upon which the problem solving approach is premised is in tension with the wide scope of content in the national curriculum as well as with the emphasis on graded performance of learners through public examinations, particularly the PLE. This tension raises questions about internal coherence of processes at the macro education system level, with curriculum change efforts on one hand and overall national curriculum and assessment processes on the other hand.

Secondly, the backlash effects of the curricular and assessment demands on pedagogic practice highlights tension between the theory of instruction for the pedagogic approach and what the national education system expects from teachers. For example, as a response to macro-system demands, teachers maintain control over selection, sequencing of knowledge and pace instruction fast so as to complete the wide scope of the science syllabus.

Thirdly, at the school and classroom levels, the analysis shows further tension between the pedagogic prescriptions for the problem solving approach, on the one hand, and common features of pedagogic practice in all the schools in the study as well as particular pedagogic forms in high and low performing schools, on the other hand. Teachers across schools maintained high degrees of control over selection, sequencing and pacing of instruction and the majority of lessons reflected hierarchical social relations and explicit codes of conduct. In general, strong teacher control over instruction highlights tension between the dominant models of 'teacher-learner' relationships pervading schooling processes on one hand and the pedagogic

prescriptions for the problem solving approach on the other hand. Dominant hierarchical social relations within the broader Ugandan society are reinforced in schooling to perpetuate teachers' roles as 'transmitters' of knowledge and regulative order, impeding the envisaged self-regulating role by learners.

In addition to the symbolic tensions between the anticipated pedagogic approach and the local context of implementation, material conditions in schools hampered the teachers in adopting the pedagogic approach into their practice consistently. In particular, these teachers emphasized how limitations of classroom space, short lesson time periods and inadequate provision of certain science equipment and supplies constrain their efforts to actively involve learners in pedagogic activities generally and practical science work in particular.

In view of the tension between curricular changes and contextual realities in the three levels above, the thesis suggests that curriculum implementation requires a holistic perspective that recognizes relevant influences within the broader systemic and school settings so as to align these to the envisaged curricular changes. This resonates with Sieburth's (1992) call for greater sensitivity to and more systematic analysis of the total context of education, particularly in developing countries.

School contextual factors as influences on curriculum implementation

This study demonstrates how differences in schools' instructional cultures, related to their achievement profiles, influence curriculum implementation. The study started with an assumption that different class sizes and academic profiles of schools would influence the manner in which the problem solving approach is implemented. However, the analysis shows that teachers' pedagogic practice and rationales for practice are more differentiated in relation to the academic achievement profiles of schools than to class size. This suggests that instructional cultures adopted in high achieving schools in both large and small classrooms were broadly similar and so downplayed the influence of class size on the overall form of pedagogic practice. The reverse is true for low performing schools.

Organization of instruction in high performing schools through centralized curriculum, instructional supervision and assessment practices requires teachers to conform to a defined set and order of instruction, leaving little room for flexibility in classroom practice as expected by the problem solving approach. However, emphasis on 'effective' pedagogic practices in the high performing schools facilitates the explication of evaluation criteria. Low performing schools provided more flexibility to teachers in relation to macro-level surveillance of instruction, however this did not necessarily translate into pedagogic practices consistent with the problem solving approach. The study shows that most of the teachers in the low performing schools provided learners with more time to undertake tasks, but they did not accompany this with explicit rules for producing the expected texts. In this regard, extended time for learning remained 'ineffective' (Morais, 2002).

Although teachers in particular schools taught in broadly similar ways and also emphasized similar issues to justify their pedagogic practice, there were some exceptions. Ssesanga's lesson and account, an exception to his school context, exemplifies this exception. Despite teaching at a small low achieving school, Ssesanga's lesson was categorized under lesson type one suggesting that his practice differed significantly from those of his counterparts, whose lessons fell under lesson type three. As discussed earlier, lesson type one which was taught in the large high performing schools, was characterized by more 'effective' pedagogic practice, particularly in relation to explicit evaluation criteria. This suggests that factors other than the school context accounted for Ssesanga's pedagogic practice. Ssesanga's 'exceptional' pedagogic practice may be explained by his long teaching experience (33 years), the longest among all teachers, that may have given him the ability to transcend the school contextual impediments to practice.

Ensor's (1999) account of beginning teachers' recontextualizing from an initial teacher education programme into classroom practice provides useful insights into the complexities of recontextualizing processes more generally as they relate to classroom practice. Ensor shows how school location does not independently provide sufficient explanation for beginning teachers' recontextualizing from teacher education. Her study reports that some teachers taught in similar school settings but taught in dissimilar ways. In view of her findings, Ensor argues that teachers'

recontextualizing from teacher education appears to be established on the basis of an intersection between the school setting and teachers' education biographies.

The findings highlight considerable tension between the curriculum policy requirements and the institutional frameworks of schools. In particular, high performing schools in this study afforded teachers little room for flexibility in instruction yet this is a crucial prerequisite for implementing the problem solving approach, or competence model of pedagogic practice (Bernstein, 2000). The study suggests that an understanding of the opportunities and limitations of particular school contexts in relation to intended curriculum changes is not only necessary but critical in curriculum reform initiatives.

Differences in pedagogic practices between high and low achieving schools mediated teachers' recontextualizing processes, illuminating the influence of school instructional cultures on curriculum implementation. The findings highlight how particular schools supported or constrained enactment of particular features of the problem solving approach, particularly evaluation criteria. These differences have implications for educational quality and equity in Uganda more generally and specifically as reflected in learners' outcomes in the public examinations such as PLE.

