

University of KwaZulu-Natal

LEARNING TO CHANGE: A STUDY OF CONTINUING
TEACHER DEVELOPMENT IN TWO CONTEXTS OF
EDUCATIONAL REFORM

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Abstract

Systemic educational reforms entail major changes at the different levels of the system, of which classroom practice is ultimately crucial to obtaining the desired output. Within this paradigm shift, experienced teachers have to replace what they are likely to consider good teaching and learning approaches with unfamiliar strategies. Continuing professional teacher development (CPTD) plays a key role in successfully changing classroom practices.

This in-depth case study research—six teachers in two different countries, Canada and South Africa—looks into the information acquisition process of instructors. Interviews were performed at different levels of the educational system – policy makers, pedagogic/subject advisors as well as teachers for which questionnaires and classroom observation were also used to collect data. A research-based analytical tool developed by Laura Desimone (Desimone, 2009) guided the exploration of the vast data collected and served as the analytical framework for the various data sources, drawing a link between the intended, implemented and attained policies. The thorough discourse analysis situated in the interpretivist framework gives global insight into the teachers’ perception of the impact of CPTD as it enables a deep understanding of the information acquisition and utilization by teachers. The examination of teachers’ pedagogical content knowledge in different reform contexts brings a profound perspective on how professional development activities contribute to the professional capital of educators, as envisaged by Hargreaves and Fullan (2012).

Data suggest that policies related to professional development are adequate in Québec and in South Africa, but that planning around implementation is hasty or lacking altogether. Regardless of the socio-economic environment and the professional development accessibility, teachers do not perceive CPTD as being a major vector of change and they were found to lack the necessary capacity to change their practices to reflect their beliefs. Finally, teachers reported that the most influential factor on practices is the availability of teaching and learning material and learners’ reaction to it.

In conclusion, in the two contexts observed, CPTD was not emphasised to the level required for a paradigm change such as constructivist-based systemic reforms. I suggest adapting CPTD delivery methods to teachers’ need by ensuring widespread and reform-aligned professional development. In addition, access to information through appropriate teaching materials combined with appealing and applicable activities should be facilitated.

Acknowledgements and dedication

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I would like to dedicate this thesis to my family.

My kids Luca and Sofia, pure source of energy, who compelled me to periodically step back, play, laugh and reflect; allowing by necessity for academic matters to churn below and surface more clearly.

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Thank you. Merci. Grazie. Ngiyabonga.

Declaration

I, Annie-Hélène Samson, declare that

(i) The research reported in this thesis, except where otherwise indicated, is my own work and original research.

(ii) This thesis has not been submitted for any degree or examination at any other university.

(iii) This thesis does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.

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- a) their words have been re-written but the general information attributed to them has been referenced;
- b) where their exact words have been used, their writing has been placed inside quotation marks, and referenced.

(vi) This thesis does not contain text, graphics or tables copied and pasted from the Internet, unless specifically acknowledged, and the source being detailed in the thesis and in the References sections.



Signed:

Date: December 19, 2013

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List of Abbreviations

- CPTD: Continuing Professional Teacher Development
- CSE: Conseil Supérieur de l'Éducation
- DBA: Department of Basic Education (South Africa)
- DHET: Department of Higher Education and Training (South Africa)
- ELRC: Education Labour Relation Council
- FET: Further Education and Training
- HSRC: Human Sciences Research Council
- ICT: Information and Communication Technologies
- INPECIP: Inventory of Teachers' Pedagogical and Scientific Beliefs
- KZN: KwaZulu-Natal
- LTSM: Learning and Teaching Support Material
- MELS: Ministère de l'Éducation, du Loisir et du Sport (Québec, from 2005)
- MEQ: Ministère de l'Éducation du Québec
- NGO: Non-Governmental Organisation
- OECD: Organisation for Economic Co-Operation and Development
- PLC: Professional Learning Community
- QC: Québec
- RSA: Republic of South Africa
- SA: South Africa
- SACE: South African council of educators
- SAE: Situation d'Apprentissage et d'Évaluation (SAE)—Learning and Assessment Situation
- UNESCO: United Nations Educational, Scientific and Cultural Organisation

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Chapter 1. Introduction

1.1 Context

1.1.1 Educational Reforms

“Education is not preparation for life: Education is life itself.” (John Dewey)

A society’s education system represents its values and embodies the very essence of what its citizens aspire for their children and their future. However, societies evolve and so must the education system. In order to stay aligned with ever changing economic, social and political needs, there is a worldwide cyclical necessity for educational change. To stay in tune with the global needs, major systemic reforms are now commonly initiated worldwide. According to Smith and O’Day (1991), a systemic reform can be defined as a movement striving for better student standards and revolving around major coordinated policies and school-level change. An educational change of this magnitude is also often referred to as whole school or comprehensive school reform.

Outcomes-based education (OBE), or different variants thereof, is a contemporary widespread example of such a drastic educational change that has been implemented in different countries around the world during the last twenty years. Some authors even refer to this phenomenon as a reform epidemic (Steiner-Khamsi, 2006). With this type of reformed education system, student performances are not measured only based on knowledge but on empirical criteria such as outcomes, competencies or standards. Most states in the United States have moved to standards-based education, where students are expected to reach well-defined and standardized skills or knowledge levels. Generally grounded on constructivist philosophies, the current reforms imply that classrooms are meant to be collegial learning spaces, where students discuss and apply concepts with a central place for inquiry-oriented education (Chisholm & Leyendecker, 2008; European Commission, 2001). Indeed, as if listening to Dewey half a century later, OBE or similar programs attempt to emulate life situations and encourage learners to understand and apply knowledge rather than rote learning. It also tends to favour a student-centred classroom over the traditional teacher-centred lecturing (Bell, 2009; Maodzwa-Taruvunga & Cross, 2012; Ministère de l’Éducation du Loisir et du Sport du Québec, 2005). This modern constructivist reform movement in education is characterized by an assumption

that “knowledge is not transmitted directly from one knower to another, but is actively built up by the learner” (Driver, Asako, Leach, Mortimer, & Scott, 1994, p.5). It is strikingly different from the traditional behaviourist approach used previously in most part of the world, where content was ‘poured’ into the student’s head in teacher-centred classrooms. This latter approach is often referred to as the transmission model of education, where the teacher knows and transmits what students ought to learn.

Nowadays, many OBE-pioneering countries such as New Zealand and Switzerland, have already abandoned OBE while many others are battling with major implementation difficulties—such as Namibia, South Africa, Australia, some provinces of Canada, many states in the United States, Argentina etc. (Fullan, 2007; Gorostiaga, Acedo, & Xifra, 2003; Steiner-Khamsi, 2006). These outcomes-based programs are anchored in the literature and supported by well-documented studies in various fields such as student and teacher learning, psychology, sociology etc. but their outcomes, no pun intended, have yet to be demonstrated (Birman et al., 2007; Gorostiaga, et al., 2003).

The implementation of a systemic reform is an enormous task and represents a major challenge for all stakeholders, including teachers. As Little (1993) expresses it, major reforms “represent, on the whole, a substantial departure from teacher’s prior experience, established beliefs, and present practice. Indeed, they hold out an image of conditions of learning for children that their teachers have themselves rarely experienced.” (p.130). OBE-type educational reforms represent a dramatic change for teachers who have always taught and were taught a list of subjects in teacher-centred classrooms. A firm critic and university academic in South Africa, Jonathan Jansen, has presented OBE in these terms: “The policy requires not merely the application of a skill, but an understanding of its theoretical underpinnings and demonstration of a capacity to transfer such application and understanding across different contexts.” (Jansen, 1999, p.149) .

Teachers play a central role in the application of such a change but unfortunately frequently find themselves lost in the immensity of the task. The envisaged role of teachers in such reforms is often one of accompanist, one that paves the way for learners to unleash their potential. This role can’t be accomplished with a technical, recipe-book type of teaching. To enact reforms aiming to realise the full potential of learners, teachers must demonstrate high levels of professionalism. Investing in continuing professional development in a context of systemic reform can play a central role in the understanding, acceptance and ultimately success of this kind of societal project. As Hargreaves and Fullan concluded in a recent book: “We

can treat teaching as just a short-term investment of business capital, and finance the present by mortgaging our children's future. Or we can make teaching a sustainable investment for professional capital, and give birth to a world of many happy returns to come." (Hargreaves & Fullan, 2012, p.186).

1.1.2 Continuing professional development in a context of educational change

Fullan (2007) also claims that teachers have to be placed in the centre of educational change. Indeed, in a context of systemic reform where teachers must learn new content and new pedagogical content knowledge (PCK) in a very short time, the particular importance of continuing professional development is generally accepted (Brodeur, Deaudelin, & Bru, 2005; Lieberman & Pointer Mace, 2008; Loucks-Horsley, 1995). Shulman (1997) compares a school reform to an ellipse where the two foci represent student and teacher learning as orbits of equal importance. McLaughlin and Oberman (1996) argue that educational reforms and teacher development share a symbiotic relationship. Literature on the subject offers many small-scale examples of successful professional development projects, which enables researchers to draw some general conclusion about what works best. Also, although academics and researchers do not always agree on all aspects of continuing professional teacher development (CPTD), the current understanding is that it should contribute to changing teachers' and schools' approach to learning, *reculturing* the educational environment to enable life-long learning (Fullan, 2007; Little, 2001). However, despite numerous attempts around the world, adaptable, effective and attitude changing continuing development programs are still lacking. Sustained efforts to better understand how to improve CPTD are ongoing, and this study gives insights into the process.

1.2 Rationale for Research

It is difficult to assess the precise outcomes of continuing professional development but the general opinion is that in most countries, it is not adequate or adapted to the needs of a large-scale reform (Jansen & Taylor, 2003; Lieberman & Pointer Mace, 2008; Schweisfurth, 2011). Ottevanger, van Den Akker and de Feiter (2007) comment: "Although only limited data on the effects and impact of in-service teacher development programs are available, existing evidence and anecdotal information does not paint an optimistic picture." (p.56). They refer to the available evidences to conclude that professional development programmes are often workshop based with no appropriate following support and provide inadequate content with regard to the teachers' skills and needs. In addition, they found that initiatives are rarely

supported by comprehensive plans to implement change locally at the level of the school or in the community. Basically, the taxpayers don't get their money's worth when investing in continuing professional teacher development.

Considering the importance of continuing teacher education and the substantial investment in designing and implementing educational reforms, it is of particular interest to be able to evaluate the efficiency of different approaches meant to change teachers' attitudes and practices and to develop a common structure when studying professional development. Recently, Borko *et al.* (2008) have pointed out the lack of consensus on how to assess in-service teacher training. As a result of this inconsistency, it is difficult for policy makers to design professional development based on research, as well as for academics to contribute to building coherent knowledge in the field. Nevertheless, it is critical to investigate and try to deepen our knowledge to develop adequate tools that promote the goals of an educational reform. As a response to the critique, Desimone (2009) proposed five critical core features to assess professional development and a possible common framework to evaluate their impact. Her framework takes into account the quality of teacher development by evaluating these core features, but also the change effected on teachers and their practice as a result of it, as well as the effect on student learning. As a new analytical framework strongly grounded on research, it serves as a basis for the present study with a differential emphasis on social learning, confidence and teacher identity. The former is inspired by Wenger's (1998) models of social learning and professional learning communities as described by Shirley Hord (1997); the latter is inspired by Graven's work on teachers' learning and confidence (2004). The emphasis serves for the assessment of the impact of learning communities on the meaning teachers make of the reform and how it helps them acquire the necessary confidence to implement it. This particular angle will allow a more *situative perspective*, rooted in sociology, anthropology and psychology, which will help in the contextualisation of teacher learning. A situative perspective "provides a powerful research tool, enabling researchers to focus attention on individual teachers as learners and on their participation in professional learning communities." (Borko, 2004, p.4).

The present study aims to uncover the complexities of teacher's perceptions of CPTD and how it impacts on them as individuals, as well as on their practices. To do so, different types of continuing teacher development is assessed in various contexts—two different countries, socio-economic background and political environments. The research therefore also examines the different strategies put forward by policy makers in different contexts and how it influences their views of continuing professional development. It also brings insights into how

professional development reaches teachers depending on their individual identity, and how it can bring about an evolution of their attitudes and practices.

Too many reform attempts have failed cohorts of learners in the first stages of the implementation. Inadequate policies, teacher capacity and resources are often cited as overwhelming obstacles, among others (Schweisfurth, 2011). For the benefit of both students and teachers, an educational reform should not have to sacrifice a generation during implementation. Educational research ought to play an efficient role in guiding policy development and implementation with regards to the vehicle used to inform teachers about their new roles, continuing professional development. This study aims to contribute to an understanding of effective CPTD, with the intention of providing research-based input into policy and practice.

1.2.1 A study of CPTD in two contexts of educational reform

The research will look at the different stages of CPTD implementation in the provinces of KwaZulu-Natal, South Africa, and Québec, Canada. The specific choice of South Africa and Canada as comparison models was serendipitous, a case of “convenience sampling” and a result of particular interest of the author. Being a Canadian teacher living in South Africa gives me the opportunity to study CPTD in two very different environments while understanding the socio-cultural contexts, simply from the comprehension that comes from having lived with its people. Issues about implementing a reform are often common in different countries and there are recurrent criticisms about how teachers receive and implement change. It is also a common argument in developing countries that teachers’ under qualifications are the cause for the lack of implementation (Maodzwa-Taruvunga & Cross, 2012). If this is the case, why has it also failed in many developed countries? An understanding of teachers’ reality in different contexts could give insights as to why teachers are embarking or not on the train of educational change. Is the information about what is expected conveyed adequately? Was there a plan to convey the new philosophies to the teachers? The idea of studying the actual state of continuing professional education emerged in my teacher’s mind: how do teachers experience professional development, what is their relationship with these new concepts and pedagogical approaches? If there is a gap between the intended and the actual CPTD practices, why is it so and how can we improve it?

The timing of the study also pointed towards these two regions as South Africa’s Education Department and Québec’s Ministry of Education have simultaneously undertaken the major

task of revisiting the curricular content and its associated pedagogy. A comparison of the historic and political motivations for both national reforms will be discussed later in chapter three. In South Africa, the curricular change was implemented in 1998 (C2005) and the first reformed cohort entered grade 12 (matric) in January 2008. This first curriculum was evaluated and revised a few years later based on a report of the curriculum review committee (Chisholm et al., 2000). Outcomes-based education was retained after the curriculum review, but curriculum statements were revised to give more direction to teachers. The resulting curriculum was called the Revised National Curriculum Statement (RNCS). In June 2010, South African Minister of Basic Education, Mrs Angie Motshekga, announced once again many changes to the curriculum, based on the report of the task team for the review of the implementation of the National Curriculum Statements (Dada et al., 2009). The new Curriculum and Assessment Policy Statements (CAPS), first implemented in 2012, is seen by many as the abandonment of OBE. Indeed, the new school program, Schooling 2025, is based on better defined content and not on outcomes.

Québec (QC)'s road to reform was not less bumpy¹. Although democratic governments can never afford to spend much time on policy making for fear of being evicted without another mandate, Quebec's government conducted public consultations before embarking on a systemic reform. A major province-wide consultation was performed before preliminary official government papers were issued in 1997 (Ministère de l'Éducation du Québec, 1997). The curricular documents were implemented in 2000 in grade 1 and 2 and, following a few revisions, restated to include the required competencies of the newly called 'Renouveau Pédagogique' ('Pedagogic Renewal' but generally referred to as 'the reform' in English)². The Ministry of Education, Leisure and Sport recently implemented a unique student grade report that focuses more on knowledge and less on competencies to accommodate the objecting population. The reformed cohort in Québec started 'CEGEP I' in September 2010, the equivalent of grade 12 in South Africa. Both country/province have opted for an Outcomes-Based-Education (referred to as competency in Québec), but as mentioned, both governments are also making major revisions which have been seen by many, or in some cases openly stipulated by government officials, as moving away from the original OBE structure.

¹ In accordance with the Canadian federalism, the different provinces have control over their education system. Therefore reference to Québec will be made throughout the document as each province's education system functions under different jurisdictions.

² Throughout the text, free translation was performed by the author.

Notwithstanding these similarities, these two contexts show major cultural and socio-economic differences. The majority of the schools in South Africa function in a low socio-economic environment, with students and teachers often teaching and learning in their second or third language (Taylor, 2011). In Québec, most schools are in moderate to high socio-economic environments (in comparison to South African's schools) and the majority of students and teachers function in their first language. The general performance of the systems is also very different, as well as the results in Sciences: in 2011, South Africa performed with an average scale score of 332 in the Trends in International Mathematics and Sciences Study (TIMSS) whereas the Province of Québec obtained 520, the TIMSS scale centerpoint being 500 (Trends in International Mathematics and Science Study, 2012). Recently, the World Economic Forum for financial development rated South Africa's sciences and mathematics education worst of 62 countries surveyed (World Economic Forum, 2012).

The in-depth case study approach chosen in this research will help to comprehend the similarities and differences in teachers' perception and attitudes toward CPTD that arise from these different contexts. Although the goal is not to generalize to a global and uniform level, the comparison will help understand different teachers' approaches to change in different environments. Chisholm and Leyndecker (2008), in discussing how policy is translated in practice in sub-Saharan countries, refer to 'convergence in divergence' (p. 203), which could apply to teachers' processes of learning to change.

1.3 Research Questions

“To conduct a piece of research, scholars must necessarily narrow their scope, focus their view, and formulate a question far less complex than the form in which the world presents itself in practice.” (Shulman, 1986, p.6)

In the light of the above, I have narrowed my research questions to the following:

1. How do the continuing professional teacher development policies align with research-based recommendations in South Africa and Québec?
 - a. If it does not, what is the nature of the gap and why?
2. How is continuing professional teacher development implemented, in KwaZulu-Natal and Québec?
 - a. Why is it, or not, implemented as intended?
3. How does continuing professional development favour a change in attitudes and beliefs as well as in confidence in a context of educational change?
 - a. Why do teachers change, when they do?
4. In what way is continuing professional teacher development reflected in teachers’ practices with regard with the reform being implemented?
 - a. How does it relate to changes in attitudes and confidence?
5. How do we establish a common analytic framework to evaluate continuing professional teacher development?

1.4 Paradigmatic View and Theoretical Framework

1.4.1 Paradigms: a broad overview

Research texts defining, redefining, clarifying and contradicting the philosophical, ontological and epistemic terminology are abundant so the next section will draw a broad historical overview of the topic for the purpose of situating the author’s paradigmatic stance.

Since Aristotle, the deductive type of reasoning rooted in syllogism was the one accepted

paradigm in order to undertake a serious investigation. It is not before the 1500's that inductive reasoning was introduced, mainly with Francis Bacon's notion of observation before generalization. Both views have then been used together but always in the purpose of uncovering the Truth through a 'pure' scientific approach. Before the term was developed, positivism was at its apogee and it is not before Auguste Comte's *positive philosophy* that positivism could be used concomitantly with social science research, in the middle of the 19th century. John Stuart Mill further propagated this accepted view from the pure sciences into the field of sociology. Mill was also, in some ways, flirting with postpositivism before it even 'existed' with his praise to the falsification method rather than validation of hypotheses. With *A System of Logic, Ratiocinative and Inductive* (1846), Mill's plea to logic and reproducibility was heard by the social scientist community and a trend of pure and applied quantitative research was initiated and glorified. This way of seeing social science research was to last for more than a century.

In 1946, Michael Polanyi's pioneer contribution on the topic (Polanyi, 1946) acknowledged the role of personal values in the practice of science. Even though the book raised controversy (or because of it), it did not bring changes in the practices of the majority of the scientific community and the strong positivist approach to science was still *en vogue*. Merely a few people dared challenge this view until Thomas Kuhn introduced the paradigm shift in 1962 (Kuhn, 1962). 'Normal' scientists could, in his view, use some undisputable findings whereas studying humanities involves adopting different standpoints to a phenomenon. This renewed view on social science research started to gradually open the door to the utilisation of different approaches and opened the paradigm concern. Contemporary with Kuhn, Karl Popper offered a paradigm that is now widely used to respond to critics qualifying positivists' proponents of being rigidly entrenched in their scientific method. Critical rationalism, as he described his philosophy, introduced the idea of refutation of hypotheses in research and gave rise to the postpositivist era, which admits the possibility of a Truth that could not be totally unveiled. With time, more naturalistic thinkers arose, influenced by Schleiermacher, Dilthey and other hermeneutics philosophers and added their word to the discussion and brought philosophies at the other end of the paradigmatic spectrum. Indeed, constructivists and interpretivists propose that the 'reality is socially constructed' (Mertens, 2005, p. 12) hence research is value dependant. Within this naturalistic viewpoint, many different traditions were identified by many authors—human ethnology, ecological psychology, holistic ethnography, cognitive anthropology, ethnography of communication, symbolic interactionism (Jacob, 1987, 1988); post-positivist, ethnographic, phenomenological, subjective, case study, qualitative, hermeneutic, humanistic (Lincoln & Guba, 1985). Whereas positivists are criticized for a lack

of situative perspective, for ignoring context and human variances, naturalists are, on the other hand, condemned on the reproducibility, validity and reliability issues. Many other schools of thoughts and paradigmatic subtleties are emerging and submerging, and individual paradigms can be promoted or demoted by the academic community through time.

As briefly shown above, many different paradigms are now described in the literature, often with divergent qualifiers and, notwithstanding the impressive amount of research texts, confusion about the exact definition for each paradigm persists (Mackenzie & Knipe, 2006). In a broader sense, one could refer to positivism and anti-positivism (or naturalistic inquiry) as defining how one plans research, with ontological subtleties within each view (Cohen, Manion, & Morrison, 2000; Dash, 2005). In addition, a paradigm that is gaining recognition in literature is the pragmatic paradigm which supposes that each inquiry requires an appropriate investigation method, with no allegiance to one philosophy in particular (Creswell, 2003; Mertens, 2005). Nevertheless, as the present thesis theme suggests, people are reluctant to change and even in our day and age, influential instances sometimes still praise a post-positivist science (Secherst, 1992). However, intermediate approaches gain recognition in diverse areas of social sciences. Let the paradigm shift.

The previous historical discussion exemplifies that paradigmatic conceptions are time-dependant and dictates how research is conducted in different periods. According to the contemporary views of reality, it is conceived differently, which means that very different ontological conceptions are preponderant in social research of a particular time. The idea that a unique reality can be uncovered by a rigorous methodology dictates strict epistemological views to postpositivists; on the contrary, if the ontological accepted views are that reality is an individual construct, the interpretivist paradigm calls for a flexible epistemological vision, with an associated methodology. It is important for an author to acknowledge this fact when envisioning a particular research in order for the methodology to be adapted to his/her beliefs rather than to the era's trend. What the above short historical perspective intends to show is that a rigid ontological view can obstruct realities from a researcher. The author's practical-moral inclination, to use Bernstein (1983)'s words, is towards what Feyerabend (1975) describes as human freedom and creativity. As such, categorization in a particular dogmatic paradigm is guiding but if the paradigm leads the investigation, it unveils only parts of a situation.

Guba and Lincoln state that a paradigm represents the basic belief system or worldview that guides the investigator, defines for the researcher what it is they are about, and what falls

within and outside the limits of legitimate research (Guba & Lincoln, 1994). In the same paper, they argue that postpositivism and constructivism cannot be accommodated more than the idea of flat versus round earth. This idea that some paradigms are irreconcilable is widespread. What if the view depended on the nature or even parts of the inquiry? Research is conducted according to the investigator's view on the world and thus epistemological grounds have to be laid beforehand but a strong classification within a paradigm also feels constraining. Research should shed light on things and give a better understanding of the world. It seems reasonable to state that a researcher's motives to study a phenomenon is to try to answer questions, to shed light or try to better understand it. Therefore, the choice of the methodology, although based on epistemological and ontological grounds, must be based, as Creswell argues, on the research problem first, and then based on the researcher, as well as the audience (Creswell, 2003). In that case, more attention should be given to reliability and validity than to the ontological or epistemological views of the researcher. The author's beliefs will influence the interpretation of the data, which should be well-reasoned using strong empirical arguments. It is not argued here that it is unimportant to define one's worldview, but that, as opposed to what some authors claim, a researcher can 'go about the business of inquiry' (Guba & Lincoln, 1994) without having to jump through the hoops of one and only paradigm; that paradigms are not 'the motivation for undertaking a study' (Cohen & Manion, 1994, p. 38). Different questions, even within one research, require different approaches and it seems simplistic to try and confine them as a whole, as one worldview. Many authors raised the issue of this fabricated duality between qualitative and quantitative data and positivist versus interpretivist approach to research (Phillips, 2005; Pring, 2000; Rowbottom & Aiston, 2006). Even Cohen and colleagues express the concern in this way: "[...] rather than advocating slavish adherence to a single research paradigm, we suggest that 'fitness for purpose' must be the guiding principle." (Cohen, et al., 2000, p. xvii).

In light of the above, the author describes her general approach to science as postpositivist, having studied first in health sciences before embarking in educational research. However, the author believes that the inquiry reported here, as well as the methodology associated, can be mainly situated in an interpretivist approach. Indeed, in order to gain a deep understanding of the reality of teachers, to find out how they experience the learning process and possibly influence their practice in class, a very thorough investigation is demanded. The main framework of this research certainly accords with the interpretivist philosophy with regard to the role of the researcher and the interactions with the people involved in the study. Indeed, in-depth, detailed data are collected and subjected to the author's perceptions. To answer the research questions, semi-structured interviews were conducted for which a relationship

between the researcher and the subject is essential, which tend to steer the discussion towards the researcher's foci of interest. Rich in details, data is therefore essentially analysed in accordance with the interpretivist views as they are influenced by the researcher/subject relationships, then classified and grouped according to interpretation. Also, hours of interviews and observation help to build a trust relationship with teachers, which help understand changes in values and attitudes. The presence of the interviewer/observer is necessary to understand changes operated in teachers' practices, which can influence the data and lead to context dependant, subjective analysis. It is thus with caution that the framework of this research will be situated in the interpretivist paradigm, with an open mind to other views. One argument for a non-positivist stance in this research is certainly the lack of a starting hypothesis-theory to prove or disprove, even though the analytical framework described later provides guiding steps for the methodology used in the present study. Grounded theory, some might claim, could therefore be adequate to the research, as their partisans advocate a somewhat 'blind' attitude to research, leaving the data to reveal and materialise the approach. However its underlying purpose to achieve a global theorization does not fit the case study report undertaken here. Indeed the purpose is one of deep understanding and does not necessarily invite grand conceptualisation such as grounded theory develops.. As argued earlier, according to the author the questions themselves call for an interpretivist view and will consequently be tackled this way. It is the intention however to keep an open mind, using what we could qualify as a 'grounded paradigm'.

1.4.2 Theoretical and conceptual framework: finally

Collectively, the research questions abovementioned all frame a major theme: implementing change. How is knowledge professionally transformed, utilized and/or appropriated by teachers. The research is based on the teachers' viewpoint, but has to be addressed from a larger perspective to understand how knowledge was developed and conveyed to them. The entire study is framed in a general interpretivist approach, with the specific following theoretical and conceptual framework guiding the detailed analysis.

Professional capital

The theoretical basis for the research draws from Michael Fullan's theory of educational change (Fullan, 1993) as well as his and Andy Hargreaves' notion of 'reculturation' (Fullan, 1999; Hargreaves, 1994). Both authors have been advocating, as a vector of change, a

transformation in culture in the professional environment of teachers. Schools have to become a source of motivation, of professional exchanges and therefore a source of informal professional development. They recently built upon this reculturation to introduce the concept of ‘professional capital’ applied to the teachers and the teaching profession (Hargreaves & Fullan, 2012). Based on their general interest in educational change, they conceptualise what ‘teaching like a pro’ involves, and how to bring it about in teachers. According to them, without building on professional capital, the isolated success stories of some schools will stay isolated. The only way of multiplying professionalism is by nurturing it in the system.

Professional capital, which they illustrate as a mathematical function, is dependant on the human capital, the social capital and the decisional capital, and each component multiplies the next, as shown in the formula: $PC = f(HC, SC, DC)$; where PC represent professional capital, and HC, SC and DC human, social and decisional capital respectively. Human capital has been described separately from a strictly financial investment in the 1960’s and 70’s (Spengler, 1977) and represents the collective *savoir-faire* of a society, acquired through education and/or practice. Hargreaves and Fullan describe teachers’ human capital as the sum of their individual talents, as what could be considered pedagogical content knowledge. Human capital in education means investing in creating adequate skills and knowledge. It can also be multiplied by social capital, which also contributes to a system’s ‘productivity’. Social capital lies in the relations between colleagues but also between teachers and students, parents and administrators. “Social capital increases your knowledge—it gives you access to other people’s human capital.” (Hargreaves & Fullan, 2012, p.90). It gives a sense of community and a common goal that can result in very high achievement. Hargreaves and Fullan deplore the lack of strategic planning to develop this important aspect in education, especially during reform implementation. They claim that the level of social capital in the culture of a school is the key variable in implementing innovation. The third variable in the function is also increased by the first two and represent one’s capacity to make discretionary judgements. Teachers in a classroom are faced with different students and situations all the time. Decisional capital is the essence of professionalism. It is drawn from Anglo-American legal systems’ common law, where “cases refer to and move on from each other over time” (Hargreaves & Fullan, 2012, p.93). Experience provides teachers with decisional capital, but it is also increased through unstructured or structured reflective practice as well as colleagues’ insights and experiences—hence the relationship with social capital. Decisional capital however is highly dependant on individual practice and evidence points that professional acquisition of a skill takes time: the milestone of 10 000 hours has been put forward, or eight years in the teaching profession (Ericsson, Krampe, & Tesch-Römer, 1993).

The result of the professional capital function is based on five interrelated Cs: 1-capability (or expertise), 2-commitment, 3-career, 4-culture and 5-contexts or conditions of teaching. The first three Cs build the professional capital, which can only be present if the last two Cs are adequate.

Capability is more than the mere competences and implies setting higher standards for greater accomplishments. Supported by evidence from various studies, capability can be increased in different ways, from a cold shower to a warm Jacuzzi, and is not necessarily the direct consequence of expertise. It is increased by commitment, which is dependant on many factors in a teacher’s life, some of which are personal but others are professional and therefore can be acted upon. Career stages are also important factors influencing capability as well as commitment—the first two Cs, and the interrelationship between these factors is represented in Figure 1.1.

		Commitment	
		Higher	Lower
Capability	Higher	Mid-career	↑ Late career
	Lower	Early career	↓

Figure 1.1. Relationship between career stage and capabilities/commitment. From Hargreaves and Fullan, 2012, p. 73.

In a teacher’s early career, one may have high commitment but low capability due to lack of experience. In mid-career, commitment and capability typically increase, developed through experience, professional development, and reflection. It could also be nurtured when the school culture is adequate to develop social capital. Late-career stages are often characterised by a decrease in commitment although capabilities are highly variable (Drake, 2002). Teachers in this career stage are often more reluctant to implementing change as most of them have been through change already hence have to be convinced that this particular reform will really help and that it is there to stay. Hargreaves and Fullan suggest the creation of various

pathways so that late-career teachers can use their experience in contributing in other ways to the system.

As the term implies, a society needs to invest in professional capital. For human, social and decisional capital to be developed, the approach of the schools needs to change so that teachers themselves are motivated to grow their professional capital. Human capital implies that a teacher has developed the necessary subject knowledge as well as the capacity to teach it, but is also increased by the social capital. Indeed, for human capital to increase, one has to interact, discuss, collaborate and trust. From the social and human capital, combined with experience, decisional capital can also grow. Indeed, with all the theory in the world, a teacher still needs to learn when and with who a specific approach is more efficient. It is all part of a multiplying formula that ought to be taken into account when wanting to increase teachers' 'performances'. The two other Cs that are added to the necessary ingredients for teachers' improvement are culture and context. Culture refers to the distinctions between different people, particularities, subtle or not, of the population. The content of a culture—its substance, is comprised of different beliefs affected by others—which interactions compose the form of a culture. These components have to be taken into account to introduce an adequate context of teaching, a professional atmosphere in a school, a district or a community that can trigger human, social and decisional capital. An adequate professional school context can trigger an enriching collaboration if it is introduced with the acknowledgement of the existing culture. "Principals don't need frontal lobotomies or any other strategy that might convert them into instructional leaders. They need to know how to identify, develop, select, and connect their people—a leadership challenge that is more powerful yet also more doable. The role of the principal, in other words, is indirect but nonetheless explicit: to build the professional capital of the school's teachers and its community." (Hargreaves & Fullan, 2012, p.146). Hence, culture and context of teaching are interrelated and necessary to develop commitment and capability.

Theories of change are diverse but professional capital, grounded in experience and research, is unifying and applicable, making it appropriate to serve as a framework for this study on change. It implies life- long learning that is so suitable for the current vision of professional development.

All the interrelated concepts described above have to be integrated in teachers' development planning. Continuing professional development should aim at developing human, social and decisional capital and the data in the present study are considered through that lens.

Furthermore, professional capital is intertwined with another important concept in this research's theoretical framework, pedagogical content knowledge (PCK).

Knowledge and pedagogical content knowledge

The concepts around knowledge—in the broad sense of anything that has been perceived, discovered or learnt, gained through experience or study—were also used to guide the research tools development, data collection and analysis of the present research. Inquisition about the nature of knowledge has absorbed philosophers since Socrates' illusion of understanding. However, although there were teachers all along, there were no serious attempts to better understand what knowledge was needed to become an effective teacher or how teachers used this knowledge. In the mid-1980s, Shulman (Shulman, 1986, 1987) raised the question, introducing the notion of 'knowledge base for teachers'. Along with colleagues, their extensive list of categories of knowledge has since become a reference in the field (see: 150 ways of knowing: Representations of knowledge in teaching (Wilson, Shulman, & Richert, 1987)). The Carnegie Task Force report (1986) supports Shulman's claim that there exists a 'knowledge base for teaching' — a codified or codifiable aggregation of knowledge, skill, understanding, technology, ethics and collective responsibility— as well as a means for representing and communicating it. The concept has since helped many researchers to describe teacher knowledge and more recently, Park and Oliver (2008) have summarized the commonalities between the different authors in a diagram representing the knowledge base for teachers, adapted from Grossman (Grossman, 1990). This categorization, shown in Figure 1.2 is used as a conceptual framework to grasp the data in the present research.

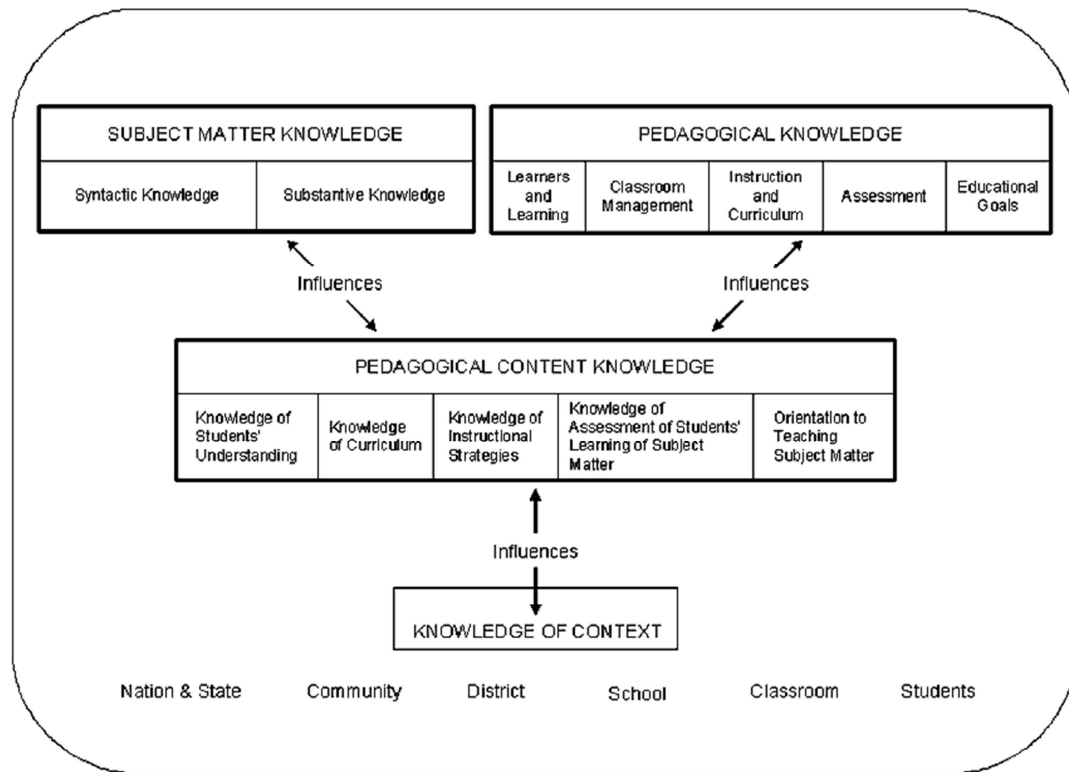


Figure 1.2. Knowledge base for teaching. In Park and Oliver (2008), adapted from Grossman (1990).

Noticeably in this representation, the concept of pedagogical content knowledge (PCK), also advanced by Shulman (Shulman, 1986) and further developed by himself and others (Loughran, Mulhall, & Berry, 2008; Park, Jang, Chen, & Jung, 2011; Shulman, 1987; Van Driel & Berry, 2012) is central to the framework. As the words depict, it lies at the junction of subject content and its appropriate pedagogy. Attempts to define and redefine PCK are abundant in the literature (for review see table 1 in Park and Oliver (2008)). The following brief definition developed by the author summarizes the construct and will be used in the present study: knowledge that a teacher uses to appropriately convey particular subject matter to particular learners. However, the questions that were originally presented by Shulman remain, to the author, the best tool to comprehend his conception: “What are the sources of teacher knowledge? What does a teacher know and when did he or she come to know it? How is new knowledge acquired, old knowledge retrieved, and both combined to form a new knowledge base? [...] How does the teacher prepare to teach something never previously learned? How does learning for teaching occur? [...] How do teachers take a piece of text and transform their understanding of it into instruction that their students can comprehend?” (Shulman, 1986, p.8).

The concept of knowledge supposes a distinction between syntactic, or procedural and substantive, or propositional, knowledge (Grossman, 1990; Park, et al., 2011). While procedural knowledge revolves around the process of inquiry, propositional knowledge is based on the outcome of this inquiry and represents various facts or concepts. Procedural knowledge, in a learner-centred science classroom implies an inquiry-orientated approach, and an understanding of how students are to critically evaluate propositional knowledge to arrive at conclusions. The process requires an excellent understanding of both procedural and propositional knowledge from teachers, for whom an acquisition process must take place. In a systemic education reform, teachers are often required to relearn some of both, but in the case of an OBE-type of reform, there is also a shift (whether intended or perceived depends on the particular program) in emphasis. Indeed, the philosophy accompanying these reforms often favour procedural knowledge over propositional knowledge (Bertram, 2009). Professional development should therefore contribute to help teachers modify their PCK to align classroom practices with the intended philosophy.

Furthermore, Shulman's elaboration of the concept is also appropriate for the present study as demonstrated by one of the main question formulated in a subsequent paper: 'What are the implications [of an idea of teaching that emphasizes comprehension and reasoning, transformation and reflection] for teaching policy and educational reform?' (Shulman, 1987, p.1). In this same paper, he explores the notion of understanding as he expressed it in a now famous statement: "those who can, do; those who understand, teach", and defines the concept of 'pedagogical reasoning and action'. To do so, he proposes five cyclical activities that would lead to PCK. It begins with the *comprehension* of the purpose as well as the subject matter. From that point a teacher must *transform* the material by means of preparation of the material to be taught, representations—analogy and metaphors—, selection of teaching methods, adaptation for the age group and learners' preconceptions, and tailoring it for the particular class. The third activity that teachers must engage with is *instruction*, which can be chosen in accordance with the subject matter, purpose, selection of students, or the confidence of the teacher. *Evaluation* and *reflection* will then lead the teacher back to a new set of *comprehensions*, closing the cycle. The questions around knowledge and PCK are central to the theoretical framework of the present research. The idiosyncratic nature of PCK renders it very difficult for researchers to identify and measure empirically. However, recent research proposes different tools giving insights into this critical concept, for example Lee and colleagues (Lee, Brown, Luft, & Roehrig, 2007), Taylor and Gess-Newsome (2007) as well as Park and colleagues (Park, et al., 2011; Park & Oliver, 2008) have offered interesting rubrics

to guide PCK evaluation in science teaching.

In addition, as shown in Figure 1.2, knowledge of context also plays a significant role in the acquisition of pedagogical content knowledge. In the perspective of the present study and the earlier discussion about context and culture, it is important to note here that context as presented in the figure comprises both the culture in which the community and the students evolve as well as the teaching context. Indeed, teachers need to acknowledge the culture of their learners to evaluate and understand their preconceived ideas, but also the school teaching context to select an instructional strategy that is harmonised and integrated between colleagues in order for learning to be significant. The different cultures and contexts studied in this research will offer a wide range for comparison purposes and enable a better understanding of the role it might play in PCK acquisition.

In a context of systemic educational reform framed in this study, learning of pedagogical content knowledge is central, as emphasised by Park et al. (2011): “PCK is essential for teachers in their implementation of teaching approaches aligned with principles that underlie the on-going science education reform movement”. Continuing professional development programs ought to allow opportunities for teachers not only to develop the necessary PCK but also to give them practical means of changing the ones they themselves consider adequate, “including opportunities to enact certain (innovative) instructional strategies and materials and to reflect, individually and collectively, on their experiences” (Van Driel & Berry, 2012, p.27).

It is therefore around the following critical concepts that the present research theoretical framework lies, it is the author’s intellectual scaffolding for the purpose of this research.

1.4.3 Analytical framework

As mentioned earlier, the analytical framework that guides the data analysis was developed by Laura M. Desimone, an academic focusing on research policy at University of Pennsylvania. Her research examines the policy effect on teaching and learning and analyses methods of studying policy effects and implementation. In a recent article, she argues, based on a wide literature review, that research on teachers’ professional development aims at a common goal: to assess teacher learning and student achievement that relates to it (Desimone, 2009). The different methodologies used throughout many studies do not however enable policy makers to draw general conclusions from reviewing the worldwide literature. Therefore, she suggests “that the use of a common conceptual framework would elevate the quality of professional

development studies and subsequently the general understanding of how best to shape and implement teacher learning opportunities for the maximum benefit of both teachers and students." (p. 181). She further proposes a framework for studying teacher professional development. The data analysis of this research is based on this framework.

A literature review of the past two decades shows that most researchers agree on key features to efficient teacher professional development, being formal programs orchestrated by the government, school(s)/district, association, non-governmental organisations (NGOs), grouping of teachers or learning communities of practice. The five features of teacher professional development, presented in different papers under different designations, are formulated as follows by Desimone: a) content focus, b) active learning, c) coherence, d) duration and e) collective participation. The description of the features is adapted from Desimone's as presented in a recent paper (2009).

Content focus is considered the most influential feature to bring about change in teachers' practice, hence a critical point of focus in a time of educational change. Recent evidence has shown that content-focused activities are also linked with improved student results (Desimone, 2011). Included in this category are activities that focus on in-depth exploration of the content or performance standards (outcomes) in science, as well as how students learn that content.

Active learning is often seen as key to science student learning and is also considered critical in CPTD activities. Active learning is seen here as an activity where the main pedagogical method is not formal lecturing. It can take different forms such as observing expert teachers, being observed and receiving feedbacks or reviewing student work. Also included in this category are hands on activities.

Coherence reflects an understanding of the initial teachers' knowledge and beliefs to ensure relevance with the intended learning. Coherence was also used in this research to show if activities are aligned with standards and assessments. Consistency of what is taught in the CPTD activity with the reform in place is used to evaluate the coherence of the professional development activity. For the purpose of the present study, consistency with teachers' everyday practices was also used in the rating.

Duration refers to both time spent in an activity and the span of time over which the activity is spread- one day, one semester, one year. Duration includes both span of time over which the activity is spread and the number of hours spent in it. The literature is consistent that duration

has a major influence on the impact of the activity (Cohen & Hill, 2001; Supovitz & Turner, 2000). Although an exact measure of timespan cannot be prescribed, literature suggest that a minimum of 20 hours spread over a semester would be necessary to bring about a change (Desimone, 2009).

Collective participation refers to opportunities for teachers to collaborate and discuss between them. It can be a powerful form of teacher learning and occurs when an activity enables potential interactions and discourses between teachers.

In the framework, it is assumed that these features favour an increase in teacher knowledge-content knowledge and pedagogical content knowledge as well as a change in attitudes. This change in turn can shape instructional practices and influence student learning. Figure 1.3 summarizes Desimone's proposed framework to increase coherence in teacher's professional development studies (Desimone, 2009, p.185). It lies at the basis of the CPTD analysis in the present study. In addition, the Policy Attributes Theory (Schwille et al., 1988) as applied and presented by Desimone in a later paper (2011) is used here to evaluate the suitability of the policies to favour a successful implementation of continuing professional teacher development. The scheme, discussed in the context of the policy analysis—chapter four—also assesses the ability of the policies to favour the participation of teachers in adequate professional development by evaluating various attributes: consistency, specificity, authority, power, and stability. It has been used in various contexts, including for the purpose of studying systemic reform (Clune, 1998). The Policy Attributes Theory, in conjunction with the framework presented below, represent the analytical scaffold of the current study and enable a wide but coherent perspective for the data presented.

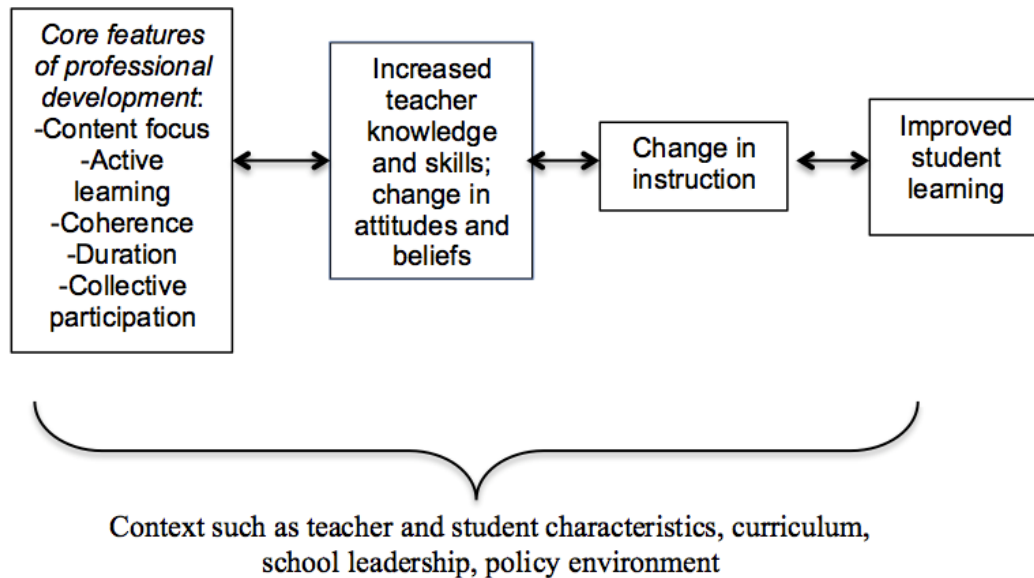


Figure 1.3. Proposed core conceptual framework for studying the effects of professional development on teachers and students (From Desimone 2009, p.185).

As represented by the double arrows in the model, all four parameter-boxes are interrelated. Indeed, the professional development intervention would increase teacher knowledge and change attitudes, which in turn favour a change in instruction but also influence further interventions as professional development should adapt to the progress of the targeted teachers. Furthermore, the change in instruction influences teacher knowledge and attitudes as well as student learning, which in turn impacts the change in instruction. For example, a teacher observing an increase in student learning following a change in instruction will gain confidence which will as a consequence influence the instruction yet again, and also could elicit an interest in obtaining more elaborate professional development, either from individual readings, teacher collaboration or formal school based/governmental activities. The interventions should then adapt to the increase in interest and growth of the attending teachers. The different aspects of the framework are thus very much interconnected. The adoption of a framework within which any research on professional development could be situated would bring homogeneity and coherence to the different data to build upon and complement each other. It could be seen as a collaborative work in progress, a puzzle for which many pieces would be placed by different researchers.

Figure 1.4 summarizes the different concepts used in the study and how they inter-relate with each other to form the theoretical framework.

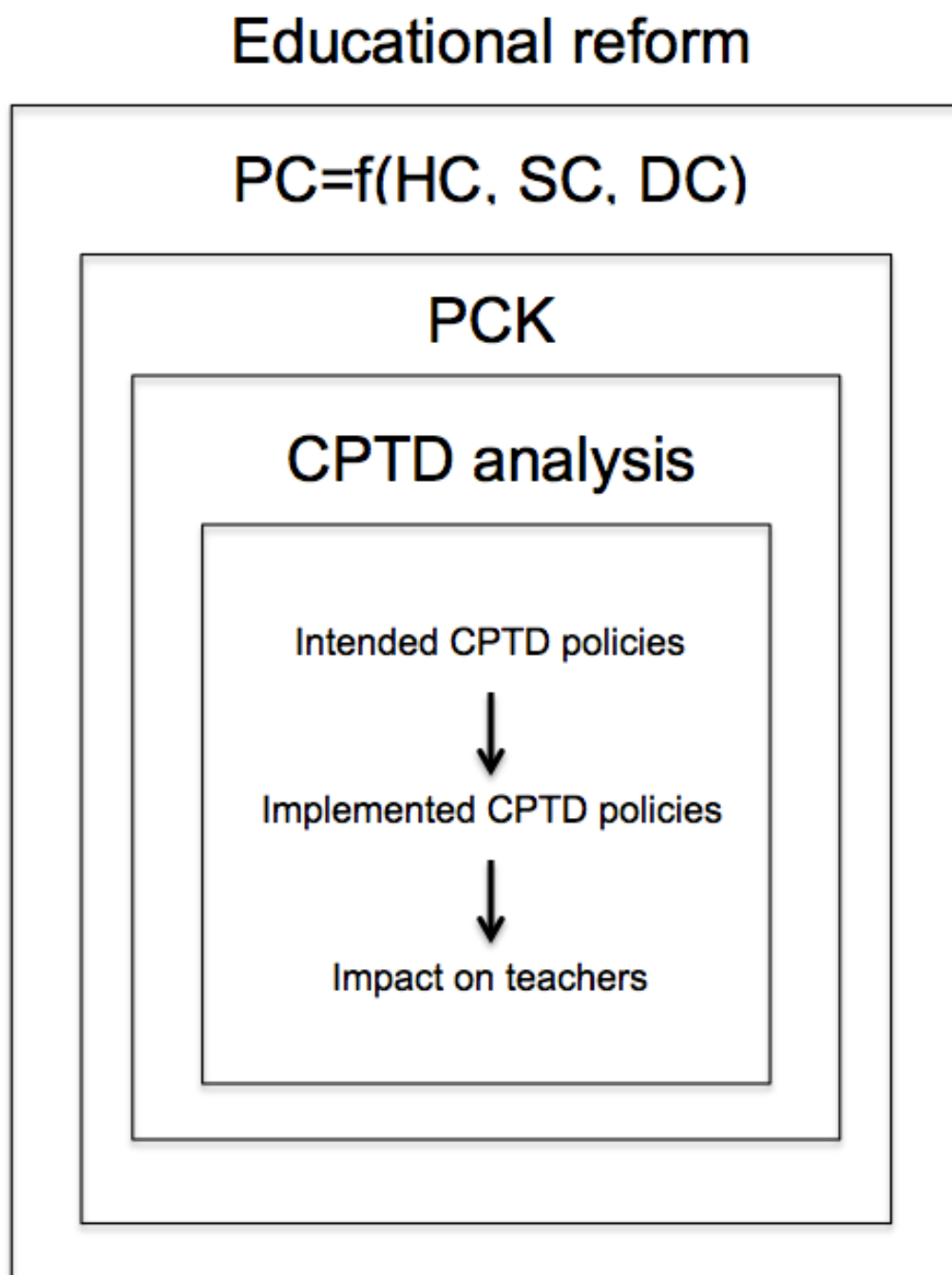


Figure 1.4. Theoretical, conceptual and analytical framework used in the study.

PC= Professional capital, HC= Human capital, SC= social capital, DC= decisional capital,
PCK= Pedagogical content knowledge, CPTD= continuing professional teacher development

As can be seen from this figure, the three main concepts used in the theoretical framework are also closely linked together. Indeed, the angle chosen in the present study looks at educational reforms from the professional capital perspective, as the overarching goal. Therefore, the development of the pedagogical content knowledge in teachers ought to be adapted and linked to further development of human capital. Concomitantly, professional development design and implementation have to consider social and decisional capital when introducing new pedagogical content knowledge. As a result, the impact on teachers would not only be punctual but rather influence the various spheres of their work, including their work environment and how they envisage the possibility of growing with their colleagues. It gives a more comprehensive analysis, which can only be obtained through close and thorough understanding of teachers' reality.

As discussed earlier, Shulman's idea of PCK has been interpreted and modified extensively through time. Because both Desimone's and Hargraves and Fullan's frameworks are quite recent, they have not yet been "re-theorised" extensively but it would be interesting to interrogate the common points of these concepts. The framework presented above provides an interesting integrative scaffold but individually, each concept does not account for the influence of the policymaking level. This level has been shown, as can be assumed, to greatly contribute to, if not dictate, the reform implementation and therefore how professional development can impact on teachers (Cuban, 2013). Desimone's framework focus on the professional development cycle and how it is interrelated to the change in beliefs and practice but does not provide opportunities for evaluating the pertinence of the principles being conveyed. Similarly, the concept of pedagogical content knowledge, although taking into account curriculum and educational goal knowledge, cannot be applied if this level is not coherent with classroom situations. Hence, these two concepts taken individually are hardly applicable to reform implementation without the enclosing concept of professional capital, which gives latitude for appropriate adaptation to the context. Indeed, professional capital implies that teachers' environment have to adapt to the overall reform principles to modify work mentality rather than attitudes and beliefs with regard to a particular knowledge area. Therefore, although the author recognises some limitations to the aforementioned concepts, the integration of the three together strengthens each of them and allow the development of emergent properties when taken as a coherent framework.

Having described the theoretical framework used in this study and the pieces of the puzzle it intends to add, the next chapter describes how it was done with a specific research design, methodology and methods.

Chapter 2. Research Design and Methodology

2.1 In depth Analysis of Teacher's Reality through Case Studies

The research questions call for a thorough understanding of the relationship between teachers' attitudes and beliefs and their perception of professional development and its impact on their practices. Having previously evolved in a health sciences background, the depth of the investigation was challenging to the author:

-How is it possible to investigate enough teachers with the required depth and also get a significant sample?

Supervisor:

-Humans are always going to react differently from one another and even from themselves at different times; qualitative data can bring insights to a phenomenon, a deep understanding.

With reflection, reading and time came the realization that studying a few teachers in great depth could indeed give a lot of information. Indeed, part of this study aims to evaluate, in the different contexts under observation, the current situation in terms of design and implementation of continuing professional development. The study also intends to better understand the teacher learning or re-learning process in a context of systemic change and their relation to professional development, as well as how it affects their practices. Case study was therefore chosen to fulfil the purpose of this research, as a thorough analysis of the situation was necessary to acquire a good understanding of the situation.

The exact definition of case study varies with different authors although Yin's definition grew as a reference in the field: "An empirical enquiry that investigates a contemporary phenomenon in its real life context when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used." (Yin, 2003, pp. 13-14). He further states that such studies are mostly pertinent to answer *how* or *why* questions. Case studies are embedded in concepts such as deep understanding, thorough examination and profound analysis, which involve thick description. With thick description, one examines not only data as numbers of statistical significance but uses conceptual and environmental factors affecting the subject, the effects of events on people (Polit & Hungler, 2003). It is a way of studying a process until most avenues have been explored, until the different faces of a phenomenon have been exposed. Using inductive logic these findings are later used to shed light on other similar practices or as a starting point for other questioning, until the

accumulation of knowledge on the matter is broad enough to give real insights to the researcher, stakeholders and decision makers. As case studies are very informative for a deep understanding of people, they are valuable to appreciate idiosyncratic teachers' attitudes, beliefs and practices, which can then be used in conjunction with the analytical framework to pool data and aim at a better, broader comprehension of the question.

2.1.1 Generalization issue

As one cannot have the cake and eat it at the same time, thick description and case studies are not meant to create global theories, although Patton (2002) states that generalizability is one of the criteria for quality case studies. Lincoln and Guba (1985) claim that the only generalization is that there is no generalization and cite Stake who introduced the concept of 'naturalistic generalization' (Stake, 1978). This type of generalization does not indicate, as the common usage of the term suggests, that the data are exactly representative of a population but that they are expressed in a way giving a personal basis for generalization. Essentially, if you provide people with a form of discourse in which they recognize themselves, "they will be able to derive naturalistic generalizations that will prove to be useful extensions of their understanding." (Lincoln & Guba, 1985, p. 120). It is nevertheless understood that conventional generalizations will not be drawn from case studies, which, one has to admit, are difficult to draw when referring to human attitudes and reactions. "When we give proper weight to local conditions, any generalization is a working hypothesis, not a conclusion" (Cronbach, 1975, pp. 124-125). It is however a widely applicable approach to generate and expend theories used by a broader research population (Yin, 2003). In that sense, Shulman refers to case knowledge with the following words: "As these approaches grow in their educational applications, we will begin to develop a more extensive case literature, as well as a pool of scholars and reflective practitioners capable of preparing and interpreting cases" (Shulman, 1986). This study is conducted with the intention of contributing to a body of case knowledge.

2.2 Naturalistic Approach

To understand teacher learning in context, a naturalistic approach was used and qualitative data collected through interviews and observations. The different levels of continuing professional development were explored, starting with the design of the policies to the implementation phase and how it is enacted by the teacher. The core data is situated around the teachers' context, and beliefs, focusing on professional development activities as well the

school environment. As pointed out by Opfer and Pedder, “To understand teacher learning, scholars must adopt methodological practices that focus on explanatory causality and the reciprocal influences of all three subsystems [the teacher, the school, and the learning activity].” (2011, p. 376). To review a massive amount of literature on professional development, they have used a complexity theory framework arguing that analysis of teacher learning has to take into account different areas of influence. In the present analysis, the teachers’ attitudes and beliefs as well as their environment and continuing professional development activities are combined with thorough interviews and relationship with the respondents; it is then added to the exploration of the intended and implemented policies to allow a holistic, situative analysis. As Cohen and colleagues suggest, understanding individual behaviour is a type of questioning that calls for an idiographic methodology (Cohen, Manion, & Morrison, 2007). Teachers’ observations and interviews occurred in their environment, during class or professional development activities, and therefore support external validity of the data as the researcher was able to observe formal and informal interactions, such as discussions during breaks and in some occasions with family and friends. However, this type of methodology also brings its disadvantages, mainly that the presence of the observer often modifies behaviour to conform to what is believed is expected. The various methods used to collect data intend to minimise this variable.

Interviews and observation provided narratives as well as anecdotes appropriate to describe and understand “the complexities of professional development in a specific context, how beliefs and attitudes change, and the processes through which teachers change their instruction” (Desimone, 2009, p. 190, citing Merriam, 1988 and Wengraf, 2004). Study of narratives has a long history in educational research, aiming to provide a better comprehension of the process of teaching and learning. In the present study, I intend to explore science teachers’ stories to inquire into the process of learning new content and pedagogy, and how the designed CPTD plays a role in this process.

2.3 Methods

This section will only summarise each phase of the analysis. Indeed, for clarity purposes and due to the various methods and tools used at the different levels of the study, details of data collection and analysis will be described at the beginning of the relevant chapter. Description of the appropriate tool and method will therefore be provided along with its associated results to facilitate reading. However, I will now introduce the general methods corresponding to the different analytical phases of the study presented in Figure 1.4—intended and implemented

policies as well as the analysis of the impact on teachers. I will also introduce the participants and discuss issues of validity and reliability for the study.

2.3.1 Unit of analysis and phases of study

Similar data were collected in Durban, South Africa and Montréal, Canada, for which school environments were selected to be representative of the urban region under study. Both regions were considered separately and then compared, which allowed the identification of broad contextual variables that could affect implementation of continuing professional development. Durban, South Africa and Montréal, Québec were therefore used as the unit of analysis in the case study and each one analysed in terms of the intended, implemented and enacted CPTD policies. To allow a better understanding of the situation, I will first give an overview of the educational history and professional development contexts both in South Africa and in Québec.

South Africa

“It always seems impossible until it’s done” Nelson Mandela.

The changes to be achieved in education in South Africa since the achievement of democracy in 1994 are not impossible, neither are they completed. Although the intended changes in the education system between Québec and South Africa were similar in many ways, the socio-political, economic and historical factors driving it are very different. In South Africa, forty years of apartheid education, and even more of racial segregation, have left a large imbalance in education among South Africans. Indeed, HF Verwoerd introduced the Bantu Education Act in 1953 (Department of Native Affairs, 1953): “There is no place for [the African] in the European community above the level of certain forms of labour. It is of no avail for him to receive a training which has as its aim, absorption in the European community.” (Verwoerd, 1953). Blacks Africans, coloureds and Indians were therefore confined to schools with reduced funding and curriculum content compared to schools attended by Whites³. In April 27, 1994 the first elections with universal suffrage were held. The majority-representing

³ The terms Black Africans, Indians and Whites refer to Black South Africans, South Africans of Indian origins and South Africans of White origins respectively. The racial denominations used in the thesis are in no way derogatory but are used to describe participants’ context.

government elected rapidly set its objectives to institute laws promoting an equal, fair and democratic society. The Interim Constitution of 1993 (RSA, 1993) states that every person shall have the right- (a) to basic education and to equal access to educational institutions; (b) to instruction in the language of his or her choice where this is reasonably practicable; and (c) to establish, where practicable, educational institutions based on a common culture, language or religion, provided that there shall be no discrimination on the ground of race. Three years later the Bill of Rights, contained in the Constitution of 1996 (RSA, 1996) stipulates that everyone has the right to a basic education, including adult basic education and further education, which the State, through reasonable measures, must progressively make available and accessible. The National Education Policy Act (1996) and the South African Schools Act (1996) were modified accordingly, and the new curriculum, (C2005) was launched in March 1997. The first post-apartheid curriculum (C2005) aimed to transform education from transmission-mode, teacher-centred pedagogy to an outcomes-based, learner-centred approach. The drastic change in teaching methods and content was ultimately to serve the learners but it also was a political statement. Although welcomed by the majority at first, it has been thereafter criticised and reviewed many times (Chisholm & Leyendecker, 2008; Jansen, 1999), but a new era of education for all had nevertheless started, trying to leave the past behind. With the immense proportion of youth in South Africa, a performing education system for all is of particular importance for the societal and economic development of the country.

Therefore, Bantu Education and its lower educational standards for non-Whites resulted in poorly educated people in the rural areas, referred to nowadays as 'previously disadvantaged'. This situation led to many under qualified or inappropriately qualified teachers in dire need of professional development. Policy change in South Africa therefore first aimed at equalizing this situation by targeting initial teacher training programmes. Indeed, to generate qualified teachers, the former Colleges of Education were closed or transferred to universities and prospective teachers now require four years of university education, as compared with the previous three years of college education. The Colleges of Education formed a tier between secondary education and universities and offered Diplomas to their graduates, who did not need to qualify for University standards to be accepted in the programme. The quality of the education offered varied considerably amongst the Colleges as no formal legislation or monitoring of the content offered was in place. In 2001, a few Colleges, along with their associated staff, were incorporated within university programmes, but most were closed down. Therefore, prospective teachers now need a Matric (secondary school exit-level certificate, university entrance level) and the initial qualification for teaching is now either a four-year Bachelor of Education or a three-year Bachelor's degree followed by a Postgraduate

Certificate in Education (PGCE). However, for example in Life Sciences, there are still a large number of teachers who did not study Biology in their initial teaching qualification. A bridging programme is now in place, called the Advanced Certificate in Education (ACE) in Biological Sciences, which aim at filling the gap, mainly in their content knowledge (Professor at UKZN School of Education, personal communication). In this context, CPTD's primary roles in South Africa are to equalize teachers' qualifications in addition to keeping them up to date with the new curriculum, new pedagogy and new subjects (and not the least, for example evolution was added to the Life Sciences curriculum in 2006 for the first time). Many governmental programmes and Non-Governmental Organisations (NGOs) are targeting the schools located in the 'previously disadvantaged' areas. However, teachers in these areas are still, to this day, too often under qualified and end up being not only 'previously' disadvantaged but also 'currently' disadvantaged. Indeed, the National Planning Commission recently declared that the efforts at levelling the education system have failed: "Notwithstanding these efforts, the quality of physical assets and infrastructure at school level remains highly unequal. There are still many schools without toilets, electricity, desks and chalkboards. In 2006 the number of schools without electricity stood at roughly 5 000, while 1 500 schools were without on-site toilets. Efforts to raise the quality of education for poor children have largely failed." (National Planning Commission, 2011, p.14). So despite the government's efforts to provide resources, continuing professional development measures are still not reaching their goal.

Life Sciences pedagogic reform

As described in the introduction, the South African curriculum has been reviewed many times since the introduction of the transitional curriculum called NATED 550 in 1996. Life Sciences itself as a subject has been modified with the introduction in grade 10 of the National Curriculum Statements (NCS) in 2006. The NCS for Life Sciences was completely different from NATED 550, both in terms of the way it was organised, and in terms of its content material. The curriculum was no longer divided into clear subjects, but instead was organised around three "Learning Outcomes" (LOs), each of which had its own set of three "Assessment Standards" (ASs). It is then that Biology was renamed Life Sciences (Johnson, 2009).

The NCS curriculum was quickly criticized for its vague definition of the content and the incoherent progression of different concepts, such as the theory of evolution (Dempster & Hugo, 2006). A revision, the "new content framework" was therefore introduced in 2009 in grade 10, which was once again replaced by the general revisions included in the Curriculum

and Assessment Policy Statements (CAPS) in 2012. Therefore, from 2006 to 2012, Biology/Life Sciences teachers had to integrate three changes in content, accompanied by a drastic change of delivery method based on constructivist learning theories.

Cascade mode of information flow for continuing professional development

The implementation of the professional development policies in South Africa was characterised by a cascade mode, where the subject specialists in the national Department of Education met the provincial senior subject advisors, who gathered with the other provincial subject advisors who in turn, generally through a workshop, informed teachers in different districts about the latest policies. These teachers then report to their colleagues in their respective schools. Provincial subject advisors, based on the national Department policies, decide on the content of the workshops and design the appropriate documentation and content for the teachers. This type of information flow is cost efficient but it has also been criticised for watering down the information (Fiske & Ladd, 2004, DHET official, personal communication, 2011). It also leaves major discrepancies between the different provinces. Some alternatives are suggested in the document 'Integrated strategic planning framework for teacher education and development in South Africa', or 'the Plan' among which the communities of practice were put forward (Department of Basic Education & Department of Higher Education and Training, 2011). Although potentially very efficient, such communities require the presence of competent leader teachers and principals. The Plan targets the identification and commitment of these leaders but it is also acknowledged as a potential important barrier to such projects. Overall, nothing indicates that this mode of knowledge transmission will be changed in a near future.

As the implementation process moved forward, it became obvious that the cascade structure could not suffice for the increasing need for professional development, and the provincial governments as well as the local districts were increasingly called upon to share the responsibility (Department of Basic Education & Department of Higher Education and Training, 2011; Department of Education, 2007b). The decentralisation of policies on CPTD was accompanied by a will to instil a positive and responsible attitude toward professional development. The ELRC's resolution No.7 specifically states that it is part of the teachers' core duty to participate in continuing professional development activities (ELRC Resoution No.7, 1998). SACE offered a workshop on IQMS, between 2007 and 2011, which, among many themes, promoted a responsible attitude towards professional development: "Nobody

can improve an educator except him/herself. Openness to change is the key to whether change will take place or not.” (Mogkame, 2007, p.55). It is clear that the teacher is central to his/her own professional development, although responsibility also becomes requirements when they are enforced by different policies.

In this regard, the Education and Labour Relations Council (ELRC) adopted a resolution (Resolution No.8, 2003) merging different quality management programmes into the Integrated Quality Management System (IQMS). The fused programmes were: 1) developmental appraisal, 2) performance measurement and 3) whole school evaluation. The IQMS of 2003 binds all educators in schools and aims at the evaluation of teachers’ needs with the intention of better responding to them, but it also comprises an evaluation aspect. The evaluation instrument is composed of thirteen performance standards, the 5th one pertaining to CPTD: “Professional development in field of work/career and participation in professional bodies”, which ought to be evaluated by answering the following question: “Does the educator participate in activities which foster professional growth?” (Section C, p.3). IQMS is associated with pay increase and different incentives such as career advancement. Other ELRC resolutions—workload for educators, occupational specific dispensation—also stipulate that in service professional development is part of the core activities of school-based educators (Collective agreement No.1, 2008; ELRC, Resolution No. 7 ,1998).

In addition to these resolutions, The South African Council for Educators, was enabled by the SACE act (RSA, 2000) to, among others, promote the professional development of educators. It is also responsible to manage a CPTD system (SACE, 2008) to complement and support IQMS. The CPTD system developed is based on a professional development (PD) point scheme where each educator ought to earn a certain number of points per 3-year cycle. SACE is responsible for the accreditation of the PD activities as well as the determination of points for each activity, based on different criteria such as duration, alignment with needs and accessibility. A minimum number of points per 3 year cycle is required to register with SACE and hence to practice, and a high number of points is rewarded with the incentives aforementioned. Participation in CPTD is therefore strongly encouraged, in theory.

Although there are no specific documents pertaining to Life Sciences teacher professional development, the National Department of Education offered a week-long workshop to introduce the new curriculum and programmes. Following this activity, teachers who attended briefed their colleagues and newly appointed teachers, and then attended, if available, a yearly provincial department workshop offered by subject advisors.

Outcomes of the professional development policies

The human sciences research council, cited in a paper commissioned by the Education, Training and Development Practice, Sector, Education and Training Authority (ETDP SETA) (Badroodien, Gewer, Roberts, & Sedibe, 2002), points out that the Department of Basic Education spends a significant amount of its budget to provide in-service education and training (INSET) for both school management and teachers. Nevertheless, it is argued that the offered activities are not optimal for different reasons, including the low competence of the trainers and a lack of focus on content and skills development of the short workshops. According to the Department of Basic Education, there is still a high number of un- or under-qualified teachers currently teaching (Department of Basic Education & Department of Higher Education and Training, 2011) and the Report on the National Certificate Examination shows that Life Sciences results are lower in 2012 compared to the previous years with 43% of students achieving over 40% , which situates Life Sciences as a high-risk subject (Department of Basic Education, 2013). Most likely for these reasons, many teachers participate in non-accredited professional development, which has not proven to have a meaningful impact on teachers' practices (Roberts, 2001). The report of the review committee on the first curriculum (C2005) has shown that too many South African teachers, subject advisors and even government officials did not understand the basic principles and requirements of OBE (Chisholm, et al., 2000). It was also stated by many that teachers' support during implementation of such a high demand curriculum was far from adequate, incoherent and fragmented (Department of Education, 2007b; Jansen & Taylor, 2003), which, as opposed to the intentions, can only increase the discrepancies between the disadvantaged and advantaged schools. Fiske and Ladd (2004) even argue that inadequate teacher professional development is the most critical factor that hampered reform implementation.

Québec

In Québec, the necessity for education reform was not as drastic but emerged from a political will to adapt to a new age of schooling. The global trend of empowering schools to provide intellectual skills adaptable to work environments and daily activities was spreading in Québec. The message was that it was necessary for the economic and social benefit of the society. Public consultations held in 1995 by the Estates General on Education revealed a large desire for change in the community, as shown by the report published in 1996 (Ministère

de l'Éducation du Québec, 1996). The Minister of Education then mandated a Task Force in 1997 to give recommendations "concerning the changes to be made to the elementary and secondary school curricula in order to satisfy the demands of the 21st century" (Ministère de l'Éducation du Québec, 1997a). The improvement of the education system to align it with the working market and globalisation is guiding the process of change but there is also a will to express cultural differences through the curriculum. Indeed, Canada being a large federation, each province possesses specific cultural references that are reflected in the education system. As stated in the Task Force report: "The curriculum is an expression not only of cultural memory, but also of a cultural project" (Ministère de l'Éducation du Québec, 1997, ch. 1.2). The Ministerial Plan of Action (Ministère de l'Éducation du Québec, 1997) was going to determine the general philosophy of the upcoming reform, along with modifications to the Education Act (Gouvernement du Québec, 2012). The first programme documents were officially launched in 2001 although the reform was first introduced in grades 1 and 2 in September 2000.

Therefore, the situation in Québec is very different from South Africa considering that the university-based initial teacher training was already producing qualified teachers. Therefore, the main role of continuing professional development was to keep teachers up to date with the reform requirements, in addition to the routine upgrading of teachers' skills. The skills required to implement a cognitively demanding reform could hence be targeted in the CPTD planning, which was intended with a university partnership: "A continuing education program based on a reflective and metacognitive accompaniment developed in a university/community partnership" (Lafortune, Deaudelin, Doudin, & Martin, 2001, p.45). Indeed, funding is available for such partnership (Ministère de l'Éducation, 2012), although the diverse interventions stay isolated as there is no provision for a coherent plan that would be integrated with other CPTD providers. However, the government acknowledged the significance of professional development and committed, during the implementation process "to allocate funds to support [the professional development activities]. In addition to the training budgets provided for in the collective agreements (C\$9 million per year), teachers also receive 20 pedagogical days, some of which can be used for professional development." (Ministère de l'Éducation du Loisir et du Sport du Québec, 2003, p. 50). Additional professional development funds were also available for specific activities regarding the new curriculum or for replacement teachers.

Life Sciences pedagogic reform

High school Biology teachers in Québec, like their counterpart in South Africa, had to adapt quickly to a change in teaching methods also based on social constructivist theories. In addition, Biology teachers became Science and Technology teachers, diversifying their field of expertise to various sciences as well as adding the technology aspect to their teaching load. The high school organisational configuration was also modified, as the new curriculum became structured on two-year cycles, hence requiring a greater collaboration between teachers from different grades.

Decentralisation of CPTD responsibilities: between the school boards, principals and teachers

Before 1997, when the educational reform project was initiated, professional development was mainly the responsibility of the school boards. Thereafter, the laws governing CPTD, the Education Act and An Act to promote Workforce Skills Development and Recognition, have been modified to define teachers as being primarily responsible for their professional development. The school principal is responsible to consult with them and provide, in conjunction with the school boards, the necessary conditions for teachers to attend adequate CPTD, based on their need identification. The numerous documents published since then continue to emphasize the importance of developing a culture of continuing professional development framed by a coherent approach and promotes professionalization of the profession (Comité d'orientation de la formation du personnel enseignant, 2000; Conseil supérieur de l'éducation, 2003; Ministère de l'Éducation du Québec, 1999).

Specifically, Science and Technology secondary teachers did not have any planned formal information about the coming reform but could attend activities of their choice once they have identified their needs. As discussed in Chapter 4, further attempts to find details about the specificity of the Science and Technology CPTD planning were unsuccessful.

Outcomes of the professional development policies

The education reform steering committee is in charge of the evaluation of the different aspects of the reform implementation. The committee has not yet submitted a report for secondary teachers but has looked thoroughly at the teachers' perceptions of different implementation

aspects in primary schools. Concerning continuing education, the report was very positive, although the year 2001-2002 was marked by a general teachers' boycott of the activities related to reform implementation. The report states that in 2001, four out of five teachers had participated in information activities related to the new programme. In addition, in 2004 and 2006, 90% of teachers had received some type of reform related training and 64% of them were satisfied. However, the greatest need for professional development is in Science and Technology, which is reflected by the 6th recommendation of the report asking for defined orientations regarding professional development, related to this field. The 8th recommendation also reflects a need for CPTD planning and suggests that the school boards coordinate a structured plan to ensure teachers' access to varied CPTD activities. Conversely, some academics are more critical concerning the adequacy of such a level of decentralization and point out that the basic requirements of the reform, or the purpose of it, is not clearly understood by all teachers (Hasni, 2005; Potvin & Dionne, 2007). Standardised tests have just been introduced in Science and Technology and therefore data on student performances are available.

Phases of analysis

Having described the context into which the units of analysis are situated, I will now briefly describe how each research phase was analysed, based on the research questions. First, to explore how continuing professional development was designed, the available documentation was examined in each country/province, using Desimone's criteria presented in the analytical framework. As most of the policies affecting regional implementation of CPTD originate from the national government in the case of South Africa and provincial government in the case of Québec, the majority of the official documents explored originated from these sources. However, when necessary, local or regional documents have also been analysed. In addition, interviews with key policy makers as well as implementers such as subject or pedagogical advisors were performed to gain an understanding of how the original message was interpreted and conveyed by the implementers. To understand how the policies were enacted and how it impacted on teachers, interviews, questionnaires and classroom observation were used with three different teachers in each region—six in total. Teachers were also very cooperative and allowed the author to observe different activities that may impact on their understanding and enactment of the CPTD policies or to allow a better understanding of the teacher, such as moderation sessions (evaluation of learners' work by a moderator, in South Africa) and cluster groups (teacher network from neighbouring schools, in South Africa) or activities such as Reach for the Top (inter-school quiz program for students, moderated by a teacher, in

Québec). Extensive data were hence generated and analysed to answer the research questions of the study. A summary of the methods, data collection and research subjects is presented in Table 2.2.

2.3.2 Participants

The first research questions pertain to the design and implementation of the reform, which, as mentioned, were analysed through document analysis and interview. The interviewed participants for this section were two Department Officials, one in each region as well as three subject advisors in KwaZulu-Natal (KZN), South Africa (SA) and two in Québec (QC), Canada (CA). To answer the questions about enacted curriculum, interviews were conducted among six high school (average student ages between 14 and 17) Life Sciences/Sciences and Technology teachers; three in KZN and three in QC, in six different schools. Teachers were selected based on the fact that they had been teaching Biology previous to the implementation of the reform and on the environment in which they practice. Indeed, schools were chosen to be situated in an urban area (Durban, SA and Montréal, QC) with at least minimum access to resources—occasional or constant access to a library and Internet, as well as a functional infrastructure—water and electricity (most of the time). It was important to that “functional” schools were selected in Durban to match the school contexts as much as possible.

In KZN, three public schools were selected, one in an informal settlement⁴, one in a previously Indian township, and one in a densely populated African area. All three schools could be described as functioning schools in the sense that, according to the teachers and from observation, teachers and learners were attending class on time and most school days were used to teach. Once schools were identified, teachers were contacted and asked to willingly participate in the study. All teachers approached accepted with the authorisation of the school principal. They had all been teaching the new Life Sciences curriculum since its implementation in grade ten in 2006 and therefore had four years of experience with the revised National Curriculum—data were collected at the beginning of 2011.

In Quebec, two of the schools were public schools and one was a private school (some funding comes from the parents as well as from the Ministry of Education). The private school caters

⁴ Although definitions of informal settlements differ in the documentation, South Africa’s Housing Development Agency (HAD) in its last report (2012) used the following: An unplanned settlement on land which has not been surveyed or proclaimed as residential, consisting mainly of informal dwellings (shacks).

mainly to the higher socio-economic population, while one public school was in a neighbourhood that could be described as middle to high socioeconomically, and the other one was in a relatively low socio-economic neighbourhood. Schools were selected to be representative of the Montréal region urban population, and all the teachers approached accepted to participate in the study, although another school was approached and the principal refused to allow teachers to participate in the study. All teachers had been teaching the new Sciences curriculum since its implementation in secondary three in 2007 and therefore had three years of experience with the *Renouveau Pédagogique*. Because courses equivalent to the South African Life Sciences were not consistently offered higher up in the schooling system in Québec, teachers from Québec were teaching in what would represent grade 9 in South Africa, hence a little lower down in the system.

This selection ensured that all teachers had access to a pedagogic/subject advisor, as well as external resources such as books or Internet, in order to ensure their professional development as originally intended by the policy-makers. Participants' background is summarized in Table 2.1; names have been changed for confidentiality.

Table 2.1. Teacher participants' features.

Teacher	Province, Country	Years of teaching experience	Background/formation	CPTD observed
Pirindha (F)	KZN, RSA	24	Bachelor degree in education + advanced certificate in education: 4 years post secondary	2 days -KZN subject advisors' workshop
Samantha (F)	KZN, RSA	17	Higher diploma in education: 3 years post secondary	2 days -KZN subject advisors' workshop
Vuyo (M)	KZN, RSA	26	Bachelor degree in education: 4 years post secondary	2 days -KZN subject advisors' workshop
Marie-Anne (F)	Qc, Canada	11	Bachelor of sciences: 4 years post secondary	3 days conference
David (M)	Qc, Canada	8	Bachelor degree, sciences education: 4 years post secondary	1 pedagogical day
Danny (M)	Qc, Canada	7	Bachelor degree, sciences education: 4 years post secondary	1 pedagogical day

F=Female M=Male

Along with the specific methods described in each chapter, exploration of the pertinent documentation, curriculum, news, government or non-governmental organisations (NGOs) plans to improve CPTD, newspaper etc. was performed during the course of the study.

Table 2.2. Summary of phases of the research, methods used to collect data and research subjects

Phase of the research	Methods used	Participants
Intended CPTD policies	<ul style="list-style-type: none"> • Document analysis • Interviews 	<ul style="list-style-type: none"> • One senior Departmental official in each country • Correspondence with various Department officials in each country for clarifications
Implemented CPTD policies	<ul style="list-style-type: none"> • Interviews • Observation of formal and informal CPTD 	<ul style="list-style-type: none"> • Three subject advisors in KZN • One pedagogical advisor and one pedagogical director in QC
Impact on teachers	<ul style="list-style-type: none"> • Interviews • Questionnaires <ul style="list-style-type: none"> ○ Cognitive maps ○ Attitudes and beliefs • Storyline • Classroom observation 	<ul style="list-style-type: none"> • Three teachers in each of KZN and QC

2.3.3 Trustworthiness

As discussed earlier, notwithstanding the ontological or epistemological view adopted, the researcher values the criteria of trustworthiness: validity and reliability. Positivists and interpretivists agree that the methodology should be adequate to the questions, and tools used throughout the investigation have to be valid and reliable for the data to be meaningful. Although the terminology varies according to different authors, the terms *validity* and *reliability* have become accepted in order to convince oneself—and others—that any quantitative or qualitative research is trustworthy. However, Hammersley’s review (1987) of the multiple definitions of validity and reliability demonstrates the lack of consensus on what exactly should be understood from these terms. The following sections describe how trustworthiness was ensured through coherent, valid and reliable methods and methodology.

Validity

Historically in quantitative research, validity was meant as a measure of accuracy and relevance of the tools for the intended purpose of the study. In qualitative research, authors tend to use the term slightly differently. Indeed, terms such as credibility and transferability (Hoepfl, 1997) are often used to account for a valid naturalistic inquiry. Lincoln and Guba (1985) suggest criteria to ensure trustworthiness through credibility and transferability but also dependability and conformability. In any type of research, one can strive for but not realistically attain 100 per cent *validity*. “Hence at best we strive to minimize invalidity and maximize validity” (Cohen, et al., 2007, p. 133). It is paradoxical, as Lave expresses, that “the most sufficiently complex instrument to understand human life is another human” (Lave & Kvale, 1995). Indeed it raises questions regarding validity when human subjectivity is involved. Some authors assert that thick description, honest reporting and deep involvement are sufficient for a research to be valid (Agar, 1986). This view is contested by many who argue that structured and rigorous criteria must support research and that strong techniques are the only guarantor of validity (Hammersley, 1992; Silverman, 1993). To be faithful, this pursuit of evidence must be precise (Winter, 2000).

In this regard, the author shares the view of Johnson (1997) when he suggests that promoting qualitative research validity is comparable to being a detective: pursuing evidence of the causes and effects through careful investigation. In the current study, careful investigation was conducted to increase internal validity using different strategies suggested by Johnson:

1. A massive amount of data and a detailed investigation of each participant contribute to ensure *internal validity*. Indeed, hours of interview and multiple days with each participant assist in building understanding and trust. It demonstrates prolonged engagement and persistent observation, which brings scope and depth to the study (Lincoln & Guba, 1985).
2. Low inference descriptors are used to reflect participant’s meaning. *Verbatim* quotes from participants is presented as much as possible to corroborate data.
3. Interpretation of answers is validated using different questions focusing on the same subjects and also during ‘casual’, informal talks, promoting triangulation. Methods triangulation is also used as different tools are used to corroborate the data.

External validity, characterised by the generalizability and transferability of findings, is reasonably easy to ensure within each country by keeping the investigation tools similar. As mentioned earlier, the study investigates teachers' contexts and its impact so the generalizability accords with the meaning described earlier. Comparison between the two countries—what is also referred to as ecological validity—needs caution and consideration. An examination of the different influences on teachers' perceptions of professional development is performed in both regions. Detailed notes were taken at each participant's school describing their workplace—facilities, interactions with colleagues, student and principal's attitude etc. to give an accurate overview of the surroundings and enable a thick description of the participant's environment. The link between these influences, perception of CPTD and classroom practices is the factor enabling external validity in such different environments.

Reliability

Reliability refers to the pertinent question “How can an inquirer persuade his or her audiences that the research findings of an inquiry are worth paying attention to?” (Lincoln & Guba, 1985, p.290). To the author, reliability is the assessment of the research design by evaluating the adequacy of the conclusions from the particular set of data presented. Guba and Lincoln (1994) refer to dependability in qualitative research to differentiate between how the term is used in quantitative and qualitative research. On the other hand, some authors do not accept the value of reliability in qualitative research. Indeed, according to Stenbacka (2001, p.552), “the concept of reliability is even misleading in qualitative research. If a qualitative study is discussed with reliability as a criterion, the consequence is rather that the study is no good”. For other authors, different strategies can be used to ensure reliability, of which triangulation gains numerous supporters. According to many, triangulation is an appropriate method to ensure reliability in qualitative research (Golafshani, 2003; Johnson, 1997). In the present study, in addition to triangulation, validated tools and questionnaires are used to confirm consistency and reliability. Also to this end, questionnaires have been informally pre-tested and data discussed with colleagues and supervisor. The data presented in the study is therefore believed to be trustworthy.

As shown here, the data presented is also very diverse, which enabled the researcher to take into account various aspects likely to influence the impact of continuing professional teacher development. As described in this chapter, data collection generated rich and wide results that were all triangulated to allow a deep understanding of how CPTD is envisioned and

experienced by the various stakeholders in two educational systems. The situative perspective is adapted to the multi faceted subject under analysis, which requires the comprehension of various aspects of the educational organisation. Indeed, it has been shown that personal and contextual factors play a significant role in the understanding of professional learning initiatives as well as their implementation in practice (Beltman, 2009). The next chapter will position the study within the context of the current literature.

Chapter 3. Review of Relevant Literature

Having situated the study in a theoretical framework, this chapter will describe the relevant current understandings on related topics necessary for adequate interpretation of the data collected in the study. It will start with a description of the reform movement initiated globally and the subjacent theories at its basis. Then it will explore continuing professional teacher development literature and models and how they are believed to impact on teachers during reform implementation.

3.1 Education Reforms: Why?

Around the world at different times, government-based schooling systems arose when the nation-state emerged. Schools were put in place with a clear mission of knowledge transmission. Brunner, in a report from the UNESCO's International Bureau of Education, describes the education system mentality of the last two centuries as such: "Their starting point is that the knowledge transmitted is slow, limited and stable; the school is the sole information channel with which rising generations enter into contact; the media for communicating what schools have to teach are what the teacher imparts verbally and the written word; schools' efficiency is demonstrated by the successful inculcation of certain types of knowledge and behaviour, as borne out by examination; the type of intelligence that needs cultivating is essentially of a logical-mathematical nature and schooling has the support of the family, the local community and the churches." (Brunner, 2001, p.134). This situation was observed until the mid to late 1950s, were the first waves of nationally initiated systemic reforms were attempted. In the United States for example, the "Space Race" triggered a feeling of urgency and focused the government's attention on the transmission of knowledge related to new scientific technologies. Also, although not applicable in South Africa, many countries worldwide, influenced by different civil rights movements, focused their attention on the reduction of social inequalities through the education system (Fullan, 2000). These noble motives were translated in curricular changes but very little attention was dedicated to the implementation of these modifications.