Instructional cultures in the high performing schools support more 'effective' pedagogic practices and this in turn promotes learners' academic performance. Practices in these schools provide explicit criteria for evaluating learners' productions and by so doing support high academic performance. In contrast, pedagogic practice in low performing schools did not provide explicit criteria for learners' productions. Although pedagogic practice in the latter schools reflects elements of a 'repair' form of pedagogy, particularly in relation to the slow pacing of learners' activities, extended time on tasks remained 'ineffective' because it was not accompanied with explicit criteria for producing expected texts. These findings are consistent with school effectiveness research which show that high performing schools are generally more 'effective' and 'functional' than low performing schools.

Although school contextual influences were significant in accounting for differences in teachers' recontextualizing processes, there were some exceptions or 'outliers'

(Miles and Huberman, 1994) to this general finding. These outliers comprised teachers whose pedagogic practices and accounts differed from those of their counterparts in similar school contexts. These teachers' recontextualizing processes were attributed to their professional expertise and experience (teacher-factors) more than to school contextual factors. In general, the study demonstrates how curriculum implementation is intricately linked to and embedded in teachers' day-to-day teaching lives, including their professional identities, pedagogic knowledge and beliefs as well as affordances and constraints within their work contexts. It is within the nexus of these factors that teachers' curriculum implementation efforts are understood.

Interpretation of the curriculum policy message

Teachers' interpretations of the problem solving approach were consistent with what the official curriculum documents foregrounds about the approach to a great extent. If teachers are considered to be 'learners' of curriculum policy (Borman, 1996; Jennings & Spillane, 1996) and so recontextualizing from it, the evidence from this study suggests that these particular teachers acquired the 'recognition and passive realization rules' for the legitimate policy text. However, teachers' inability to produce the pedagogic practice (legitimate texts) legitimated by the official curriculum can be attributed to tensions between curricular prescriptions on one hand and the dominant structures and processes of schooling at the national, school and the micro-classroom levels. These tensions are exacerbated by material and human resource constraints within schools along with some teachers' professional competence more generally.

Implementation of progressive pedagogic approaches

Further, the study enhances our understanding of the implementation of progressive pedagogies in developing world contexts, contributing to scholarship in this area. The study informs debates on the implementation of progressive pedagogy in contexts where the broader social relations in society, schooling structures and processes including teachers' previous schooling and professional experiences significantly differ from those envisaged by this pedagogic approach. The current study shows that whereas progressive pedagogic approaches require relatively high teacher autonomy

and flexibility both in classrooms and school level, strong external regulation of teachers' work militates against this key requirement. The dominant social relations within the broader Ugandan society are incompatible with the pedagogic principles of the problem solving approach.

Further, the economic implications of implementing progressive pedagogic approaches are particularly demanding in the Ugandan context where primary school enrolments continue to increase, occasioned by the UPE programme. Bernstein (2000) suggests that competence models of pedagogic practice are costly to provide because of their sophisticated theoretical base and a range of other 'hidden' costs.

The findings highlight some inconsistencies between teachers' classroom practice and accounts that draw attention to possible 'misinterpretations' of the official curriculum. This underscores a need for continuing professional development support to enable teachers to move beyond the 'outward forms' and rhetoric of the pedagogic approach, to embrace its 'spirit' and 'substance' (Brodie et al, 2002b; Sykes, 1990). This need is critical given that teachers' accounts confirmed the curriculum specialist's position that teachers received inadequate in-service training for the present primary school curriculum.

Bernstein's theory of pedagogic discourse provides the means to conceptualize the curriculum implementation process and a set of concepts to analyze and describe classroom practice. Although he acknowledges the influence of school contextual factors on pedagogic practice through external framing and pedagogic culture, Bernstein's work focuses mostly on recontextualizing processes through the operation of the official pedagogic device.

The evidence from this study shows that teachers' recontextualizing processes are mediated by curricular prescriptions along with affordances and contingencies within particular schools. The latter include material constraints such as inadequate classroom space for high class sizes, limited lesson time frames and instructional resources. The foregoing aspects highlight material non-discursive factors that constitute an underdeveloped part of Bernstein's theory of pedagogic discourse. Bernstein's theoretical project focuses primarily on developed country contexts where

effective functioning of the official pedagogic device shapes pedagogic practice in deterministic ways, minimizing contextual constraints of a material nature. This study shows that application of this model to contexts with less 'effective' functioning of the pedagogic device calls for further theoretical development to accord the theory more explanatory power in developing world contexts.

By analysing the influence of school contextual factors on pedagogic practice, the current study contributes to empirical work employing the concept of pedagogic culture, a relatively underdeveloped aspect of Bernstein's theory of pedagogic discourse. From this perspective, the thesis builds on Jacklin (2004) who draws on the concept of pedagogic culture and positions it in dialogue with other theoretical resources to conceptualize and provide empirical realizations of relations between school instructional cultures and pedagogic practice in South Africa. Bernsteinian studies on pedagogic practice in developing country contexts, particularly in South Africa, (Hoadley, 2005; Bolton, 2005; Reeves, 2005) focus primarily on the interplay between pedagogic practice and the social class bases of schools.

Further, although the analysis shows weakly classified learner-learner spaces in all group work lessons, these forms of classroom organization were not accompanied by interaction among group members in all classrooms. In some instances, learners sat together but worked independently. In general, such 'unexpected' coupling of physical 'forms' of classroom organisation and their underlying power relations suggests that the social organisational of schooling in Uganda provides pedagogic forms that fall outside those currently conceptualized in the theory.