Much of the reform attempts until the mid to late 1980s were based on behaviourist learning theories, where conditioning plays a central role in teaching. With this approach, a change in behaviour or knowledge is expected when students learn what the teacher lectures. Although according to many authors the success of these reforms were limited (Fullan & Pomfret, 1977;

Gross, Giacquinta, & Bernstein, 1971), it served as a basis for many years of trials and research to improve the process of implementation. The various attempts combined with research findings lead to changes in the design of policies as well as in their execution and enactment. Indeed, attention was drawn to the implementation process, focusing on the different bridges between the intended, implemented and enacted curriculum. Armed with this knowledge, many countries have again initiated systemic reforms in the late 1980s and 1990s. This second wave of large-scale reforms was largely focused on learning philosophies as well as school purposes and organisation rather than on content (Delors, 1996; Prospectives, 2001). Although subtleties in the foundations and application of reforms remain, we will explore in the next section that most systemic reforms worldwide, specifically sciences reforms, are based on constructivist learning theories, or variants of it. However, the interpretation of such a comprehensive theory is far from coherent and varies in different countries, states, provinces, districts and even within schools.

Bybee (1995) points out that in the United States, contemporary educational reforms are initiated in each state rather than nationally, which reduces the coherence and the influence of research-based findings on the curriculum. Also in the United States, science curricula targeted a wider understanding of scientific issues, aiming at scientific and technological literacy for all, not only for future scientists or “superior” students. In Canada, the Science Council of Canada (1984) recommended that teachers use scientific concepts and skills relevant to and embedded in the social and technological contexts of the students to increase understanding and application in their everyday life. Successive reforms are likely to be seen again while the needs and priorities change quickly in our societies, although with the common framework of an inclusive education system that is meaningful and aligned with the global economic needs. It is therefore essential to get a better understanding of the change process for the educational systems to produce the desired output. It is a challenge that Fullan (2000) acknowledged: “Although the source of blame varies, it is now an undeniable conclusion that the educational system and its partners have failed to produce citizens who can contribute to and benefit from a world which offers enormous opportunity, and equally complex difficulty of finding your way in it.” (p.7). Indeed, the acquired experience from the previous nationwide reforms does not guarantee better success. Some academics even doubt that a change of that magnitude can be implemented (Carnoy, 1999; Jerald, 2005).

3.1.1 When politics and economy are involved

Nevertheless all the difficulties in implementing change and considering the global trend of education reforms, a static system is politically perceived as a lagging, ill-adapted one. Intentions and purposes of educational reforms are varied, although increasing access to education and a will to give equal chances to all is a priority for many global educational instances and is generally targeted as a broad aim. The relative success of this aim is demonstrated by the fact that most secondary institutions now see a major increase in attendance. Education can bring equity, be a key to a democratic society; it is also a powerful political instrument. Indeed, educational reforms are often closely entwined with politics and economy, for better or for worse, as pointed out by some authors (Apple, 1994; Fuhrman, 1994). Because the different political factors can impact CPTD policies, their influence will be discussed here.

Education is a politically sensitive subject in most cultures and pressures from the 'global academic and economic trend' are pushing for a better match between schools and employment. Indeed, as much as education reflects and protects the culture of societies, globalisation imposes an integration of cultural and economic values. It therefore influences reform and curriculum design, an influence that has been criticized by many, warning of its possible harm in a context of market liberalism (Taylor, Rizli, Lingard, & Henry, 1997). Investigating the origins of the reform policies, Carnoy (1999) refers to three kinds of responses in the education and training sectors as a reaction to globalisation and changes in the world economy:

- Competitiveness-Driven Reforms, which aim at raising the productivity of labour and education institutions.
- Finance-Driven Reforms, which aim to reduce spending on education, with an ultimate goal of improving the productivity of labour.
- Equity Driven Reforms aim at increasing equality of economic opportunities. The investment in greater equity can be justified when demonstrating that goals of competitiveness are also increased.

In South Africa's context, the primary motivation for reform is Equity, although Competitiveness is also targeted, whereas in Québec, although Equity is a motivating factor, Competitiveness is more of a driving force to trigger changes. The different types of responses can influence the design of CPTD policies and the perception that teachers hold of it, the

identity and purpose they make of their profession. Indeed, equity would aim at levelling the differences while competitiveness targets the alignment of teachers' philosophy with the market-driven institutions.

Moreover, one can frequently observe a struggle for power between different government levels resulting in a schizophrenic effect that gives more or less authority to the local governments. Indeed, successive waves of educational reforms, for example in the United States, are the result of a pendulum effect between local and national goals. Consequently, there is no coherent and stable public policy. It is the case in many countries where the state wants to give more power to the local governments and schools but as they often cannot or will not implement the policies, legislation from the federal governments tightens (Gorostiaga, et al., 2003; Hirschland & Steinmo, 2003). The consistency of the policies directly affects reform implementation, as well as the support given to and from the teachers (Phillips, et al., 2011).

Other motivations for initiating reforms are emerging from the population or in many cases, especially in developing countries, reflecting the priorities of the funding agencies and international partners, which powerful role can also be influential in the shaping of policies. In the present examination of the design, implementation and enactment of professional development, all these factors have to be taken into account in data interpretation, as they potentially hold a significant influence on the different steps of the implementation of educational reform.

3.2 Educational Reforms: How?

Although the needs and motives for systemic reforms are diverse, common points can be observed in the design of educational reforms (Gorostiaga, et al., 2003; OECD, 1994). As briefly discussed previously, most of the countries who have embarked on education reform since the 1990s have been changing their curriculum and pedagogy to a learner-centred education (LCE), based on a constructivist approach to learning (Fullan, 2000; OECD, 1994). Some countries are still, to this day, adopting an Outcomes-Based Education (OBE) type of education based on these premises (Bell, 2009; Maodzwa-Taruvinga & Cross, 2012; Steiner-Khamsi, 2006).

3.2.1 OBE and the constructivist approach

The Organisation for Economic Co-operation and Development (OECD) and United Nations Educational, Scientific and Cultural Organisation (UNESCO) supported a general movement of competency based reforms, which hold roots in the constructivist theory of learning (Faure et al., 1972; Prospectives, 2001; Schoen, 2008). Although there are many variants of constructivism as well as many names for the resulting reforms (OBE being the one used in the present study), this perspective generally claims that knowledge is not directly transmitted from one erudite to a knower-to-be, but constructed within individual minds “based upon the interaction of what they know and believe, and the phenomena or ideas with which they come into contact” (Richardson, 1997, p.3). Based on Jean Piaget’s (1957) theories of knowledge generation and cognitive development, various constructivist theories of learning have been put forward and most of the contemporary science educational reforms policies were inspired by this philosophy, sometimes referred to as neo-Piagetian cognitive development theories (Mathews, 1998). According to constructivist proponents, knowledge is constructed by learners based on their previous knowledge and conceptions—or misconceptions, and educators are seen as facilitators guiding individual learners. Their role is to trigger an inquiry process that would lead to the discovery of knowledge. Although many different variants of constructivism have been put forward, a detailed comparison would not be appropriate for the context of the study. However, socio-constructivism theories have drawn much attention in the educational world and gained popularity in classrooms, where discussions and learning dialogues have been strongly encouraged (Prospectives, 2001). In its pure application, constructivism in general is a way of learning and teaching that is radically opposed to the previous behaviourist model, which supposed an underlying determinism and where conditioning is considered at the basis of learning. Most educational systems around the world have been, until the 1990s, based on more or less behaviourist models, hence most teachers currently teaching have not been taught or even been in contact with a constructivist-based form of teaching. Constructivism, although widespread in recent educational movements, is also criticised by many for its implication in education. Indeed, its detractors often criticize the movement for being elitist, as ‘discovery learning’ is seen to be more accessible for previously “advantaged” students who already have the support and stimulation at home (Hirsch, 2010). It is also criticised for its lack of accountability and evidences to evaluate and support its implantation (Liu & Matthews, 2005).

Compared to the traditional ‘vase’ analogy where students are empty containers that teachers have to fill, constructivism-based teaching corresponds in education to what Irez and Han

describe as a paradigm shift (Irez & Han, 2011). Indeed, a reform of this type represents an enormous step between its aims and what the majority of teachers had been trained for (Jansen & Taylor, 2003). It has been suggested that teachers, as many other professionals, are hesitant to adopt new practices unless they are certain to be capable of making them work (Lortie, 1975). It is indeed arduous for any professional to change deeply anchored practices; it can be argued that it is even more so for teachers as they are exposed to the students' scrutiny while experiencing new strategies, which can jeopardise the delicate trust relationship that they need in the classroom. "Therefore, even when presented with evidence from the most carefully designed experimental studies, teachers do not easily alter or discard the practices they have developed and refined in the demanding environment of their own classrooms." (Guskey, 1986, p.9). Tabulawa (1997), in a study on LCE implementation in Botswana points to the challenge posed by the paradigm shift from traditional education to LCE policies. "To propose that they shift from a banking education [traditional education] pedagogical paradigm to a learner-centred one is necessarily a proposal that they fundamentally change their views of the nature of knowledge, of the learner and his/her role, and of classroom organisation in general. But this also necessarily calls for the disintegration of the reigning paradigm, thus of the practitioner's taken-for-granted classroom world [...] The result of this might be the practitioners' rejection or subversion of the proposed pedagogical innovation." (p.192). It is therefore particularly important, in the design of continuing professional development policies, to take into account this inertia factor and to find strategies to get around this obstacle.

Overall, contemporary reforms aim at a better fit between schools and evolving societies' priorities, which are increasingly influenced by a globalised environment. This relationship caused a misfit between the traditional schooling system and the outputs intended, and although a constructivist-based schooling system is far from unanimous, professional development should adapt in parallel to the intended reform. It is generally believed that continuing professional teacher development ought to increase its impact on teachers' practices, this critical impact is increasingly required while it is needed to modify the paradigm within which teachers are working. In fact, Villegas-Reimers (2003) found, in her global review of professional development, that educational reforms which did not include teacher development have failed to be successful in the past, urging governmental instances to invest in significant continuing professional teacher development to implement a reform. Because of the inclusive notion of professional development, the extent of the impact of formal CPTD on teachers' practices is, although well documented, difficult to measure. Evidence is nevertheless pointing to a link between them, which is explored later.

3.3 Continuing Professional Development

Together with the paradigm shift in education philosophy, the new vision of continuing professional teacher development is also referred to as a shifting paradigm (Cochran-Smith & Lytle, 2001). The shift is reflected in the literature terminology and it is now less common to refer to ‘in-service education training’ as the terms ‘continuing professional development’ reflect better the professionalising role intended for the educational upgrading of teachers. The following section will first describe how CPTD is conceptualised in the literature and some common models adopted worldwide will be described. Then a description of the current knowledge related to the impact of continuing professional development on teachers’ practices and student learning will follow.

3.3.1 Conceptualizing CPTD

Continuing professional development is a concept that has evolved in time. A retired Ministry official in Québec, responsible for programme design and implementation, summarised the situation as follows: “For a long time we thought that reading the programme was enough to change practices, whereas now we consider that to develop capacity (knowledge, ability, attitudes), educators need the appropriate conditions: time, learning communities, support, tools...” (email communication, 2013). The following question therefore needs to be answered before moving further: what is professional development and its intended goal? Glatthorn (1995) has suggested a broad but adequate definition for how it is perceived now: “Teacher development is the professional growth a teacher achieves as a result of gaining increased experience and examining his or her teaching systematically.” He contrasts this to staff development, which he defines by: “The provision of organized in-service programmes designed to foster the growth of groups of teachers; it is only one of the systematic interventions that can be used for teacher development.” (p.41). In other words, professional development should provide tools for teachers to identify and consciously use any learning opportunities that the school structure should encourage. However, throughout the text, professional development refers to the formal activities attended by teachers that can lead to teacher learning. Havighurst (1953) popularised the term “teachable moments” referring to students in classrooms, but it has further been used in CPTD literature to describe these learning opportunities favouring teacher development. Havighurst defines these moments as follows: “When the timing is right, the ability to learn a particular task will be possible. This is referred to as a ‘teachable moment.’ It is important to keep in mind that unless the time is right,

learning will not occur. Hence, it is important to repeat important points whenever possible so that when a student's teachable moment occurs, s/he can benefit from the knowledge.” (p.7).

In light of the theoretical framework of the study, professional development is seen here as a vector that should, by favouring a methodical examination of one's practices, provide opportunities for pedagogical content knowledge and professional capital development. Indeed, if reform movements brought a paradigm shift, the shift has to be reflected in continuing professional development for teachers to not only cope but also understand and apply the intended modifications. Since the paradigm shift has been shown to potentially constitute by itself a barrier for successful implementation (Irez & Han, 2011), the investment in adequate professional development is essential during systemic reforms to provide professional capital and lead to a change in attitudes and beliefs.

Indeed, in a time of systemic reform, CPTD should accompany teachers during the change; it should lead to professional capital and help them to face such a paradigm shift, which is necessary to change as well as to implement change.

3.3.2 Reculturing CPTD

However, as discussed in the introduction, although the key role played by professional development can be translated into massive investment, specially in developing countries—the World Bank devoted two-thirds of its education budget to teacher professional development initiatives in the 1980s—little evidence demonstrated an associated change in practices in classrooms (Fuller, 1987). In-depth teacher change such as is required during an education reform process described earlier implies a drastic mind-shift leading to a change in classroom practices. In order to create this change, modification in attitudes and beliefs also need to be performed. To accomplish this, reform attempts must also be accompanied by a profound reorganisation in the teaching environment that would allow schools to be educative for both teachers and students. After a career dedicated to educational change, Fullan concludes a recent book with: “[...] we also must simultaneously and more fundamentally change the *cultures or working conditions* within which educators work.”(Fullan, 2007, p. 291).

The perspective that the mentalities of teachers have to change implies that the traditional way of “delivering” professional development also has to be revisited. It is indeed utopian to think that a change of that magnitude can be accomplished with a few bi-annual workshops. Continuing professional education should therefore go beyond traditional methods aimed at

lecturing teachers about specificities of the content or requirements of the designed reform and move towards alternative and longitudinal teacher support (DuFour, 2004; Fullan, 2007; Lieberman & Pointer Mace, 2008; Little, 1993; Loucks-Horsley, Hewson, Love, & Stiles, 1998).

It is therefore generally agreed that the format of professional development should be remoulded, but the key concern is to replace it with a suitable system. This implies a deep knowledge of what favours learning and change of practices. It also implies adequate evaluation of the formal activities as well as what conditions favour informal learning. There are unlimited ways of evolving in the profession, which is why CPTD has to support a holistic culture of learning rather than focusing on a particular aspect of teachers' work. It is thus important to give teachers opportunity to learn in their daily activities, implying rethinking school structure as part of the professional development of teachers (Barth, 1990; Little, 2001).

According to Villegas-Reimers (2003), the new perspective of professional development has the following characteristics (p.13):

- based on constructivism;
- perceived as a long-term process;
- perceived as a process that takes place within a particular context;
- intimately linked to school reform;
- conceived as a collaborative process;
- very different in diverse settings.

Along the same lines, Leu (2004) contrasts the previous to the present approaches to teacher learning in the following table.

Table 3.1. Teacher learning. From Leu (2004, p.6)

Previous approaches	Present approaches
Goal is to have teachers who are competent in following rigid and prescribed classroom routines	Goal is to have teachers who are reflective practitioners who can make informed professional choices
Teachers are “trained” to follow patterns	Teachers are prepared to be empowered professionals
Passive learning model	Active and participatory learning model
Cascade model- large, centralised workshops or programmes	School-based model in which all teachers participate
‘Expert’ driven	Teacher facilitated (with support materials)
Little inclusion of “teacher knowledge” and realities of classrooms	Central importance of “teacher knowledge” and realities of classrooms
Positivist base	Constructivist base

The table shows the shift from the traditional positivist-behaviourist attitude towards a constructivist view of learning that would be the appropriate framework for professional development associated with constructivist-based reforms. However, literature indicates that CPTD activities are not often following this pattern, although its impact would be greatly increased (Little, 1993). In Québec, the Conseil Supérieur de l'Éducation (CSE) points out the need to increase the examples given to teachers to help them apply the profound pedagogical changes brought about by the reform (Ministère de l'Éducation, 2007). The World Bank initiated a project called Secondary Education In Africa (SEIA) and reported on the situation of science, mathematics, and ICT in secondary education in 10 countries in Africa, including South Africa. Regarding continuing professional development, the report states that “The provision of continuing professional development programs seems most often made on a short-term basis, and mostly does not form part of an overall national strategy to develop a sustainable support infrastructure.” (Ottevanger, et al., 2007, p. 56).

Without a national strategy that supports the implementation, continuing professional teacher development is not likely to change from what it was before reform implementation, which is represented in the “previous approaches” in Leu’s table. Many different factors can affect how the professional development activities are offered. For example, a poor opinion of teachers’ capacity can lead to a more traditional-transmissive model, as in this case teachers are perceived as incapable of being reflective practitioners who can make informed professional choices. Strong attitudes and beliefs that are opposed to what Leu presents as the “present approaches” can also lead to a poor implementation of the prescribed teaching methods. Also, poor conceptualisation of the approaches, or incapacity to translate the model into professional

development activities might explain the poor representation of the recent approaches in CPTD activities. Many activities might as well sit between the two extremes described in Table 3.1, as the people responsible for professional development are processing the change, slowly incorporating their changing attitudes and beliefs in their own practices and gaining the corresponding pedagogical knowledge.

3.3.3 Models of professional development

This section will present the most common models representing broad categories of how continuing professional development is made available to teachers. It is not an exhaustive list but rather a description of the main trends in continuing professional teacher development around the world to allow a critical perspective on the data presented in the study. Most countries, states or provinces offer a combination of these, either as part of a national or provincial comprehensive planning or as a result of spontaneous initiatives.

Workshops and school-university collaboration

The more traditional format for formal continuing professional teacher development is certainly the conventional workshops offered by a “specialist” to a group of teachers. They can be organised at different levels, by the national or local governments, by non-governmental organisations (NGOs) or by teachers for the school or a group of schools.

Traditional workshops or conferences organised by the Department of Education, NGOs, teacher associations or unions are still very common around the world (Loucks-Horsley, 1995) due to the large mass of teachers that they can reach and the low cost involved. However, they have been frequently reported to be used to convey administrative information based on the external agenda of policymakers. This situation leaves teachers with a perception that continuing professional development is inadequate, inappropriate and inapplicable in their classrooms (Lieberman & Pointer Mace, 2008). However, some examples of such successful interventions, integrated with other follow-up programmes have also been reported (Choy & Chen, 1998), for example with the introduction of the new curriculum in New-Zealand (Zeegers, 1995). It is nevertheless, as discussed, generally agreed that this model by itself is insufficient to produce sustainable change in teachers’ attitudes and beliefs and in classroom practices (Villegas-Reimers, 2003).

In the recent reform movements, some school-university partnerships were established and valorised as they are generally based on research professional knowledge. Some workshops, formal lectures or seminar classes are therefore offered in partnership with universities or what is often referred to as the professional development school (PDS) model. These PDSs represent a model that requires organisation and often institutionalisation when credits or points are associated with teachers' attendance. It has the advantage of increasing the professionalization of teachers, as in theory schoolteachers and university faculty members contribute equally to the outputs. Miller (2001) points out four core goals to these partnerships:

- Establish firm basis to the school and university cultures
- Bridge the school and university environments in order to better serve school needs
- Include teachers in the decision-making processes
- Provide venues for professional development opportunities

Villegas-Reimers (2003) reviews such successful initiatives, amongst which science teachers in the Western Cape (South Africa) have been brought together at King's College in London and at the Cape Peninsula University of Technology in Cape Town to discuss curriculum-related issues and mentorship interventions through collaborative work. The initiative has positively impacted on teachers' knowledge and skills. Another example was reported by Watson and Fullan (Watson & Fullan, 1992) which included four school-boards and the University of Toronto with the Ontario Institute for Studies in Education. It included, in addition to formal conferences on various themes, less formal activities allowing reflective practices and strategies as well as collaborative work enabling linking these strategies with school practices. These initiatives have a great potential, especially to link academics and practitioners, which can guide the interventions towards adapted and relevant content for teachers. It also usually offers diverse type of formal CPTD and allows for less traditional activities—less lecturing and more collaboration between teachers. However, it is an option that is offered on a voluntary-basis and does not, in its current format, reach a great mass of teachers.

Another common scheme for the provision of continuing professional development is the introduction in the school calendar of non-teaching days, which is the prevailing situation in Québec. However there is considerable debate about the benefits of this practice where days of intended professional development are interspersed throughout the school year and a general lack of evidence about the impact of such 'respite' days (Bates, Gough, & Stammers, 1999).

In summary, the workshops or formal professional development activities can be offered in conjunction with various CPTD plans, on an ad hoc, uncoordinated basis, as is usually observed during these school-based professional development “non-teaching days”. In this case, the principal, the teachers, or various independent organisations can offer them. They can also be used by the policy makers as a cascade mode where a few trainers are trained and further inform more trainers who in turn pass on the information to many teachers. It can lead to the next model presented where some teacher trainers can also become mentors.

Mentorship and teacher-trainers

Another increasingly common model in continuing professional development delivery is the introduction of mentors, especially to help in the integration of beginning teachers. In Pakistan, Mohammad and Harlech-Jones (2008) show that an amalgamation between workshops and mentorship has been very successful. Indeed, they report on teachers who attended an in-service university-based workshop followed by strong collaboration between the teachers and the teacher-educator. They found an increase in adequacy between the workshop and teachers’ context and realities of their schools. Coaching and mentoring is a type of training that is usually transient, used for evaluation or to help in the school-integration of new teachers. Nevertheless, on a longer-term basis, it can be very powerful as it produces professional growth to both the mentor and the mentored. However, for the relationship to be optimal, mentors need training (Holloway, 2001), which constitutes a barrier for the generalisation of this type of continuing professional development as it involves time and resources as well as a close collaboration between the participants. Jones (2001), based on a study of mentorship in the United Kingdom and Germany describes three different types of mentoring 1- the apprenticeship model, where the mentor is seen as the “master” who should be emulated. 2- the competence model, where specific standards are pre-determined and assessment of the mentored is based on fixed criteria. 3- the reflective model, where the mentor acts as an active, critical and collaborative observer (Jones, 2001). She found that mentors most commonly perceived their role as the reflective type, which is also the preferred type for mentored. Because the model is mainly used for beginners or trainers, the common addition of an assessment factor for the mentored affects the relationship and decreases the effect of the process.

Schools' or teachers' networks

Governments and policy makers expect a lot from schools or teachers' networks (Department of Basic Education & Department of Higher Education and Training, 2011; Ministère de l'Éducation du Québec, 1999). Indeed, they match the contemporary views that collaboration and social learning lead to sustainable attitude-changing professional development. They are by nature bottom-up types of professional development and therefore could be more applicable and relevant to classroom practices. This type of networking is often referred to as learning communities, or communities of practice and is favoured by proponents of social learning theories (Wenger, 2009). Hargreaves and Fullan (2012) discuss the difficulties but also the necessity of implanting professional learning communities (PLCs) to generate professional capital. They visualize these PLCs with a mixture of various elements from the "professional", the "learning" and the "community" to create an environment "where collaborative improvements and decisions are informed by but not dependent on scientific and statistical evidence, where they are guided by experienced collective judgment, and where they are pushed forward by grown-up, challenging conversations about effective and ineffective practice." (p. 128). Collaboration can indeed lead to incredible teachers' professional growth but to achieve this output and use PLCs or school networks as a tool for continuing professional development, leaders must emerge to favour the perfect mix of spontaneity and direction. Lieberman (2011) reviews many of these learning communities and praises the achievements that they can yield. However, she recognises the challenges that they create such as the reorganisation of school structure, which is, in most cases, still embedded in its traditional bureaucratic structure and does not facilitate collaboration and social learning. As they rarely have a precise description, the agenda is variable and therefore they can be very different in content and effectiveness. Hargreaves and Fullan (2012) point out that policy makers often formalize these networks to impose their agenda. They also warn against negative collaboration, referring to different cultures within the collaborative culture, such as 1) balkanisation where teachers associate in different groups, sometimes with opposing views; 2) contrived collegiality where a superior in rank, often the school principal, imposes a form of collaboration that does not always lead to positive outputs or take into account the unpredictable aspect of collaboration.

However, examples around the world of such successful initiatives have been reported. Indeed, an Australian action research project, the National School Network, was put in place to help teachers implementing their own initiatives as part of the school reform movement. It has been described as very successful in helping teachers with the acquisition of the reform

specificities (Sachs, 2000). Another example is reported by Thair (2003) and represents an Indonesian school network that has been successful in changing teachers' practices. However, the author also points out major limitations and calls for a coherent national planning in order for these networks to provide large-scale continuing professional development, as they remain isolated in their present format. Teachers' networks are also coherent with the present views on professional development as they can be embedded in teachers' daily lives, hence have the potential to affect their attitudes and beliefs in a sustainable way. Many examples of nationally-initiated networks have been reported to have positively impacted on teachers' practices, including in Finland, Columbia and Spain (Villegas-Reimers, 2003). In Japan, perhaps because of the low level of professionalization that teachers hold in the society, elaborate teachers' networks are set up in most schools and act as teacher-based continuing professional development to compensate the poor state investment in CPTD (Shimahara, 1998).

Overall, most of these networks around the world do not benefit from government funding and are not always facilitated by qualified teachers, both factors reducing their outcomes (Villegas-Reimers, 2003). Indeed, it does not provide opportunities for reflective learning unless a leader emerges that can stimulate these types of interaction between teachers.

All of these "delivery" models can be observed in combination with each other and in conjunction with various national planning methods. However, it is clear that any top-down planning will need adaptation at the level of the provinces, districts and school. The next section discuss a step-wise model of implementation that address this challenge.

Zone of Feasible Innovation

Rogan and Grayson (2003) discuss a model where schools are rated based on their "readiness" for change. They designed criteria with particular reference to developing countries that allow the assessment of a school's "readiness" to implement a constructivist-based science reform. Their theory revolves around three major constructs that take into account the various influences that may affect school practices, all of which are rated to assess the school readiness for change.

Construct one is the Profile of Implementation and is rated on the following criteria:

- Classroom interaction
- Science Practical Work

- Science in Society
- Assessment

Construct two represents the Capacity to Support Innovation with the associated criteria:

- Physical resources
- Teacher factors
- Learner factors
- School ecology and management

Construct three is the Profile of outside support, with the following criteria:

- Types of encouragement and support:
 - Physical Resources:
 - buildings, apparatus, curriculum materials (print and electronic), computers, etc.
 - Design of professional development
 - Direct support to learners
- Dominant change force evoked by agency
- Monitoring mechanisms and accountability

From these criteria, one may evaluate the level of change that a particular school can support for each individual construct, which enables a step-wise progression towards the implantation of the intended reform. The step-wise concept is at the basis of their theory of implementation, for which they present a series of propositions. Proposition one introduces the concept of a zone of feasible innovation and describe how each school should proceed to implement change according to its current state, which is determined from the aforementioned criteria. It states that “innovation is most likely to take place when it proceeds just ahead of existing practice. Implementation of an innovation should occur in manageable steps.” (Rogan & Grayson, 2003, p.1195). Rogan (2006) developed this concept further with a precise definition of the Zone of Feasible Innovation, based on Vygotsky’s Zone of Proximal Development. (Vygotsky, 1978). The ZFI “consists of a collection of teaching strategies that go beyond current practice, but are feasible given the existing resources available to that teacher, or group of teachers, and the prevailing environment of the school in terms of its ability to foster and sustain innovation.” (Rogan, 2006, p.441). It is an interesting model based on school development, educational development and educational change theories and allow for an adapting scheme of implementation that takes into account its idiosyncratic nature and the school context. It also addresses many aspects of the implementation process within individual school environment.

It is, in the author's view, the next educational challenge to generate a CPTD model that would involve a restructuration of the school context in order for the desired framework of continuing professional development to be applicable; an adaptable framework where the different models can be integrated in a feasible national planning allowing lifelong learning and the development of teachers' professional capital. An incrementing model such as the one proposed by Rogan with his concept of a Zone of Feasible Innovation is certainly favourable to the developing world and could enable the adaptation of various models in countries with very different contexts. Many authors have criticised the adoption by developing countries of CPTD models designed in and for the developed world. However, in the context of globalisation that we are witnessing now, the developing world have access to these models and will be tempted to adopt them in an attempt to stimulate their education system and reach a level of competitiveness required to be recognised worldwide. A step-wise type of implementation is certainly an option worth exploring and under documented. However because the zone of feasible innovation criteria were based on one case study involving teachers in a rural school, its generalizability can be limited and require many resources. Individual school administration might require qualified academics to evaluate the stages at which they can be situated in order to translate the reform policies into adaptable recommendations based on their context. A zone of feasible innovation can indeed be identified and its theoretical application is logical but the generalizability of its practical application is difficult. Hence, although the model was considered as a theoretical framework for this study, it was judged difficult to practically apply it.

The various types and models of continuing professional development discussed here are applied with various success and outcomes in different contexts. The next section reviews and discusses the literature around the current knowledge regarding the impact of CPTD.

3.3.4 Effect of Continuing Professional Development on teachers' practices and student learning

"There is widespread agreement now that of all the factors inside the school that affect children's learning and achievement, the most important is the teacher." (Hargreaves & Fullan, 2012, p.xii). Teachers are the keystone of student learning and their practices in class have been singled out as the most important factor influencing students' achievement (Hattie, 2003). Because teachers have such a key role in student learning outcomes, concerns about the influence of the different interventions on their practices are well justified. Although the concerns are not recent, they are recurrent. In 1957, Corey described in-service teacher

education as ‘uninspiring and ineffective’ (Corey, 1957). Davis, ten years later (1967), crudely said: “Inservice education is the slum of American education-disadvantaged, poverty stricken, neglected, psychologically isolated, riddled with exploitation, broken promises, and conflict” (cited in Rubin, 1971, p. 38). Many authors later concurred with Davis about the poor state of in service education (Flanders, 1980; Howey & Joyce, 1978). Goodlad (1984) showed that in the seventies, despite growing efforts at introducing more complex teaching behaviours, many teachers were still practicing the same routinely simple teaching. Interest has grown further and the last twenty years have seen a blooming of research on continuing professional development (Borko, Jacobs, & Koellner, 2010; Opfer & Pedder, 2011; Villegas-Reimers, 2003). As previously discussed, the different studies aiming at measuring the impact of professional development on teachers’ practices often use different methodologies and are difficult to compare. Nevertheless, features have been identified, as shown in the analytical framework, which contribute to quality professional development and improvement of teacher knowledge and skills (Garet, Birman, Porter, Yoon, & Desimone, 2001). Some findings indicate a relationship between adequate CPTD and improvement in teaching (Loucks-Horsley, et al., 1998; National Commission on Teaching and America’s Future, 1996). Fishman and colleagues (2003) collected evidence showing that targeted continuing professional development influences teachers’ practices towards the intended teaching standards. Also, a massive study evaluating teachers’ perception of CPTD was conducted in the United Kingdom following the implementation of a new national continuing professional development plan (Hustler, McNamara, Jarvis, Londra, & Campbell, 2003). It showed that a majority of teachers were satisfied with their professional development activities, specifically when they were applicable to classroom practices. Teachers were asked to rate how much impact their experience of CPTD activities had had on a range of teaching and learning skills over the last 5 years. The rating scale ranged from 5 (very significant impact) to 1 (no significant impact). The results for teachers overall is as follows:

Table 3.2. Mean score for impact of continuing professional development on teaching and learning. From Hustler et al., 2003 (p.103).

	Mean Score	n	Standard deviation
Your professional development	3.71	2372	1.04
Your teaching skills	3.58	2374	0.96
Your desire to learn more	3.55	2360	1.06
Your pupils learning outcomes	3.54	2365	0.92
Your self-confidence/self esteem	3.28	2361	1.15
Your leadership skills	3.10	2338	1.22
Your promotion prospects	2.74	2331	1.31

It shows that British teachers perceive continuing professional development activities as having an impact on most characteristics directly affecting their classroom practices. Further analysis of the results also shows that secondary teachers consistently perceived a lower impact than primary teachers on all aspects under study. Data are however obtained through questionnaires only and therefore might not represent the entire reality experienced by teachers.

Some data also suggest that the change in practices can in turn significantly increase students' performances (Fishman, Marx, Best, & Tal, 2003). Huffman and colleagues (2006) showed that a specific intervention designed to help science teachers integrate constructivist views in the United States positively impacted on teachers' practices as well as on student performances. However, questions still remain in the literature about the causal relationship between CPTD, change in practices and students performances (Opfer & Pedder, 2011). As discussed previously, it is a major challenge for the educational community to consolidate and compare all the studies in the field, hence the need to validate a common framework into which various studies can add evidences.

3.4 Science Education Reforms and Associated Professional Development

The paradigm shift characteristic of the reform movements and continuing professional development frameworks can also be observed in most reformed Sciences programmes. Indeed, constructivist's views on learning have also greatly influenced the design of Sciences programmes around the world (Department of Basic Education, 2011b; Henze & van Driel, 2009; Ministère de l'Éducation, 2010; National Research Council (NRC), 1996). Based on constructivist notions, learners are at the centre of the science programmes as teachers construct knowledge with them, guided by their inquiries and preconceptions. It also implies that science learning is no longer based on a strict scientific method that needs to be transmitted to future scientists but is rather open to a wider student population in order for them to critically understand sciences as relevant to their lives (Bybee, 1995). However, science teachers—and designers—have not or rarely been exposed to such education, hence Smith and colleagues (2007) appropriately asked in a recent paper: who teaches that way? The answer seems to lie in teachers' initial training as well as their participation in efficient professional development, particularly content-focused (including pedagogic content). As noted by different authors, this particular pedagogy implies high cognitive conceptualisations from teachers, hence an extremely important need for professional development for teachers who have never encountered such learning frameworks (Irez & Han, 2011; Loucks-Horsley, et al., 1998). In Québec, it is suggested that science teachers' challenges are “among the greatest that a teaching professional may encounter” (Potvin & Dionne, 2007, p.395) due to, among others, the integration and the addition of different disciplines—including the technology component. The requirements of the reform on science teachers were acknowledged by the American National Research Council by emphasizing the important role of pedagogical content knowledge (PCK) for the professional integration of teachers' propositional and procedural knowledge (National Research Council (NRC), 1996). Park and colleagues also show evidence that teachers' PCK is correlated with the enactment of the reform in their classrooms (Park, et al., 2011). It is therefore necessary in these times of paradigm shift to adapt professional development activities so that they provide PCK and prepare teachers for different classroom situations and conditions. Van Driel and Berry (2012) showed that to provide PCK, professional development has to be aligned to practice and summarise what was described here as the paradigm shift of science continuing education programmes: “Professional development programs aimed at the development of teachers' PCK should be organized in ways that closely align with teachers' professional practice, including opportunities to enact certain (innovative) instructional strategies and materials and to reflect, individually and collectively, on their experiences.” (p.27).

It is interesting to conclude by coming back to the notion of a paradigm shift. The new educational views based on constructivist conceptions of learning—not so new anymore but as we have seen, reforms based on associated theories are still implemented and used worldwide—are diametrically opposed to what teachers have themselves been exposed to. Notwithstanding the debate around whether these theories are valid or not, it is appropriate to adapt teachers' continuing professional development to the views promoted by the implemented reforms. Hence the paradigm shift imposed on teachers should be accompanied by CPTD that is leading by example to promote and allow teachers to experience for themselves what they now have to inculcate in their students. The different theoretical models discussed in chapter two lead to an emphasis on the social, collaborative applied models for CPTD discussed in the present chapter. However, it is not clear how teachers and implementers live this paradigm shift and how they perceive it—if they do recognise the shift. The present study fits in as another piece of the puzzle by trying to expose how the paradigm is shifting at the different levels of the chain, from the designers to implementers and to the teachers.

Chapter 4. ⁵The Intended Policies

To better understand how CPTD is perceived and can impact on teachers during reform implementation one needs to understand how it is designed and what it intends to achieve. In this chapter, the original message sent by continuing professional development policies is examined. If the wrong message leaves the chain, it needs to be acknowledged and acted upon as it impacts on the meaning teachers make of CPTD. Although most policies are general and apply to all disciplines, the analysis will focus on secondary schools Life Sciences/Sciences and Technology continuing professional development in South Africa (province of KwaZulu-Natal) and Canada (province of Québec) respectively. The analysis will give a comparative point of view to answer the following questions: Are the CPTD policies well conveyed and adapted to their context? Are they based on research and likely to move teachers to commit to significant professional development?

In theory, the perfect information flow would be as follow: 1) stakeholders design policies, 2) organisations—governments, universities, school boards, NGOs, unions etc. take the middle role of conveying it to the teachers 3) who should then gain the knowledge and skills to make their classrooms a learning area compliant with the designed policies. The ideal chain actually becomes a cycle and returns to the designers who remodel the plans based on comments from the implementers and needs of the teachers. Unfortunately, the practice is not always that simple and is too often like a game of Chinese whispers:

“Chinese whispers is one name for a game played around the world, in which one person whispers a message to another, which is passed through a line of people until the last player announces the message to the entire group. Errors typically accumulate in the retellings, so the statement announced by the last player differs significantly, and often amusingly [sic], from the one uttered by the first.” (Wikipedia, 2012).

4.1 Methods

To examine how the design of continuing professional teacher development aligns with research findings in South Africa and Québec (research question 1), a database of the official documents pertaining to or potentially having an impact on the delivery of CPTD was

⁵ An adapted version of this chapter is in the process of publication.

compiled. The documents were selected after a thorough review of different text pertaining to CPTD from various sources such as NGOs, unions, national, provincial and local governments etc. The selection was performed with the criteria that they 1) are produced by governmental or specifically mandated bodies 2) include content strategic planning that can influence CPTD delivery 3) affect teachers' understanding of the change being implemented. A list of the reviewed documents can be found in Appendix A. In addition to the documents, interviews with government officials (Department/Ministry of Education) and subject/pedagogic advisors were also included where they could complement the exploration of the policies. The analysis was performed in two ways:

a) Effective professional development criteria from the analytical framework were used to correlate CPTD policies with research findings (see Figure 1.3). In order to make the process more rigorous, individual criteria of the framework: **content focus, active learning, duration, coherence, collective participation** (Desimone, 2009) were rated in each document according to the proportion of items in the document promoting it. An item was rated as such when it clearly promoted one of these aforementioned criteria either with the acknowledgement that it is important or with measures put in place to support the implementation of CPTD in accordance with the criterion. As each document has very different levels of detail, a proportion of each occurrences rather than an absolute number served as a basis to rate each criterion. Occurrences varied from zero to more than five and were ranked accordingly as: absent, low, moderate, or high for each document. A general 'mean rank', pooled from each analysed document was then assigned to each criterion.

b) The analysis also explored the possible policy impact on teachers' selection of effective professional development, according to different attributes identified as contributing to the successful implementation of policies. The selected criteria were based on the policy attribute theory, inspired by Weber and William Boyd's writing and developed by Peter and colleagues (Porter & Brophy, 1988; Porter, Kirst, Osthoff, Smithson, & Schneider, 1993; Schwille et al., 1988). It has been used in the literature to evaluate the impact of different policies in various contexts (Berends, Chun, Schuyler, Stockly, & Briggs, 2002; Clune, 1998). The theory identifies attributes that contribute to effective policy implementation. The three following criteria were selected and analysed based on a recent paper on the impact of policies on CPTD in the United States (Phillips, et al., 2011): consistency, authority and power. Specificity and stability were considered inadequate for analysis of the present documents, as they pertain mainly to curricular attributes or school policies.

Consistency refers to how much the different policies or recommendations are aligned and support each other. Consistent policies should complement and reinforce each other. It was shown that in a context of educational reform, the alignment between the state standards, assessments and teacher professional development is a strong measure of consistency (Schmidt & Prawat, 1999). Moreover, data suggest that it could be the most important factor to incite teachers to take part in such CPTD activities, at least for high-stakes subject areas (Phillips, et al., 2011). It was therefore examined if the state requires a standard test aligned with the prescribed outcomes as a first measure of consistency. Furthermore, in the context under study, the alignment of professional development with state standards are critical. We consequently examined whether some provisions were made in the policies to ensure that all teachers would have access to information about the new prescribed competencies and PCK of their subject via a minimum of aligned teacher professional development.

Authority refers to how well the policies are supported by laws, incentives, financial provision etc. Rather than threatening schools, districts or provinces, authority indicates the value that the state gives to a policy by the commitment associated with it. Policies were therefore considered authoritative if they prescribed time and/or allocated funds to continuing professional development.

Power is, on the other hand, associated with rewards and threats. It is represented by sanctions when schools or teachers do not meet specific criteria, or by rewards such as pay increase or promotion when the guidelines are followed. Policies were therefore analysed for consequences attached to the non-respect of the rules stipulated in the CPTD documents database, or for rewards associated with compliance to them. Even though the positive impact of power on policy implementation was clearly demonstrated (Berends, Bodilly, & Kirby, 2002; Datnow, 2000), some research findings show that it can be associated with short-term implementation. On the other hand, authoritative policies would lead to more sustainable results (Desimone, 2002).

Overall, the investigation serves to:

1-expose whether the documents provide adequate guidance to offer quality professional development (Desimone's research-based criteria)

2-expose whether the policies have the characteristics of a successful implementation to lead teachers into adequate professional development (policy attribute theory criteria).

The following section describes the analysis of the South African (KZN) documents, followed by the ones from Quebec (QC), and a brief discussion to highlight the implications of the findings.

4.2 South Africa

In the South African review, a database containing Life Sciences FET phase (emphasis on grade 12) CPTD policy documents was created. In the database, a National Curriculum Statement (NCS) teacher workshop document was included, although not a policy document. It was selected as it has been designed and issued by the government for a weeklong workshop targeting all teachers. It gives indications regarding how the Department of Education envisage CPTD and affects directly teachers' access to information about the intended curriculum. The other organisations dispensing CPTD will be guided by this document, which can therefore influence the delivery of such activities.

Although CPTD responsibilities are jointly shared with the provincial and local governments, the KZN department of education clearly states, as its only reference to CPTD in its strategic plan (KZN Department of Education, 2010), that they will follow the National Framework for Teacher Development in South Africa (Department of Basic Education & Department of Higher Education and Training, 2011). In fact this key document, based on the Teacher Development Summit held in 2009, is the guiding document for all instances involved in CPTD. It explains why most of the documents reviewed are documents issued by the National Department of Education (Department of Basic Education since 2010).

4.2.1 Policies according to the selected criteria

In general, the documents often refer to research-based evidence and in many instances clearly state what ought to be implemented for adequate CPTD. They also acknowledge the general situation in South Africa, based on different reports and make general recommendations about specific South African problems, such as HIV/AIDS, absenteeism, under qualification of teachers etc. For example, the National Policy Framework for Teacher Education and Development states that “many teachers’ poor conceptual and content knowledge contributes to low level of learner achievement”. It also states that “continuing professional development has the vital role of equipping teachers to undertake this task [prepare learners appropriately]” (Department of Education, 2007b, p.13). In particular though, it is not clearly stated which

actions are to be taken, and refer to the teacher's statutory body, South African Council for Educators, (SACE) to monitor and accredit the CPTD courses, via a professional development (PD) points system. It clearly states that: "the CPTD will succeed only if the recording of PD points, data capturing, and monitoring can be accomplished quickly and adequately" (p. 21).

Content focus. The NCS Training Manual for Life Sciences (2006) accompanied the nation-wide weeklong (35 hour) workshop available before the implementation of the NCS for Life Sciences in Grade 10 in 2007. It comprises an entire section (15 hours) on subject statements. However, according to the document as well as based on interviews performed with teachers, the workshop did not include enough subject content *per se*. The section on subject statements was dedicated to the introduction and enumeration of the learning outcomes and associated skills and approach, as well as a review of the content to cover, without giving particular tools for teachers to apply in the classroom. However, a 2h section on *indigenous knowledge in the Life Sciences* was introduced, including teaching and learning material to support it. Consequently, a very low proportion of the workshop was dedicated to new subject content; some difficult subjects, such as evolution, were not formally introduced to teachers before the first year of implementation, if at all, although most teachers were unfamiliar with the concept. Subject advisors, should the district have one, were left to decide if, how and when they should introduce subject content. Policies about roles and qualifications of subject advisors, who have the particularly critical role of ensuring this crucial task, are unfortunately lacking.

The other policies examined do not prescribe any type of professional development but all strongly emphasises the need for increasing content knowledge and qualifications for teachers, based on research findings indicating that this area was a major deficiency in South Africa. Specifically, the Integrated Strategic Planning Framework for Teacher Education and Development in South Africa (thereafter referred to as the Plan) (Department of Basic Education & Department of Higher Education and Training, 2011) highlights the need for 'pedagogically sound, content rich courses' for teachers. Accordingly, the most recent policies such as Schooling 2025 (Department of Basic Education, 2011a) states 'increasing subject knowledge' as one of the five priority goals. The associated technical report also targets under-qualified teachers for focused interventions. Indeed, although 90% of public school teachers have more than three years of training, it was reported that the initial training, at least prior to 1994 was not adequate: "However, often the pre-service training of teachers was not of a sufficient quality. It is important to bear in mind that most teachers entered the profession before 1994." (Department of Basic Education, 2011a, p.106). Another issue is that many secondary school Life Sciences teachers have the requisite four years of teacher education, but

have not specialised in Life Sciences. SACE tried to clamp down on teachers teaching out of their subject area, but the practice continues. (UKZN Education teacher, personal communication, 2013).

Active learning. The NCS Training Manual for Life Sciences (2006) shows that opportunity for active learning was highly promoted. All teachers present at the workshop would have come in contact with a type of teaching that would allow time for reflecting on different practices. Indeed, each lecture presentation was followed by an activity, most of them promoting active learning such as: answering a test and discussing results, question-and-answer activities, critique of text or student work, design of new material etc.

However, none of the other policies examined mentioned that any form of active processes should accompany learning, for teachers or learners.

Duration. The NCS Training Manual for Life Sciences (2006) lasted for a week, which gives the participants enough time for adequate learning but dramatically lacked follow-up. Teachers who participated in the workshop did not have proper ways of questioning the learning material after a classroom trial, but more seriously, new or absent teachers did not access the basic information.

The Education Labour Relations Council (ELRC) resolution No.7 on the workload of educators stipulates that educators may be required to attend up to 80 h of professional development per annum, outside of their school day. It was actually suggested in the technical report of the Plan that time should be allocated by the schools for the CPTD to take place, offering different modifications of the school week schedule to accommodate CPTD.

It was however reported by the Education, Training and Development Practices SETA report (ETDP SETA, 2010) that the current format of CPTD offered by the Departments of Education is too short, being generally a once-off workshop per year.

Coherence. The NCS Training Manual for Life Sciences (2006) was highly coherent with the curriculum and associated documents, as the method of instruction was in accordance with a learner-centred, constructivist form of learning. All sessions targeted the introduction of the new curriculum or its associated requirements. Most of the workshop focused on the different outcomes of the Life Sciences curriculum, with sessions on guidelines on planning and

assessment⁶. It was also coherent with teachers' prior knowledge as a section was dedicated to comparing the new curriculum with the previous one, encouraging teachers to pinpoint the new areas. However, the workshop was deficient in subject content tools and material and therefore lacked coherence with classroom activities.

Documents other than the NCS Training Manual for Life Sciences (2006) do mention alignment of the CPTD with national policies as well as with teachers' needs, with a strong emphasis on research to assess teachers' needs. The Plan technical report highlights the need to transfer responsibilities to local authorities to allow for context-adapted CPTD.

Collective participation. The NCS Training Manual for Life Sciences (2006) allows for collective participation as it was highly organised around group work. It would thus favour communication and interactions between Life Sciences teachers of different backgrounds. Some activities were done with a partner and others in larger groups. In other policy documents, it is strongly recommended to form a *cluster group*⁷, which in principle could also allow for interactions and professional development. For example, the Plan strongly recommends that teachers work in such communities of learning. Subject advisors and Department officials have also reported trying to promote the creation of cluster groups (personal communication, 2011).

Consistency. Policies were judged consistent if the state required a statewide test that was custom-developed to match state content standards. In the specific case of grade 12 (matriculation year) in Life Sciences, the state does require such a test (matric exam). Underperforming schools also had four provincially-developed common tests during the year, whereas other schools could choose to administer them or not. Also, in addition to the weeklong initial workshop, yearly workshops are offered to teachers by provincial officials (subject advisors) to provide information about the current changes. Additionally, a process of

⁶ Teachers' lesson and assessment plans had to be shown and approved during a process called mediation. These new requirements-among others, panned out to be contested by teachers for taking too much time away from classroom work for little input in returns (SA interviewed teachers, personal communication).

⁷ A cluster is defined as a group of schools in the same geographical location such that the teachers of these schools can meet regularly for the purposes of professional development and sharing of ideas/resources (KZN, Department of Education, 2011, p.13)

mediation by peers and/or subject advisors was put in place to assess and give feedback on the assessments and class activities offered by the teachers to ensure policy alignment.

Authority. In this case, state policies definitely require that time be set aside for professional development, and that some funds are made available to teachers to participate in such activities. However, concerning the yearly departmental workshop, a subject advisor reported: “[...] we’ve called teachers to come in grade 10, 11 and 12 on both days. Teachers are telling us that the principal is not releasing them” (Paul, personal communication, 2011). Another subject advisor continued: “But they are not prepared to come weekends. We set workshops on weekends, it’s voluntary and they don’t come, you get a handful.” (Rani, personal communication, 2011). Although the ELRC agreement (Education Labour Relations Council (ELRC), 1998) specifies that professional development is the teachers’ responsibility and that it should be done outside school time, it is specifically stated in the Plan that budget and replacement should be provided to teachers so they can fulfil the recommended 80 hours of CPTD. However no such provisions are actually made and therefore the policies and recommendations, although pointing towards authority, are not supported by funding or time allocation to teachers, which considerably reduce the authority of the policies.

Power. The guardian of continuing professional development, SACE, is responsible for the implementation of a point system designed to monitor teachers’ CPTD activities. It is associated with a minimum of 80 hours of professional development per annum. CPTD requirement is part of the Integrated Quality Management System (IQMS), designed for teachers’ development appraisal and performance measurement, as well as whole school evaluation. The evaluation is for the purpose of salary progression, grade progression, affirmation of appointments and rewards and incentives, characteristic of a policy with power (Education Labour Relations Council (ELRC)2003). In addition to incentives to teachers, the identification of low-performing schools for remediation interventions, also characteristic of policies with power, sums up to give strong power to the South African CPTD policies.

It should however be noted that the Plan specifies that the system of points should not be associated with a pay increase or professional advancement, as it undermines the intrinsic motivation of teachers to attend CPTD for their own professional satisfaction. There is therefore an acknowledgement that power should not be the way to direct teachers in professional development, but it has not been reflected in the policies.

4.3 Québec

In Québec, the original reform documents ‘A new direction for success’ and ‘Quebec schools on course’ acknowledged the general need for teacher’s professional development and a separate body, the Comité d’Orientation de la Formation du Personnel Enseignant (COFPE)—Counselling Committee on Teacher’s Training—was institutionalised to advise the Minister on general orientations about teachers’ initial and in-service training. Also, a separate division of the Ministry of Education, Leisure and Sports (MELS), la Direction de la Formation et de la Titularisation du Personnel Scolaire—Direction of Permanent Staff Status and Training of the Scholastic Personnel, was mandated to define and structure the initial as well as continuing formation of all teaching staff and education managers, managing the associated budget.

The Québec’s reform movement was strongly characterised by a high decentralisation of powers from the Ministry and School Boards to the schools and teachers. Accordingly all professional development decisions are ultimately left to the teachers, with guidance from the school principal who is responsible for offering such opportunities, responding to the needs of the teachers. This type of regulation underlines the will for coherence of the professional development with the teacher’s environment and with its own development level.

Despite a general document describing the intended orientations of teacher professional development, Orientation for the Professional Development of Teachers (Ministère de l’Éducation du Québec, 1999), the only policies acting directly on CPTD are the Education Act (c. I-13.3) and An Act to Promote Workforce Skills and Development and Recognition (c. D-8.3).

The relevant sections are the following:

- 1- Education Act:
 - a. A teacher shall take the appropriate measures to attain and maintain a high level of professionalism (c.22, s.1).
 - b. The principal shall see to the organization of such professional development activities for the school staff as agreed with the staff, in accordance with the provisions of the applicable collective agreements (c.96.21, s.3).

- 2- An Act to Promote Workforce Skills and Development and Recognition: Every employer whose total payroll for a calendar year exceeds the amount fixed by regulation of the Government is required to participate for that year in workforce skills

development by allotting an amount representing at least 1% of his total payroll to eligible training expenditures (c.3, s.3).

In addition, the collective agreement between the government of Québec and teachers of the French school boards, which include the majority of teachers, stipulates that the school board should allocate an amount of \$240 per annum per teacher; the amount should be used according to a local or regional agreement but a proportion of it shall be used for professional development (CPNCF, 2011)

Additional research to find subject-specific documentation was unsuccessful. The ‘Direction de la Formation et de la Titularisation du Personnel Scolaire’ refers to ‘Direction des programmes—programme directorate; the person responsible for the Science and Technology programme stated: “It should be mentioned that the MELS [Ministère de l’Éducation, du Loisir et du Sport] does not intervene in the content of continuing education offered by the school boards” (email communication, 2013). Therefore, because of the limited official documentation in Québec, the documents reviewed are narrower than in South Africa. Nevertheless, they are analysed below with the same criteria.

4.3.1 Policies according to the selected criteria

Content focus. The plan of action for the reform of the education system points out that CPTD should focus, among other points, on upgrading teachers in their field of study, hence pointing towards content focus and PCK-oriented professional development. In the document ‘Orientation for the Professional Development of Teachers’ (thereafter referred to as: ‘Orientation’), there is a strong emphasis on allowing teachers to acquire integrated skills. The document mentions moving “beyond in-service training geared to the acquisition of compartmentalized knowledge to in-service training geared to the development of integrated teaching practices”.

Active learning. Once again in the Orientation document, there are a few mentions of the previous models of CPTD involving only passive lecturing and a will to move away from it, suggesting action research as a possible solution.

Duration. The Orientation document does promote professionalization and lifelong learning through integrated CPTD, without specifications about how it should be addressed. It recommends that schools and school boards adopt a coherent approach to professional development. There is thus acknowledgment of the need for activities that span over an extended period of time.

Coherence. The entire decentralised vision of the continuing professional development and the changes in legislation to accommodate it show the importance that the government is giving to CPTD that would be coherent with teachers' need. In the Orientation document, there is a high emphasis made on how the activities should be relevant to teacher's professional environment. A change in delivery method is also recommended, in accordance with the socio-constructivist learning advocated, which makes the policies highly coherent, both with the teachers' classroom and with the reform being implemented.

Collective participation. The Orientation document, as well as the Plan, recommend forming communities as a source of lifelong learning. Without details or suggestions of format, it is nevertheless acknowledged that learning communities should be promoted.

Consistency. At the time of the research, the state was initiating a criterion-referenced test to match the standards in sciences, in secondary 4. Schools had been offered the choice to use it the previous years and it was becoming mandatory in 2012. It was therefore considered a consistent policy as teachers reported feeling pushed to cover the entire curriculum content because of this test (interviewed teachers, personal communication, 2011). Hence it increases the likelihood of the teachers attending content focused CPTD. However, no regulations would ensure that teachers have minimum access to reform-related information.

Authority. Many different documents aim at organizing a culture of professional development, without properly regulating it. In the Orientation document, one passage mentions that as an incentive, different possible ways of formally recognizing CPTD are considered. However, it ends with: "Finally, it should be remembered that although such means of recognition have their place, they should not overshadow the importance of intrinsic motivation." (p.16). The Education Act also gives the teacher responsibility for his or her own development. In addition, a 2002 amendment to An Act to Promote Workforce Skills and Development and Recognition implies that school boards have to allocate at least 1% of its total payroll to training, so funding backs up the policy, showing a real commitment to encourage teachers to

commit to professional development. This funding can be used to fund such activities or for a replacement to allow teachers time to attend CPTD. The Education Act also stipulates that school principals have the responsibility to ensure suitable CPTD activities are available and the Ministry funds programmes for universities wanting to initiate development programmes for teachers. In addition to that, teachers recognize this commitment and comments from them lead to understand that the policies are indeed applied in their schools. Together, these policies show strong authority by trying to motivate teachers to attend adequate professional development activities.

Power. If authority comes out as a strong commitment in the legislation and policies, there is absolutely no power given to these documents. Teachers, schools and school boards are completely free to evaluate the best way to develop professionally and no sanctions or control can be imposed on them. In fact, the COFPE response to discussions from the Quebec Professions' Office to instate a professional body which could inspect teachers and prescribe professional development, summarizes the general teacher's vision of the idea: "Individual inspection would go against the reform [...] which fits in a context of school accountability." (Comité d'orientation de la formation du personnel enseignant, 2002 p.25). The project was never pursued. According to a government official close to the Minister at the time of reform implementation, the lack of accountability in Québec is critical and go beyond a lack of power: "I could never know how the money was spent [...] the accountability in Québec is 'yes we have spent the money', that's about it" (personal communication, 2011).

As repeated in the documents, professional responsibility ought to be enough to motivate teachers to get involved in CPTD adapted to their needs.

Table 4.1. Summary of CPTD policy characteristics in KwaZulu-Natal and Québec.

Recommended features	KZN-South Africa	Québec-Canada
Core features of CPTD from Desimone (2007)		
Content focus	Moderate/ high	Low/moderate
Active learning	Low	Low/moderate
Duration	Low/moderate	Low/moderate
Coherence	Moderate/high	High
Collective participation	Moderate/ high	Low/moderate
Policy attribute theory from Desimone (2011)		
Consistency	Moderate/high	Moderate
Authority	Low/moderate	High
Power	High	Absent

4.4 The intended policies: a brief discussion

A first distinction between South Africa and Québec's policies pertains to how much it provides guidance for what should be addressed in the CPTD activities. In South Africa, the research-based features for adequate professional development identified by Desimone (2007) tend to be emphasized in the national/provincial policy documents—content focus, coherence and collective participation whereas the opposite is notable in Québec. The non-prescriptive model in Québec demonstrates the strong decentralisation will, consistent with the expectations of a developed country where most teachers are assumed to be qualified with a strong level of professionalization. It could therefore be argued that a professional ethic will push teachers towards adequate professional development activities without having to prescribe the content of it. However, it has been shown in the United States that even though 70% of the teachers choose their own CPTD activities, only a few of them actually participate in content-focused training (Garet, et al., 2001). Within the features proposed by Desimone, it is interesting to note that content focus was determined to have the most influence on teacher practices (Desimone, 2011) and that it is the feature most emphasized in South Africa. However, in Québec, coherence is the strongest feature, demonstrating either the resistance of teachers to some form of control, or a genuine reliance on teachers to keep up with completely new prescribed practices.

As for the characteristics of implementation identified by Desimone (2011a) and formally expressed in the policy attribute theory—consistency, authority and power—it is remarkable that in South Africa, policies have a high power and some authority attached to them, tending to force the teachers into professional development, at least in the short term. In Québec, an approach using authority rather than power was used, with incentives put in place rather than laws.

The findings also show that in a context of under-performing schools and under-qualified teachers, South Africa will promote extrinsic motivation by introducing external incentives to attend CPTD whereas self-regulated learning is promoted in Québec, where a high level of professionalization is already attained. The powerful policies to push teachers into adequate professional development observed in South Africa could in principle level the inequalities, at least on the short term. The new policy frameworks also point towards a longer term, mentality-changing climate with more authoritative than powerful policies. In Québec, the latter approach is grounded in assumptions that, as recognised by Fullan (2007), schools are collaborative environments conducive to life-long learning. It also seems to assume that these ideal circumstances are attained without any form of guidance and that a majority of teachers are going to spontaneously make the efforts to assimilate the new content, pedagogy and philosophy associated with a large scale competency based reform. It is critical to assess the impact of such policies in order for developing countries to adjust their policies accordingly as their context evolves.

The CPTD documents are overall in accordance with research findings and recommendations summarised by Desimone (2009, 2011) and the differences observed are well adapted and context-dependant. However, both systems of cascade or heavy decentralisation do not provide for a uniform or at least a minimum level of CPTD in the reform context. In this context, where the pedagogy, curriculum and programmes are so drastically changed, the educational community is unanimous about the crucial role of CPTD. It is therefore surprising that the basic needs should not be ensured. The high resources involved in such reforms could justify a rearrangement of the school calendar to guarantee quality professional development to all teachers. The politics around teacher's organisations or unions is often mentioned as a reason for not having such policies (Department officials in South Africa and Canada, subject and pedagogic advisors: personal communication, 2011).

Now that the message is so clearly whispered, it will be interesting to see if or where it gets distorted. Whether the policies do get through the implementation phase and how the implementers and teachers perceive it is explored in the next chapters.

Chapter 5. The implemented policies

To understand professional development and its impact on reform implementation, the last chapter explored continuing professional development policies in the two contexts under study. Although some gaps were found, it showed that policy design generally aligns with research findings. The second research question explored in this chapter pertains to how professional development is implemented and what factors account for the observed implementation.

5.1 Methods

The analysis was performed in four different ways:

Firstly, CPTD activities attended by teachers are analysed with regards to the analytical framework's criteria, also used to explore professional development policies (see Figure 1.3). One CPTD activity attended by each teacher was observed and audio recorded (Montréal) and video-recorded (Durban)—due to the diversity of the activities and the numerous people involved, video recording was not possible in Montréal for ethical reasons. Scan sampling was performed, coupled with discontinuous sampling as details of the activity were precisely described every five minutes or at shorter intervals if necessary.

Secondly, the Reform Teaching Observation Protocol (RTOP) (Piburn & Sawada, 2000a) is used to evaluate the degree of 'reform teaching' of the CPTD activities. This tool was developed in the United States to assess how classroom practices reflect the science reform principles being implemented. Although designed for classroom practices, the tool was used here to assess the level of reform teaching present during CPTD activities, as they also should be aligned with the prescribed reformed pedagogy. Indeed, as shown in chapter 4, the documents recommend that continuing professional development should move away from traditional teaching and adhere to a collaborative, more constructivist-orientated approach. Since science reforms in Québec as well as in South Africa are based on similar constructivist principles to the one implemented in the United States (Department of Basic Education, 2011b; Department of Education, 2008a; Ministère de l'Éducation, 2010; National Research Council (NRC), 1996), the RTOP instrument was considered suitable for this study. The questions composing the protocol were analysed for suitability, thus assuring validity of the instrument. In addition, Park and colleagues (2011) found that RTOP is related to teachers'

PCK and although they did not infer a causal relationship, it is also appropriate to explore the evidence of PCK in the analysed activities. The tool consists of five sections; the first two comprise researcher's observations such as demographic data and classroom environment information. The last three are divided as follows: (a) lesson design and implementation, (b) content (two subscales: propositional knowledge & procedural knowledge), and (c) classroom culture (two subscales: communicative interactions & student/Teacher relationships). The three latter sections comprise 25 items rated from 0="never occurred" to 4="very descriptive", for a maximum score of 100, reflecting highly reformed teaching. The 25 items can be found in Appendix B.

Thirdly, interviews with Department/Ministry of Education officials and subject advisors' were also performed and audio-recorded to examine and better understand how they perceive continuing professional development's impact on teachers.

Fourthly, observation of Vusi and Samantha's cluster group was performed on three different occasions. Details of the activity were precisely described every five minutes, or at shorter intervals if necessary. However, Vusi was absent for one session whereas Samantha missed two. Also, two moderation sessions were observed, one with Premilla and the other one with Vusi and Samantha. In these sessions, teachers are required to show an example of learners' work and lesson plans to the subject advisors, material that ought to be previously signed by a school colleague and the principal, to allow comments and suggestions from different sources.

To contextualise the findings, the first section presents a summary of the implementation situation in South Africa and Québec at the time of writing (end of 2012).

5.2 Implementation Situation

5.2.1 South Africa

Although the CPTD documents in South Africa were written in accordance with research findings and were considered appropriate for the context, it was found that little implementation of these policies has actually taken place. Indeed, the cornerstone of the South African continuing professional development policy, the IQMS, is not yet implemented in schools. It was found that, in 2009-2010 "Only 7% of schools visited could be considered as having fully implemented the IQMS" (Department of Basic Education, 2011a, p. 138). A Department of Higher Education and Training Official (DHET) official added: "The IQMS has

been really problematic from the teachers' perspective and it is one of the things that was highlighted significantly in the summit. That IQMS was not doing the job that it was intended to." (Personal communication, 2011). Moreover, the SACE points system (PD points) is still not operative in schools, as exposed by the following correspondence with a SACE representative: "We have just completed the CPTD pilot and we are working with the Department of Basic Education on the CPTD System implementation plan. We are likely to start with phased-in implementation from 2014. Between now and December 2013 it will be advocacy, and putting systems into place." (Personal email exchange, September 2012). The same situation was also exposed by one of the interviewed teachers: "With regard to the SACE-IQMS professional development points, I'm really not sure if they do apply? At school we fill in the required details and all we get back is the standard 1% increase annually! I do not know of any other teacher that gets more than this and if they do I'm not aware of it" (Pirindha, 2011). Therefore, as clearly shown above, the key aspect of the policy is not yet implemented and some teachers are not aware of whether they should be doing anything about it. However, it was clearly stated in the Framework for the National Strategy for Learner Attainment (NSLA) that: "the CPTD will succeed only if the recording of PD points, data capturing, and monitoring can be accomplished quickly and adequately" (Department of Education, 2007b, p. 29).

Therefore, in South Africa, critical CPTD policies, which were found to be adequate and context-relevant, have yet to be implemented more than 10 years after the reform initiation.

5.2.2 Québec

In terms of implementation of the policies, Québec is in a much better place than South Africa, considering that the main goal of the policy change was to decentralise powers from the Ministry of Education to the schools and teachers. It is actually decentralised to a point where accountability is vague and rather poorly applied. A Ministry of Education official commented on the situation: "Continuing professional development is so decentralized in Québec that we, at the Ministry, don't know what they are actually doing at the school board and school level." (Personal communication, 2011). However, the intended policies are implemented and the incentives to attend professional development activities are available to the teachers. Marie-Anne, in response to a question regarding the cost of a professional development activity, reported: "Well it [the registration fees] was all paid for by the school. We paid transport and then with the receipts, they paid us back [...] It was during school time and the school got a replacement for me" (Personal communication, 2011). The other two

teachers also corroborated that they could attend professional development activities of their choice. Therefore, the decentralised powers do give teachers responsibility for their development, as intended in the policies. Whether this responsibility is profitable and results in the selection of adequate professional development is examined by analysing the activities attended by the selected teachers.

5.3 CPTD activities

5.3.1 South Africa

The activities attended by the South African teachers were uniform, as none of the three teachers selected 'external' professional development and only attended the workshop from the provincial Department of Education. Although teachers were from different schools and districts, they were part of the same circuit and therefore the subject advisors offered the same workshop in the different districts. The analysis will first present the activity with regards to the selected criteria followed by the RTOP analysis.

The annual workshop was subject-specific but not grade-specific and therefore included Life Sciences teachers from grade 10, 11 and 12. Most of the two-day workshop was in the lecturing format with PowerPoint presentations. Three subject advisors presented on various themes. The senior subject advisor began with a personal touch, congratulating and thanking teachers for their work. He followed with an introduction to the workshop, asking teachers for their input; however, none of the teachers responded. The remaining of the day consisted of presentations on various topics starting with last year Life Sciences' results across the province, highlighting the questions with low pass rates. The other two subject advisors presented on different administrative requirements, as well as on content-related topics. The second day also mainly consisted of lecturing from the subject advisors, with an external presenter discussing how a particular software could enhance teaching. He presented on evolution to demonstrate the software possibilities. Teachers were asked twice to work in team on a given topic. The workshop is discussed below based on the selected analytical criteria.

Selected criteria

Content focus. Nearly half of the workshop was dedicated to activities that contained content-focused material, or related to ways to teach a particular topic. The topic was selected from what was considered difficult topics based on the previous year's standard test results (matric): linking molecular studies with evolution. There was therefore a significant proportion of the workshop focused on content and electronic material such as PowerPoint presentations, exemplars of 'hands-on' activities or official documents were distributed to the teachers. A retired teacher, colleague of the senior subject advisor presented self-designed software and made a content-focused presentation to demonstrate the software possibilities.

Active learning. Each day ended with a group activity that lasted between 10 and 20 minutes, where teachers were asked to actively reflect on classroom management or a topic from the syllabus. However, the observation of these activities showed that only one or two groups out of the 10 to 12 groups were discussing the task at hand. Also, each group's work was supposed to be collected and compiled for redistribution to the other groups. All the teachers interviewed did not receive the compiled work at the end of the term.

Duration. As mentioned, the workshop was a two-day workshop, which started at 8 am and finished at 2 pm. However, the workshop actually started at 9 am and only 3.5 hours per day was compiled as working time, the remaining time being lost between presentations, in breaks or questionnaires to fill. There was no follow-up workshop during the year but teachers were free to contact the subject advisors for help. However, the underperforming schools receive frequent visits from subject advisors, mainly to moderate their work such as student assessment, lesson planning etc. A subject advisor pointed to the lack of time as the limiting factor for increasing the impact of the workshops. He also mentioned the lack of follow up for their own training as a source of under qualification for some subject advisors (Paul, personal communication, 2011).

Coherence. The workshop was highly coherent with both the policies being implemented and classroom practices, as content along with learning and teaching support material (LTSM) were distributed. However, a significant proportion of the time was dedicated to the enumeration of a long list of schools and student performances. Designed as a diagnostic analysis, it was covering learners' weaknesses in the province, without being entirely relevant to individual school or teacher.

Collective participation. Along with active learning, collective participation was only allocated a very small proportion of time and was not guided by the subject advisors, hence discussions easily moved away from the subject. During breaks, teachers were discussing in small groups, giving them the opportunity to meet Life Sciences teachers from other schools. Hence the workshop itself is an opportunity for collective participation although guided activities were lacking.

Vusi and Samantha were members of a cluster group. The hour-long sessions took place in a neighbouring school at the end of the school-day. The first meeting was lead by a chairperson who presented a few logistic issues followed by the election of the executive committee—chairperson and secretary. The remaining time was spent forming groups of teachers in each grade to plan controlled tests and assessment. The two other sessions were limited to exchange of assessment material and individual teachers working on a particular section of the upcoming assessment in the computer lab. Most teachers were using the exemplars given in the workshop, or from previous ones, as a guide for setting assessment task.

The Orientation Booklet for teachers distributed during the workshop (KZN Department of Education, 2011, p.13) contained a list of suggested activities as well as guidelines on how cluster groups should be managed but out of the ten activities suggested, only number 8: Setting common assessment tasks, was observed during the three sessions attended by the researcher. The documents strongly encouraged collective participation, particularly through cluster groups. In an interview, a DHET official noted: “It’s going to rely [the new professional development plan] on continued collaboration and co-ordination, which I think has been a facet missing in the South African teacher development experience [...] if we can set up that kind of structure in the country, across the country – strong teacher bodies that drive learning, learn with and from each other and use those as the context in which this kind of training can take place. I think it will work better.” (Personal communication, 2011). However, the interviewed subject advisors reported that very few districts succeeded in forming functional groups.

In addition, the observed moderation sessions were also not conducive to learning. For the first one, as the subject advisor was absent, Premilla acted in his name and looked over and signed her colleagues’ work. However, it was observed that she did so very quickly, without giving any feedback or reading the work presented to her in detail. During the second session observed, a subject advisor was present and signed Vusi’s and Samantha’s work, also without feedback and little attention given to the work presented. Only limited conversation occurred,

generally not around pedagogical issues. However, although teachers did not spend much time at the session, the atmosphere was amicable.

RTOP

The workshop in Durban scored 26 out of a possible 100 points on reformed teaching. The central reason for this low score was that the entire workshop was devoted to lecturing, without much participation from the learners (teachers), which resulted in a very low score for Lesson Design and Implementation as well as Procedural Knowledge (3 and 1 out of 20, respectively). All the items referring to student involvement were either absent or underrepresented. Indeed, according to the protocol, students should be the starting point of the lesson, with discussions and questions guiding the orientation of the teachers' intervention. The traditional lecturing format shown during the workshop is not conducive to such an approach. However, strengths were observed in the presentation of fundamental concepts presented such as molecular foundations of evolution. Also the respectful atmosphere during the workshop and the patience shown to learners gave Propositional Knowledge and Classroom Culture (student/teacher interaction) the highest scores. Each section and subsection score is presented in Table 5.1; detailed scores for each question can be found in Appendix B.

Table 5.1. RTOP scores for the South African professional development activity.

Item	Score
Lesson Design and Implementation	3/20
Content: Propositional knowledge	11/20
Content: Procedural knowledge	1/20
Classroom culture: communicative interactions	4/20
Classroom culture: student/teacher relationships	7/20
Total	26/100

Department official and subject advisors' perception

From the perspective of government representatives and subject advisors, inadequate CPTD activities would be a logical consequence of the poor qualifications and guidelines provided to the implementers. A senior subject advisor, Paul, reflected on the matter in an interview and

deplored the lack of professional development they, themselves as subject advisors, were exposed to. However, some of the interviewed subject advisors mentioned that a few workshops were available on specific content—diversity, assessment and evolution (Thabi and Rani, personal communication, 2011), although these workshops have been qualified both by a DHET official and a subject advisor (Paul, 2011) as ‘hit and miss’ workshops due to the lack of follow up. Therefore, subject advisors are often ‘self taught’, as exemplified by Thabi : “To speak the truth I was not trained. I was not trained but I taught myself because I had to read. I was not sleeping I was reading.” (Personal communication, 2011). As a consequence of the lack of professional development, qualifications of subject advisors are very often less than the teachers’ themselves, as expressed by a DHET official: “When the Teacher Colleges either closed down or merged with particular Universities, some of the people were able to be taken up by the Universities, [those] who had the kind of experience and qualifications that the Universities required in order to appoint staff, but there were many who didn’t have that. Those were either re-deployed as teachers or as subject advisors or taken up into official positions, and often not in their area of expertise. Often out of the area of expertise, because they needed to have a post. They were earning a salary and needed to be aligned to a particular post, so I think that was one process of how many subject advisors are in place at present, who perhaps don’t have the necessary expertise that they need.” He also added: “[...] appointments of the subject advisors—the leadership level—has been highly problematic and largely based on affiliation to particular unions or in relation to who you know and a lot of unsuitable people have ended up being in subject advisor positions, who actually rely on the teachers that they are supposed to be supporting, to support them, has been the kind of story that people were talking about”. Although he did not provide supporting evidence and was speaking anecdotally, he is a senior Department official with experience, giving credit to his comment. When asked about remedial solutions, he clearly implied that it was not to change in the near future: “[...] but at present there’s nothing in place and it will be reliant on negotiation with unions and others, around setting minimum requirements for particular positions.” (Personal communication, 2011).

Paul also commented on the guidelines they were offered: “It’s only recently, about a year or two ago that there is a document [...] but prior to that we actually learnt on the job.” He also added that the material and pedagogy in these workshops are highly dependent on personal experience: “[...] because of my experience now as an in-service lecturer, I had a fairly good indication of what the needs of the teachers were. And based on that I actually developed programmes to help out, you know to help the teachers along” (Paul, personal communication,

2011). So not only are the subject advisors sometimes appointed without proper qualifications but no guidelines and training or need analysis are provided.

5.3.2 Québec

As opposed to the South African situation, all the activities attended by the teachers in Québec were different. One teacher, Marie-Anne, attended a conference held by a science teacher association, l'Association pour l'Enseignement de la Science (et de la Technologie) au Québec (APSQ)—Association for Teaching of Science and Technology in Québec, recently renamed AESTQ to account for the Technology as being part of the Science teaching. The two other teachers, David and Danny, attended the school-based pedagogical days as the unique source of professional development during the semester under study. The next section will briefly introduce the three activities, followed by the analysis based on the analytical framework's criteria, RTOP, and pedagogic advisors and department official perspective.

APSQ conference

The three-day conference takes place every year in a different city in the province of Québec. Members and non-members of this teacher association are invited and can, should the school management deem relevant, benefit from funding and teacher replacement to attend (the meeting is usually from Thursday to Saturday). This provincial conference consists of plenary sessions and various workshops from different organisations, either private speakers or corporate companies, organised by themes from which attendants select. Kiosks are also present for participants to visit at their will, which consist of private companies demonstrating their products or promoting activities designed for Sciences and Technology teachers or students. In the present case, the title of the conference was 'Cuisinons la Science—Let's Cook Science'. The researcher was present with Marie-Anne in each workshop she selected, as well as during lunch and breaks to document the formal and informal learning. Marie-Anne chose four workshops and a visit to the Montréal Cosmodome, a scientific museum showing educational exhibitions and space-related activities for children/students. Astronomy is one of the new subjects included in the Sciences and Technology syllabus with which she reported having difficulty. The topics of the selected workshop were the following:

1. Genes in a Bottle. A corporate company presenting a hands-on activity to be carried out by the teachers. The activity kit was sold by the company with the detailed directions to extract cheek DNA from cheek cells and to encapsulate it in a necklace.

2. WET project. Water Education for Teachers (WET) consisted of a presentation followed by activities exemplifying water properties and its crucial role for life. The animators presented detailed material to help teachers create learning situations for their students. The WET project was initiated in the United States and accredits teachers, following a short course, to deliver their educational material, now translated into French.

3. Pop Bridge. Teachers were asked to create a bridge out of Popsicle sticks. Teachers could then help their students to participate in an annual bridge-making provincial competition. It consisted of a presentation explaining the basics of bridge mechanics followed by an activity of bridge construction. Marie-Anne and her colleague have a school-based bridge competition.

4. Planting wild leek. Teachers were given instructions and suggestions as to how to get involved in wild leek plantations with students, either around their schools or at different sites. Teachers also participated in two classroom based learning activities adapted for the students, around the theme of ecology.

Marie-Anne also attended two plenary sessions, which were around the theme of the conference, cooking. They were presentations that addressed different scientific—mainly chemical—aspects of food and cooking. Also, between the workshop sessions, she visited the kiosks and collected documentation on different products and activities. As they are not formal CPTD activities, the plenary sessions, visit to the Cosmodome and the kiosks will not be assessed with the formal criteria and for reformed teaching (RTOP) but will be taken into account in the discussion around the selected criteria such as collective participation.

Pedagogical days

The two pedagogical days attended were different in the two schools and each teacher reported that they are very different within the same school throughout the year, but rarely consisted of what they qualified as 'professional development activities'. Rather, they are often used as free time for teachers to grade or prepare classes, or for departmental meetings should they be deemed necessary. The observed days were purposely selected to include more formal

continuing professional development activities. They consisted of presentations on various themes, from school drop out problems to Information and Communication Technology (ICT) utilisation in class. They will be briefly described here before the analysis.

David's school pedagogical day. The day started with a departmental meeting followed by a 'grade level meeting', where all teachers of the same grade were gathering, with the grade coordinator. The discussions were focused on logistical issues. The afternoon started with an ICT-related discussion around the use of ICT in education, including the use of tablets in teaching, social media and electronic communication with parents. It was followed by a meeting for teachers participating in an ICT project which gave them the opportunity to get funding to buy a laptop—which David was part of. It consisted of a presentation on the use of 'cloud computing' in class.

Danny's school pedagogical day. There was a presentation in the morning followed by an activity for which teachers parted to work in groups; Danny's group consisted of seven teachers, from different grades and subjects, and he was designated facilitator of the group. Discussions were around predetermined themes, assigned by the principal, and were mainly pertaining to school issues such as pupil motivation with regards to dropping out, absenteeism, assessment, interdisciplinary projects, discipline issues and ICT. The goal was for the school to draw a 'Plan de Réussite'—Success Plan, which is meant to be sent to the school board for targeted interventions and collaboration. The afternoon also started with a presentation, followed by the different groups presenting the results of their discussion, favouring a discussion between all teachers in the school.

Selected criteria

Content focus. The APSQ conference offered limited content knowledge. However, most of the activities provided tools or activities related to Sciences and Technologies teaching, and teachers were experimenting from the learners' perspective, therefore potentially contributing to PCK formation. For example, one workshop offered various activities on water but very little interpretation of the data or indications of how to integrate the activities within the Science and Technology syllabus. It therefore gives pedagogical tools but provides limited content knowledge. Most workshops began with a short presentation followed by an activity with very little room for reflective discussions. The workshops provide, along with the kiosks, opportunities to explore what is on the market in terms of learning and teaching support material (LTSM) as well as possible activities or exhibitions available for the students.

The pedagogical days, on the other hand, were very low on content focus. A high proportion of the time was spent on logistical school-related issues such as new library procedures or a leaking roof in a classroom. The ICT presentation was an overview of the possibilities of some software in teaching. It was not focused on Sciences and Technology and therefore not considered content focus. Consequently, the general score for content focus CPTD in Québec is low to moderate, as presented in Table 5.3.

Active learning. All three professional development activities dedicated a high proportion of time on active learning, and only a minority of the activities were in the traditional lecturer-listener format. However, because the learning was not concentrated on Sciences and Technology content, it decreases the relevance of this particular criterion. For example, there were highly reflective discussions about how to recognise and motivate a potential drop out student or what type of technology is efficient for the learners, which brings a lot to the school culture but little in terms of the identified criteria. Discussions also favour active learning by promoting reflection on practices and focus on what could be changed, and how. The APSQ meeting was slightly higher in content focus and therefore makes the active learning more relevant.

Duration. The APSQ meeting occurs once a year, on a different topic every time. It therefore lacks continuity, although most presenters offered their contact details for further questions. The pedagogical days occur every month, which is a good provision for sustained development but as reported by all three teachers, they rarely offer proper professional development and rather leave time to teachers to catch up on their planning or grading. Although these days can be used to attend an externally offered activity, as Marie-Anne did, it does not provide continuity. Overall, duration was not adequate as it lacked follow-up possibilities.

Coherence. Coherence with classroom practices was relatively high in the APSQ meeting but very low in the pedagogical days. However, they were coherent with teachers' everyday activities, as departmental and grade level meetings deal with nitty-gritty matters that need to be addressed for a coherent functioning of the school. The APSQ workshops were mainly offered in a format that is coherent with the science reform policies as it suggested 'learning and assessment situations' (SAÉ), which has a central role in the new Sciences and Technology programme and favour active learning.

Collective participation. Collective participation was strongly emphasized in all the activities. The three activities allowed for discussions and collaboration among teachers. Activities were developed so as to favour dialogue. During the pedagogical days, teachers from different subjects were meeting together, which also favoured discussions, although not focused on content knowledge. Discussions in the two schools would promote reflection, with particular remarks such as: “As an educational institution, I think we should value the use of freeware and be careful if we use materials from companies that favour monopoly and short term usage of materials, such as Apple I Pads, which are obsolete after 11 months on average” (teacher from a discussion in David’s school pedagogical day, 2011). At the APSQ, Marie-Anne spent time—lunch and breaks—with a previous colleague, discussing particular projects or SAÉ and their feasibility in class. Therefore activities in Québec largely favoured active participation.

RTOP

The RTOP scores were rated for each pedagogical day, and the four workshops at the APSQ meeting were rated independently and then used to calculate the average for the activity. Each section and subsection score is presented in Table 5.2 and details of each question’s score can be found in Appendix B. A summary of the entire analysis of the CPTD activities in both regions is presented in Table 5.3. It is important to note here that evaluation of the quality or accuracy of the content being offered was outside the scope of this study, hence only the objective theoretical criteria are reported.

The APSQ meeting scored a mean of 45, with the lowest activity at 34 and the highest at 58. The strongest items were the active participation of the learners, as well as the climate of respect and the connection with real world or other disciplines. The weakest topic pertained to the lack of reflection on learning. All four workshops scored higher in the propositional knowledge and student/teacher relationship and showed lower scores for procedural knowledge.

David’s pedagogical day scored 38, with the strongest items being the active involvement of students and the respectful atmosphere during the activity. However, discussions were not focused on important concepts and content knowledge. Both propositional and procedural knowledge were therefore lacking.

Danny’s pedagogical day scored the highest with 55, due to the extremely high proportion of learner’s discussion and the fact that their ideas, relevant to their environment, lead most of the

discussions, which is a central point in reform teaching. However, both propositional and procedural knowledge were lacking as well.

The general RTOP mean in Québec was 46, with generally high lesson design and implementation classroom culture, although communicative interactions were lower than student/teacher relationship. Also, as was the case in Durban, procedural knowledge is systematically lower than other practices.

Table 5.2. RTOP scores for the Quebec's professional development activities.

Item	Montréal (mean)	APSQ	David Ped. day	Danny Ped. day
Lesson Design and Implementation	10/20	9	11	12
Content: Propositional knowledge	10/20	11	5	8
Content: Procedural knowledge	6/20	5	5	8
Classroom culture: communicative interactions	9/20	8	8	12
Classroom culture: student/teacher relationships	12/20	11	9	15
Total	47/100	44/100	38/100	55/100

Note: Montréal mean was calculated from all the activities and workshops (APSQ), hence varies from the mean of the 3 activities showed here.

Table 5.3. Summary of CPTD activities in KwaZulu-Natal and Québec.

Recommended features	KZN-South Africa	Québec-Canada
Content focus	Moderate/ high	Low/moderate
Active learning	Low	Moderate
Duration	Low	Low
Coherence	Moderate/high	High
Collective participation	Low	Moderate/High
Reform Teaching	26/100	47/100
Observation Protocol		(from 38 to 55)

5.4 Department Officials and Pedagogic Advisors' Perception

In Québec, the role of pedagogic advisors is similar to the one in South Africa, to inform and assist teachers to understand, interpret and apply the departmental policies. However, their role is more of accompanying schools/teachers towards what they identify as their needs. Here again, there is no specific requirement to be a pedagogic advisor, and the understanding is that they acquire their professional knowledge 'on the job'. Most of them will advise many schools in various subjects; hence their qualifications can be limited with regards to content or pedagogical content knowledge. Despite this fact and as opposed to the situation in South Africa, the overall opinion of the interviewees was that pedagogic advisors are generally well qualified. However, many of the pedagogic advisors reported that they would require more assistance and resources to accomplish their function, especially in the first few years (Gagnon, 2010). The situation was slightly different in David's school as it is a private school. In this school, there was no pedagogical advisor but Julie, the pedagogic director, is organising the school in order to provide support to the teachers according to their needs. Her role is an administrative one and therefore she was required by law to have certain minimum qualifications, such as a diploma in school administration. Occasionally, when she deems necessary, she assigns a teacher in a specific subject to act as a resource person in the school, with released teaching time. She reported doing so when the reform was first implemented, although it is on a voluntary basis and not accompanied by any form of professional development. She also, at that time, altered the school schedule to allow one hour and a half every nine days for meetings with the teachers. Meetings were not an addition to the regular teachers' daily schedule and were about the new structure of the programme, with the reported goal of creating a learning community within the school. In addition, teachers attended subject specific meetings organised by the private schools association, once a year.