10.3 Limitations of the study

The methodological design of this study does not provide a basis from which to make empirical generalizations on curriculum implementation in Uganda, less so in the research schools. The study contributes theoretical insights into the interplay between curriculum implementation processes and schools' instructional and organizational cultures. This study, therefore, informs debates on how and why instructional reforms are modified during implementation. Generalization of findings to schools with similar characteristics is dependent on further research. Similarities in pedagogic forms and teachers' accounts across similar school contexts strengthens the theoretical

generalization of the findings by emphasizing how the curriculum implementation process is shaped by particular school contextual factors.

A clear limitation of the current study relates to the recognition of, but insufficient attention to, other influences on pedagogic practice such as teachers' professional backgrounds, knowledge and beliefs as well as adequacy of in-service training for the present curriculum. The study, nevertheless, acknowledges the influence of these factors on teachers' recontextualizing processes.

10.4 Further research

The present study focused on a small number of teachers and schools. It would be productive for other studies to extend the depth and breadth of the issues investigated in this study. For example, studies correlating teachers' adoption of curriculum policy with learner achievement would provide insights into the interplay between curriculum implementation and learner outcomes. Studies focusing on a smaller number of teachers in the different school contexts where pedagogic practice is observed over a longer period of time would build upon other facets not covered in this study; for example, the nature of learning about policy in the schools' community of practice. Studies to examine the degree to which pedagogic practices, reflected in low and high performing schools in this study, are typical and representative of other similar schools would strengthen the insights gained in this study.

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APPENDICES

APPENDIX A: LESSON CODING INSTRUMENT

DISCURSIVE RULES

SELECTION: The extent to which the teacher and learners control selection of knowledge

Indicators	F ⁺⁺	F ⁺	F ⁻	F ⁻⁻⁻
Topics and content	The teacher selects the topic and content for the lesson without contribution from the learners. S/he ignores or rejects the learners' spontaneous interventions. The teacher also recapitulates the salient concepts of the lesson which may be taken down as lesson notes.	The teacher selects topic and content for exposition. S/he accepts learners' spontaneous selections relevant to current theme and defers the rest to the appropriate time. The teacher synthesizes the major issues of the lesson, and provides lesson notes on the major issues.	The teacher indicates the general topic and content for exposition and accepts learners' spontaneous selections that are incorporated into the exposition. S/he guides learners to summarize the major issues covered in the lesson through questioning. The learners do an exercise covering the major aspects of the lesson.	Learners select sub topics and issues for discussion under a general topic selected by the teacher. S/he accepts and incorporates all the learners' spontaneous interventions, regardless of their relevance to the topic of discussion. The teacher does not provide learners with lesson notes although some make their own notes.
Learning activities & problems for investigations	The teacher solely selects activities and problems for investigation without contributions from the learners. S/he also outlines procedures for conducting investigations.	The teacher selects activities and problems for investigation but may modify these according to learners' interventions. The teacher also outlines the procedures for conducting the investigations.	Learners select specific activities and problems for investigation from a general collection selected by the teacher. The teacher provides general guidelines for investigation procedures which learners may modify according to their specific tasks.	Learners select their own activities and problems for investigation as well as the procedures for conducting the investigations. However, they may request the teacher's help where necessary.
Materials for class activities.	The teacher selects instructional materials for the lesson exclusively.	The teacher selects most of the materials but may also allow learners to select following his/her guidelines.	The teacher selects a collection of materials from which learners select according to the specific requirements of their activities.	Learners select materials for their activities but may request help from the teacher where necessary.
Observations, interpretations and conclusions of practical work.	The teacher selects the main issues for observations in the practical work and interprets these without contribution from learners. S/he also draws conclusions about the practical work exclusively.	The teacher selects what to observe and interprets these observations incorporating contributions from learners. S/he formulates conclusions and incorporates learners' suggestions into these after modifying them.	The teacher provides a protocol to direct learners on what to observe and in the practical work. Learners interpret and draw conclusions from the practical work following the teacher's guidelines.	The learners select what to observe in the practical work and interpret the observations with minimal guidance from the teacher. Learners draw conclusions from the practical work and present these for discussion to the rest of the class under the