As opposed to the situation in South Africa, although minimum qualification requirements are not necessary, they were given some support to implement the changes. Indeed, the pedagogic advisors, pedagogic director and department officials interviewed all commended the biannual meetings held by the Ministry of Education during the first years of implementation. The national meetings/training sessions targeted the pedagogical advisors (1998 to 2008) and education managers (1999 to 2012), and allowed collaboration between the different stakeholders such as university researchers, unions, educational editors, pedagogic advisors and Ministry representatives. A Ministry of Education official described it as a 'co-construction of the reform'. However, he commented on the 'battles' between the different

schools of thought and Julie, the pedagogical director at David's school, criticized the lack of 'grounded' guidance that would come out of them.

With regards to the resources allocated to teachers' continuing professional development, a Ministry of Education official observed that the majority of teachers do not attend what he qualified as 'proper' continuing professional development and those who attend occasional meetings are the ones who would find a way to develop professionally, with or without resources. He adds that school boards have a high budget to spend but deplores the lack of coherent planning associated with it.

5.5 Examination of the Implemented Policies: A brief Discussion

Overall, the message sent by the policies, which looked relatively adequate from the intended CPTD analysis, seems already somewhat distorted.

In South Africa, the poor level of implementation is disturbing, more than ten years after the first year of reform implementation. Although the CPTD activities, with regards to the selected criteria, show some strength such as content focus and coherence with the policies, the key point of the sciences reform, which implies student participation and inquiry, is not well represented. The low RTOP score is indeed indicative of the poor understanding of the reform requirements by the subject advisors. Teachers, who have themselves never been exposed to learner-centred methods, have no exposure from the annual professional development they attend. This finding is critical as the annual department workshop is, at least for the three teachers observed, the only source of official professional development. There is definitely a gap here that does not provide for good implementation of the CPTD policies in the classrooms.

In Québec, the main distortion comes from the duration and continuity of CPTD. The activities observed were more representative of the reform requirements, with active participation and collaboration from the teachers to the different activities offered, and a slightly higher RTOP score. However, procedural knowledge is also lacking. Provision for teachers to attend relevant professional development are made and teachers are aware of it, although there is not a coherent plan in place for a continuum of activities that could lead to a change in culture. The main obstacle between a better and more sustained participation seems to be the teachers themselves. Notwithstanding the individual motivational method to attract teachers towards CPTD, it cannot assist in reaching professional capital if it does not provide

for a collaborative, learning culture. They need to be attracted to the activities offered by trusting that they will impact on their classroom practices and on them as professionals.

The exploration of the activities show that in South Africa, the implementation level creates a large gap between the design and enactment of policies, whereas in Québec, although potholes were observed, the message whispered to the next level is still coherent. Analysis of teachers' perceptions and enactment of continuing professional development will add another piece to the puzzle in the next chapter.

Chapter 6. Enacted Policies: Teachers' Perception

If the last chapter showed an important aspect in understanding continuing professional development, understanding how teachers experience CPTD is the ultimate question, considering that its goal is to improve instruction, and, in the situation under study, to align classroom practices with the intended systemic change. A deep understanding of teachers' perceptions of CPTD as well as of the factors influencing this perception is therefore essential for a full comprehension of how it can impact their practices and eventually students' learning. An essential point of the present research is to understand how teachers' attitudes and beliefs as well as their context affect how they perceive professional development and the impact on their practices. Teachers' views on science teaching and learning is an important factor influencing their disposition to enact reforms. Indeed, although constructivists' views are not a guarantee of successful implementation, epistemological absolutism can certainly act as an obstacle to change (Da-Silva, Mellado, Ruiz, & Porlán, 2007). In line with the constructivist approach to learning, teachers' preconceptions potentially interfere with their learning and therefore influence their perception of CPTD, their participation in it as well as its impact.

This chapter therefore explores research question three and presents the teachers' attitude and beliefs and how they perceive that CPTD can affect them and their practices. The next chapter studies teachers' practices and its relation to CPTD, which addresses research question four. General conclusions on this topic will be highlighted at the end of the next chapter and then discussed in the context of the previous findings in the last chapter (Discussion chapter).

6.1 Methods

6.1.1 Data collection and analysis

To investigate teachers' attitude and beliefs and their perception of CPTD, various methods described here were used to allowed triangulation and validation of the data.

Interviews

First, two interviews with each participating teacher were performed and audio-recorded. The interviews took place at the teachers' location of choice; most took place at the school, in their

office or classroom. One interview had to be conducted elsewhere because of water leakage at the school, and the teacher suggested moving to his house. Teachers were therefore always in a familiar environment. Interviews lasted for around one hour, according to the teacher's available time and were conducted before and after the observed CPTD and teachers' lessons (see classroom observation, next section). Interviews were semi-structured and therefore some questions differed from one teacher to the next, but examples of common questions can be found in Appendix C. The first part of the interview pertained to teachers' background and general information, which served as an 'ice breaker' as well as to provide an understanding of who they are and what are their personal context. As Shulman says, it is important to "trace their intellectual biography, that set of understandings, conceptions, and orientations that constitutes the source of their comprehension of the subjects they teach" (Shulman, 1986, p8).

Discourse analysis was used to identify sources of knowledge for teachers in changing times as well as their perception of how they grasped the intended change and the general as well as the Life Sciences policies. There is an understanding that a multitude of factors can affect their claims, including self-protection and lack of understanding of definitions and expectations. Context as well as body language was noted and taken into account during data analysis and interpretation. Discourse analysis was performed using QSR International's NVivo 9 qualitative data analysis software (NVivo, 2010). In the open coding process, the interviews and storylines were transcribed *verbatim* and then imported into the software where selective codes were introduced. Many readings of the transcripts and open coding allowed narrowing down of the relevant categories to a subset common to all the interviews, using a constant comparative method to allow axial coding—connections amongst the categories and the subcategories (Strauss & Corbin, 1994). Given the diverse nature of the discourses, different sets of codes were used for teachers, government officials and subject advisors/pedagogic counsellors; a categorisation, frequency of words, terms and association of themes was then performed on the data to target a change in knowledge, attitudes, beliefs and confidence (see results section for a list of axial and selective codes). Trends were then evaluated in light of teachers' cognitive maps and questionnaire.

Classroom observation

Classroom observation was also performed to validate discussions as the author takes O'Sullivan's (2006) stance who passionately claims that classroom observation is a necessary step to appreciate teachers' reality and to corroborate teachers' perceptions of their practices, as they often see themselves differently than they actually are (Simmons et al., 1999). Data

included one videotaped lesson observation with pre/post audio-recorded interviews in combination with each observation (see previous section). Teachers were asked to select, as much as possible, a lesson relevant to the CPTD activity observed as well as representative of their regular teaching. Many occasions to informally inquire about the teachers' reality also presented and were duly noted and described afterwards, for example, lunch or tea/coffee breaks with the teachers, discussing with their family and students etc. The extended time span spent with the teachers allowed for proximity and a relationship that was the source of rich yet informal data that was used for discourse analysis. To complement the analysis, teachers' material such as class hand-outs or PowerPoint presentations were also examined, along with the assessments used for the subject content observed.

Storyline

To complement the interviews, the storyline method (Gergen & Gergen, 1986) was also used in this study as a narrative inquiry tool. This technique, where teachers draw a graph of their perceived aptitude, helps with the expression and verbalisation of events that might have had an influence on them. The storyline represents the teacher's evaluations of a series of experiences or events concerning, in the present situation, their perceived competency to teach the new syllabus. It is drawn as a graph format, with their perceived competency on the vertical axis plotted as a function of time on the horizontal axis. It serves as a "trigger to make teachers tell their story" (Henze & van Driel, 2009, p.187). The method has previously been used to help reveal some important aspects of teachers' 'story' (Beijaard, Van Driel, & Verloop, 1999; Henze & van Driel, 2009; Van der Sanden & Teurlings, 2003). Teachers were asked to plot, on a 5-point scale (1=insufficient, 3=sufficient and 5=good) how they perceived their competency to teach according to the new requirements of the curriculum and its associated pedagogy from the first year of implementation. While they graphed, they were encouraged to comment on how they were teaching at the beginning of the implementation, what resources they used and how they perceived their knowledge of the new curricular content. As they proceeded, they were asked about the factors contributing to the change in their competency (eg. did anything particular happened during that period of time?). At the end, teachers were asked to 'reflect prospectively' on their future by extending the graph by a year (2012). This final step indicates their motivation or intention at getting better, as well as the tools they intend to use to reach that point. The entire exercise lasted between 15 and 45 minutes. Examples of a teacher's storyline can be found in Appendix D.

Questionnaire and cognitive maps

In addition to the above mentioned, a questionnaire was distributed to the selected teachers pre/post professional development activity. The questionnaire contained a first section with open questions about their comments on the workshop. The second section asked Likert-type questions assessing their pedagogical and scientific beliefs to draw the teachers' cognitive maps. Assessing pedagogical and scientific beliefs is a significant step in the understanding of continuing professional development. As Porlán and del Pozo (2002) stated: "Teachers work with various kinds of knowledge (that of their pupils, of the sciences, of textbooks, their own knowledge as teachers etc.), and they more or less tacitly possess related meta-ideas, i.e. they have personal epistemological conceptions. These conceptions may have a[n] influence on their interpretations and actions in teaching, and therefore constitute information that is indispensable for appropriate intervention in initial and ongoing teacher education." (p.152). The questionnaire used in the present study, Inventory of teachers' pedagogical & scientific beliefs (INPECIP), was developed by Porlán at University of Seville (Porlán, 1989) and further utilized and validated by comparing teachers' cognitive maps from the INPECIP questionnaire with cognitive maps from interviews (Farré & Lorenzo, 2009; Mellado, 1998; Porlán & del Pozo, 2002, 2004; Porlán, del Pozo, & Toscano, 2002). Cognitive maps are used as a tool to evaluate teacher's general conceptions and can then be drawn from any type or questionnaire, although it is facilitated when the questionnaire is designed for this specific purpose (Mellado, Peme-Aranega, Redondo, & Bermejo, 2002). For the purpose of the current study, questions pertaining to 'scientific learning' and 'teaching of sciences' were selected and then used to create a cognitive map of teacher's beliefs. "The representation in a cognitive map gives an overall and unfragmented view of each teacher's conceptions about different aspects of education" (Da-Silva, et al., 2007, p466). The map was further used, along with the interviews, to describe their attitudes and beliefs towards science teaching and learning. The questionnaire was originally in Spanish and an English version was kindly provided by the author of the tool. The French version was translated by the author from the original Spanish version and compared with the English version for reliability. It was also revised with two colleagues to ensure reliability. To complement the maps, a questionnaire assessing teachers' beliefs and acceptance of the evolution theory was also used and rated according to the level of acceptance of the theory. The questionnaire, Measure of Acceptance of the Theory of Evolution (MATE), was developed and validated by American scholars specifically for high school biology teachers (Rutledge & Warden, 1999). It is a five-point Likert-type questionnaire of 20 questions and each answer is associated with a score from 1 to 5 for a total of 100, the highest score representing the highest acceptance of the theory of evolution. The

two questionnaires were analysed concomitantly to give a broad perspective of the teachers' scientific beliefs. The INPECIP questions used to draw the cognitive maps can be found in Table 6.1 and the MATE questions are in Appendix F.

Together, all data from the multiple approaches were triangulated to allow trustworthiness.

6.2 Teachers' Attitude and Beliefs and Continuing Professional Development

To present teachers' attitudes and beliefs, and consistent with the case study approach, individual teacher's views are first described. Cognitive maps were outlined to expose their beliefs on teaching and learning of sciences. The MATE questionnaire was also added to specifically target teachers' beliefs regarding evolution, as it is a conflicting topic for many, especially in South Africa where it was only recently introduced into the curriculum (Dempster & Hugo, 2006). It was therefore considered important to evaluate their preconceived ideas about evolution since in KwaZulu-Natal, a considerable part of the CPTD workshop focused on the subject; it was also the topic of the observed lesson. Teachers' perceptions could therefore potentially bias the result on how the activity impacted on them and on the enactment of the intended change (Kennedy, 2004). Their content knowledge on the topic, also assessed in the questionnaire, is also an important factor affecting their classroom practices. Together, these two questionnaires in conjunction with the interviews were used to gather a comprehensive representation of teachers' perception of sciences teaching and learning. It can thereafter be associated with their general attitude toward CPTD and its perceived impact as well as how they responded to the change being implemented.

6.2.1 Cognitive maps

Porlán and colleagues (Porlán, Rivero, & Martín del Pozo, 1997) proposed that teachers' attitudes and beliefs towards sciences could be placed on a continuum from traditional-transmissive (later referred to as traditional) at one end to innovative-constructivist (later referred to as constructivist) at the other end. The former model is associated with traditional lecturing lessons and the latter is based on learner-centred teaching where teachers contrast learners' preconceived ideas and interests with new information to stimulate their critical learning. For the purpose of this study, the two ends of the continuum have been used as opposing models.

The maps therefore also allow an examination of how much teachers have enacted the change required of them. Indeed, they expose the predominant views of the teacher as either traditional or constructivist, the latter being associated with inquiry-based, learner-centred teaching methods representing the intentions of both reforms in Québec and in South Africa. Therefore, although it cannot be entirely attributed to professional development, teachers' strong constructivist stances on science teaching and learning reflect a higher predisposition to acceptance of the policies. The opposite reflects a lack in information flow and poor professional development that failed to convey the intended policies or to resistant to the intended policies from teachers (Huffman, 2006; Lieberman & Pointer Mace, 2008).

To draw the cognitive maps, a technique similar to that used by Novak and Gowin (1984) was used: each statement of a category—learning or teaching of science— as well as their negations, are assigned to a model—constructivist or traditional. The statements are then linked from the more general to the more particular, forming either the constructivist or traditional maps. Four maps were therefore drawn for each teacher, comprising whether 1- the traditional statements for teaching of science, 2- the constructivist statements for teaching of science or 3- the traditional statements for learning of science, 4- the constructivist statements for learning of science; there is a total of 24 maps. For simplicity and clarity, teacher's maps have been converted to a score representing the total statements in each model—traditional or constructivist; this was performed separately for learning and teaching of science. Four scores are therefore presented for each teacher, reflecting beliefs and attitudes inclined towards the constructivist or traditional model. When relevant to demonstrate a position, particular statements are cited and the final scores are presented in Table 6.2. Originally, each category (learning and teaching of science) contained 14 statements, but two were removed from the category Teaching of Sciences, since the English version was unclear and incorrectly worded compared to the original Spanish version. To increase validity of the questionnaire, statements 6 and 9 were removed; the original questions can be found in Table 6.1. Figure 6.1 and Figure 6.2 are models of a constructivist map where a teacher would have scored entirely in the constructivist model for science learning (14/0) and science teaching (12/0), respectively.

To construct a category's cognitive map, the Likert-type statements are linked together from the more general and inclusive to the more particular. The map was analysed based on the categories used by Da-Silva and colleagues (2007), which separates between the technical-traditional and the innovative-constructivist models. The statements corresponding to the traditional model as well as the negations of the statement corresponding to the constructivist model are then selected and used to construct the traditional cognitive map, similarly to what

was done for concepts by Novak and Gowin (1984). A similar process is used to construct the constructivist model map. Four maps were therefore constructed for each selected teacher, two representing their attitudes toward *science learning*—one traditional and one constructivist, and two representing their attitudes toward *science teaching*. When possible, the same process was applied a year later. When the maps differed after a year, correlation with the perceived influence of the CPTD, as stated by teachers during interviews, storyline, questionnaire, was analysed to allow identification of the source(s) of this change and the possible influence of the professional development activities. This analysis enabled the researcher to validate teachers' perception of a change—or lack of it—in relation to the constructivist model as well as the inquiry-based approach to teaching and learning of science.

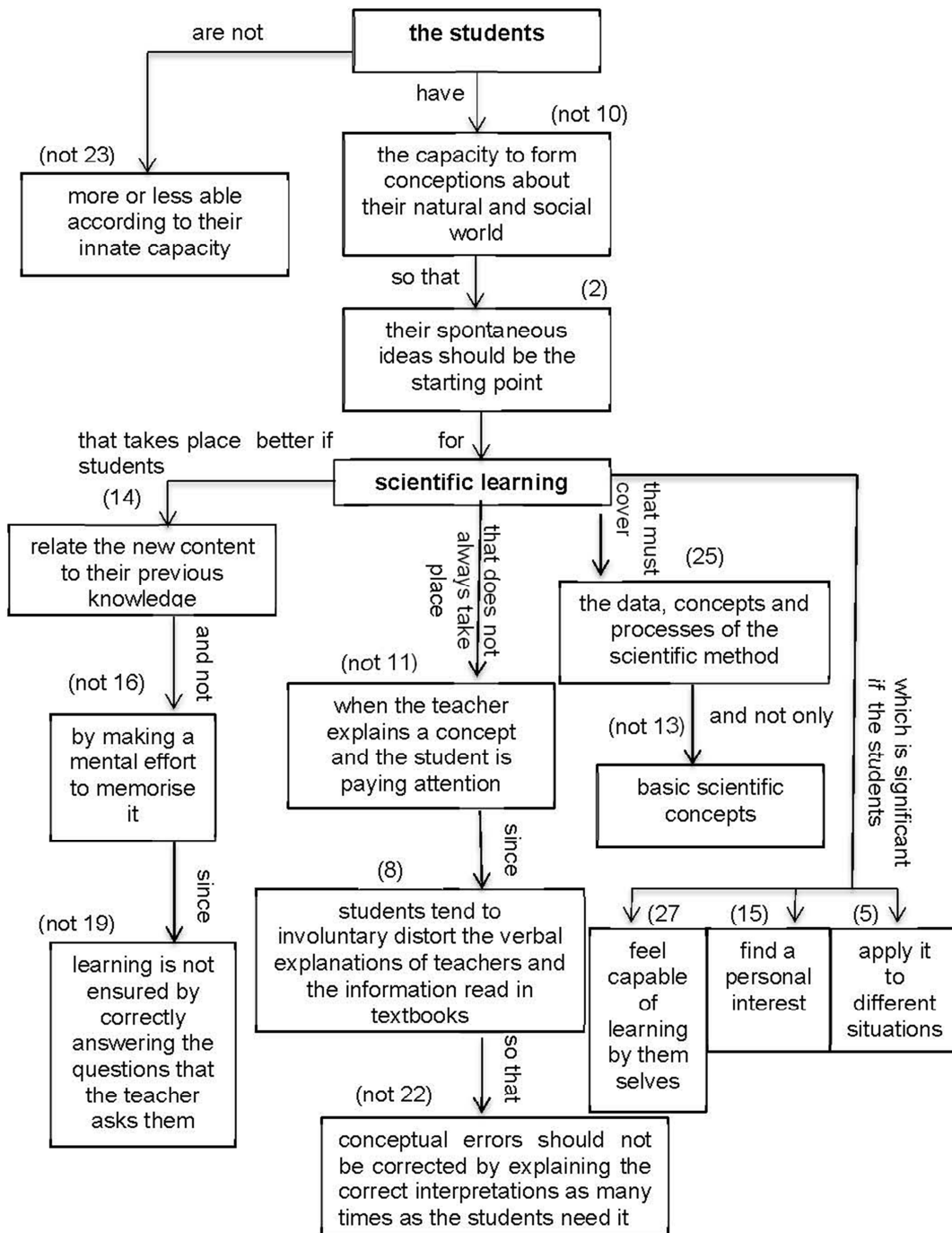


Figure 6.1. Cognitive map representing a constructivist approach to science learning. Adapted from Porlán, 1989.

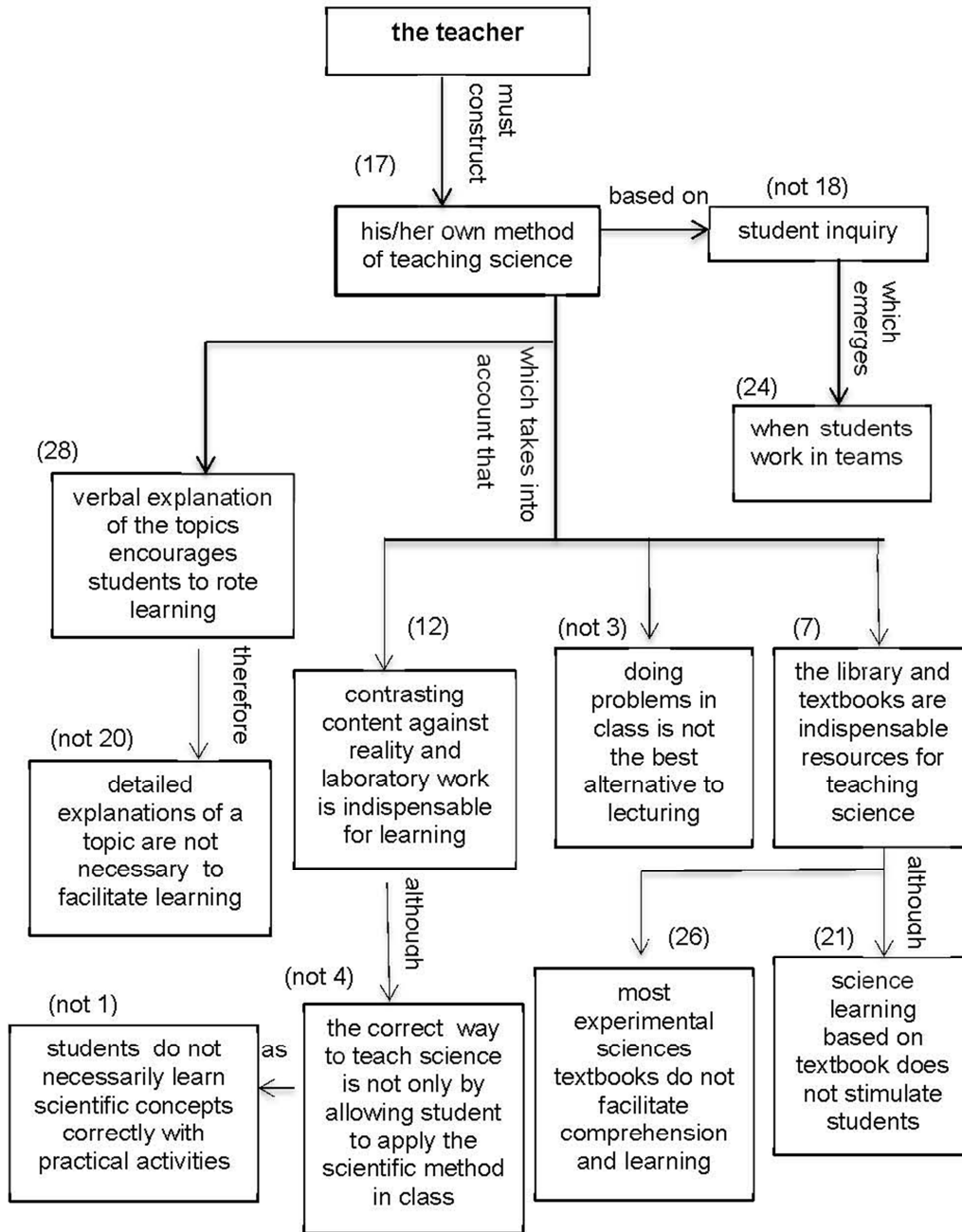


Figure 6.2. Cognitive map representing a constructivist approach to science teaching. Adapted from Porlán, 1989.

Table 6.1. Inventory of Teachers' Pedagogical and Scientific Beliefs (INPECIP) questionnaire with the associated key

1. The students learn scientific concepts correctly when they apply them in practical activities.	Agree __T__ Disagree __C__
2. The spontaneous ideas of students should be the starting point of scientific learning.	Agree __C__ Disagree __T__
3. Problem solving in class is the best alternative to the traditional lecture method of teaching science.	Agree __T__ Disagree __C__
4. The correct way to teach science is only by allowing students to apply the scientific method in the classroom.	Agree __T__ Disagree __C__
5. Learning will be meaningful if the students are capable of applying it to different situations.	Agree __C__ Disagree __T__
6. The teaching method is the way in which the scientific content is presented.	Agree __T__ Disagree __C__
7. The library and textbooks are indispensable resources for teaching science.	Agree __C__ Disagree __T__
8. The students tend to involuntarily distort the verbal explanations of teachers and the information read in textbooks.	Agree __C__ Disagree __T__
9. The teacher must replace the list of topics by a list of key points of interest that cover the same content.	Agree __C__ Disagree __T__
10. By themselves, the students do not spontaneously have the capacity to form conceptions about their natural and social world.	Agree __T__ Disagree __C__
11. A scientific concept is learned when the teacher explains it clearly and the student pays attention.	Agree __T__ Disagree __C__
12. Contrasting with reality and laboratory work is indispensable for scientific learning.	Agree __C__ Disagree __T__
13. The scientific learning that students must undertake in school is all related to basic scientific concepts.	Agree __T__ Disagree __C__
14. Students are better prepared to learn new content if they can relate it to previous knowledge.	Agree __C__ Disagree __T__
15. Scientific learning only occurs when the students find a personal interest in what they are learning.	Agree __C__ Disagree __T__
16. To learn a scientific concept, it is essential that the students make a mental effort to memorize it.	Agree __T__ Disagree __C__
17. Each teacher must construct his or her own method of teaching science.	Agree __C__ Disagree __T__
18. Science teaching methods based on student inquiry do not stimulate the learning of concrete content.	Agree __T__ Disagree __C__
19. Students learn when they can correctly answer the questions asked by teachers.	Agree __T__ Disagree __C__
20. To teach science, it is necessary to explain the topics in details to facilitate learning.	Agree __T__ Disagree __C__
21. Science education based on textbook work does not motivate the students.	Agree __C__ Disagree __T__

22. Conceptual errors should be corrected by explaining the correct interpretation as many times as the students need it.	Agree __T__ Disagree __C__
23. In general, students are more or less able according to their innate capacity.	Agree __T__ Disagree __C__
24. In science classes, it is advisable that the students work in teams.	Agree __C__ Disagree __T__
25. Science learning must not only cover data and concepts, but also the processes of the scientific method (observation, hypothesis, testing, etc.).	Agree __C__ Disagree __T__
26. Most textbooks on Experimental Sciences do not facilitate student understanding and learning.	Agree __C__ Disagree __T__
27. For learning to be meaningful, it is important that the students feel capable of learning by themselves.	Agree __C__ Disagree __T__
28. Science education based on verbal explanation of the topics encourages the students to mechanically memorize the content.	Agree __C__ Disagree __T__

C= constructivist map

T=traditional map

The following statements were used to construct the science teaching map:

1, 3, 4, 7, 12, 17, 18, 20, 21, 24, 26, 28

The following statements were used to construct the science learning map:

2, 5, 8, 10, 11, 13, 14, 15, 16, 19, 22, 23, 25, 27

Note. Questions 6 and 9 were not used for analysis

An example of Danny's Learning of Science and Vuyo's Teaching of Science's cognitive maps can be found in Figures 6.3 to 6.6, while all teachers' maps are presented in Appendix E. Table 6.2 summarizes individual teacher's score on the cognitive maps as well as on the acceptance of evolution, and the following paragraphs detail and discuss the results.

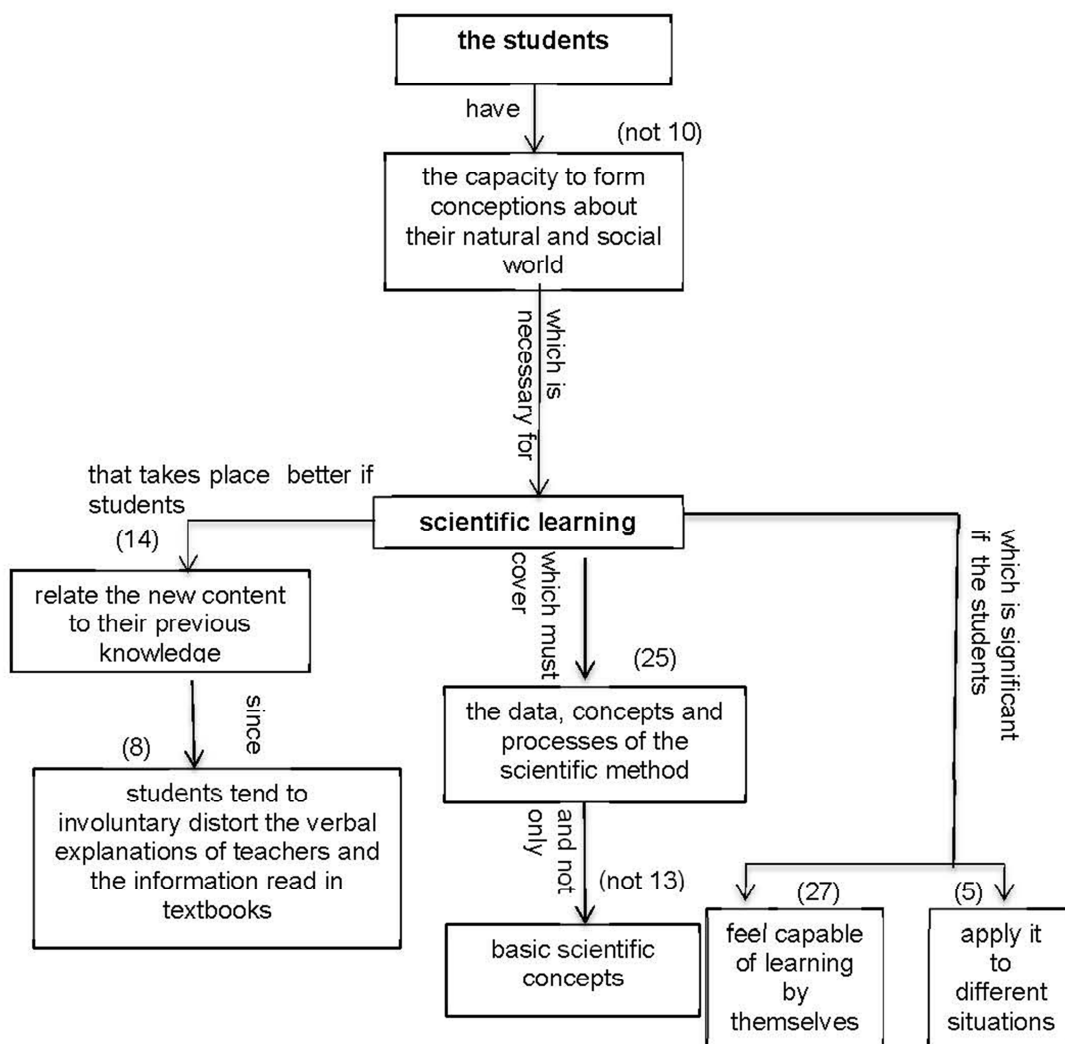


Figure 6.3. Danny's constructivist cognitive map on science learning

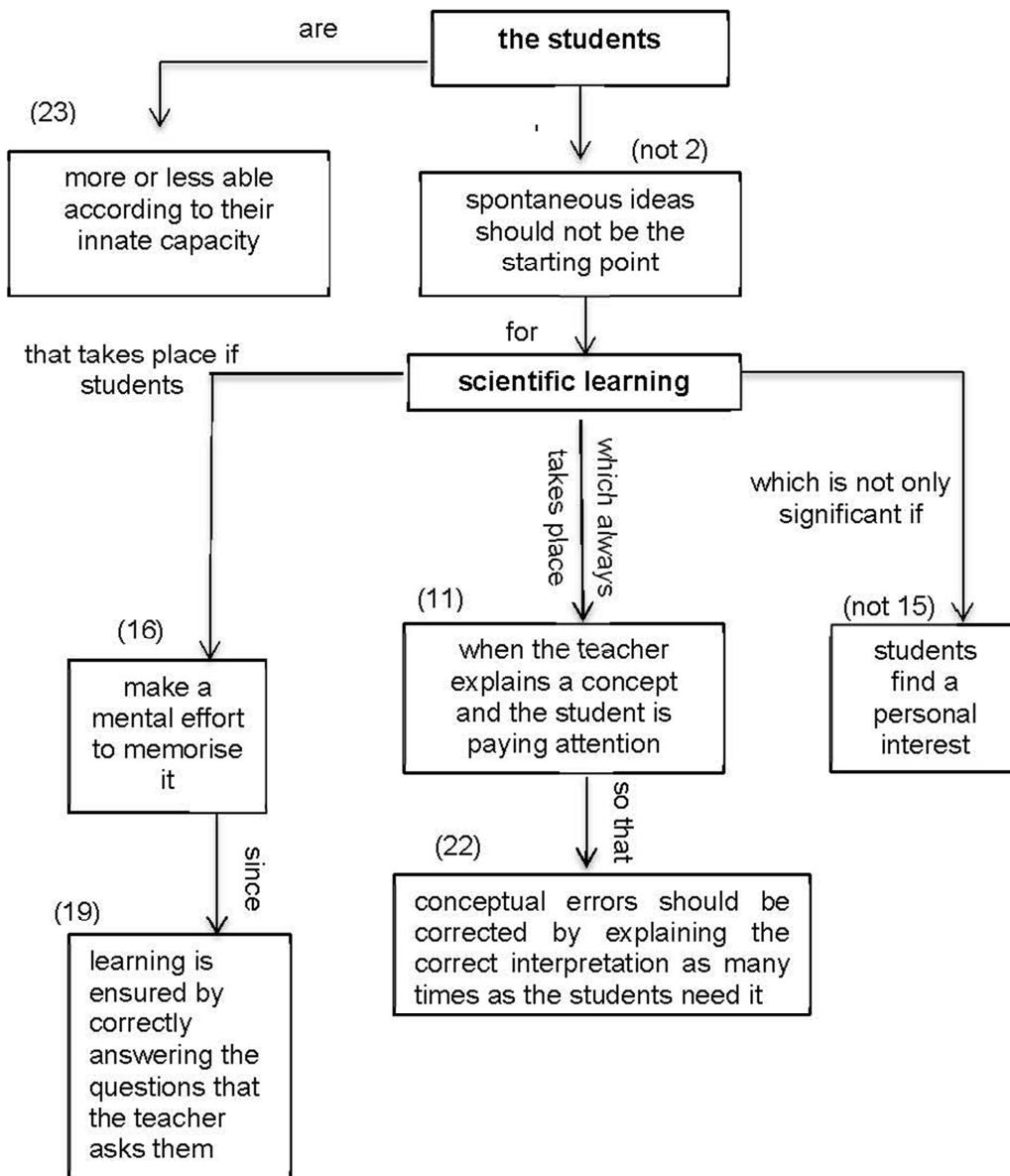


Figure 6.4. Danny's traditional cognitive map on science learning

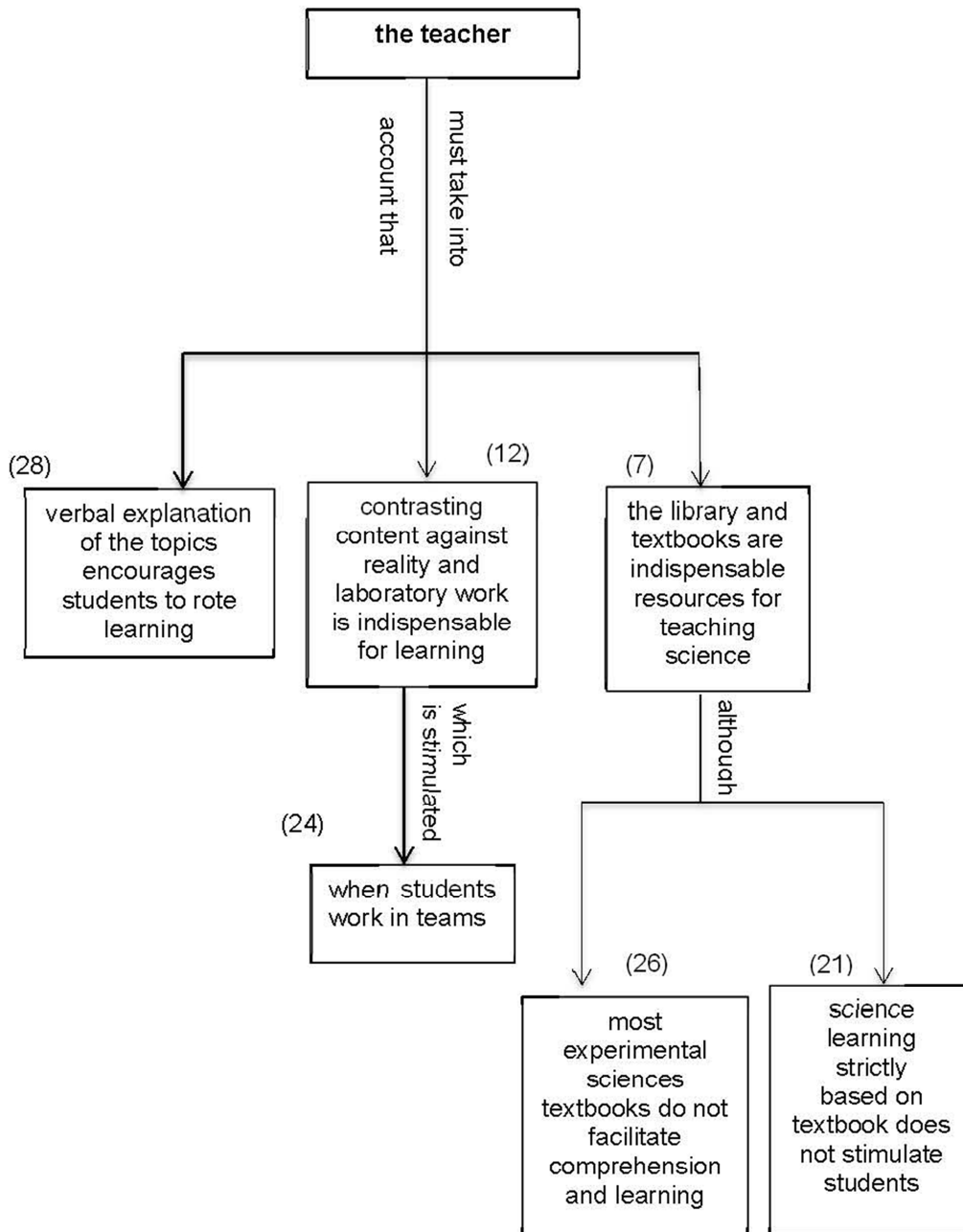


Figure 6.5. Vuyo's constructivist cognitive map on science teaching

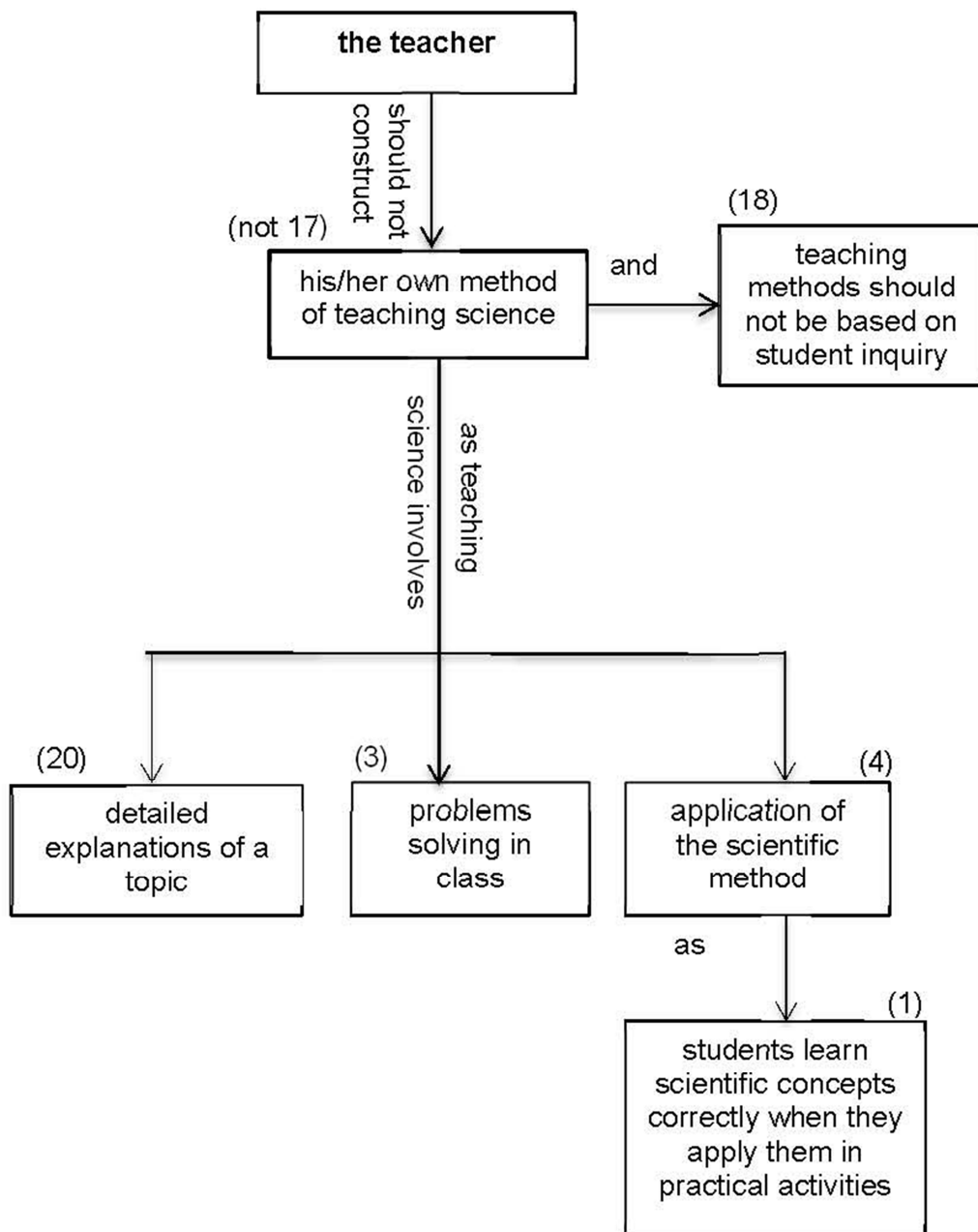


Figure 6.6. Vuyo's traditional cognitive map on science teaching

Table 6.2. Teacher’s scores reflecting their attitudes and beliefs towards science teaching and learning, and evolution.

Teacher	INPECIP score (constructivist/ traditional)		Acceptance of evolution (MATE score /100)
	Learning of science	Teaching of science	
Pirindha	Strong constructivist 11/3	Slightly traditional 5/7	89
Samantha	Slightly constructivist 8/6	Equal 6/6	82
Vuyo	Slightly constructivist 8/6	Equal 6/6	76
Marie-Anne	Constructivist 9/5	Slightly traditional 5/6	41
David	Constructivist 9/5	Slightly traditional 5/7	87
Danny	Equal 7/7	Slightly constructivist 7/5	90

INPECIP: Inventory of Teachers’ Pedagogical and Scientific Beliefs

MATE: Measure of Acceptance of the Theory of Evolution

Pirindha. Her score from the INPECIP questionnaire suggests that she has very strong constructivist views on science learning. Indeed, her answers show that she believes the learners have to actively integrate the content and relate it to their lives, while contrasting it to their previous knowledge. However, it does not translate into her beliefs about science teaching. Indeed, she selected statements revealing that she envisaged learning to occur mostly by listening to the teacher or reading books, following a strict plan. It was confirmed by the discussions with her, which suggested that she is aware of the rationale behind the outcomes-based approach but incapable of translating it in a classroom: “You do tend to fall back on your old methods, lecturing I mean, I know you are not supposed to do it as much but you’ve gotta cover content.” (Personal communication, 2011) She also has a high acceptance level of the theory of evolution.

She pursued a university course to upgrade her qualification when the new government introduced the curriculum. She reported that the course covered the basis of outcomes-based teaching and that it helped her understand how learning occurs according to the underlying constructivist approach. However, she also mentioned being frustrated and less committed now as she would like to “move up”, do something different but not being offered the possibility despite her qualifications and numerous applications. Notwithstanding the fact that teaching was not her first career choice, she reported having developed a liking for the profession.