				teacher's guidance.
SEQUENCING: The extent to which the teacher and learners control the sequence of the pedagogic communication				
Exposition and recapitulation of content	The teacher exposes content following an inflexible order in spite of learners' interventions and needs. Any intervention that potentially alters the set order is referred to an appropriate time.	The teacher explains and recapitulates content following a defined order although this is subject to minor changes resulting from learners' interventions and productions.	The teacher explains and recapitulates content altering its micro sequence arising from interventions from the learners or their productions.	The teacher explains and recapitulates content following a very flexible sequence which can be altered at macro and micro level arising from learners' interventions and productions.
Learners' tasks (Class exercises & group work)	Learners conduct tasks following a defined sequence provided by the teacher which is not deviated from at all. For example, s/he provides a defined order for the group presentations and does not allow any alterations to this set sequence.	Learners' tasks follow a defined sequence set by the teacher although some minor alterations are made on the basis of learner's interventions and productions.	The sequencing of the learners' tasks follows a flexible order which may be altered according to the learners' productions or interventions. For example, the teacher suggests general guidelines for presenting group work, but allows each group to structure details according to their preference.	Learners' tasks are sequenced according to very flexibly according to individual learners' productions and preferences.
PACING: The extent to which the teacher and learners control the rate of acquisition of the pedagogic communication				
Exposition of themes	The teacher exposes content following a defined time frame. S/he never repeats concepts that have already been dealt with. The teacher does not accept interruptions from learners, deferring these to an appropriate time later.	The teacher observes time during exposition of content. S/he does not repeat concepts that have already been covered but addresses learners' interventions as they surface. S/he responds to learners' interventions briefly and resumes the exposition.	The teacher exposes content flexibly, revisiting previously covered concepts to clarify learners' misconceptions whenever need arises. S/he occasionally pauses exposition to check if the learners are following the pace and adjusts this accordingly.	The teacher is very flexible during the content exposition, frequently stopping to check if the class is comfortable with the pace and revisiting previous work ever so often. S/he attends to all learners' interventions to clarify concepts and may even promote a debate on the issues until the learners' misconceptions are all clarified.
Learners' tasks (Group work & class exercises)	The teacher specifies time frames for the learners' tasks and ensures that this time limit is followed. S/he constantly reminds the learners about the time left and does not extend time for tasks at all.	The teacher sets time frames for the learners' tasks and occasionally reminds learners about time. However, s/he makes a few extensions on the basis of learners' productions.	The teacher paces the learners' tasks flexibly, adjusting time according to their rates of progress. Although the teacher does not exert pressure on the learners to complete their tasks, s/he reminds them to complete the tasks. Parallel tasks are set for faster	Tasks are very flexibly paced according to learners' rate of progress and quality of productions. The teacher does not set time limits on the learners' tasks nor exert pressure on them to complete tasks but sets parallel activities for fast learners.

			learners.	
Questioning sessions	The teacher asks questions and if learners do not respond immediately, s/he answers the question and moves on to ask another question.	The teacher asks questions and if the learners do not respond immediately s/he helps them to construct the answer and proceeds to the next question.	The teacher asks questions and gives learners some time to build the answer. S/he repeats or clarifies the question to enable learners produce the expected answer.	The teacher asks questions and allows time for learners to build answers. S/he probes learners and through reflection and discussion guides them to construct expected answers.
CRITERIA OF EVALUATION: The extent to which the teacher makes explicit the criteria for evaluation of learners' productions				
	F⁺⁺	F⁺	F⁻	F⁻⁻
Exposition of content	The explanations are very detailed and illustrated. The teacher recapitulates the main concepts of the lesson and writes these as lesson notes on the chalkboard. S/he asks learners to seek clarification on any aspect of the lesson they have not understood which s/he clarifies.	The explanations are detailed and illustrated and the learners take notes on the main aspects. The teacher recapitulates the main concepts covered in the lesson and writes these on the chalkboard as lesson notes. Learners copy the notes into their notebooks.	The explanations are less detailed and illustrated. The teacher summarizes the main concepts through questioning. Learners do not take down lesson notes.	The explanations are neither detailed nor illustrated and learners do not take any notes.
Conduct of practical work	The teacher provides detailed guidelines on the procedures for practical work for group activities. For the demonstrations, the teacher poses a series of questions to explore the various facets of the activities in detail as a basis for the observations, interpretations and conclusions made. The teacher synthesizes the important aspects of the activity which are taken down as lesson notes by the learners.	The teacher provides general guidelines for practical work or demonstrates it to the class. S/he makes clarifications to learners where necessary. Through questioning the teacher leads learners to identify important aspects of the activities. The teacher provides learners with lesson notes on the main aspects covered.	The teacher provides guidelines for the practical work but these are not detailed and clear. However, s/he provides clarifications when requested by learners. For the demonstrations, the teacher asks learners direct questions to find out if they are following the procedures. The teacher points out the main aspects of the activities. Learners may take down main points of the lesson.	The teacher does not provide learners with guidelines for conducting the practical work or s/he demonstrates the practical work without asking learners any questions. The teacher does not indicate important aspects of the work to the learners as lesson notes.
Instructions for tasks	The teacher provides learners with detailed instructions on what is expected in the tasks. S/he clarifies instructions to learners during the course of the tasks where necessary.	The teacher provides learners with general instructions for tasks. S/he clarifies instructions when learners ask for these or when s/he notices mistakes in the learners' work.	The teacher provides general instructions for tasks and refers learners to these guidelines when they request for help. The teacher may also repeat the instructions when s/he teacher notices mistakes in the learners' work.	Learners embark on the tasks without prior instructions from the teacher. The teacher does not provide learners with any clarification or help in the course of the task even when s/he notices mistakes in the work.

Correction of class exercises	The teacher marks the learners' work indicating correct and incorrect answers. S/he writes correct answers in the learners' exercise books. The teacher finally revises the class exercise with the class, providing reasons for correct and incorrect responses.	The teacher marks the work indicating correct and incorrect responses in the exercise books. S/he finally corrects the work with the class and instructs learners to make corrections in their exercise books.	The teacher puts a tick or cross against learners work without further elaboration. While revising the class exercise, the teacher indicates correct responses but does not instruct learners to correct their work.	The teacher does not provide any indication of what is correct or incorrect in the work but s/he awards an overall mark to the learners' work. The class work is not revised and corrected in class.
Presentation of group work.	The teacher systematically points out what is correct, incorrect and incomplete in each group presentation. S/he indicates what is missing in the texts and provides the missing texts.	The teacher points out what is correct and incorrect in the presentations and indicates what is missing in the group productions in a general manner.	The teacher points out what is incorrect incomplete, but does not clarify nor provide the missing texts in the group productions.	The teacher accepts all group productions. S/he does not indicate what is correct, incorrect or missing from the texts but only asks questions to clarify what is presented by groups.
Handling of learners' oral responses	The teacher accepts all responses given by the learners. S/he elaborates correct responses and shows why some responses are incorrect. The teacher provides missing texts or guides learners to build up incomplete responses.	The teacher accepts both the correct and incorrect responses. S/he elaborates correct responses and shows why some responses are incorrect.	The teacher accepts only the correct responses, which s/he elaborates briefly and rejects incorrect responses without further elaboration.	The teacher accepts correct responses but does not elaborate then further while s/he ignores incorrect responses without further elaboration.