Samantha. She is slightly inclined towards the constructivist way of learning science and neutral with regards to science teaching. She agreed with most statements encouraging the scientific method and practical activities for science teaching and learning—statements 1, 3 and 4, but did not acknowledge the central place of student inquiry and discussion—10, 18, 20, 23, 24. Interviews revealed rather constructivist views on science teaching and learning, for example as she is saying: “I don’t just concentrate on the lesson at hand. If some kid asks me then we end up going, you know, to that kind of thing. I try to broaden their mind-sets because some kids are very poor, all they know is just Verville Park [name was changed for confidentiality purposes] and their own environment. They don’t really go out as much you know?” (Personal communication, 2011). She also showed very positive views about the new teaching strategies, stating that unconventional teaching gives an advantage to the low achievers as they now have an opportunity to demonstrate their knowledge using different communication means, better adapted to the different types of learning. Her acceptance of evolution score is high although she mentioned during the interviews that it has been hard for her to reconcile her religious views with teaching evolution: “For me evolution was like taboo you know. So much nonsense kind of thing, it was my attitude towards it so I really didn’t bother with it. So to see evolution in a syllabus it’s like oh my god! Now what?” (Personal communication, 2011).

She is enthusiastic and positive in general, and often referred to the lack of resources or poverty in the school area as a challenge to overcome rather than complaining about it. Although teaching was not her first career choice either, she is caring, taking her role from a humane perspective, often saying that she tries to give the kids around an opportunity to do better.

Vuyo. His views on science learning are inclined towards constructivism but he perceives science teaching as less constructivist, since he scored equal points for constructivist and

traditional perceptions. In fact, his cognitive map is very similar to Samantha, differing by only two questions and yielding the same scores. His acceptance of the theory of evolution is moderately high, while slightly less than the other teachers—with the exception of Marie-Anne who does not accept it. During interviews, he pointed that he struggles with the terminology and the new requirements and admitted to ‘teaching to the test’. Indeed, he stated that when using the Department of Education’s guidelines to plan his lessons, he was not teaching what was required, highlighting a misalignment of the assessments with the support documents. He therefore now uses the previous years’ test to scope the depth of a topic to explore with his learners.

He is also a dedicated teacher although he was, in his words, ‘pushed’ into teaching by the Bantu education context. He is now Head of Department, regularly stays after school to give extra lessons and bought a computer and a projector—using his own funding—to use in class. He pursued one year of postgraduate studies before the reform through a Non-governmental Organisation (NGO).

Marie-Anne. Her INPECIP responses also show a stronger commitment to constructivist views with regards to science learning, while slightly inclined towards the traditional views for science learning (one question was left blank). Her interviews suggest strong constructivist opinions on science learning, for example she reported that pupils’ questions are often a trigger for a new class focus, which is typical of constructivist, reformed classrooms. Her acceptance of the evolution theory is very low, as shown by her MATE score of 41, although during her interviews she did not mention any discomfort in teaching it.

From her interviews, it can be inferred that Marie-Anne generally welcomes change and likes new challenges. She worked for one year in what she described as an ‘alternative’ school—open to different approaches and innovative methods—and reported that the different approaches she discovered there, before the reform, were interesting to her. She is the senior Science and Technology teacher in her school (8 teachers in 10 years worked with her), she is seen as the resource person and her colleagues come to her for evaluation and projects,

David. As seen in Table 6.2, David was in agreement with the constructivist way of learning science, although not as much with its implications for teaching science. His INPECIP responses show similar attitudes towards science teaching and learning as Marie-Anne. He was in agreement with the theory that learning of science occurs in a way that has to take into account learners’ background but was not convinced about how to apply it in a classroom.

Rather, he gives indications that he believes in applying the scientific method to teach sciences, which can interfere with a constructivist form of teaching based on learners' preconceived ideas and spontaneity in the classroom. One example from an interview corroborates these findings: "they [the researchers] based it [the programme] on the way we learn [...] But will the way we learn have that much of an influence on how to manage a class or work on a daily basis?" (Personal communication, 2011). Many times during the interview he described constructivist views, even mentioning that his initial training included some of these concepts as well as examples of projects favouring learning based on the constructivist theory—he graduated when the reform was being implemented at the primary level. However, in his words, none of the courses at university was any different from the traditional teaching he was previously exposed to, implying that his initial education was not a learner-centred, constructivist-based environment. He also has a strong commitment to the theory of evolution as shown by his high score in the MATE questionnaire. While responding to the questionnaire, he mentioned that it might have been more relevant to have questions regarding the atomic theory, specifically the string theory, as he pointed out that it is more controversial and therefore more indicative of teachers' beliefs than the theory of evolution. There was no doubt in his mind that critics of evolution were only a small—American—pocket of religious people: "it [the questionnaire] is very American, the whole dichotomy between religion and sciences, or humanity and pure sciences." (Personal communication, 2011).

From a personal point of view, David presents as a confident, organised, involved teacher (he is president of the school teacher's union). Except for the first year of his career, he has always taught at this school and appears proud of it. A feeling of belonging could be sensed during David's interviews, as illustrated by the fact that he answered most questions using the 'we' when discussing teaching strategies and resources, specifically during the storyline method where he seems to associate his progress with the department and school's progress. However, he attaches great importance to his personal life, as shown by the sabbatical year he opted for in 2012 to spend time with his young family.

Danny. His score on science learning shows that he has a mixed attitude about the way science is learnt but a slight tendency towards constructivist views in relation to science teaching, which represents the only constructivist score in the study. These ambiguous findings were somewhat corroborated in the interviews, where he often stipulated that he valued knowledge and rote learning, as long as it enables pupils to gain knowledge in the perspective of applying it in different contexts. He showed some impatience towards people who used the

'competencies' as an excuse for intellectual laziness. His acceptance of evolution is high, which was also confirmed in his interviews.

He is extremely rigorous and is well known in his school for his memory. Although he has only been teaching at the school for 5 years, he is the 'senior' science teacher, pointing out that many teachers at the beginning of their careers are hired on a short term or partial time basis, therefore they teach in different schools and are more likely to quit during a term if they are offered a better position. Consequently, the turnover is very high; Danny reported that four different Life Sciences teachers already left his school that year (in December). He suggested that it reduces the amount of collaboration within the Department. He is dedicated, coaching 'reach for the top' during his lunchtime, a knowledge-based game which many schools practice in friendly tournaments. As the other teachers from Québec, he became a science teacher by choice.

OBE perceptions

To complement the general attitudes and beliefs about science teaching and learning, the opinion of the reform itself is reported here as it can impact on how teachers respond to professional development. A description of the similarities and discrepancies between teachers' perceptions of the outcomes/competency-based education is therefore presented here.

In general, all six teachers showed, after five to six years of implementation, a general understanding of the reform requirements. Some teachers struggled with the terminology, confusing OBE with FET (Further Education and Training, the high school phase in South Africa) for example, but all of them gave indications that they understood at least the minimal theoretical aspects of inquiry orientated, learner centred classrooms. Some of them showed a very good knowledge of the theories supporting the structure of the new curriculum, discussing details of specific mechanisms; for example, Danny questioned the 'learning cycles' as a method of teaching sciences. To the question: 'what is your general opinion of the reform?' they all answered, with more or less convictions, that it had strong theoretical grounds or that it had to be done, or that it was reflecting good intentions. However, all of them also expressed doubts about the feasibility as it was originally designed. "So when the government introduced OBE as a new system of education, I think I was delighted, but I think something, somehow went wrong in now... implementing it" (Vuyo, personal communication, 2011). Teachers mentioned time or logistical constraints as the major barrier to implementing such methods. Danny said the following: "I can't afford to let them waste 25 minutes to try

and find out how the microscope works. So I am still lecturing very much. And sometimes I would like to let them work but I find that they don't work." (Personal communication, 2011). David added: "It's a huge programme that we need to go through in the year and after that, we have a test that comes from the Ministry, we can't neglect it. It's our principal preoccupation to get them ready for that test [...] school is organised by periods, and we need time and in the end, we have to give a grade and with a group of 39 pupils, it's difficult and heavy to manage." (Personal communication, 2011). Pirindha concurs: "Maybe we want to do so much – skills take a long time to develop. You can't do it with a whole lot of content. So, you are in a struggle, you don't know what to do – complete content or teach a skill" (Personal communication, 2011). "That's what I find difficult with the programme, it's to try and integrate these notions [competencies], these activities with the regular practices in the class" (Danny, personal communication, 2011). It shows a conflicting vision of science teaching where the traditional, lecturing mode and the prescribed competencies are separated instead of being integrated. In summary, all six teachers had generally the same attitude towards the reform: welcoming it in theory but without the professional capacity to really engage with it.

During the interviews, many teachers showed signs of irritation about the reform and some stated that they were very pleased with the step back that the government was taking, such as the reduction in the number of outcomes/competencies to evaluate and the greater emphasis on knowledge.

Moreover, there is a general understanding that the reform curriculum, being based on life-competencies, is asking the school and teachers to raise children instead of parents. As expressed by Marie-Anne, "according to me, a part of a child's education happens in school but a large part at home. And this, whatever reform is never going to change it, they can't ask us to do it all." (Personal communication, 2011). This sentiment is obviously widespread as newspapers in Québec and in South Africa have devoted space to discuss the issue, with titles such as 'Don't ask schools to do parents' job' (Bradley, 2011), or 'Don't make your problem mine, Angie tells parents' [referring to South African Basic Education Minister, Angie Motshekga] (Williams, 2012).

The numerous changes in both the content and evaluation has also been mentioned many times by all teachers as an enormous source of confusion and a reason for not engaging more with the reform implementation. It is obviously demotivating to professionally develop when keeping in mind that many of the acquisitions will be modified or removed shortly. Indeed, as discussed earlier, curricular changes have been very frequent in Life Sciences. "They changed

this about two or three times now, I am getting lost with the changes, we don't know the real reason behind this" (Pirindha, personal communication, 2011).

6.2.2 Teachers and CPTD

In this section, each teacher's general perception of CPTD will be discussed. To this end, narrative analysis was first performed to understand the individual culture of teachers (Connelly & Clandinin, 1990). Interviews and storyline extracts were categorised according to the selected Desimone's criteria. A second categorisation was done to reveal individual teachers' perceptions of how CPTD impacted on their practices, PCK and professional capital. The analysis was based on the interviews and the storyline method, which revealed relevant evidence with regards to how teachers perceive CPTD's impact. Indeed, teachers were expressing what they perceived as being the main sources of a change in their practices—when they did perceive a change. Moreover, the researcher's questions focussed interviewee's reflections on the impact of the formal professional development and the resulting free discussions often revealed more than the formal interview questions. Following the individual teachers' perceptions, teachers views on different themes are presented. Some of these themes were focused on the research protocol—such as confidence, and others emerged during the analysis—such as learning and teaching material.

General attitude with regards to Desimone's criteria

Active learning. The data do not suggest that teachers are significantly preoccupied with whether professional development activities orient them toward active learning strategies. Although a key element of the reformed teaching strategy, teachers or subject/pedagogical advisors did not identify this criterion as a gap in the activities attended. Consistently however, the lack of leading information during the first few years of implementation, which led to 'active learning' from the teachers as well as the subject/pedagogical advisors was identified as a major source of confusion. Indeed, the cascade model lead to discrepancies in the interpretation of the requirements, as the information was transmitted from one another or acquired through various sources.

Coherence. Teachers' perceptions of how much professional development is coherent to the reform being implemented as well as to their classroom varies considerably among teachers. Although two of the three teachers in Québec did complain about how workshops can become

'airy fairy' or used for 'personal therapies', they all said that it eventually becomes useful when they get material or ideas for activities to use with their pupils. In KZN, all the teachers mentioned either the inadequacy of the workshop or of the material. For example, during the workshop observed, one of the activities was to produce, in groups, a weekly plan for a particular topic; all the groups' plans should have been collected by the subject advisors and sent back to other teachers for them to use as a reference to make their yearly plans. None of the three teachers had their plans returned to them at the time of the second interview, a few weeks later. However, they all mentioned that the workshop gives good guidelines and keeps them up-to-date with the changes being implemented by the Department of Education. Although these changes could be distributed as paper 'circulars' during the year, it does, as Pirindha says, 'give you a guideline and you need to be guided. As much as people like to do their own thing and like to interpret it but if you are given a guideline then you know where you are heading. And I always believed that if you know where you are going you go there quickly enough'. The data clearly shows that the three Québec teachers were inclined to find professional development activities more coherent with their classroom activities whereas the three KZN teachers were finding it more coherent with the reform policies being implemented.

Collective participation. None of the teachers from Québec were participating in formal communities of practice at the time of the research, although all of them reported having the opportunity to exchange with other teachers. However, both Marie-Anne and Danny attended, during the first few years of the reform implementation, a university-organised professional development activity called Partnership for Education Renewal of Science and Technology of the island of Montreal—Partenariat pour le Renouveau de l'Enseignement de la Science et de la Technologie de l'île de Montréal (PRESTIM, 2012). The professional development activities are learning communities that meet in groups of around 15, four to five times a year and are held during school days. The two teachers who attended reported having benefited from these meetings more than any professional development. Different themes are offered although both of the selected teachers chose Technology, due to their lack of knowledge, training and confidence in teaching this subject. Danny talked about it in the following terms: "[...] pool the resources together to provide training in Technology especially for Science teachers and this was essential. Because personally, a band saw I had never used that in my life, I do not have access to a band saw at home (laughs)! So it was so very helpful. When I do it with the kids now, you know, I am still not thrilled to do it, but I am more qualified than I was. I, personally, am more competent". Therefore, the collective participation aspect was of particular interest to these teachers. Marie-Anne reported that meeting other teachers with similar difficulties helped her, whereas Danny emphasised the important tools and experience

acquired, which give him confidence to teach a subject with which he was not familiar. In KZN, where both Samantha and Vuyo participate in formal 'cluster groups' they were not particularly appreciative of their communities of practice: "Frankly speaking, we do not discuss much about the subject matter [...] So, in the cluster situation we discuss mainly the tasks that we are to give to the learners". (Vuyo, personal communication, 2011). Pirindha, during an informal discussion, mentioned that she once participated in a cluster group but found that too many teachers come to benefit from 'free' material. She reported favouring discussions with her sister, also a Life Sciences teacher, to help her with difficulties.

In all situations, time was mentioned as a barrier to discuss and collaborate with colleagues. To the question: 'Do you discuss issues, content or pedagogy with your colleagues?' all teachers replied that they don't really have time to discuss non-logistical issues. They exchange evaluation material but do not discuss content or pedagogy. Some teachers in the same school use the same 'hands-on' activity in class, in which case they discuss the logistics of sharing material and therefore plan a specific project together. David also mentioned working very closely with another teacher, but always keeping clear that each teacher works differently and therefore extensive collaboration is limited. "Teachers are individualistic" concludes Danny (personal communication, 2011).

Content focus. It was clear from all teachers that their perception of the impact of any professional development activities was strongly influenced by whether they were provided with information about content, or pedagogical content knowledge. The strongest emphasis was on teaching material, which will be discussed as a separate category later. The science programme in Québec, designed and based on 'learning and assessment situations' (situations d'apprentissage et d'évaluation, SAE), focuses teachers' attention toward access to material providing resources that they can use in class. In KZN, teachers are really concerned about getting information on relevant content, and mostly regarding the 'matric' exam at the end of grade 12: "I may teach a concept and when an external exam comes, when something comes, there is something that the examiner touches that I may not have emphasized in my class." (Vuyo, personal communication, 2011).

Duration. Although some workshops are offered throughout the year, the three KZN teachers attended only the annual workshop and were dissatisfied with it, claiming that it was not sufficient to cope with the largescale change: "Initially we had to attend a workshop during the school holidays but it was like a week, in holidays. But the workshops following that one,

we had to attend like a day workshop or two days workshops something like that. Which was like... I don't know whether it was sufficient" (Vuyo, personal communication, 2011). The three South African teachers very often pointed out the lack of continuity and follow-up as a key barrier to the coherence of professional development. They frequently stated that guidelines were given during the yearly workshops but complained that it did not allow for long-term support.

The same situation applies in Québec, even if schools have at least one pedagogical day per month, the lack of continuity between them does not allow for a follow-up. Although the three schools visited do not allow general conclusions, it is clear that the three selected teachers did not perceive these days as professional development days, and rather refer to out-of-school activities when reflecting on their professional development. Most of the other activities referred to are also one-time workshops without follow-up. However, the PRESTIM communities mentioned earlier were on-going, and the fact that teachers reported such an impact from them is also indicative of the influence that duration can have on the professional development activities.

Individual teachers' perception of professional development and of the impact on their practices

Pirindha. She was positive towards the annual workshops in her first interview answers, however the various methods used as well as the building of a 'confidence relationship' throughout the study revealed that she could not really pinpoint or state any positive aspects or perceive a change in her practice due to the workshops themselves. As seen earlier, she observed that the workshops give information about the new policies, but later stated that: "The workshop didn't influence my teaching, it just confirmed that what I was doing is right." However, from the storyline, she stated that a workshop on evolution, organized by a school in the north of Durban, really helped her: "She did a beautiful presentation on evolution so it actually gave us visual linkages and we could put that together". She also states Internet and books as a source of improvement: "I was getting there, to very good or good [pointing at the storyline graph] because I am making very [*sic*] use of the Internet. [...] You get most of it on the net so you're going to rely most on that but I like the books, and I like the children's books because they explain it in a very simple way so you just get it like that". (Personal communication, 2011). As the other teachers expressed, she says that students' responses in class are an important factor for change in practices, indicating that to reach the learners in this day and age, you have to use material and methods that are active, such as Powerpoint

presentations. Overall, it is clear that she prefers to seek information on her own as opposed to sitting in a workshop for two days where she feels the information is not always relevant to her classroom activities.

Samantha. Samantha's first answers indicate that her perceptions of CPTD were generally positive, more than the other two KZN teachers. She was happy with the format of the workshop, and says that "some things that you learn from there you come back and you implement". She is also very positive about the community of practice and referred to it in these terms: "I guess it depends on you as an individual. You can either get a lot from it or you can either get nothing from it." (Personal communication, 2011). However, when asked about how it could influence her classroom practices, she specifies that what is taught can't really be applied in her school for different reasons, one being the short, once-a-year aspect of the workshop, or the lack of teaching material and resources etc. When reflecting on interventions that could affect her practices, she directed the conversation towards the interventions from the provincial Department of Education targeting underperforming schools. She emphasised the distribution of teaching and learning materials as having a key influence on teaching and learning. This was also confirmed by her questionnaire responses, where she says that in the workshop, information about the curriculum was sufficient but teaching methods or classroom practices were not addressed. Initially, she appeared enthusiastic overall about the CPTD attended at first, but the different methods of investigation allowed me to discover that she did not perceive the workshops as being able to change her teaching methods or attitude.

Vuyo. Vuyo attends the annual workshop with indifference, and does not perceive it as having any impact on his teaching practices. "Frankly speaking not much [influence]. The persons presenting... I don't know how they are choosing. They select whatever they want to do all day. We do not normally have these workshops, how do we call them, the informative, instructive kind of workshops". (Personal communication, 2011). Being the Head of Department, he receives the Department of Education's documents directly and in his words, does not get more from the workshop than he could get by only reading them. He says it lacks pertinence, as it is not based on teachers' needs. The storyline reveals that he perceives his professional capacity as increasing over the years and even foresees an improvement in the future. The only time where he mentions professional development as a source of this improvement is a workshop on evolution he attended during the first years of implementation. He said it helped him understanding the subject content, although it was only a once-off workshop and he would have liked a follow-up. The students' questions and experience are

his first motivation to seek information, which comes mainly from Internet: “Internet number one. The second thing that helped me a lot was the department gave this three-in-one kind of study guide. With the content, questions and answers, so I had a bulk of those books to give to my learners. Also [...] because our school was kind of an underperforming school so the Department gave us a lot of Life Sciences study books they gave me a number of these, and they gave me DVDs”. (Personal communication, 2011). Overall, he sees himself as better equipped for teaching the reformed curriculum, but does not see professional development as a source of improvement.

Marie-Anne. Regarding teaching methods and pedagogy, she often said that it all depends on her ‘style and personality’. She frequently pointed out that her teaching practices are not influenced by any professional development or readings but by her personality and students’ responses to different strategies. However, she also claimed that some professional development activities she attended could influence her practices in class, as they provided ideas of learning and assessment situations (SAE) to use with her pupils. During the few years following the reform implementation, she was a ‘subject respondent’ in her school, someone attending most of the training offered by the school board to inform her colleagues about the requirements. However, she mentioned that the authority of the ‘position’ was limited and her colleagues were in a situation where they could voluntarily come to her for information. She reported that some of them never did so. She therefore pointed out that CPTD was targeting teachers that are motivated and already seek information from different sources. She does not feel that the school community brings her much professional development. She often attends CPTD activities outside her school and related that her students once asked if she was sick due to the numerous days absent from her classroom. She reported that being up to date with the latest science discovery and also the contact with a scientific teaching community were the main motivating factors for her to attend. She is overall relatively positive about how CPTD can impact her classroom practices, although sceptical about how many teachers it does reach.

David. David is cynical about how much CPTD can affect his practices, and even less his attitudes and beliefs. However, he uses material from different CPTD activities for his teaching. He mentions that he may be starting a Facebook page for a project in class, which is directly linked with the IT focus of the professional development observed. He also applies different projects in class that are inspired from colleagues having attended different professional development, such as building a speakerphone, which is a project aligned with the reform as it integrates different subjects such as technology, biology and physics. In the storyline, he also mentioned a specific CPTD activity about technical drawing that helped him

in class with a subject he was not familiar or comfortable with at the beginning of the implementation. However, he did not report, when specifically asked, that professional development has had a major impact on his practices and pedagogy. He rather mentioned experience and students' reactions as the major factor influencing on his practices.

Danny. He is very selective about the professional development activities as he reported having attended many irrelevant ones. However, he claims that the relevant ones empowered him. The activities he considers relevant are the ones that help him with particular subject content where he considered his competency insufficient. He insisted that content knowledge was of particular importance to him and that relevant professional development activities can provide it, specifically when targeted on new topics. He mentioned that he attended a few interesting activities during the first few years of the reform implementation but not in the last two years. Lack of time and better understanding of the new topics made him feel that it was not as necessary. He expressed doubts about how it can influence his attitudes and beliefs about science and science teaching, but rather pointed to the students' reactions and classroom experience as the central instrument of profound change.

Experience, confidence and CPTD

The themes of experience and confidence appeared frequently in the course of the interviews and most of all during the storyline. The storyline graphs of all teachers improved to reach four or five (minimum of one: insufficient; maximum of five: good), except Samantha's graph that reached 3. During the process, all teachers mentioned confidence linked to experience as a major source of progress in their teaching. Danny and Marie-Anne added that a particular professional development activity (PRESTIM) played a central role in enhancing their confidence in teaching Technology, but they also mentioned that the students' reactions and questions to their teaching were the main drivers for changing practices. Indeed, they reported that experience is key in gaining enough confidence to try new strategies and to allow learners more participation during lessons. Questions can be a source of pressure and anxiety when teaching new content but it also, with repetition, gives the necessary confidence to engage in discussions with the learners in subsequent years. Confidence is built after "trying and breaking your neck; then you get up and get it right next time" (Danny, personal communication, 2011). In relation to the confidence and relationship with pupils, a related theme emerged which a teacher called: 'taking classes up' (teaching the same students for two or three years). Four teachers mentioned this practice as having a positive impact on how they teach. They stated that the building of a relationship with students enables teachers to adapt to

the students' learning styles; the other two teachers implicitly refereed to the practice by saying that knowing the students and how they think is very valuable and improve teaching and learning. The following quotes exemplify the evidence:

“In our schools, we take our classes up. So what you start doing, what ideas you have for the children you can then do it over three years. And it makes such a difference because your teaching style, their learning style, you are familiar with. You know what you have covered you know what you need to work on in your children and then it just goes on from there.” (Pirindha, personal communication, 2011).

“Yes, yes, yes, definitely [it makes a difference]. I know them, we know each other, I mean, I can anticipate them!” (David, personal communication, 2011).

“And you know another factor, my last year's learners, I have been growing up with them as from grade 10. I started teaching them grade 10, went with them to grade 11 and then to grade 12. They understood me well and I understood them well. [...] But with this class, one of the reason I gave that [referring to an increment in the storyline graph] is that I have been with them for the past three years. Maybe that's why, that could be another factor to perform very well” (Vuyo, personal communication, 2011).

It is therefore evident that teachers reported having gained most of their confidence from the school organisation and the experience, rather than with the help of the official documents or professional development activities.

Additionally, teachers' storyline revealed that in the first year of implementation, only Pirindha and David considered they were sufficiently competent (3 on the scale) to teach the new curriculum, the four other teachers situated themselves between one and two on the scale (1=insufficient, 3=sufficient, 5=good). They reported that this situation brought a lack of confidence and a decrease in their teaching performances. They all stated that the information provided at that time, either through the documents or professional development, was inadequate.

Teaching and learning support material related to assessments

Answering the question about how professional development can influence their classroom practices, teachers have mainly focused on issues about how to translate the learning in their

classrooms, ideas for project or hands on activities, as well as material that they can use. The following answers exemplify the situation:

“It depends on what equipment and what materials I would have to supplement my teaching in my class. You know when you go to the workshop it is all idealistic and when you come to the class it is real. So then you make do.” (Pirindha)

“It is often resources that are interesting, but the workshop needs to be relevant.” (Danny)

“Yes, yes, definitely, if it is interesting. We have assisted to training on technical drawings that we apply directly in class.” (David)

“Ja I think they do have an influence [...] Once we did a DNA extraction using wheat and I have done it successfully over the couple of years because that one is pretty simple you know.” (Samantha)

It was also found that all the teachers use textbooks and/or the teachers' guide that usually accompanies the learners' textbooks to plan their lesson. In Quebec, electronic resources are usually provided with the manuals, which teachers use in class. In KZN, it is rather the Internet that provides the electronic material, which is not written specifically for South African schools. Textbooks are also frequently accompanied by assessment examples that teachers use as a guide for what to teach, and to what extent. Some teachers also reported having used the Internet to find assessment questions. Hence, the bulk of the information transmitted to learners in the case of the six teachers observed came from the textbooks, complemented by Internet.

6.2.3 Evolution of teachers' attitude and beliefs

To evaluate how teachers' attitudes and beliefs evolve over time, the INPECIP questionnaire was also distributed one to two years later to the available teachers (David was on sabbatical and Samantha could not be reached). Results are presented in Table 6.3. Three out of four teachers only differed by two statements, one of which was common to all three: “Each teacher must construct his or her own method of teaching science.” (statement 17). They are now in agreement, which shows in the constructivist map for science teaching. For the fourth teacher, Marie-Anne, although the scores did not indicate much change in terms of her general views,

nine statements were modified, in both categories of science teaching and science learning. Interestingly, two of these modified statements refer to the use of textbooks (7 and 21) where she now rejects how they can be useful. Three of the four teachers were slightly more constructivist regarding science teaching than the previous years, but Danny was more traditional.

Table 6.3. Teacher's evolution of attitudes and beliefs towards science teaching and learning.

Teacher	INPECIP score (constructivist/ traditional)		INPECIP score 1-2years later (constructivist/ traditional)	
	Learning of science	Teaching of science	Learning of science	Teaching of science
Pirindha	Strong constructivist 11/3	Slightly traditional 5/7	Strong constructivist 10/4	Equal 6/6
Vuyo	Slightly constructivist 8/6	Equal 6/6	Equal 7/7	Slightly constructivist 7/5
Marie-Anne	Constructivist 9/5	Slightly traditional 5/6	Constructivist 9/5	Slightly constructivist 6/5
Danny	Equal 7/7	Slightly constructivist 7/5	Equal 7/7	Slightly traditional 5/7

Data from table 6.3 shows that evolution of teachers' attitudes and beliefs have not significantly changed in one or two years. It is a relatively short period of time to enable to infer on the impact-or lack of impact- of professional development but nevertheless adds to the general portrait that teachers have not been influenced greatly neither by their environment or by any workshops or activities.

Overall the data presented here show that teachers' beliefs on science learning are not in total accordance with how they perceive science should be taught in class. Indeed, interestingly the six teachers show science learning views that are more constructivist compared to how they see science teaching. There was no clear difference between teachers from KZN as compared to teachers in Québec. The similarity in the data regarding their attitudes and beliefs does not allow to infer whether it impacts on how they perceive CPTD. However, the Quebec's teachers tend to show more positivism toward the professional development activities, which

have been found to be more in line with how they believe science learning occurs. The correlation between their beliefs and their classroom practices are explored in the next chapter and further discussed at the end.

Chapter 7. Enacted policies: teachers' practices

7.1 Teachers' practice

To complement the analysis of the teachers' perceptions of CPTD, classroom activities were also explored using the Reform Teaching Observation Protocol (RTOP). The analysis allows a deeper understanding of how the professional development activities, analysed with the same tool in the other chapters, can influence teachers' practices. The intended goal here is not to make a rigid generalisation of a causal relationship. Rather, it is to supplement the analysis and validate teachers' perceptions of the change they have already incorporated in their practices and deepen the understanding of how CPTD can influence their practices.

As mentioned, teachers were asked to select a lesson relevant to the CPTD observed, as well as representative of their teaching for observation. Each teacher's lesson was rated according to the same criteria as the professional development, using the RTOP scores. Detailed scores of teachers' lesson are presented in Table 7.1, while a summary of the RTOP scores can be found in Table 7.2. A qualitative description of the lesson and classroom environment is then presented for each teacher, followed by the RTOP analysis.

Table 7.1. Detailed Reform Teaching Observation Protocol (RTOP) scores for all teachers' observed lessons.

Item	Pirindhya	Samantha	Vuyo	Marie-Anne	David	Danny
1. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	3	4	4	4	4	3
2. The lesson was designed to engage students as members of a learning community.	2	2	3	3	3	2
3. In this lesson, student exploration preceded formal presentation.	0	1	0	1	3	1
4. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	0	0	2	1	3	1
5. The focus and direction of the lesson was often determined by ideas originating with students.	0	0	0	2	2	2
Lesson Design and Implementation	5	7	9	11	15	9
6. The lesson involved fundamental concepts of the subject.	4	4	4	4	3	4
7. The lesson promoted strongly coherent conceptual understanding.	3	3	3	3	3	3
8. The teacher had a solid grasp of the subject matter content inherent in the lesson.	3	3	3	3	4	4
9. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	1	2	2	2	4	3
10. Connections with other content disciplines and/or real world phenomena were explored and valued.	1	3	2	3	3	3
Content: Propositional knowledge	12	15	14	15	17	17
11. Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent phenomena.	1	1	1	1	3	1
12. Students made predictions, estimations and/or hypotheses and devised means for testing them.	0	1	1	2	3	2
13. Students were actively engaged in thought-provoking activity that often involved the critical assessment of procedures.	0	1	2	2	2	2

14. Students were reflective about their learning.	1	1	2	2	2	2
15. Intellectual rigor, constructive criticism, and the challenging of ideas were valued.	1	1	2	3	3	4
Content: Procedural knowledge	3	5	8	10	13	11
16. Students were involved in the communication of their ideas to others using a variety of means and media.	0	0	0	1	1	1
17. The teacher's questions triggered divergent modes of thinking.	1	2	1	2	2	2
18. There was a high proportion of student talk and a significant amount of it occurred between and among students.	0	1	1	1	3	2
19. Student questions and comments often determined the focus and direction of classroom discourse.	0	0	0	3	2	3
20. There was a climate of respect for what others had to say.	3	3	3	3	3	2
Classroom culture: communicative interactions	4	6	5	10	11	10
21. Active participation of students was encouraged and valued.	1	2	2	3	3	3
22. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	1	2	2	3	2	3
23. In general the teacher was patient with students.	4	4	4	4	4	2
24. The teacher acted as a resource person, working to support and enhance student investigations.	1	2	3	3	3	3
25. The metaphor "teacher as listener" was very characteristic of this classroom.	1	1	2	3	3	3
Classroom culture: student/teacher relationships	8	11	13	16	15	14
TOTAL	37	44	49	62	71	61

Pirindha. During the entire lesson on molecular studies and evolution, learners were very attentive, responding quietly to questions that the teacher asked every time she explained a new concept. The questions asked were not open, thought-provoking questions but rather 'filling the blank' type, using the cloze procedure (Taylor, 1953). For example, she would say: "Because these giraffes had access to more resources, they were able to...." and waited for the learners to answer: 'reproduce'. Discipline was not an issue during the lesson, where Pirindha talked the entire time, using a worksheet and PowerPoint presentation. The learners had the worksheet in hand and some of them were taking notes on it. Neither the worksheet nor the PowerPoint presentation were using specific material distributed during the workshop,

although the topic was relevant to the observed lesson hence could have been inspired by it. However, Pirindha reported that she did not use notes from the workshop for the worksheet but rather information from books and Internet, which she found more complete.

Her classroom is vast and adequate for the number of learners. The school facilities are extensive and well kept, with toilets and a library with a computer for the teachers. There is a large sports ground but Pirindha reported that they do not use it very often. Situated in what used to be an Indian suburb, learners in the classroom were all of Indian origin. Although Pirindha reported that the school is composed of learners from a diversity of ethnic origins, the majority of learners are Indian-South-African. Historically, most of the Indians of South Africa came as indentured labourers to work on the sugar plantations at the end of the 19th century. Once they had served their time, they left the farms and moved to the cities. It is a tight-knit community, the smallest ethnic group in South Africa and, as it is the case for the Black community, most of what used to be Indian suburbs during the Apartheid era remained mainly inhabited by South Africans of Indian origin (Indian Diaspora, 2000).

The lesson RTOP score was 32, out of a possible 100. The strengths of the lessons were the fundamental concepts presented in the lesson and how well she mastered it, as well as her patience with students, which gave her higher scores for propositional knowledge and student/teacher relationships. The weaknesses were the strict plan she adhered to, without giving opportunities to learners to contribute to the lesson, nor to discuss with each other or with the group. Also, the topic was presented in such a way it did not promote alternative or critical thinking. The latter resulted in low scores for procedural knowledge and communication in the classroom.

Samantha. The lesson focused on the presentation of evidence of evolution, and learners were also well behaved and attentive. Samantha asked many questions although only a few learners answered. Towards the end of the lesson, she read aloud an activity given to the learners as homework, giving them hints on what the answers might be. She referred to real life phenomena such as a recent tsunami in Japan to exemplify some concepts that she presented in a lively manner, stimulating learners' interest. The topic was presented very differently from how it had been introduced in the workshop and the hand-out distributed to the learners was not similar to the workshop material. She indeed confirmed that although the workshop could have helped her grasping the concepts presented in the lesson, she did not use the material distributed as it was not 'for her learners'.

The school facilities were in functioning order with running water and electricity and teachers have access to one computer. The school serves a poor area, surrounded by small houses and shacks. Samantha mentioned that she often teach up to 50 learners in her class, all of them black African.

The RTOP score of the lesson was 44 out of 100, with the main strengths being the fundamental concepts involved as well as the acknowledgement of learners' preconceptions when teaching. The weaknesses are also the lack of involvement of learners in the course of the lesson. As with Pirindha, her lowest scores pertain to the procedural knowledge and communicative interactions whereas her strengths lies in propositional knowledge as well as teacher/student relationship.

Vuyo. The observed lesson was offered as a remedial after-hour class to cover topics left out during regular hours, due to time constrains and cancelled school days. He practiced what is referred to in South Africa as 'code switching', meaning that he was teaching in English but also used Zulu words to clarify concepts, although the adequate biological English vocabulary was emphasised. He used a very active tone and often asked the class to complete his sentences, answered in chorus by many students. He used many examples that were adapted to the learners' culture, interests and daily lives, using for example siblings' skin colour in the class to demonstrate gene dominance. He was helped by a PowerPoint presentation for which most of the material was taken, as he reported, from the Internet. However, he presented similar examples as the ones from the workshop, although he did not use the same images and reported that the material he used was more relevant than the one offered at the workshop.

The school facilities were well kept, with running water and electricity and a small yard for sport activities. There was no library but Vuyo reported that there is one 'around the corner' where teachers occasionally take the learners, although he never personally went with the learners. The school, being located in what is referred as an 'informal settlement' serves learners from many areas who live here for week days, mostly in small shacks, following their family working in town. Vuyo mentioned that children are often absent from school, having to travel to their homes for various reasons. Learners are black Africans.

The lesson's RTOP score was 49, with the main strengths being the consideration of learners' prior knowledge, the climate of respect and the fundamental concepts covered, which also resulted in high scores for propositional knowledge and teacher/student relationships. Its weaknesses were also principally the strong lecturing mode with very little space for learners'

discussion or leading the lesson, although Vuyo challenged his students and engaged more in critical thinking with them, which resulted in slightly higher score for procedural knowledge compared to his South African colleagues.

Marie-Anne. The lesson focused on the molecules of life and although Marie-Anne was lecturing with the help of PowerPoint, she was more guided by pupils' questions and, within the theme of the lesson, would add information based on their comments. During the lesson, they were given an exercise from their workbook where they had to individually fill in words or draw molecules, and a homework task was also given for the next day, as well as a short discussion of a science project where pupils had to choose their own topic.

She works in a public school in a rather wealthy neighbourhood. She teaches in a programme particular to the school—language, literature and sciences—for which parents pay extra money for specific projects and pedagogical outings. However, Marie-Anne reported having some pupils that come from very modest backgrounds in her regular program's classes. The facility is rather old but very functional, with a library and sports facilities.

The lesson's RTOP score was 62, with strengths also being associated with the fundamental concepts covered as well as the patience and the respect for pupil's previous knowledge. The weaknesses were also similar to what were observed in the other classrooms: limited pupils' exploration, discussion and general communication. Although her general scores were higher than her South African colleagues, the relative scores between propositional and procedural knowledge is constant, with propositional knowledge higher than the procedural.

Danny. His lesson was also in the lecture format on the topic of electric and electromagnetic waves, using the blackboard for illustrations. He was following his lesson plan that was based on the textbook's 'fiches'—units associated with a topic. These fiches, in addition to the pupils' questions, often lead to many 'real life' situations, for example how the microwave warms the food, infrared cameras, radio-therapy for cancer etc. Pupils were slightly more disruptive than those from other classes observed, and Danny had to spend time restoring order on a few occasions.

The school facilities are vast and in good state, with a library and sport facilities. It serves a population that is much less wealthy than the other two schools visited in Québec, with a high proportion of immigrants and low-income families.

The RTOP score of the lesson was 61, with its strengths associated with the fundamental subject content, the teacher's grasp of it as well as the scientific intellectual rigour transmitted during the lesson. Students' exploration and investigation as well as a lack of communication amongst them were the weak points. Once again, student/teacher relationship and propositional knowledge score high while procedural knowledge and communicative interactions are low.

David. His lesson focused on magnetism and began with the collective correction of the homework given the previous day. The exercises given were taken from the pupil's workbook and during the lesson David referred to their textbook and used images drawn from it. He was using PowerPoint, the blackboard and also presented a demonstration using an overhead projector, with an electric wire and a compass. The lesson ended with homework that they started in class, where exchange with other students or with the teacher was possible.

Working in a private school, David's working environment is slightly different than the other schools visited. Students have more resources and most of all, teachers' conditions being slightly better than in public schools, the school can select from a wider group of candidates. However, class size is similar to the other schools visited, with classrooms between 25 to 40 students, with no dedicated facilities for laboratories. The facility is an ancient (for Quebec's standards) building, renovated and rather well kept, although teachers reported that some classrooms were cold in winter and had some leaks. There is a library and sport facilities.

The RTOP score of the lesson was the highest of all, 71. The teacher's solid grasp of the subject and his patience in teaching it also respected student's prior knowledge and encouraged diverse representations of phenomena under investigation. The most negative point was the lack of different communication means offered to the pupils, which resulted once again in low procedural knowledge and communication in the classroom.

The tables below summarize the findings concerning teachers' beliefs, attitudes as well teaching practices.

As one can see from Table 7.2, the observed lessons' strengths all lie in the propositional knowledge and student/teacher relationship. Their weaknesses are reflected by low scores in procedural knowledge and communicative interactions in the classroom. It was also found in the CPTD activities that procedural knowledge and communication in the classrooms are lacking (see Table 5.1 and Table 5.2).

It is noteworthy that teachers' constructivist views and relatively good understanding of the reform lead to an acknowledgement that communicative interactions would provide a suitable environment for science learning. However, they do not deem it possible to create such an environment with large number of students. Indeed, it was clearly understood by the researcher, and sometimes stated (see narrative below,) that although teachers believe that such an approach could stimulate active learning, it would not be enhanced without close supervision of such activity. This supervision could not, in teachers' opinion, be provided with large students' number.

" I would love to leave them work and discuss in class, but I realise they are not working. They take the time as a free period so if you're gonna loose your time, I am moving on!" (Danny, personal communication).

Hence, Table 7.2 and 7.3 show that the classroom practices are more correlated with the CPTD activities than they are with the personal beliefs, which could be explain by the fact that they feel helpless to change their practices without having previously observed or experienced what they believe should be implemented.

Table 7.2. Summary of Reform Teaching Observation Protocol (RTOP) scores for all teachers' observed lessons

Item	Maximum score	Pirindhha	Samantha	Vuyo	Marie-Anne	David	Danny
Lesson Design and Implementation	20	5	7	9	11	9	15
Content: Propositional knowledge	20	12	15	14	15	17	17
Content: Procedural knowledge	20	3	5	8	10	11	13
Classroom culture: communicative interactions	20	4	6	5	10	10	11
Classroom culture: student/teacher relationships	20	8	11	13	16	14	15
TOTAL	100	37	44	49	62	61	71

As noted in chapter 6, the attitudes and beliefs of all six teachers are relatively similar, with Pirindha showing more constructivist stances on learning of sciences. However, Table 7.3 shows that her stance does not affect her RTOP score. The acceptance of evolution is high for five teachers, and although very low for Marie-Anne, it is not reflected in her attitudes and beliefs or her reform teaching scores—these scores are similar to the other teachers' from Québec. The greatest difference lies in the constantly lowest RTOP reform lesson scores in KwaZulu-Natal (KZN) compared to Québec (QC), which does not seem to be related to the teachers' attitudes and beliefs but rather to the professional development scores. However, the lesson reform teaching scores, both in KZN and QC, are higher than their associated professional development reform teaching scores. Another important difference is the relatively more traditional views on learning of science, compared to teaching of science, for all six teachers.

Table 7.3. Summary of teacher’s attitudes and beliefs and reform teaching scores, with their associated professional development (CPTD) scores.

Teacher	INPECIP score (constructivist/traditional)		Acceptance of evolution (MATE score /100)	Lesson reform teaching (RTOP score/100)	CPTD reform teaching (RTOP score/100)
	Learning of science	Teaching of science			
Pirindha	Strong constructivist 11/3	Slightly traditional 5/7	89	32	26
Samantha	Slightly constructivist 8/6	Equal 6/6	82	45	26
Vuyo	Slightly constructivist 8/6	Equal 6/6	76	49	26
Marie-Anne	Constructivist 9/5	Slightly traditional 5/6	41	62	45
David	Constructivist 9/5	Slightly traditional 5/7	87	61	38
Danny	Equal 7/7	Slightly constructivist 7/5	90	71	55

7.2 Examination of the enacted policies: a brief discussion

7.2.1 Teachers’ attitude and beliefs and CPTD

As confirmed by teachers’ interviews and INPECIP scores, there is a gap between agreeing and adhering to constructivist concepts of learning science and applying them in teaching science. None of the teachers believed in a traditional lecturing model of science learning but they were incapable of reconciling constructivist methods with their vision of teaching. They do not have the tools to apply the learner-centred classrooms that they would want, which seems to be a source of irritation. “For sure learning that comes from experience stays, it is generally durable, I agree with that, except that if they would give me time, I would gladly do it” (Danny, personal communication, 2011).

In terms of how attitudes and beliefs interfere with the vision of CPTD they hold, it seems that the major factor is whether they perceive a need to seek professional development. Both in QC and in KZN, teachers value the content-focussed professional development that gives them confidence to teach a particular topic. Their views on science or even acceptance of evolution was not related to how teachers perceive CPTD's influence on their teaching. Indeed, all six teachers, notwithstanding their beliefs about science learning or teaching, did not perceive professional development as a vector that could help them gain the necessary PCK to modify their teaching. In addition, they were not motivated to pursue CPTD to align it with how they perceived learning to occur, as they did not recognise that professional development could make a difference in their pedagogy.

Moreover, the storyline showed that most of the observed teachers did not feel their teaching was adequate during the first few years following reform implementation, which leads to entire cohorts of students being taught by teachers who do not feel they are competent enough to give their learners a professional education. Continuing professional development in a context of educational reform, where constructivist ideas are promoted, should lead by example and ensure that teachers perceive themselves as adequately equipped from the beginning of the reform implementation. To exemplify the impact that preparation can have on this perception, David's case is important to mention. As previously mentioned, out of the six teachers and schools examined, David's private school was the only one to offer meetings and discussion before the reform implementation; he is also the only teacher who reported his teaching competency as being sufficient from the first year. Professional capital is difficult to achieve when teachers feel inadequate. Continuing professional development role should include confidence acquisition, which also increases participation in a project such as a systemic reform.

7.2.2 Teachers' practice and CPTD

When specifically asked about impacting on their practices, teachers did not feel that CPTD could influence how they teach. However, through different questions and the storyline method, it was shown that suggested activities or specific, targeted, content-focused professional development activities do impact on how they perceived their teaching. Most teachers do not see CPTD as a process that can bring about a change in mentality, however the use of material from a professional development activity can impact how they teach. Indeed, a specific activity can bring about discussion, open the classroom for students' talk or give an opportunity for learners to discover new ways of communicating sciences results; or it can do

the opposite. As most teachers reported, the perceived success of an activity in class will determine one's confidence and can bring about a change in practice. Therefore, the material used in class combined with assessments that are aligned with the prescribed pedagogy is of particular importance and can be the starting point for a change in teachers' practices.

Teachers' lesson RTOP scores are low, but more worrying are the CPTD lower scores. In a systemic reform, continuing professional development is, for most teachers, the only contact with a reformed, learner-centred, inquiry-based science classroom. It appears that changing teachers' beliefs about how science is learnt is not sufficient to change practices, but rather that professional development has the greatest impact. It is therefore critical that, not only teachers are exposed to CPTD but that the activities are in a format that shows new methods that teachers can apply themselves, rather than gathering the information from different, sometimes unreliable sources.

In the last chapters, the findings linked with each research question were exposed and briefly discussed independently. The next chapter focuses on the interpretation of the results and the exploration of what they expose in the context of the present theoretical framework.

Chapter 8. Discussion

The current study was vast and its intention to unravel different aspects of continuing professional development in two different contexts of reform implementation was performed through an investigation of the different levels of policy implementation: intended, implemented and enacted. In this chapter, the discussion will first highlight the distinct findings in the context of the current knowledge in the field, and how they help to answer the research questions. They are then discussed in relation to pedagogical content knowledge and professional capital. Based on the holistic picture drawn, a conclusion and recommendations are then formulated.

8.1 Alignment of intended policies and research findings

8.1.1 Research question one

How do the continuing professional teacher development policies align with research findings, in South Africa and Québec?

a. If it does not, what is the nature of the gap and why?

The rigorous analysis of CPTD documents and policies performed in chapter four show that they are context dependant and generally developed in accordance with research findings, based on Desimone's criteria and the policy attribute theory.

With regards to Desimone's criteria used throughout the study, important points need to be discussed here. First, content knowledge was mentioned many times in the South African documents, in accordance with the acknowledgement that many teachers are in dire need of targeted interventions. In Qc, the documents do not target specific needs but as the initial teacher training was more homogenous than in KZN, the content focus will be shaped by teachers' needs created by the introduction of new subject in the syllabus. The documents are therefore context-adapted. With regards to the pedagogy however, although a form of active learning was promoted in South Africa from the NCS Life Sciences training document, the policies pertaining to continuing professional development do not emphasise that active learning is an important facet of the changes to implement in classrooms. Although the curricular documents in both cases state that teaching strategies ingrained in the social constructivist mode are central to the reform, nowhere is it mentioned that a key step would be

for all instances providing CPTD to adopt these practices. In Qc, there was a mention of the ‘previous passive form of teaching’ being obsolete, promoting new methods. Although a bit vague on the details of how to apply those methods to professional development interventions, there is recognition that if classroom practices are to be changed, it needs to start with professional development. The policies on CPTD are therefore coherent in Qc as teachers would select according to their needs, but in both cases it would need more consistency with the programme itself and prescribe a coherent pedagogy.

Differences were observed between KwaZulu-Natal and Québec in terms of how to trigger teachers’ motivation to attend these activities—extrinsic and intrinsic motivation respectively. As shown by Sachs (2001), these different discourses, *managerialist* professionalism demonstrated by South African policies, and democratic professionalism promoted by Québec’s policies, impact on teachers’ identity and are likely to generate entrepreneurial type of teachers in the former, or activists in the latter. Inspired by Bernstein’s retrospective and prospective identities (Bernstein, 2000), entrepreneurial teachers will tend to be individualistic and externally defined while activists will more likely work with and for the communities. Policy makers should acknowledge that the two types of policies adopted are likely to impact on teachers’ identity and affect the development of their professional capital. Investing in activist teachers is likely to provide for a sustainable, improving system whereas entrepreneurial teachers can lead to incoherent reform implementation and unstable systems. The South African Council for Educators (2008) recognised the need for both types of motivation:

Undertaking professional development activities [...] will improve teachers’ motivation, competence and professional confidence. [...] External recognition will be an important part of the CPTD system. Teachers who meet the PD points target in their three-year cycle will receive a certificate from SACE in recognition of their achievement. Teachers’ PD points status will be noted in their service records.

Although professional capital involves a profound change in teachers’ culture and context, it should be acknowledged that while before these profound changes can be achieved, the state ought to promote quality teaching and learning and therefore act upon the qualifications for teachers by all means available. In South Africa, the context discussed in Chapter 2 left too many teachers underqualified which could justify an increased need for extrinsic motivation. Extrinsic motivation has been found to impact in the short term, for targeted goals. Once the qualifications have been increased to an acceptable level, intrinsic motivation will push

teachers further in their professional path. In Québec, as more teachers are in schools by choice and most attended uniform and adequate pre service institutions, it allows the state more leeway and to 'capitalise' on professional capital.

While the South African and Quebec's policies are overall aligned with the criteria and they are context-adapted, there are a few common important gaps. Indeed, considering that governmental institutions rely heavily on external entities such as NGOs, professional associations or academics to offer appropriate professional development, one would expect clearer direction and support for any organisations or individuals willing to offer such activities. It has been shown in the United States that even though 70% of the teachers choose their own CPTD activities, only a few of them actually participate in content-focused training (Garet, et al., 2001). It might therefore not be sufficient to rely on teachers to choose the best activities. Indeed, policies could in this instance act on the providers to increase the offer of adequate activities. Subcontractors and various organisations dispensing continuous education are not working within a common framework, which increases the discrepancies between the interventions and does not favour quality, uniform and coherent CPTD. In Québec, substantial funding is now available for higher education institutions to associate with schools to provide continuing education, but the offerings are still very variable and not always adequate, and most importantly, not coordinated.

Also, as seen previously, broad requirements for adequate professional development have been highlighted in the literature. However, specific necessities are context dependant and unfortunately under-investigated. Hence there is a need for guidance to assist planners of CPTD programmes to prepare local, need-dependant intervention strategies (Keke, 2013). The documents related to professional development should provide such critical information, or make provision for the needs to be assessed more rigorously. Consequently, although documents are found to be context-adapted, they do not provided emphasis on pedagogical practices, which is more critical in a context of educational reform.

In addition to these flaws, both systems of cascade (South Africa) and heavy decentralisation (QC) do not provide for a uniform or at least a minimum level of CPTD for teachers in the reform context. It has been noted by many during the course of this investigation that motivated teachers will find a way to access professional development. Teachers who are keeping their work to the bare minimum, however, will not. There is indeed evidence that teachers who seek effective professional development are the most qualified teachers

(Desimone, Smith, & Ueno, 2006). It is not yet entirely part of teachers' professional culture that they have to modify and seek new, better methods, even in a situation of systemic change. Local professional development can act on these teachers by promoting and favouring a context where the professional attitudes of teachers impose pressure on the indolent ones. Principals in that instance should ensure that teachers in the school value professional development by establishing a culture where CPTD is part of teachers' activities. State policies ought to account for their decisive role and provide supervision at that level to favour a change in mentality. Québec's Education Act cited earlier stipulates responsibilities for principals in terms of professional development; however the schools visited, although receptive to teachers' initiatives, did not offer continuous, targeted support for teachers to introduce such a culture.

When reforming the education system entirely and drastically—pedagogy, curriculum and programmes, the educational community generally agrees on the crucial role of CPTD (Lieberman & Pointer Mace, 2008; Loucks-Horsley, 1995). It is therefore unexpected that the state policies would not provide sufficient guidance for continuing professional development to be adequate and uniform, so that teachers can move forward with the intended change. Teachers have been found to be generally reluctant to adopt and fearful of change (Irez & Han, 2011), understandably so considering ever-changing programmes and policies that did not provide for them to be adequately prepared. Accompanying, motivating and timely professional development is necessary to inform teachers and implement a reform in the classrooms and should be, at this stage of research and knowledge, framed by better policies. Politics around governments, teachers' professional organisations or unions are often cited as a reason for not having such prescribing policies (Hargreaves & Fullan, 2012, Department officials and pedagogic advisors: South Africa and Québec, 2011) as they are usually known to favour democratic professionalism. While associated with democratic professionalism and professional capital, the lenient types of policies do not ensure a comprehension of new pedagogical content knowledge associated with a large-scale competency-based reform and seems to assume that conditions for professional capital are already attained in schools. A delicate balance between the two might be appropriate. Further assessment of the impact of these policies is critical in order for developing countries to adequately adjust their discourses as their context evolves.

In this section, the state of the current policies in the two contexts observed in the research was discussed. The next section will discuss how politics and policies are intertwined and how the former affect the latter.

8.1.2 Policies and politics

Reform implementation, as discussed in chapter three, is largely influenced by political motivations. Fuhrman (1994) argues that transient political systems cannot provide for a coherent approach to reform implementation. There is also evidence that suggests that policy can influence teachers' participation in effective professional development (Desimone, Smith, & Phillips, 2007). Two parameters associated with political influences are discussed here, pace of implementation and union influence.

Pace

One theme common to both Qc and South Africa that emerged during data analysis was the pace of implementation, strongly linked with socio-political issues. Although the need for professional development was recognised in the reform documents, the analysis shows that the planning and concretisation around it was vague and not timely, which lead teachers to perceive the reform as 'coming down on them'. Although the reform process, especially in Québec, involved extensive consultations, it was perceived by the interviewed teachers as being rapidly implemented through a powerful top-down approach. Professional development policies, although recognising the need for teachers to be adequately informed, were not structured and implemented before the reform implementation, which might have caused this perception. Indeed, at the time of writing, the key aspect of CPTD implementation in South Africa is still not in place—SACE PD point system. In Québec, the only reference document concerning continuing professional development was produced in 1999 (Ministère de l'Éducation du Québec, 1999). Other documents and recommendations have been published for example by the advisory bodies Conseil Supérieur de l'Éducation or Comité d'Orientation de la Formation et du Personnel Enseignant (Comité d'orientation de la formation du personnel enseignant, 2000; Ministère de l'Éducation, 2007) but have not been synthesised into guiding policies.

In a review of various learner-centred education (LCE) implementation attempts, Schweisfurth (2011) shows that in many developing contexts, policies indeed make inadequate provision for the massive task that systemic reform represents, for example in India, China, and Sub-Saharan Africa in general, where speed of implementation does not match state provision of CPTD. The data presented here show that in both situations analysed, including a developed context like Québec, CPTD policies do not follow the implementation pace. Indeed, the relatively short mandates given to political parties cause most reform plans to span over a

period of a few years, which does not allow for long term planning. One of the consequences is often the lack of a structured plan for teachers' professional development during the first few years of implementation. In Quebec, a Department official said: "It was out of the question for the Minister that we departed from the fixed schedule, which was a crazy one and [when we told her], what we said was not admissible."—the Minister at the time left the Ministry two years later and was succeeded by another Minister who allegedly stated: "I am not here to manage continuity" (Ministry of Education political advisor, personal communication, 2011). In South Africa, Jonathan Jansen reported: "Schools and their allies had been repeatedly warned by the National Department of Education that January 1998 was an 'absolutely non-negotiable' date for the implementation" (Jansen, 1999, p.1). These statements suggest that political instances are imposing inappropriate implementation schedules for political reasons. The situation examined here is also corroborated by research that confirms teachers feel uninformed and lack sufficient time to make educated choices in educational reform contexts (Datnow, 2000). Political goals therefore impact on the application and viability of a reform, as well as on the leadership given to the policies and therefore on the commitment to professional development by teachers. Schweisfurth (2011) states: "[...] the *Realpolitik* of governments' desire to be making visible, positive, *modern* changes drives policy forward at a pace which practice cannot match" (p. 427). It is therefore assumed, in these conditions, that the first few years will bring confusion with consequences for teachers' acceptance of the project and for how much they will learn. The present study will not impact on political systems but hopefully the continuing professional development policies can be put forward by responsible political structures so that they can lead the way instead of lagging behind.

Unions

Although not in the scope of the present study, the theme of Teacher Unions imposed itself during the analysis of CPTD policy development. A short reflection on unions and professional organisations' impact on reform implementation is deemed appropriate. By wanting to maintain the independence and the liberties of the teachers, these organisations might be putting sticks in the wheels of the reform wagon. In line with the theoretical framework described earlier, governmental structures would wish that teachers' freedom were an incentive to develop professional capital. In both KZN and QC, unions have a powerful influence and are certainly, justifiably or not, perceived as a barrier to change by political structures.

In Québec, a previous union president also associated with the wide pre-reform consultations reported about the unions attending the consultation: “They agreed with everything that did not concern them directly [...] but anything that concerned them closely, they were not open to any change that was going to affect them directly [...] they are not agents of change, they are curbing agents, agents of status quo [...] but politicians are afraid of them, that I can tell you...” (Personal communication, 2011). In South Africa, a Department official mentioned: “[...] appointments of subject advisor - the leadership level - has been highly problematic and largely based on affiliation to particular unions [...]” (Personal communication, 2011).

No interviews with Union representatives or professional groups were conducted in this study hence no conclusions will be drawn from these quotes. The short discussion represents ‘food for thought’, a possible question for another study, and helps in the understanding of the actual intended policies. I will now discuss the next level of Chinese whispers, the CPTD activities and how subject/pedagogic advisors perceive the analysed policies.

8.2 Implemented Policies

Indeed, if the policies whispered were acceptable with regard to the selected criteria, it is now important to see how they translate in practice by analysing what the implementers get from the policies and what they transmit to the teachers. This analysis pertains to research question two.

8.2.1 Research question two

How is continuing professional teacher development implemented, in KwaZulu-Natal and Québec?

a. Why is it, or not, implemented as intended?

8.2.2 South Africa

The South African data show that the step between policy and implementation is high and arduous; the policies showed moderate consistency, and although little authority was associated with them, the policies show high power. However, implementation of most of the policies is not yet achieved. The prescriptive policies have been interpreted in the present study as being a transient force intending to level the discrepancies left by years of differential education, with the rationale that directing teachers to a prescribed form of professional development would enhance equity in the quality of training. However, the fact that no

subject advisors are yet appointed in some districts, and other districts get disappointingly unqualified subject advisors ruins any intentions shown in the policies. In addition, the context under study is an urban one and although not in the highest socio-economic environment, it is reasonable to assume that access to resources and qualifications of teachers and subject advisors are above the average in KwaZulu-Natal and in South Africa. Moreover, the workshops analysed are not meeting the criteria to a level that could induce change. Critically, it does not use the prescribed pedagogy to teach the teachers. The poor quality of the continuing professional development offered by the Department of Education was already highlighted in 2002 by the Human Sciences Research Council and acknowledged by the Education, Training and Development Practices SETA, which reached the same conclusions ten years ago (ETDP SETA, 2010, p.40):

[...] the DoE budgets a significant amount of money for the provision of INSET programmes for teachers and school managers. The majority of these informal skills development programmes are workshop-based, not accredited and are between one and five days in duration. There have been strong criticisms of these DoE-led programmes, in relation to:

- A focus on policy advocacy rather than a substantive focus on skills development*
- The competence of the trainers*
- The short duration of programme*

However, nearly ten years later, a DHET official commented on the new Plan on teacher development:

“[...] forward from the summit was a steering committee—a teacher development steering committee—that held the process together supported by an advisory committee and a secretariat and different working groups that worked on different aspects. [...] and the plan talks about a national committee, a national committee that replaces the steering committee to a certain extent, but still keeps the key role players on board in a committee that oversees implementation. Obviously can’t take responsibility for it but can look at progress and monitor progress and provide input. And then at the provincial level, similar kinds of things in terms of provincial committees, so there are aspects, co-ordination mechanisms built into the plan that, hopefully, will provide the kind of monitoring and control you need.” (personal communication, 2011)

No responsibility or accountability is stipulated for the national or provincial committees, for which investigations failed to account for their activities, or existence. These committees, as

well as the subject advisors hold a pivotal role in the implementation of a reform, especially where CPTD is designed in a cascade model. Literature accounts for the relationship between policies and professional development (Phillips, et al., 2011; Schmidt & Prawat, 1999) but the key role of linking policy makers and teachers is neglected. If there is one weak link in this three-bond chain, the message cannot reach the teachers. It would therefore be important in the design of policies to emphasise the qualifications as well as the appointment of sufficient subject advisors.

The pedagogical content knowledge necessary to nurture professional capital can only be provided when the context and the culture are adequate. For the culture and context to be changed, teachers need sustained guidance and, above all, they need to evolve in a professional capital environment, which could be provided from the subject advisors.

8.2.3 Québec

In Québec the whispers are still relatively clear at the implementation level and although some weaknesses in terms of coherence of the continuing professional development activities with the prescribed pedagogy were observed through the RTOP score, the message relayed by the CPTD is more coherent with the authoritarian policies as teachers do benefit from the intended incentives. Indeed, as shown by the diversity of professional development observed from only three teachers, CPTD offerings are wide and easily accessible for motivated teachers. However, it did not, for the cases under study, direct teachers towards subject content focused activities, although it was present in some cases. It can be inferred that teachers would have a greater need to broaden their pedagogical repertoire rather than strictly content knowledge as the initial training of teachers would have provide for adequate content knowledge, with the exception of the newly introduced technology aspect. The learner-centred, inquiry-based pedagogy was not targeted in the observed activities although it is highly coherent with their classroom activities as well as with the reformed curricular policies. Some components of the activities were in accordance with this need, although ten years after implementation, the extent of the reform teaching should be much higher than the RTOP score observed in order to trigger a change in practices.

It is important to note here that although school boards have the liberty to work with the schools with regard to their professional development, pedagogic advisors praised the bi-annual meeting and were perceived as competent by the relevant interviewees. However, they are not solely responsible for the CPTD of teachers and a lack of coherence between the

Ministry and the different structures could therefore cause the low reform-teaching observed during the CPTD activities.

8.2.4 Perceptions of the implementers

Both in Québec and in KZN, the interviewed subject/pedagogical advisors give indications of disillusion with regards to how much the reform is or is not going to be implemented. The lack of understanding of the policies by the teachers is repeatedly mentioned as if the barriers would never be broken, particularly with the policies ‘retracting’ many aspects of OBE. Indeed, according to them, the change in policies from both governments give a clear sign that outcomes-based education it is not a goal to target as much as when the reform was first implemented, more than a decade ago. A South African subject advisor recommended—informally, during a casual talk witnessed by the researcher—to teachers that they should not worry about fancy teaching techniques, as there is nothing better than the good old school. Clear leadership and directions are not being transmitted to the implementers nor the subject/pedagogic counsellors and the various changes in policies are seen as ‘going back’ to pre-reform policies. The policy documents were, in both situations, favourable to good implementation but as they encountered difficulty during implementation, changing the policies according to the popular demand seems to be considered the best option, rather than working on the professional development of the relevant key professionals.

8.3 Attained Policies

The last section discussed the gap created between the intended and the implemented policies. This section explores the step between the implementers and the teachers, adopting the teachers’ views. This is yet another link in the game of Chinese whispers.

8.3.1 Research question three and four

- *How does continuing professional development favour a change in attitudes and beliefs as well as in confidence in a context of educational change?*
 - a. *Why do teachers change, when they do?*

- *In what way is continuing professional teacher development reflected in teachers’ practices with regard with the reform being implemented?*
 - a. *How does it relate to changes in attitudes and confidence?*

8.3.2 Attitudes and beliefs

Attitudes and beliefs are important factors to consider when looking at teacher learning and professional development and could actually be the most significant predictor of change (Smylie, 1988). Teachers' values are therefore an important aspect to evaluate in understanding their perception of continuing professional development. Literature also shows that, in accordance with the professional capital theory, holistic change requires that different spheres of teachers' internal and external environment be modified. If professional beliefs or practices are not altered in synchrony, effects will not be systemic and learning is likely to be transient or absent. Opfer and Pedder (2011), in a recent review of professional development systems cited Clarke and Hollingsworth (2002): "For teacher learning or growth to occur, change must occur in multiple areas of influence" (p.386). The next sections discuss the findings in relation to the beliefs and attitudes of the selected teachers and how they can be related to their attitude towards CPTD.

Beliefs

There is no remarkable evidence that the selected teachers in KZN have different beliefs than their Québec's counterparts with regard to their cognitive maps. The results show that none of the six teachers agree with the traditional way of learning science characterised by a teacher-centred classroom where it is believed that students will learn if they are told what they need to know. Rather, they all agreed that students play a central role in the learning process, implying that prior knowledge and misconceptions have to be taken into account in order to achieve conceptual change. However, there is an evident trend for teachers to be more constructivist in their vision of science learning than science teaching. These results open very interesting debates, as they show teachers that hold constructivist beliefs about how science is learnt but traditional ones about how science is taught. Interview results indicate that classroom experience exposed the difficulty of constructivist teaching, which could cause the shift towards more traditional practices. It is difficult to identify a cause for their constructivist position on science learning, however we can infer that continuing professional development failed to give the necessary pedagogical background for teachers to teach in agreement with their beliefs and the ideology being conveyed by the reform. In a perspective where the target is to get teachers to acquire new pedagogical content knowledge, data have shown that they are not exposed to different forms of pedagogy, active learning or collective participation to an extent that would equip them to change. Many studies have focused on teachers' subject matter knowledge, especially in South Africa where teachers' under-

qualification is often targeted as the major contributing factor for low performances of the education system (ETDP SETA, 2010; Makole, 2012). However, the study here shows that continuing professional development has not focussed on the pedagogical aspect of science learning, which would give teachers adequate knowledge for teaching, in particular knowledge of instructional strategy or orientations to teaching subject matter—two necessary components identified for PCK as shown in Figure 1.2. The selected teachers all had the minimum professional teaching requirements, and often more, but failed to understand how the pedagogy associated with the reform could help in providing learners with the prescribed content. All the teachers held the belief that science teaching cannot meet the right criteria for science learning. This situation can only lead to a decrease in teachers' perceptions of self-efficacy. Continuing professional development ought to equip teachers with adequate tools for them to achieve their own ambitions, as without it they will not develop a sense of identity associated with high capability and commitment, leading to professional capital.

The research also shows that the lack of pedagogic tools given to teachers leads to a decrease in their support for changes being implemented. Indeed, both in KZN and in Québec, teachers reported being enthusiastic about the changes at first but now seemed to envisage implementation as an epic endeavour. They therefore gave indications, principally during interviews, that teaching how they always did was the appropriate practice; learners will certainly learn something. Throughout the study, I grew to call this attitude the ABC attitude. It is based on a comment from a retired official at the Ministry of Education of Québec, in reference to the Minister's answer to questions regarding the pace of implementation of radical changes of the reform: "Well, there will still be the same number of letters in the alphabet and the numbers will not change" (reported from a personal communication, 2011). The ABC attitude is therefore growing amongst the interviewed teachers as they found themselves short of resources and examples of how to apply what researchers have found to be the best way to teach science. Subject content is transmitted, the alphabet will be learnt.

Attitudes and CPTD perceptions

General teachers' attitudes towards CPTD can have a major impact on the learning that will follow and therefore is an important aspect of the evaluation of CPTD impact (Simpson, Koballa, Oliver, & Crawley, 1994; Thompson & Mintzes, 2002). In the study, the observed teachers' attitude towards CPTD was generally a sceptical one. Even in Québec where two of the three teachers responded that professional development could impact their practices, they added many conditions to be met for them to perceive a possible change. One condition that

was repeated by all interviewed teachers was that learning needs to be applicable in their classroom, to be relevant. Whether they perceive it as relevant or not might also be influenced by their attitudes towards learning. “Learning orientations are likely to be changed, if at all, when learning provides, amongst other factors more and better field and classroom experiences” (Opfer & Pedder, 2011, p.389). Teachers have indeed reported that the greatest vector of change is experience, specifically students’ attitudes and reactions to their practices. Knowledge that is relevant to teachers is therefore knowledge that can enhance their perception of self-competency, how they can help and impact on learners’ understanding and performances. While teachers start teaching with beliefs that are likely to be strongly based on what they experienced as students (Richardson, 2003), there is evidence that the gap between personal expectations and actual practice would generate self-questioning that could act as an agent of change. However, some authors have suggested that if dissonance between beliefs and practice is too important, teachers might reject change (Timperley & Alton-Lee, 2008; Wheatley, 2002). Therefore, there is a fragile equilibrium that needs to be obtained between an adequate sense of efficacy and motivating doubts that improvement is possible. The data shows that attitudes of teachers can therefore be changed if they perceive that the:

1. Present approaches can be improved
2. New approaches will be more aligned with their beliefs
3. New approaches will not compromise the credibility and relationship with the students, and can improve their learning

I believe that CPTD can respond to these conditions. The six observed teachers’ school environment was not conducive for collaborative learning, sharing and communication, although David’s school was superior to the other five. As mentioned, in order to respond to these conditions, improving the collaborative culture is an area that CPTD could target.

Similarities observed in the two different contexts provide an interesting perspective, as they show that teachers from different backgrounds and evolving in different contexts encounter the same difficulties and some common solutions could be generated. It is possible that the urban context studied reduces the differences in attitudes and beliefs between KZN and QC, as South Africa is a nation of extremes, with so much diversity and a spectrum of regions that extend from underdeveloped to fully developed. The urban region chosen for the research could be qualified as mid-developed and results would most likely have been different in a rural area. The choice of urban context is however valid as in the situation under study, external factors impacting on CPTD are reduced and the absence of activities or teachers’ qualifications cannot

by itself be the cause of CPTD failure or success. Far from controlling external factors, selecting comparable situations between the two nations led to a better understanding of how continuing professional development can improve education systems in a general sense.

Despite the interesting similarities, I will focus in the next section on the different contexts and how they can also produce different situations.

KwaZulu-Natal—KZN

Different particularities of the KZN situation are worth describing in light of the observed results. First, the three selected teachers, although not tremendously critical of CPTD, showed disenchantment and held low expectations from it. The most positive teacher, Samantha, when asked about the positive outcomes of the workshops, emphasised that “you have to make the most of it yourself”. This attitude could be explained by a general disenchantment towards government’s interventions due to the perception (sic) that it has not offered much in the past; it is an attitude that has been anecdotally, but generally observed by the researcher in Durban. Also, all three teachers reported that teaching was not their career of choice, which can impact on how much they are committed to professional development. It is a situation that is not only observed in the South African context of apartheid but in many developing countries where educators are not required to show high academic credentials to access the profession. Schwesfurth (2011) argues that “it shapes the extent of their commitment to effective pedagogy in general and to the challenging changes posed by learner-centred education specifically.” (2011, p. 428). This factor plays against the building of the desired professional capital and, although CPTD could play a motivating factor by contributing to creating a desirable culture within the teaching community, it is a factor that needs to be taken into account. As mentioned, given the differences between schools in KZN and South Africa in general, subject advisors assigned to a particular circuit of schools should be aware of the needs and culture of the particular schools to be able to act in this regard. A formal needs analysis would help to take their prior knowledge and preconceptions into account and allow for more constructivist CPTD activities.

Another point to raise here is the generally lower RTOP scores of the KZN teachers, and also for the workshop observed, in comparison to any CPTD activity in Quebec. *Why is this the case?* is a crucial question regarding reform implementation in different contexts. Several explanations for the low implementation in developing countries have been advanced in the literature and most of them apply to KZN context. They include teacher capacity, limited

resources and cultural factors (Association pour le développement de l'éducation en Afrique, 1996; Schweisfurth, 2011). In the present case however, the teachers observed were adequately trained initially, based on their credentials as well as observation, and did not cite the lack of resources as a reason for not being able to apply certain practices. Cultural differences however can certainly account for the reception of learner-centred, inquiry-orientated policies. Indeed, South Africa could fall into a cultural context described by Hofstede as 'high power distance' (2003), characterized by a distant relationship between authorities and teachers and also between teachers and learners. Indeed the author observed that culturally, the schooling system remains, compared to Québec, a generally more conservative environment where learners wear uniforms and are intimidated by the teachers. In Québec, dress codes are often flexible, and students tend to call teachers by their first name and to show more familiarity. This situation could contribute to the difference between beliefs about science teaching and science learning, where it is understood that learners must do a conceptual reconstruction to learn but teachers should nevertheless be at the centre of the classroom to preserve the due respect. Therefore the RTOP scores in South Africa might be skewed negatively due to the traditional culture where learners are not expected to ask many questions or to discuss with the teacher. This situation was observed in Namibia, where **learning**-centred orientations were believed to be more appropriate than **learner**-centred ones when taking context into account (O'Sullivan, 2004). Although all these factors can explain some of the results, the situation in Québec is not much better in terms of implementation in the classrooms, as shown by the relatively low RTOP score. The comparison will help in understanding how the different factors interfere in the implementation of such policies.

Québec-Qc

There are many arguments in the literature against trying to replicate reforms or policies from one context to another (Schweisfurth, 2011), but in this case the replication is worldwide, with very few successful examples. In this context, it is also very informative to ask what went wrong everywhere else—including in QC—rather than trying to find out why it did not go right in South Africa. When looking at the results in QC, the three motivated teachers were not using a large proportion of reform-teaching methods either, as shown by their RTOP score. Moreover, they did not acquire the necessary pedagogical knowledge to apply what they believe is good practice, according to how they envisage science to be learnt. Interestingly, their beliefs about science teaching are also relatively traditional, or at least they are not very constructivist, as opposed to how they imagine science learning to occur, which indicates that they are processing and acquiring a new pedagogical philosophy without fully believing in its

application. They are slightly happier with the CPTD, although David's attitude is similar to the KZN teachers. Marie-Anne and Danny reported that CPTD could affect their teaching, although not to the extent that experience and contact with the students could trigger. They both mentioned that for the Technology aspect, the CPTD had an influence on how they perceived their capability to teach. However, it is not change-provoking with regard to their practices but only provides subject content knowledge for a subject that is new to them. The point of focus here should be for CPTD to help teachers change their practices to adapt it to the reform being implemented. The activities attended in Quebec will not help in doing so as long as the pedagogy is not aligned with the policies. Therefore, although the perception of CPTD is slightly more positive in Québec, most likely due to the better offering and accessibility, it has not been a key vector of change.

Attitudes and CPTD perceptions: a comparative study

In terms of attitudes and practices in the classrooms, there is also remarkable difference between KZN and Quebec's teachers. As stated earlier, the comparison is not presented here for generalization purposes but rather as a reference for the assessment of the role that different contexts might play in teachers' perception of CPTD impact as well as on their identity.

Professional development activities and classroom practices are more aligned with reformed teaching in Québec than in KZN, where none of the observed lessons received an RTOP score above 50%. However, the storyline shows that all teachers felt competent at teaching according to the reform requirements at the time of the study (all the results ended with a four or a five, five being the maximum on the scale). This result could be explained by the teachers' beliefs about science learning and although they cannot apply it in the classroom, they report their competency as higher than it actually is. It was indeed shown in the literature that changing teachers' beliefs can alter self-reports about their behaviour without affecting it (Desimone, 2009). It is also interesting to note the consistency with which teachers' classrooms scored higher than the CPTD, which could indicate that the change in beliefs pushes them towards trying techniques and practices that are more constructivist, although the continuing professional development would not be responsible for the observed beliefs.

Overall, interviewed teachers from South Africa and Québec all had a positive attitude toward the reform at the beginning but the difficulty in grasping the essence of it and more

importantly the difficulty in implementing it in their classrooms brought about frustration and may have prevented the change in beliefs to be represented in their practices.

The general teachers' attitude toward professional development is more positive in Québec than in KZN. Analysis of the interviews, storyline, and questionnaires' answers shows that two teachers in Québec are overall positive about continuing professional development (Marie-Anne and Danny); one is neutral (David) whereas the three KZN teachers are either negative (Pirindha and Vuyo), or neutral (Samantha). In addition, although Samantha first showed some enthusiasm she could not say how it could affect her practice. The perceived impact of CPTD does influence how much time they dedicate to attending such activities, and Marie-Anne and Danny showed this by actively seeking additional activities to increase their knowledge in what they perceived as being areas of weaknesses. None of the three teachers in KZN did so. The negative perception of the activities is not the sole factor in the low attendance of KZN teachers, as few opportunities to attend additional activities arise.

To move teachers towards a learner-centred, inquiry-based, outcomes-based mentality, none of the two strategies—intrinsic or extrinsic motivation—have fully reached their goal with the teachers observed. Indeed, even though teachers held slightly more constructivist beliefs, results showed that both in South Africa and in Québec, all the teachers observed demonstrated low implementation of the constructivist approach advocated. Although the results are slightly more satisfying in Québec, it is difficult to directly link the positive outcome with the professional development. Keeping in mind that these teachers are probably more motivated than the average teachers, being motivated and confident enough to let the researcher examine their practices, the data examined here are worrisome and question generating: Why do consenting teachers not change their practices? How can continuing professional development help them change their practices? It seems that notwithstanding the offering of incentives, the constructivist approach to learning ingrained in the reform policies is not going to be assimilated by the teachers if they are not exposed to it in situations where they are the learners, in a learner-centred classroom, feeling the feelings of the students, their fear, their lack of confidence. Marie-Anne reported that when attending a particular workshop on Technology, she was afraid when she heard a directive such as: “Ok, today, you are going to build an articulated arm.” This is the type of activity that would be stressful for both teachers and students to perform, and lecturing about it might seem to be a safer option for the teacher if not previously put in the same type of situation. Professional development could provide opportunities for teachers to get familiar with these situations in a safe context. For CPTD to reach a goal of providing complete PCK and eventually reach professional capital,

the assumptions that professional development must teach by example is key to interpret the results in this study. The same assumptions were described by Opfer and Pedder (2011) “[...] teacher professional development consists of a repertoire of activities and methods for learning and teacher learning follows more or less directly from the frequency with which professional development programs use these specific activities, structures, and so on” (p. 378).

The CPTD that is perceived by teachers as having the greatest influence on their practice are the ones that give material applicable in a classroom, or that gives them content knowledge to gain confidence in teaching. It is in accordance with Desimone’s criteria of adequate professional development (subject content and coherence mainly) but it does not provide for the pedagogical aspect of teaching, as desired by a systemic reform. The content knowledge can be increased but in the present state of affairs, with the textbook being constructed in the same traditional way, the pedagogical content knowledge is ignored. In systemic reforms such as OBE, the pedagogical philosophy is completely revised and cannot be ignored when professionally developing teachers.

8.3.3 Confidence, experience, teacher identity and social learning

The data concerning confidence and experience are mainly related to classroom activities rather than formal professional development activities. Indeed, when questioned about how they acquired their confidence and expertise, teachers always referred to the classroom. Confidence can be a key learning tool as well as an outcome of learning (Graven, 2004). Teachers in this study all highlighted its importance and acknowledged that any successful learning would generate this indispensable tool that a teacher needs in a classroom situation. In addition, the data presented in this study show that confidence was perceived as a tool for further learning but also allows holding a particular role in a community. The greater the confidence, the more prominently teachers envisioned this role. Initial teacher training teaches specific pedagogical and content knowledge whereas experience and continuing professional development, by forging confidence, can mould a professional identity and are essential to build professional capital (Hargreaves & Fullan, 2012; Sachs, 2001). It was discussed in the context of policy design that different types of teacher professional identity can emerge from different motivational approaches, either the managerialist or democratic. The role of confidence in this context is underrepresented in the literature although it is likely to play an important role in teacher identity development. Graven (2004), in a thorough study of professional development of mathematic teachers through a community of practice remarked “that the notion of confidence is pivotal in understanding and explaining mathematics teacher

learning” (Graven, 2004, p. 177). Confidence is discussed here within a social practice conceptual framework in relation to teacher learning, as Graven explored it, both as a product and a process of learning. Indeed, she suggests that confidence is an essential aspect of social learning, as teachers need to trust their own knowledge before admitting their shortcomings. In the present context, continuing professional development through social learning is envisioned as a cycle to gain capability and confidence, which generates more social capital and develops human capital. Communities of practice are a privileged method of continuing learning, and the policies in both KZN and Québec acknowledge that they represent an essential component of professional development. However, without appropriate supervision, these measures will not serve the intended purpose. The observation of the cluster group in KZN exemplifies the fact that a community of practice does not always provide for a learning context. Taking the Finnish example of educational restructuring, the investment in social capital through school-structured social learning might be worth the expense (Sahlberg, 2010).

To discuss confidence within this social framework, I will add here what I call the social structural framework, which is related to the structure of the school and organisation of school days, hence to the culture and context of teaching as described by Fullan and Hargreaves (2012) in the professional capital theory. It is argued here that to make a contribution to teachers’ professional capital, continuing professional development ought to influence teachers’ confidence, which can be achieved by influencing the culture and context of teaching. Within their reflection of how to improve their confidence through daily activities, teachers in the present study are pointing to a different school organisation. Indeed, as shown in the results, teachers and policy makers reported that the amplitude of the reform calls for structural changes, which could facilitate collaboration and learning at school. These changes can be of various orders. Firstly, instructors reported that ‘taking their classes up’, or teaching the same students for a few years, improve class relationships and trust as well as teaching and learning. It is aligned with the constructivist approach where knowing students’ backgrounds, misconceptions and learning styles improve learning. The present data also suggest that it increases teachers’ confidence. It was suggested by a policy maker in Québec, and also observed in some Scandinavian countries, that a reform advocating interdisciplinary outcomes calls for school days to be restructured to favour collective continuing professional development through daily activities. Lifelong learning is efficient if it merges into a teacher’s life. Incorporating learning through school days is likely to yield human capital. For example, time allocated for common projects between different disciplines, or for teachers to discuss particular students or common approaches could be envisaged. However, the latter would be more appropriate when a certain level of professional capital is already attained, or would

require the presence of a facilitator. Kotter (1996) built a list of eight of the major mistakes when introducing change in an organisation, which include not anchoring changes in the [organisation's] culture. The high resources involved in such reforms could justify a rearrangement of the school calendar to guarantee quality professional development for all teachers.

Anchored in the school structure, continuing professional development might improve teachers' confidence through the social structural framework. As CPTD cannot replace experience, it could include an analysis or simulation of students' reactions to help teachers anticipate what can be expected and develop decisional capital. Simulations have gained popularity in health sciences with, for example, the Script Concordance Test (Lubarsky, Charlin, Cook, Chalk, & van der Vleuten, 2011), developed to increase professional competence with ill-defined problems. Although specific to health professionals, the test could be adapted for teachers to improve their decisional capital in various situations, without sacrificing four to five years to gain the necessary experience. Video analysis has also been suggested as a tool for teacher development (Goldman & McDermott, 2007). Danny's comment serves as a good conclusion for this section, as teacher professional development could try to copy experience in what it can accomplish: "But really experience, experience with students' reactions, repartee, you work it out with time. One becomes much more intense, much sharper. Because there are behaviours that are recurrent, so when you have seen the range of possible behaviours, it is easier to gauge what reaction one must have." (personal communication, 2011).

8.3.4 Textbooks and educative curriculum material

As reported by teachers in this study and corroborated by other authors, professional development must be relevant to a teacher's classroom (De Feiter, Vonk, & Van Den Akker, 1995; Garet, et al., 2001). As an educator finds himself in a situation where learners pull a long face and post an interrogation mark on their foreheads, it becomes very handy to have a practical example, an exercise or a figure to use. Shulman states that "since there are no single most powerful forms of representation, the teacher must have at hand a veritable armamentarium of alternative forms of representation, some of which derive from research whereas others originate in the wisdom of practice." (Shulman, 1986, p 9). While nothing can replace the wisdom of practice, learning and teaching support material (LTSM) can offer that armamentarium to teachers and trigger a change in practice which can lead to any of the desired effects. Data in this study shows, in agreement with the literature (Schmidt & Prawat,

1999), that the central piece of information teachers use to plan their classroom activities is the textbook, associated with the internet to get material and information. It is therefore situated in a powerful position to influence their practices, which in turn can impact on their attitudes, beliefs and confidence (see Figure 8.3.).

Self-responsibility is featured in CPTD policies in both observed contexts and can lead to uneven development among educators. It exemplifies the tension between guidance and choice that any stakeholders have when designing continuing professional development (Davis and Krajcik, 2005). In light of the results presented here, more guidance through meaningful educative curriculum material could be considered, as an addition to existing CPTD. In a study on reform implementation in Québec, Potvin and Dionne (2007) found that teachers in Québec reported being in need of high-quality teaching material. Indeed, this type of material can be used as a tool to promote teacher learning (Ball & Cohen, 1996; Bruner, 1960; Davis, Nelson, & Beyer, 2008) and could contribute to teacher continuing professional development: “Teachers could be engaged with curriculum materials in ways that generated learning if the materials were integrated into a program of professional development aimed at improving their capacity to teach.[...] We have proposed to redraw boundaries between teachers and materials in the construction of curriculum. We see no alternative if curriculum is to play a more constructive role in improving instruction, for the curriculum that counts is the curriculum that is enacted.” (Ball & Cohen, 1996, p.8).

An activity or project in class can have a major impact on teachers’ pedagogy, as it can integrate different subjects, focus on students and trigger inquiry-based learning. However, teachers do not perceive these activities as being a trigger for change, but only as an aid to teaching. Different class-applicable activities and examples of teaching ‘tricks’ as well as the most common students’ misconceptions are therefore powerful tools to enact change. Improving the material teachers already use to promote student and teacher learning concurrently is potentially very effective as learning is very meaningful and applicable when embedded in high quality textbooks. It does involve considerable restructuring for policy makers as well as for politicians with regard to the relationship with the publishing lobbies but it could promote a minimal continuing education system while acting on resources already in use by teachers. Shulman elegantly stated that “the curriculum and its associated materials are the *materia medica* of pedagogy, the pharmacopeia from which the teacher draws those tools of teaching that present or exemplify particular content and remediate or evaluate the adequacy of student accomplishments” (Shulman, 1986, p.10). Indeed, textbooks can also provide better

guidance for evaluation, which is a critical pedagogical content knowledge in the implementation of a reform: knowledge of assessment of students' learning of subject matter.

Commercial textbooks are often designed in haste and although a supervising body usually manages the operations, it is not a guarantee that it correctly promotes the reform philosophy, or teacher learning. A pedagogic advisor in Québec, Marc-André, who has also worked for the publishing industry reported: "The great misfortune of this reform was this: we wrote our textbooks along with programs, and educational content was broad and unfocused when the programs were written; came a [textbook] collection and they published the notions by universe [instead of integrating various disciplines] and then everything fell apart. People began to completely reverse what the reform wanted, which was precisely the mix of disciplines." (Personal communication, 2011).

Sedibe (1998) suggested that implementing an outcomes-based education depends on appropriate continuing professional teacher development and adequate teaching and learning materials. It could therefore be efficient to fuse continuing professional development that promotes constructivist views with teaching and learning materials already used by teachers. Indeed, it is possible to use teachers' textbook to convey knowledge of concepts into classroom activities. For example, in the case of a learner-centred, inquiry based reform, a textbook could suggest a series of questions that teachers would use to probe pupils' previous knowledge. Based on their answers, a selection of various activities would be proposed, some for large groups, others for discussion or individual work. All the activities would be in agreement with the proposed reform and would help teachers to discover how a classroom can be a different learning environment from what they have been used in the past. Proposed evaluation scheme based on each activities could be presented as well. Another powerful potential aspect could be the introduction of collaborative work between teachers of various disciplines. Based on the curriculum of each subject, an activity could integrate two or more concepts and can be performed concomitantly with other teachers.