HIERACHICAL RULES: The extent to which the teacher and learners control conduct, character and manner

	F⁺⁺	F⁺	F⁻	F⁻⁻
Communication	The teacher initiates communication with the learners all the time, s/he ignores learner-initiated communication. The teacher addresses the class as a group, rarely mentioning individual names. There is a tense, quiet and businesslike atmosphere in the class. Learners keep to themselves.	The teacher initiates communication most of the time and learners only seek for clarification on teacher's communication. Teacher addresses the class as a group most of the time but occasionally refers to some learners by name. The social climate is moderately formal. Few learners communicate with one another when prompted by teacher.	Both the teacher and learners initiate communication to one another. Teacher employs personalized communication some times and addresses learners as a group other times. The atmosphere in the classroom is quite relaxed as groups and individuals discuss amongst themselves.	Both the teacher and learners initiate communication. The teacher uses personalised form of communication with learners all the time. The atmosphere is very relaxed, groups and individuals freely discuss amongst themselves.
When learners	Learners do not express their	The teacher listens to learners'	Learners express their opinions,	The teacher solicits learners' opinions

give their opinion	opinion most of the time, but when they do, the teacher ignores them.	opinions but does not accept them.	and the teacher considers them most of the time.	and takes these into consideration all the time.
Control of learners' conduct	Teacher employs imperative control all the time. S/he admonishes learners when they make mistakes, and may also employ physical punishment.	The teacher employs positional control most of the time. S/he sets rules of conduct and reminds learners about the rules when they digress from the expected conduct.	The teacher employs positional and personalized control. S/he sets rules for conduct and in some cases s/he gives learners reasons why they should follow these rules.	The teacher employs personalized control all the time. Whenever, learners digress s/he explains to them the consequences of their conduct to themselves and the rest of the class.

CLASSIFICATION OF DISCOURSE- DISCURSIVE RELATIONS

INTRA-DISCIPLINARY RELATIONS				
	C⁺⁺	C⁺	C⁻	C⁻⁻⁻
Relations between concepts in current topic and other science topics	The teacher does not relate knowledge to other science topics. Learners' interventions relating to other science topics are absent or very minimal but when they occur, the teacher rejects or defers them to an appropriate time.	The teacher presents concepts relatively independent of other science topics. However, s/he occasionally draws concepts from other science topics when prompted by learners' questions.	The teacher presents the content relating it to other science topics most of the time. S/he accepts and responds to learners' interventions relating to other science topics.	The teacher recalls previously learnt knowledge and links it to the new topic. S/he frequently draws concepts from other science topics to elaborate concepts. S/he accepts learners' interventions relating to other topics and integrates them into the discussion.
Relations between science 'concepts' and 'procedures'	The teacher maintains a very strong boundary between science concepts and procedures, showing no relations between the two forms of knowledge at all. S/he emphasizes either of the two forms of knowledge exclusively.	The teacher maintains a relatively strong boundary between science concepts and procedures but occasionally relates the two when prompted by learners' productions or interventions.	The teacher provides strong links between science concepts and procedures most of the time.	The teacher provides very strong links between science procedures and concepts all the time, through questions, learners' tasks and content exposition.
INTER-DISCIPLINARY RELATIONS				
Exposition of content & instructional activities	The teacher presents content independent of knowledge from other subjects. Learner interventions relating to other school subjects are absent or very minimal but when they occur the teacher rejects or defers them to	The teacher presents the content relatively independent of other subjects except briefly when prompted by the learners' interventions. Learners' tasks require science knowledge primarily. The teacher refers to	The teacher relates knowledge to other school subjects most of the time. S/he accepts and responds to learners' interventions relating to other subjects. Learners' tasks require some knowledge from	The teacher relates concepts to other subjects all the time, presenting the content in an integrated form. S/he accepts learners' questions relating to other subjects and incorporates them into the discussion. Learners' tasks draw on knowledge from different school

	appropriate time. Learners' tasks do not require knowledge from other school subjects.	other subjects only to clarify concepts and tasks.	other subjects.	subjects considerably.
ACADEMIC/NON ACADEMIC DISCOURSE RELATIONS				
Exposition of content & instructional activities	The teacher maintains a very strong boundary between science and everyday knowledge. Learners' interventions relating to everyday knowledge are absent or minimal, but when they occur the teacher rejects them or defers to an appropriate time.	The teacher maintains a strong boundary between science and everyday knowledge. S/he refers to everyday knowledge briefly to illustrate or introduce science concepts or through materials. The teacher accepts learners' interventions relating to everyday knowledge but explains these from the science perspective.	The teacher relaxes the boundary between science and everyday knowledge. S/he employs everyday life examples to illustrate abstract science concepts. S/he accepts and responds to learners' questions relating to everyday knowledge ledge.	The teacher establishes a very weak boundary between science and everyday knowledge, presenting knowledge in an integrated thematic form. She frequently employs illustrations from everyday knowledge to explain science concepts. S/he accepts and incorporates learners' interventions relating to everyday knowledge into the discussion.
Learners' tasks	Learners' tasks do not require everyday knowledge at all; they dwell exclusively on science concepts.	Learner's tasks are primarily based on science knowledge. Everyday knowledge is only referred to within the materials.	Learners' tasks entail strong relations between Science and everyday knowledge. Tasks are framed in everyday terms or they are based on everyday life incidents.	Learners' tasks require a complete integration of science and everyday knowledge, basing on thematic issues of everyday life.
Application of topic to everyday life	The teacher does not show how the lesson content applies to everyday life at all.	The teacher only hints at the application of the topic to everyday life in a general way. S/he may tell learners to use science knowledge to deal with everyday life generally.	The teacher provides a clear indication of how the lesson content applies to everyday life citing some examples.	The teacher provides a very clear indication of how the lesson topic applies to everyday life citing numerous examples of specific incidents in the learners' community.
CLASSIFICATION OF SPACE				
Teacher-learners' space	A very distinct boundary exists between the teacher's and learners' space. The two spaces are separated by a desk and are far removed from each other. The	There is a distinct boundary between the teacher and learners' space although these are in close proximity. The teacher and learners work from their space but	The boundary between teacher and learners spaces is blurred by very close proximity of the desks. Learners and teacher work from their respective	There is no clear distinction between teacher and learners' spaces. The teacher and learners freely move within the classroom. Learners perform some of their activities in the teacher's space and

	teacher and learners work in their respective spaces all the time.	learners move to the teacher's space when they need help.	space but move to each other's space when necessary.	the teacher also performs some of her/his activities in the learners' space.
Learner-learner space	Learners are seated on separate desks arranged in rows. Each learner conducts work in his or her own space using his or her own materials.	The learners are separated on desks of two or three learners each. Learners conduct work in their own spaces but may consult those in close proximity. Learners mainly use their own materials but may share with others in proximity.	The learner's desks are organized in a semi circle. Learners work in concert with others on the same table and can move to other desks as well. Learners utilize materials together in defined groups.	Learner's desks are organized in groups, allowing them to freely move and consult the rest of the class. Learners work in groups, and share materials with other group members. They are free to move and consult or share materials with other groups as well.
CLASSIFICATION OF AGENTS				
Supporting learners' learning needs.	The teacher identifies learners with specific needs and offers them individualized help.	The teacher asks learners with particular learning difficulties to pay attention as s/he goes over the relevant knowledge to deal with the difficulties.	The teacher asks for difficulty issues and through questioning leads learners to discover the relevant information to deal with these difficulties.	The teacher addresses the learning needs of the class as a group. S/he does not provide individualised attention at all.
Allocation of roles for tasks	The teacher selects the group leaders and allocates them specific duties to perform in the group.	The teacher allows learners to select group leaders but allocates the leaders particular roles.	Learners select their group leaders and allocate roles determined by the teacher.	The learners select their group leaders and allocate themselves roles without any intervention by the teacher.
Learner to learner cooperation during group work	Particular learners carry out all the tasks and also dominate communication in the group. Other group members contribute to the tasks and communication although their interventions may be ignored or rejected.	Some learners dominate in carrying out tasks and in the communication within groups although the rest make some suggestions.	Learners share out the tasks but they eventually put the different aspects together. All learners communicate with one another during the group activities.	All learners in each group work as a team producing the work jointly. All the learners freely communicate with one another and they value each learner's communication.
Composition of learners' groups.	The groups are homogenous in terms gender and /or academic abilities	Groups are of mixed academic abilities but homogenous in gender.	Most groups are of mixed ability and gender but some are dominated one gender or ability category.	Groups are heterogeneous in ability and gender

APPENDIX B: Aggregate results for coding classification and framing for all teachers

1. Nekesa, Bethel, P.S

Selection	3.66	F++
Sequence	3	F+
Pacing	2.66	F+
Criteria	4	F++
Hierarchical rules	2	F-
Intra-disciplinary	2	C-
Inter-disciplinary	4	C++
School/everyday relations	3	C+
Classification of space	4	C++
Classification of agents	3	C+

2. Suubi, Harambee, P.S

Selection	3.66	F++
Sequence	4	F++
Pacing	3.66	F++
Criteria	1.25	F--
Hierarchical rules	4	F++
Intra-disciplinary	4	C++
Inter-disciplinary	3	C+
School/everyday relations	2.66	C+
Classification of space	3	C+
Classification of agents	3.4	C+

3. Musaali, Ebenezer P.S

Selection	3.75	F++
Sequence	3	F+
Pacing	2	F-
Criteria	3.8	F++
Hierarchical rules	3	F+
Intra-disciplinary	2	C-
Inter-disciplinary	4	C++
School/everyday relations	2.33	C-
Classification of space	3	C+
Classification of agents	4	C++

4. Weere, Canaan, P.S

Selection	4	F++
Sequence	4	F++
Pacing	3.66	F++
Criteria	3.25	F+
Hierarchical rules	3.66	F++
Intra-disciplinary	3	C+
Inter-disciplinary	4	C++
School/everyday relations	1.33	C--
Classification of space	1.5	C-
Classification of agents	3	C+

5. Sakwa, Alpha, P.S

Selection	3.75	F++
Sequence	3.5	F++
Pacing	3.5	F++
Evaluation criteria	2.8	F+
Hierarchical Rules	3	F+
Intra-disciplinary relations	4; 3	C++; C-
Inter-disciplinary relations	4	C++
School/everyday relations	3	C+
Classification of space	3	C+
Classification of agents	3	C+

6. Kabi, Fahimu, P.S

Selection	3.5	F++
Sequencing	3.5	F++
Pacing	2	F-
Evaluation criteria	3.5	F++
Hierarchical rules	3.3	F+
Intra-disciplinary relations	4, 3	C++, C+
Inter-disciplinary relations	4	C++
School/everyday relations	3	C+
Classification of spaces	2	C-
Classification of agents	2.5	C+

7. Nambuya, Gonzaga P.S

Selection	4	F++
Sequence	4	F++
Pacing	4	F++
Criteria	2.25	F-
Hierarchical rules	3.33	F+
Intra-disciplinary	3	C+
Inter-disciplinary	3	C+
School/everyday relations	1.33	C--
Classification of space	3	C+
Classification of agents	3	C+

8. Opio, Ddembe

Selection	4	F++
Sequence	3.5	F++
Pacing	4	F++
Criteria	1.25	F--
Hierarchical rules	3	F+
Intra-disciplinary	3	C+
Inter-disciplinary	4	C++
School/everyday relations	1	C--
Classification of space	3.3	C+
Classification of agents	3.4	C+

9. Bwogi, Ddembe, P.S

Selection	4	F++
Sequence	3.5	F++
Pacing	4	F++
Criteria	1.75	F-
Hierarchical rules	3.67	F++
Intra-disciplinary	2	C-
Inter-disciplinary	4	C++
School/everyday relations	1.5	C-
Classification of space	3	C+
Classification of agents	2.5	C+

10. Asii mwe, Alpha P.S

Selection	3.67	F++
Sequence	3.5	F++
Pacing	2.67	F+
Criteria	4	F++
Hierarchical rules	2.67	F+
Intra-disciplinary	2	C-
Inter-disciplinary	3	C+
School/everyday relations	3	C+
Classification of space	3	C+
Classification of agents	4	C++

11. Kulaba, Bethel P.S

Selection	3.67	F++
Sequence	3.5	F++
Pacing	3.67	F++
Criteria	3.8	F++
Hierarchical rules	3.3	F+
Intra-disciplinary	2	C-
Inter-disciplinary	4	C++
School/everyday relations	3	C+
Classification of space	1.5	C-
Classification of agents	2.25	C-

12. M alongo, Canaan P.S

Selection	2	F-
Sequence	3	F+
Pacing	2.67	F+
Criteria	3.2	F+
Hierarchical rules	2.67	F+
Intra-disciplinary	2	C-
Inter-disciplinary	3	C++
School/everyday relations	2	C-
Classification of space	2	C-
Classification of agents	2	C-

13. Bogere, Fahimu P.S

Selection	4	F++
Sequence	4	F++
Pacing	2	F-
Evaluation criteria	3.25	F+
Hierarchical rules	3	F+
Intra-disciplinary relations	3	C+
Inter-disciplinary relations	4	C++
School/everyday relations	4	C++
Classification of space	1.5	C-
Classification of agents	3.25	C+

14. Aco m, Harambee P.S

Selection	4	F++
Sequencing	4	F++
Pacing	3.3	F+
Evaluation criteria	3.2	F+
Hierarchical rules	3	F+
Intra-disciplinary relations	3	C+
Inter-disciplinary relations	4	C++
School/everyday relations	1.3	C--
Classification of spaces	2	C-
Classification of agents	3	C+

15. Ssesanga , Gonzaga P.S

Selection	4	F++
Sequence	3.5	F++
Pacing	3	F+
Criteria	3	F+
Hierarchical rules	3.67	F++
Intra-disciplinary	3; 2	C+; C-
Inter-disciplinary	3	C+
School/everyday relations	4	C++
Classification of space	2	C-
Classification of agents	3	C+

16. Erone, Ebenezer PS

Selection	3.5	F++
Sequence	3.5	F++
Pacing	2	F-
Criteria	4	F++
Hierarchical rules	1.67	F-
Intra-disciplinary	2	C-
Inter-disciplinary	4	C++
School/everyday relations	2.3	C-
Classification of space	3	C+
Classification of agents	3	C+

APPENDIX D: An extract from the integrated science syllabus showing guidelines for teaching one of the science topics

Primary 5

Integrated Science

THEME 5 : MATTER AND ENERGY

TOPIC : HEAT ENERGY

GENERAL OBJECTIVES:

To enable the learner to:

1. acquire basic scientific knowledge on effects of heat on things in the environment.
2. develop skills investigating effects of heat on matter.

MAIN IDEAS	PREVIEW OF TOPIC	METHODOLOGY AND ACTIVITIES	INSTRUCTIONAL MATERIALS
<ul style="list-style-type: none"> • Heat is one of the forms of energy like sound, light etc. Heat energy is measured in calories. • There are natural sources and non-natural sources of heat. • There are many types of thermometers used for different purposes • Hotness is a sign of the presence of heat energy and is measured using thermometers. • Heat energy is able to change form and nature of matter • Heat energy can be transformed in many different ways depending on the state of matter through which it is being transferred. • Methods of heat transfer is important in nature are day-to-day work and in making of some instruments 	<ul style="list-style-type: none"> • Learners are likely to confuse heat energy with hotness or coldness. • Heat energy is measured in calories while hotness or coldness are measured using thermometer in degrees. • Examples of methods of heat transfer include: conduction in solids; convection in gases and liquid and radiation in gases and vacuum. • It is important to develop facts about heat from learners own experiences but taking care of their misconceptions especially on: sources of heat, transfer, and application in nature and human activities. • The environment too has a lot to offer on how people manage and work with heat energy • Precautional measures are required when learners have practicals with hot objects. 	<ul style="list-style-type: none"> • Discussion on natural sources and man made sources of heat • Practical experiments on heat transfer, and application should be done by learners e.g. Transfer of heat in solids, transfer of heat in liquids and the ability of heat energy to change states of matter using water cycle as an example • Involve learners in measuring temperatures of various objects. • Use heat energy to produce work, cooking, ironing, etc 	<ul style="list-style-type: none"> • Sources of heat e.g. stones, heaters, wood fire • Water, kettle, cooling surface. • Thermometers of different types and uses. • Diagrams on charts on application of the effects of heat, e.g. expansion of matter.

ASSESSMENT: Ask your learners questions which can check if your learners can:-

- State what matter is
- Identify the different sources of heat energy
- Describe the effect of heat on some materials.
- Observe learners on their skills of practicals demonstration on different methods of heat transfer
- Find out if learners can explain the importance of heat in nature and human activities.
- Check if learners can use heat for domestic purposes, in cooking, ironing, etc.

APPENDIX E: An extract from the *Teachers' guide to the integrated science syllabus* showing guidelines for teaching one of the science topics.

THEME 5: MATTER AND ENERGY (DURATION 18 PERIODS)

TOPIC: HEAT ENERGY

GENERAL OBJECTIVES: To enable the learner to:

1. acquire basic scientific knowledge on effects of heat on things in the environment.
2. develop skills of investigating effects of heat on matter.

SPECIFIC OBJECTIVES	CONTENT
<p>By the end of this topic, the learner should be able to:</p> <ol style="list-style-type: none"> 1. <u>state</u> what matter is and <u>investigate</u> the three states of matter. 2. state what heat energy is and identify different sources of heat. 3. describe the effects of heat on matter. 4. (a) describe different types of thermometer for measuring temperature. (b) state the difference between, heat energy and temperature; and read thermometers correctly. 5. describe the different types of heat transfer in different states of matter. 6. explain the importance of different methods of heat transfer in the surrounding. 	<ol style="list-style-type: none"> 1. Matter and its states, solid, liquid, gas. 2. Heat energy: (a) sources of heat (b) uses of heat 3. Effects of heat on matter. 4. Thermometers - types and their uses. 5. Heat transfer: how heat travels 6. Uses of different methods of heat transfer in our surrounding.

Hint: The teacher should relate this content on heat transfer to the processes in the water cycle to bring out ideas of changes in the states of matter.

APPENDIX F: Teachers' descriptions of the problem solving approach

Teacher	Main features of the problem solving approach highlighted by the teachers	Teachers' examples of empirical incidents illustrating the problem solving approach
Acom	Active learner involvement, 'Set tasks and learners find out the solution'; teacher as guide', 'bring in real life situations'	Finding answers to the group tasks
Asiimwe	Identifying and attending to learners' individual abilities, practical science work	Within oral questions- <i>'that approach was coming in through these oral questions I was giving them.'</i>
Bogere	More learner involvement, - 'an approach where the learners do more of the job than the teacher... finding out things for themselves'	Group tasks
Bwogi	'Teaching using the question and answer method', practical science work	Oral questioning- <i>'to see whether they can find out before I explain to them'</i>
Erone	Instilling knowledge useful in solving future problems	Importance of birds for tourism
Kabi	Discovery method- 'let them discover what is happening by themselves'	Practical work undertaken by learners using guidelines from the teacher
Kulaba	Learners finding out information about particular tasks; learners are more involved in the learning process, teacher just gives guidance	Learners planted bean seeds, cared for them, they also observed, recorded & reported information on plants
Malongo	Finding solutions to problems – 'a method whereby you get a problem then you see how learners can come up with solutions to the problem'	Role plays on first aid for accidents, learners gained skills & knowledge for addressing actual problems(accidents)
Musaali	'Involving learners to find solutions to problems themselves using different sources'; applications to real life issues, teacher as 'moderator, guiding them'	Questions basing on their observations of practical science activities
Nambuya	'Children will learn how to solve their problems in future', role plays	<i>'I would give them a problem and they role play solving a problem'</i>
Nekesa	'Solving problems by applying prior knowledge to actual contexts'	<i>'For example if I gave children a bird to care for they should not ask me what to do because we have already learnt about it'</i>
Opio	Learners finding out answers to questions/problems by themselves	Oral questioning
Sakwa	'Practical teaching' and 'involving the children to solve their day-to-day problems'.	Observed that the demonstration lesson did not provide 'real' problem solving incidents because learners did not conduct the practical work
Ssesanga	'Doing it by themselves' - 'we sometimes call it a discovery method... it leads them to discover something', 'not direct teaching, they first do it themselves'	<i>'Giving them to work by themselves... for example the other boy was demonstrating how to do the thing' (Making temporary magnets- LS)</i>
Suubi	'It is child centred not teacher centred', 'The child to be involved all the time' 'to solve the problem themselves'	<i>'Like when they went out to get the leaves they picked the leaves themselves I did not tell them that you bring this and that';</i>
Weere	Finding solutions to a problem/task- 'Doing things themselves'	Finding solutions for the group tasks