Such a claim, based on teachers' interviews as well as on the observation of the great influence that textbooks have on a lesson in this study, does not suggest that the textbooks could play the sole role of teacher professional development. The necessity for reflective and active learning as well as for collaboration implies that it could serve to introduce teachers to the basis of constructivist views through a medium that is already widely used but could not replace discussions and collective participation in CPTD.

This reflection concludes the discussion about how the selected teachers perceive CPTD and how they learn, process, inquire and implement the reform policies. Based on these considerations, the next section will present a reflection on the analytical, conceptual and theoretical framework used throughout the study.

8.4 Common Framework

8.4.1 Research question five

How do we establish a common analytic framework to evaluate continuing professional teacher development?

The last research question pertains to the elaboration of a common framework to inform professional development research approaches. Desimone's framework was used in this study as a powerful analytical tool and although exploration of CPTD will always focus on only parts of a more complete process, adding pieces of information on a common framework would allow for a multifaceted and complex analysis. Opfer and Pedder (2011), using the complexity theory lens, argue that a study focusing on teachers or learners only, without the contextual influencing factors, does not yield the necessary information for adequate conclusions. Rather, they plead for researchers to take different subsystems into account: teacher, school and learning activity. However, global studies that take into account all the diverse parameters affecting CPTD are not always feasible, hence a common framework allowing for pieces of the puzzle to be added would be useful. Although bearing limitations, it is a step towards standardization that could help in the understanding of professional development as envisaged in the complexity theory and professional capital, which take different aspects of teachers' lives into account.

Data presented here show that Desimone's framework is useful, although some adjustments to it would make it more relevant to the results of the current study. Indeed, the lack or little change in teachers' practices calls for reflection. Note that although teaching practices did not match the required reform-teaching, it is acknowledged that changes in practices could have happened without being accounted for as teachers were not evaluated before the reform; yet instruction should, after ten years of reform implementation, show a better correspondence with the prescribed pedagogy. For clarity purposes, Figure 8.1 repeats Desimone's original framework from which the study's analytical framework was drawn.

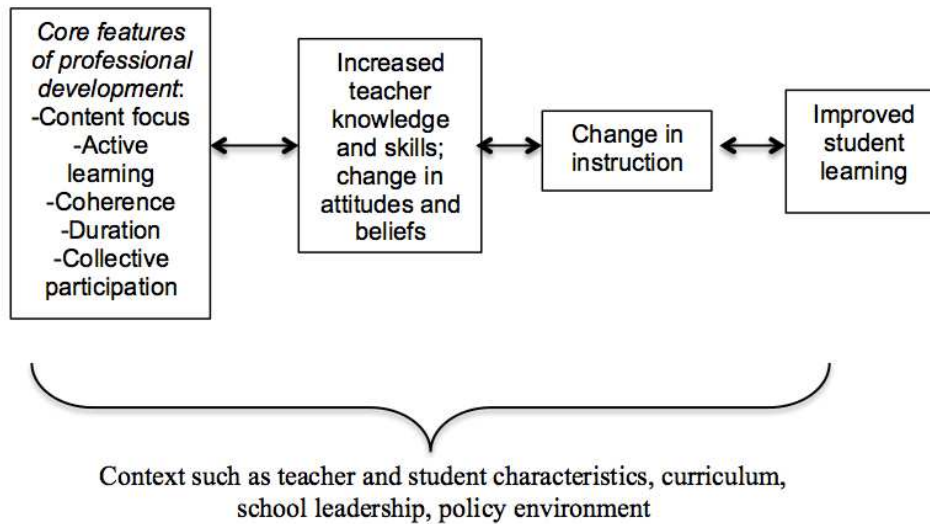


Figure 8.1. Core features for adequate professional development. Desimone’s conceptual framework for studying the effects of professional development on teachers and students (2009, p. 185).

More than 20 years prior to the publication of Desimone’s framework, Guskey proposed the following model of teacher change, reproduced in Figure 8.2. Both models suggest a linear relationship between professional development, teachers' attitudes, beliefs and practice, as well as learners' achievement.

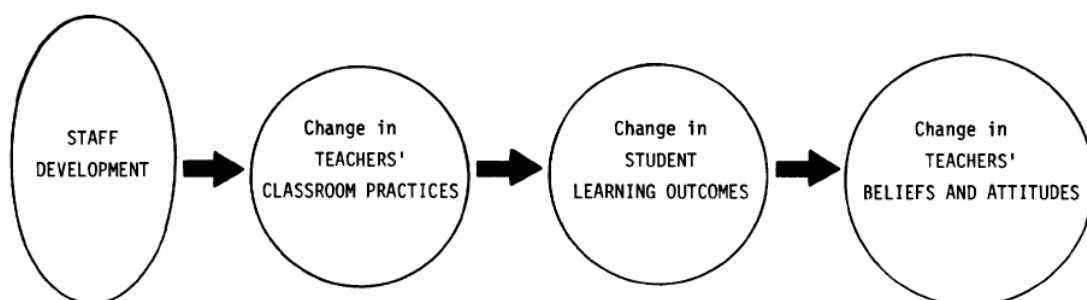


Figure 8.2. A model of the process of teacher change. From Guskey 1986, p.7.

Because the six teachers observed in this study showed that beliefs about science teaching and learning were partially changed, but practices did not follow, it raises questions about a linear relationship and therefore points towards a more integrative model, aligned to the complexity theory. As shown by Opfer and Pedder: “Although a substantial literature exists about the ability of specific features of professional development to improve teacher practice and student learning, some researchers have begun to question this as causal knowledge.” (2011, p. 387). Supporting this point, teachers in this study show more constructivist views on science learning than on science teaching and do not translate these views in their teaching practices, which leads to the conclusion that the six observed teachers did not fully align their practices to their beliefs; or at least not as much as one might hope for following professional development. In addition, they all reported that students’ reactions and performances greatly influence their practices. It would therefore suggest that, as Guskey (1986) proposed, students’ learning outcomes could lead to a change in beliefs and attitudes. However, as opposed to what his model suggests, the data presented in this study shows that a change in beliefs is not always preceded by a change in teachers’ practices. In addition, teachers reported a change in students’ performances as being influential to their teaching but also a change in attitudes. Indeed, from teachers’ reports, a perceived lack of interest from the students can lead to the abandonment of a practice. Therefore, it is not only how students succeed as a result of a change in practices but also how they react. Also, according to the professional capital theory and the data presented in this study, school context could play a more important role than proposed in these models for changing attitudes and beliefs, as well as confidence and social learning. Based on these results, I therefore suggest redesigning the parameters in Desimone’s framework in the form of a Venn diagram, as shown in Figure 8.3.

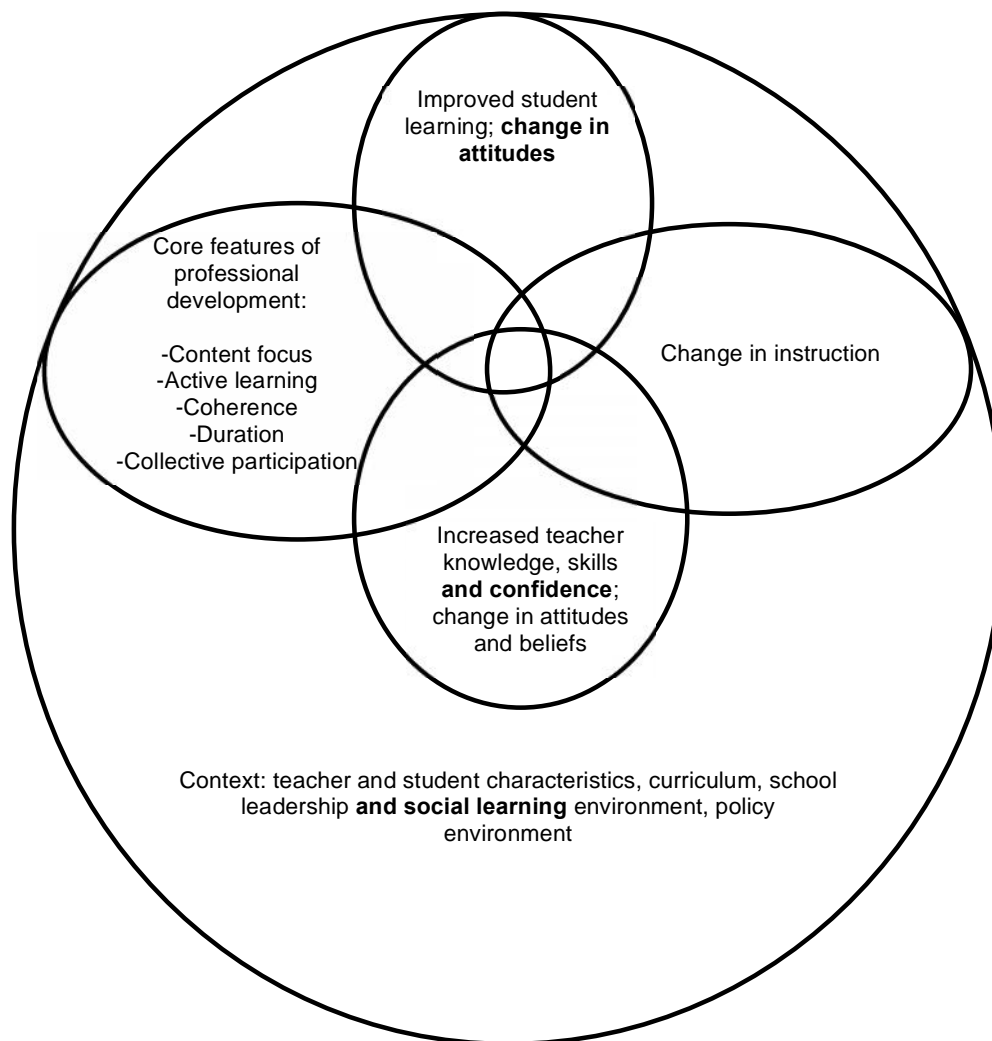


Figure 8.3. Proposed conceptual framework for professional development.

The figure shows that in this envisaged conceptual framework, all features are interconnected and likely to influence each other rather than being situated in a linear relationship. Indeed, the causal relationship between such complex systems is difficult to precisely identify and, in terms of the model, all features need to be acted upon for professional development to create profound change and generate professional capital. The framework keeps the same core features of professional development suggested by Desimone while the other features were slightly modified (bold in Figure 8.3) to account for the aspects discussed earlier--confidence, school social environment and change in students' attitudes. The key point is the centre circles showing the interconnections between all the proposed features likely to influence each other.

As discussed previously, it has already been recognised in the literature that integrating factors might be a more realistic way to approach continuing professional teacher development (Clarke & Hollingsworth, 2002; Opfer & Pedder, 2011). However, the integration in a diagram model of Desimone's research-based criteria, the confidence and social aspects as well as the change in attitude and beliefs caused by improved student learning (Guskey, 2009) represent a new amalgamation of various concepts. It symbolizes partially, and adds to, the angle used by Opfer and Pedder's complexity theory (2011). Indeed, CPTD is a complex study and any integrating model must take into account the reciprocal relationship of various aspects.

8.5 Professional Capital and Pedagogical Content Knowledge

8.5.1 Pedagogical Content Knowledge

Pedagogical content knowledge, in view of the present theoretical framework, is seen as a knowledge that can lead teachers to **capability** and **commitment**. Indeed, knowledge of the subject matter, curriculum and educational goals are primary in times of reform, but it has to be coupled with different types of knowledge such as knowledge of students' understanding and their preconceived ideas, as well as misconceptions to motivate teachers to change. Pedagogical content knowledge can motivate teachers to re-evaluate their practices and create an environment for them that will create a learning **culture** and professional **context**, within a valued **career**. It is a knowledge in, for, and of practice (Cochran-Smith & Lytle, 2001) that concords with the envisioned CPTD that would be embedded in teachers' everyday lives and lead to a different perception of teachers' self-identities as well as professional identities, essential to develop professional capital. In light of the present results, none of the CPTD activities observed comprised the entire range of criteria selected, and therefore could not contribute to building a strong PCK which, by definition, includes different types of knowledge as opposed to only selected criteria. Continuing professional development cannot by itself provide the entire range of complex knowledge necessary for teaching but should contribute to provide, as Shulman described: "A broad liberal education that serves as the framework for old learning and as a facilitator for new understanding" (Shulman, 1987, p. 9).

Continuing professional development should not be band-aid activities providing temporary answers for each addition of content or pedagogical methods. In order for CPTD to contribute to a permanent solution, it would have to be embedded in the teacher's life to provide PCK and professionalize its environment so that teachers could not function in a school without the appropriate attitude contributing to building professional capital.

8.5.2 Professional capital

It is believed, in light of the results, that reculturing professional development to achieve a collaborative professional development that can produce changes in teachers' practices, attitudes, beliefs, and student achievement would lead to professional capital. According to Hargreaves and Fullan, professional capital is a function of human capital, social capital and decisional capital, which can be acted upon by professional development. Concerned by the enacting of their theories, these two pragmatic authors claim that the following measures can generate professional capital by transforming the hearts, minds, and culture of the profession, as well as spreading the impact (Hargreaves & Fullan, 2012, p. 42) :

1. Professional capacity building
2. Collective responsibility, teamwork, and collaboration
3. Moral commitment and inspiration
4. More rather than less professional discretion
5. Personally engaging curriculum and pedagogy with technology as its accelerator
6. School-to-school assistance rather than punitive intervention from on high
7. Systemic policies that are coherent and cohesive

As can be observed here, all of these parameters can be targeted by professional development. CPTD's impact in building teachers' professional capacity could be enhanced by providing professional development that contributes to the collective responsibility and moral commitment, as well as school-to-school assistance. By increasing teachers' confidence, professional development could also provide for the right conditions to increase professional discretion. The data in this study show that teachers' are in need of examples to trigger a change in their attitudes, beliefs and practices that could increase collective responsibility, teamwork and collaboration, commitment and inspiration.

In the two contexts observed, the policies are sending a relatively clear message, which is not translated into the implementation stage. Hence teachers have little opportunity to interact with what it represents to be professionally capable with regards to the reform. Indeed, the reform context is characterised by a need for relearning; most teachers interviewed have been teaching for many years and had acquired what they considered good practices. This *know-how* needs to be revisited when capability takes a new meaning, hence the need for them to be convinced

that the theory behind the policy can produce good results. Instructors are not given the opportunity to *experience* how different practices can lead to different results. It leads to less commitment and inspiration, which undermines confidence, hence collective responsibility and collaboration. It is therefore critical that measures are put in place to increase teachers' exposure to 'new' capabilities, especially when they are experienced and in a career stage where they have built an image and identity that is resistant to change. It is important to note at this point that the observed teachers were all around the same career stage, which was shown to have a possible impact on their response to change, therefore possibly to professional development related to change (Hargreaves, 2005). Indeed, teachers in mid-career (8 to 23 years of experience) are "confident but not complacent, open but not innocent, questioning without being cranky" (Hargreaves & Fullan, 2012, p.71). As shown in Figure 1.1, it represents the highest potential for commitment and capability, leading to professional capital. The selected teachers had between 7 and 26 years of experience, hence are within this category of people that would welcome change compared to younger or older colleagues.

The study suggests that teachers do not perceive professional development as having a major impact on how they act in their classrooms. It also indicates that, in the cases observed, the paradigm shift required from the policies is not facilitated by the current professional development and that the enactment of the expected changes in the classrooms are limited in the two different contexts under study.

8.6 Limitations of the Study

This study gives insights into the entire process of continuing professional development of teachers in times of education reform. It gives detailed information about how teachers, within their individual contexts, perceive and utilise CPTD. Similarities between the two countries studied here add information about how to reach and impact teachers through professional development. However, the study is limited by different factors, one being that although the number of teacher is too small to generalize, it is large enough that data were limited in time—one semester, with only one lesson observation that does not allow the researcher to measure overall instruction. It does nevertheless indicate how teachers perceive good instruction, as they were asked to select a representative lesson, where they feel comfortable and competent. The lesson analysis tool, RTOP, was originally designed to be used by more than one trained observer, to validate the process (Piburn & Sawada, 2000b). In the case presented here, the different languages as well as the numerous lessons and CPTD activities did not allow for more than one observer to evaluate each activity. The absolute scores can therefore differ

when compared to other studies using the same tool, but the relative scaling between teachers and CPTD activity, as well as between countries remains useful. Also, the presence of the observer is known to alter behaviours and has to be taken into account. Another bias can also come from the selection of teachers, which was on a voluntary basis. Indeed, colleagues have mentioned (although anecdotally) the great difficulty of finding teachers to agree to an observer (and a video recorder) in their classroom. The more confident teachers are likely to be willing to cooperate, although none of the teachers approached in the present study refused to participate.

Another limitation is the honesty of the participants, which can be biased, particularly in a context where the culture of respect between teachers and authorities can elicit answers that represent what they believe is expected rather than what they believe. This phenomenon can lead to ‘rhetoric-reality gulfs’ (Schweisfurth, 2011, p. 426). The wide variety of tools used in the study however enabled a valid triangulation that contributes to closing the gap. In addition, the large amount of time spent with each participant created a trust relationship that would reduce this risk. It was observed that during the first interview, teachers made comments reflecting their concern: “Don’t tell the Department/Ministry/Subject advisor what I said...”. During the last interview they were more inclined to criticise authorities.

Also, as pointed out by Opfer and Pedder in their review (2011), the relationship between professional development and change in teachers’ attitudes, beliefs, and practices can only be inferred by correlation rather than a direct measure of its impact on these outcomes.

The study, although carefully designed and analysed, was conducted over a relatively short period of time, one semester. It could therefore be argued that the impact of the particular CPTD activity could not be evaluated to its full potential. It is indeed worth considering that changing values, beliefs and attitudes takes time but there is also strong world-wide evidence that the impact of a particular training diminishes over time, particularly for learner-centred methods (Mohammad & Harlech-Jones, 2008; Mustafa & Cullingford, 2008; Thair & Treagust, 2003). Also, as discussed earlier, the number of cases is small which limits the generalization of the findings. Also, one always have to consider the Hawthorne effect when analysing and interpreting data, which is the consideration that any situation would have been different should the observer—researcher, not be there.

8.7 Conclusion and recommendations

The study shows that the policies pertaining to continuing professional development are prescriptive in KwaZulu-Natal and rely on power to motivate teachers towards professional development activities. In Québec, incentives are more authoritarian and rely on intrinsic motivation. These policies could be explained in light of the inequalities in South Africa and the need to increase teachers' competency, whereas the policies in Québec are targeting homogenous teachers with focused development needs and therefore would be context-adapted. However, their possible impact on the emergence of teachers' professional identity as managerialist or democratic, which can in turn impact on the emergence of professional capital, should be considered.

The investment in professional development did not bear fruit in developing human capital for the implementers, especially in KwaZulu-Natal where subject advisors are inadequately appointed and professionally resourced. The CPTD activities offered are poorly aligned with the intended reformed PCK which does not provide adequate exposure for teachers, once again especially in KwaZulu-Natal although Québec's were also insufficiently aligned.

The six teachers observed did not perceive CPTD as a major vector of change. Rather, in the most positive cases, they felt it can provide helpful content knowledge for newly introduced curricular subjects where they recognise a need. For example, in South Africa, the workshops that had the greatest impact were the ones giving content focus on evolution, a new subject in which teachers felt they needed more information than the mere activities in a textbook. In Québec, it is professional development about Technology, and technical drawing, as well as Astronomy that teachers have mentioned impacting on their practices, all of them new subjects in which they felt under-competent. However, none of the teachers reported needing more information about how to create a learner-centred classroom or to teach using competency or inquiry-based methods, all of which were essential in the reforms. Indeed they did not, in general, identify PCK as a lack in their teaching armamentarium, although the pedagogy used in classrooms was misaligned with the reform requirements. The use of textbooks has been found to potentially reduce the perceived need for CPTD as it provides them with classroom guidance. Hence, the observed teachers were seeking continuing professional development only if they felt a need while performing their daily activities. Therefore the need to identify their needs should be addressed. No one is more knowledgeable than someone who knows nothing. One who knows very little ignores the fact that there is more to know. A minimum

mandatory CPTD through social practice during the first year of pre implementation as well as the first years of implementation would require a reorganisation of the school calendar but would be an investment that could generate invaluable professional capital. It could make the later investment in CPTD more profitable, better attended and certainly more coherent and efficient. Indeed, as teachers know what there is to know and what they do not know, they might seek pedagogical content knowledge and not only content knowledge to fill a gap from a new subject introduced in the programme. As the systemic reforms nowadays aim at modifying teachers' attitude by creating a different school environment, the Pedagogical aspect of PCK cannot be unaccounted for in CPTD, and the senior management team in a school has a key responsibility in creating a culture for learning.

Three major recommendations emerge from this study:

- 1) Formal professional development activities should represent and be aligned with the reform being implemented. In the present case, learner-centred, inquiry-based applications of constructivist teaching have to be exemplified during these activities.
- 2) A reorganisation of the school-structure and instruction time is necessary to allow for collaboration and professional development to occur during school time, more so and more formalised during the first years of reform implementation. Professional development would be part of a collaborative learning culture, hence building social capital.
- 3) The use of textbooks and teaching and learning support material for continuing professional development could create a uniform learning basis for teachers. These materials, in conjunction with other professional development activities, should emphasise the reform philosophies theoretically but mostly practically.

Appendices

Appendix A. List of analysed documents

South Africa

Name of document	Author	Date	Reference
Strategic Plan 2011-2014	Department of Basic Education, RSA	2011	(Department of Education, 2011)
Integrated Strategic Planning Framework for Teacher Education and Development in South Africa	Department of Basic Education/Higher Education and Training, RSA	2011	(Department of Basic Education & Department of Higher Education and Training, 2011)
Action Plan to 2014: Towards the Realisation of Schooling 2025	Department of Basic Education, RSA	2011	(Department of Basic Education, 2011c)
Strategic Plan 2010/2011-2014/2015	Department of Education, KZN	2010	(KZN Department of Education, 2010)
The Design of the Continuing Professional Teacher Development System	South African Council of Educators	2008	(Department of Education, 2008b)
Framework for the National Strategy for Learner Attainment (NSLA)	Department of Education, RSA	2007	(Department of Education, 2007a)
National Policy Framework for Teacher Education and Development	South African Council for Educators	2008	(South African Council for Educators, 2008)
NCS Training Manual: Life Sciences	Department of Education, RSA	2007	(Department of Education, 2007b)

Québec

Name of document	Author	Date	Reference
Education act	Gouvernement du Québec	2012	(Gouvernement du Québec, 2012)
An Act to promote workforce skills development and recognition	Gouvernement du Québec	2011	(Gouvernement du Québec, 2011)
Orientation for the professional development of teachers	Minsitère de l'Éducation du Québec (MEQ)	1999	(Ministère de l'Éducation du Québec, 1999)
A new direction for success-ministerial plan of action for the reform of the education system	Minsitère de l'Éducation du Québec (MEQ)	1997	(Ministère de l'Éducation du Québec, 1997)
Québec schools on course (L'école tout un programme)	Minsitère de l'Éducation du Québec (MEQ)	1997	(Ministère de l'Éducation du Québec, 1997b)

**Appendix B. Detailed Reform Teaching Observation Protocol (RTOP)
scores for continuing professional development activities**

1. Durban Workshop

Item	Score
1. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	2
2. The lesson was designed to engage students as members of a learning community.	1
3. In this lesson, student exploration preceded formal presentation.	0
4. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	0
5. The focus and direction of the lesson was often determined by ideas originating with students.	0
Lesson Design and Implementation	3
6. The lesson involved fundamental concepts of the subject.	3
7. The lesson promoted strongly coherent conceptual understanding.	2
8. The teacher had a solid grasp of the subject matter content inherent in the lesson.	2
9. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	2
10. Connections with other content disciplines and/or real world phenomena were explored and valued.	2
Content: Propositional knowledge	11
11. Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent phenomena.	0
12. Students made predictions, estimations and/or hypotheses and devised means for testing them.	0
13. Students were actively engaged in thought-provoking activity that often involved the critical assessment of procedures.	0
14. Students were reflective about their learning.	0
15. Intellectual rigor, constructive criticism, and the challenging of ideas were valued.	1
Content: Procedural knowledge	1
16. Students were involved in the communication of their ideas to others using a variety of means and media.	0
17. The teacher's questions triggered divergent modes of thinking.	1
18. There was a high proportion of student talk and a significant amount of it occurred between and among students.	0
19. Student questions and comments often determined the focus and direction of classroom discourse.	0
20. There was a climate of respect for what others had to say.	3
Classroom culture: communicative interactions	4
21. Active participation of students was encouraged and valued.	1
22. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	1
23. In general the teacher was patient with students.	3

24. The teacher acted as a resource person, working to support and enhance student investigations.	1
25. The metaphor “teacher as listener” was very characteristic of this classroom.	1
Classroom culture: student/teacher relationships	7
TOTAL	26

2. APSQ meeting

Item	APSQ conference scores				
	Genes	WET	POP	Leek	Mean
1. The instructional strategies and activities respected students’ prior knowledge and the preconceptions inherent therein.	3	3	3	1	2,5
2. The lesson was designed to engage students as members of a learning community.	3	3	2	2	2,5
3. In this lesson, student exploration preceded formal presentation.	0	2	1	1	1,0
4. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	1	3	3	1	2,0
5. The focus and direction of the lesson was often determined by ideas originating with students.	0	2	1	1	1,0
Lesson Design and Implementation	7	13	10	6	9,0
6. The lesson involved fundamental concepts of the subject.	2	2	3	1	2,0
7. The lesson promoted strongly coherent conceptual understanding.	2	2	2	0	1,5
8. The teacher had a solid grasp of the subject matter content inherent in the lesson.	2	3	3	3	2,8
9. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	1	2	3	2	2,0
10. Connections with other content disciplines and/or real world phenomena were explored and valued.	3	4	3	2	3,0
Content: Propositional knowledge	10	13	14	8	11
11. Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent phenomena.	0	2	1	1	1,0
12. Students made predictions, estimations and/or hypotheses and devised means for testing them.	1	1	3	0	1,3
13. Students were actively engaged in thought-provoking activity that often involved the critical assessment of procedures.	1	2	1	1	1,3
14. Students were reflective about their learning.	0	2	1	0	0,8
15. Intellectual rigor, constructive criticism, and the challenging of ideas were valued.	1	1	1	1	1,0
Content: Procedural knowledge	3	8	7	3	5

16. Students were involved in the communication of their ideas to others using a variety of means and media.	0	1	0	1	0,5
17. The teacher's questions triggered divergent modes of thinking.	1	1	1	1	1,0
18. There was a high proportion of student talk and a significant amount of it occurred between and among students.	1	4	1	1	1,8
19. Student questions and comments often determined the focus and direction of classroom discourse.	1	2	1	2	1,5
20. There was a climate of respect for what others had to say.	3	4	3	3	3,3
Classroom culture: communicative interactions	6	12	6	8	8
21. Active participation of students was encouraged and valued.	3	4	4	3	3,5
22. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	1	1	3	1	1,5
23. In general the teacher was patient with students.	3	3	3	2	2,8
24. The teacher acted as a resource person, working to support and enhance student investigations.	2	2	2	2	2,0
25. The metaphor "teacher as listener" was very characteristic of this classroom.	1	2	2	1	1,5
Classroom culture: student/teacher relationships	10	12	14	9	11
TOTAL	36	58	51	34	45 (rounded)

3. Pedagogical days

Item	Pedagogical days	
	David	Danny
1. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	2	3
2. The lesson was designed to engage students as members of a learning community.	3	2
3. In this lesson, student exploration preceded formal presentation.	1	3
4. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	2	2
5. The focus and direction of the lesson was often determined by ideas originating with students.	3	2
Lesson Design and Implementation	11	12
6. The lesson involved fundamental concepts of the subject.	0	1
7. The lesson promoted strongly coherent conceptual understanding.	0	1

8. The teacher had a solid grasp of the subject matter content inherent in the lesson.	3	2
9. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so.	0	1
10. Connections with other content disciplines and/or real world phenomena were explored and valued.	2	3
Content: Propositional knowledge	5	8
11. Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent phenomena.	0	1
12. Students made predictions, estimations and/or hypotheses and devised means for testing them.	0	1
13. Students were actively engaged in thought-provoking activity that often involved the critical assessment of procedures.	2	3
14. Students were reflective about their learning.	2	1
15. Intellectual rigor, constructive criticism, and the challenging of ideas were valued.	1	2
Content: Procedural knowledge	5	8
16. Students were involved in the communication of their ideas to others using a variety of means and media.	0	1
17. The teacher's questions triggered divergent modes of thinking.	0	1
18. There was a high proportion of student talk and a significant amount of it occurred between and among students.	3	4
19. Student questions and comments often determined the focus and direction of classroom discourse.	2	3
20. There was a climate of respect for what others had to say.	3	3
Classroom culture: communicative interactions	8	12
21. Active participation of students was encouraged and valued.	3	4
22. Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	1	2
23. In general the teacher was patient with students.	3	3
24. The teacher acted as a resource person, working to support and enhance student investigations.	1	3
25. The metaphor "teacher as listener" was very characteristic of this classroom.	1	3
Classroom culture: student/teacher relationships	9	15
TOTAL	38	55

Appendix C. Example of interview questions

First interview: Pre CPTD and classroom observation

1. How long have you been teaching here?
 - a. Did you have previous experience in teaching?
2. Why did you choose to become a teacher?
 - a. And why Biology (Life Sciences)?
3. What is your general opinion on the new curriculum (CNS)?
4. Do you feel like you were given sufficient information to teach according to the requirements of the new curriculum?
 - a. Where did you gather the information about the new content and evaluation proposed in the new curriculum?
 - b. Do you talk about it with your colleagues?
 - c. With your students?
 - d. With your cluster group?
5. Do you think the new curriculum helped the learners to acquire knowledge?
 - a. Do you think they are effectively better persons and more prepared for the world, as the new curriculum intends to do?
6. Is it necessary to have a deep understanding of genetics to understand evolution?
Why?
7. Do you think your participation to the workshop can have an influence on your classroom practices?
 - a. And on the performances of students?

Post CPTD and classroom observation

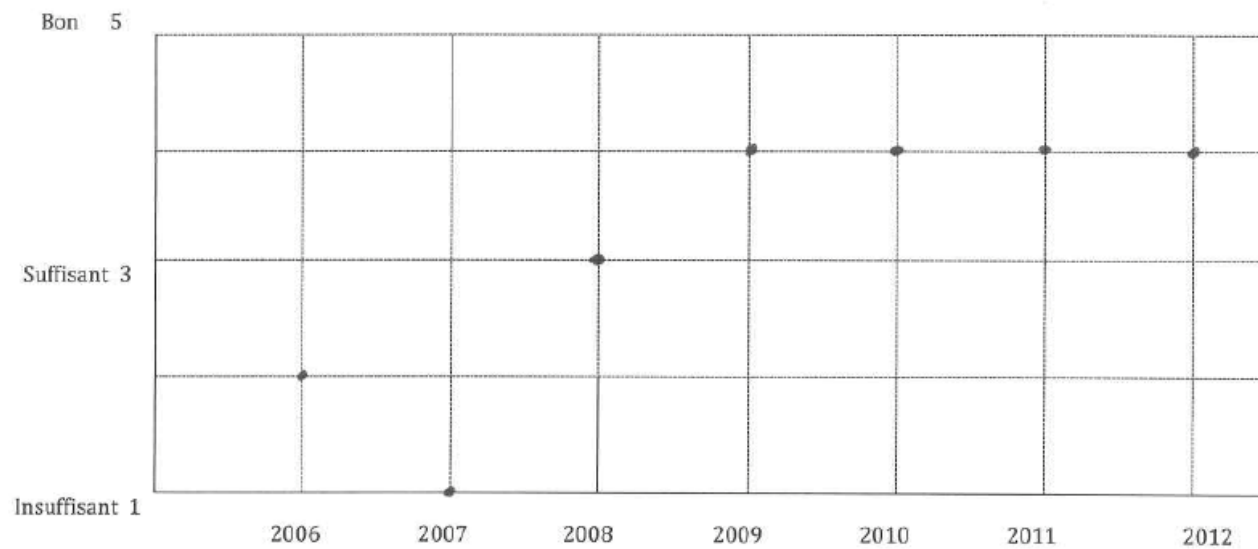
8. What were the most important things you learnt from the workshop?
 - a. Can you tell me some more about that?
9. Can that workshop influence your teaching?
 - b. How so?
10. Is it necessary to have a good understanding of genetics to understand evolution?
Why?
11. Do you think your participation in a cluster group help your teaching?
 - a. And your understanding of the content to be taught?

12. How would you describe, in your own words, the outcomes based education (OBE) as it was intended by the Department?
13. Did you use the work plan made in the workshop to plan your lessons on evolution?
 - c. Did you get the work plan back from other groups?
14. Did you use the examination guidelines to plan your lessons on evolution?
15. Did you use the content material given in the workshop to plan your lessons on evolution?
 - d. Where did you get the worksheet you gave in the lesson I attended for example?
 - e. Where did you get most of your information for it?
16. What did you use to plan the lesson that I have observed, and to write the hand-outs?
17. How do you think you have gained most of your confidence as a teacher?

Appendix D. Examples of a teacher's storyline

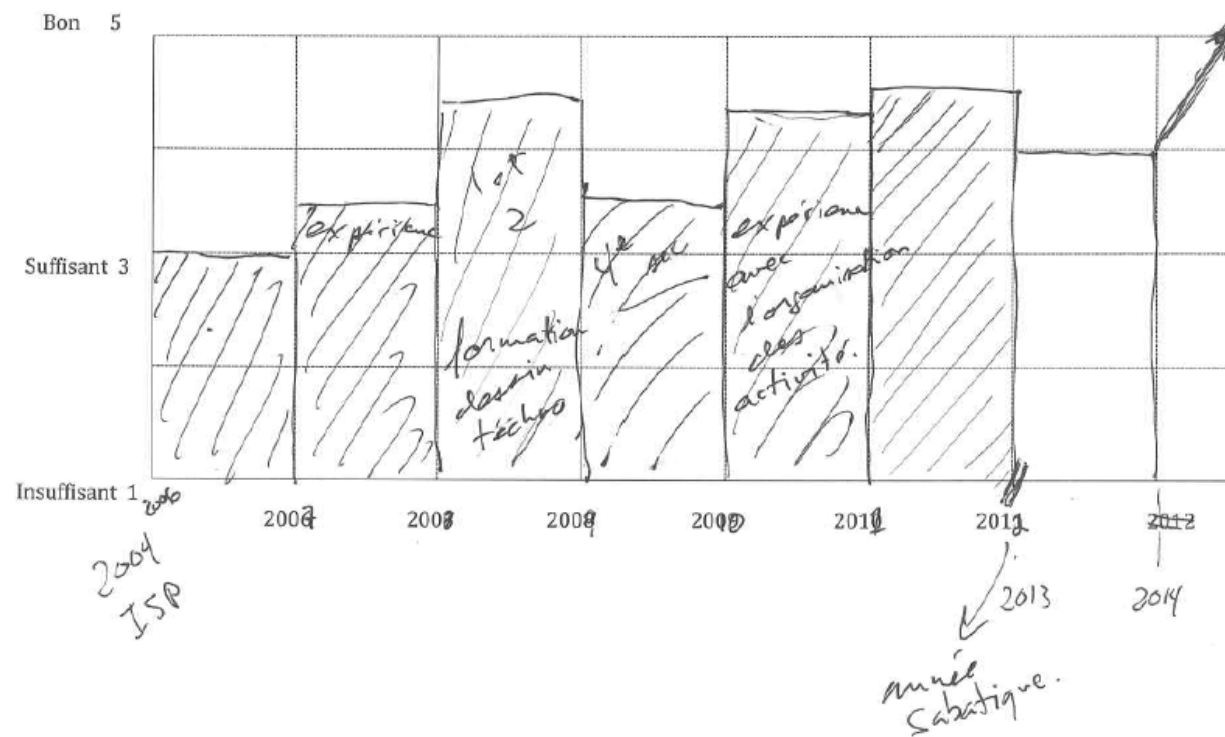
1. Danny

Perception de votre compétence à enseigner le nouveau programme de science au fil des ans

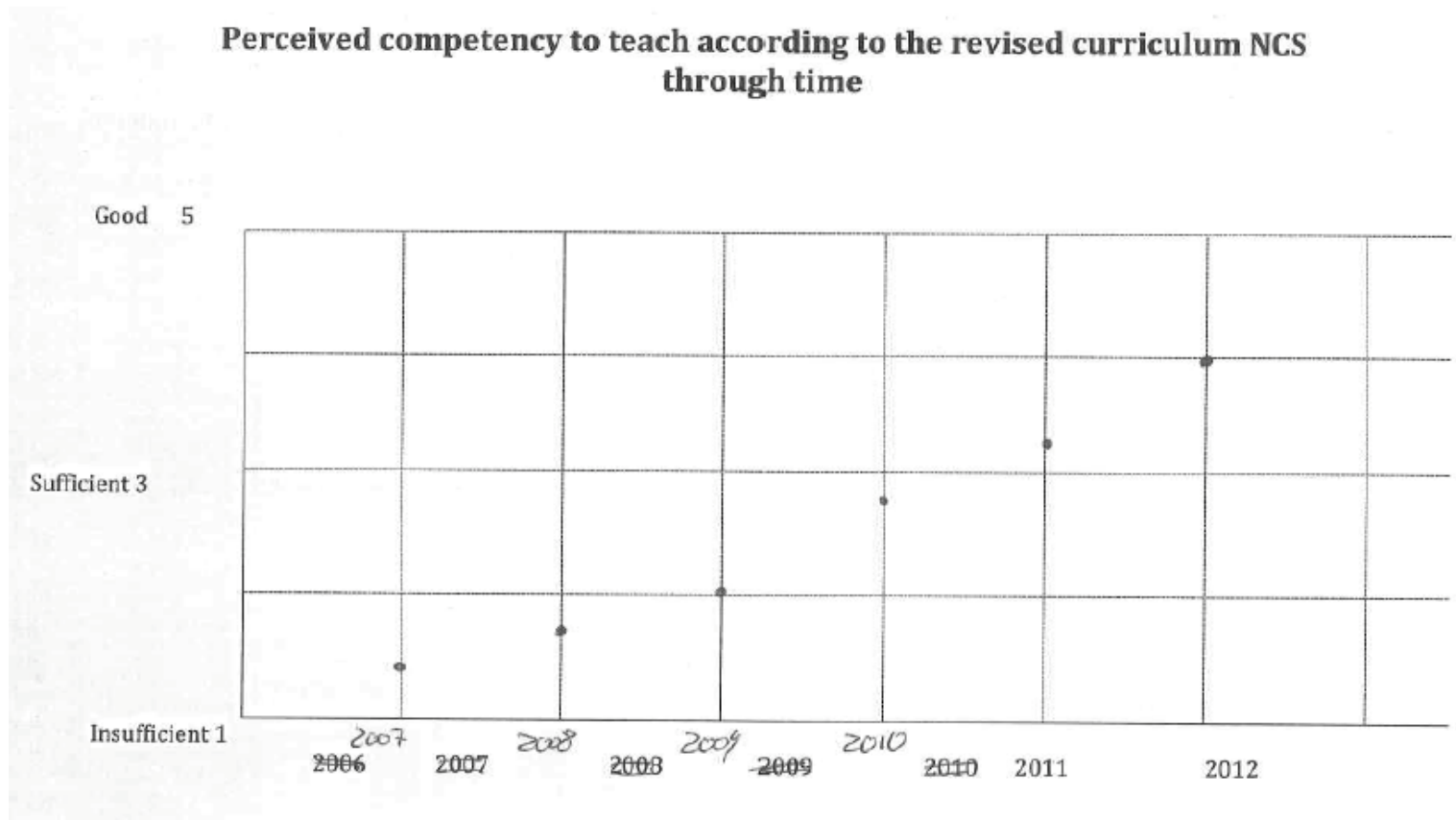


2. David

Perception de votre compétence à enseigner le nouveau programme de science au fil des ans

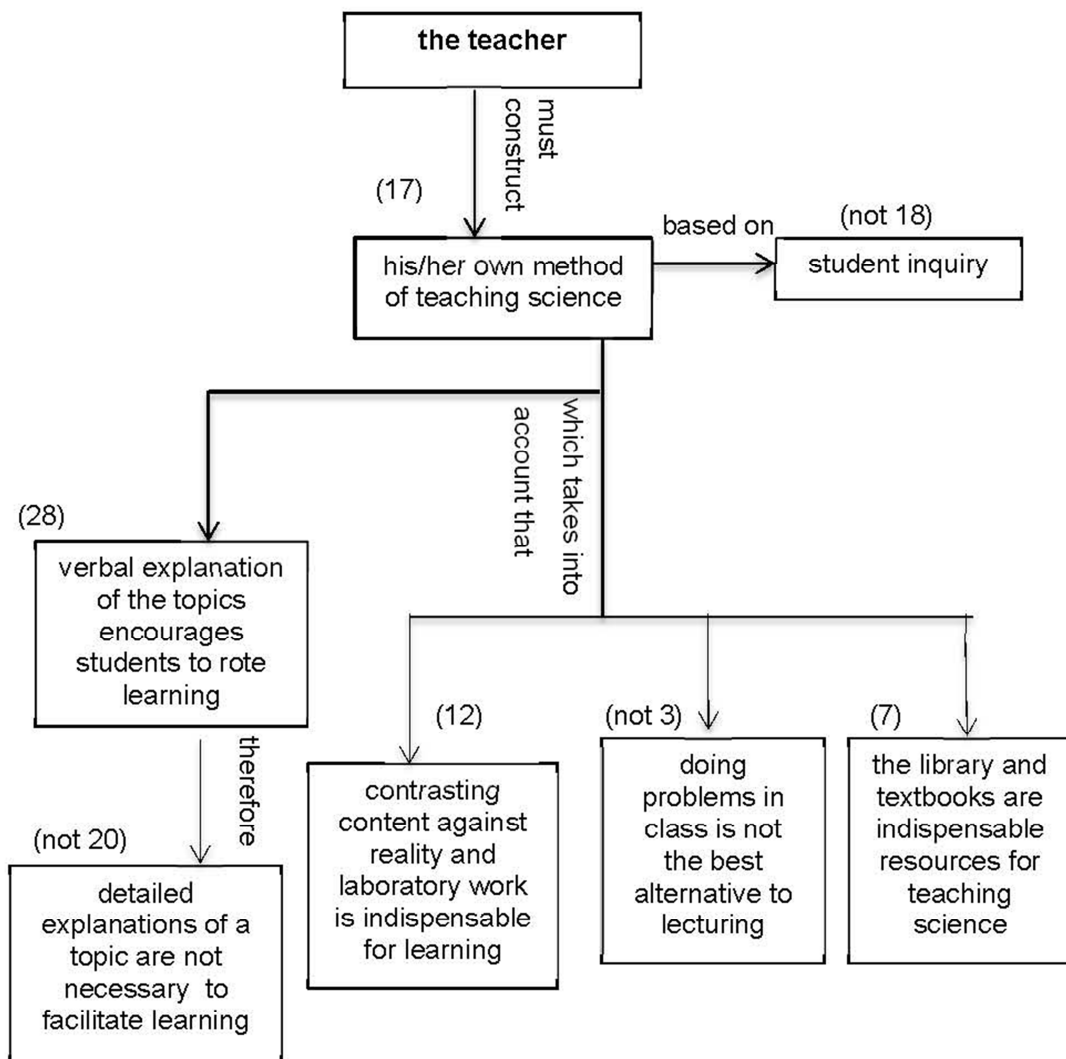


3.Vuyo

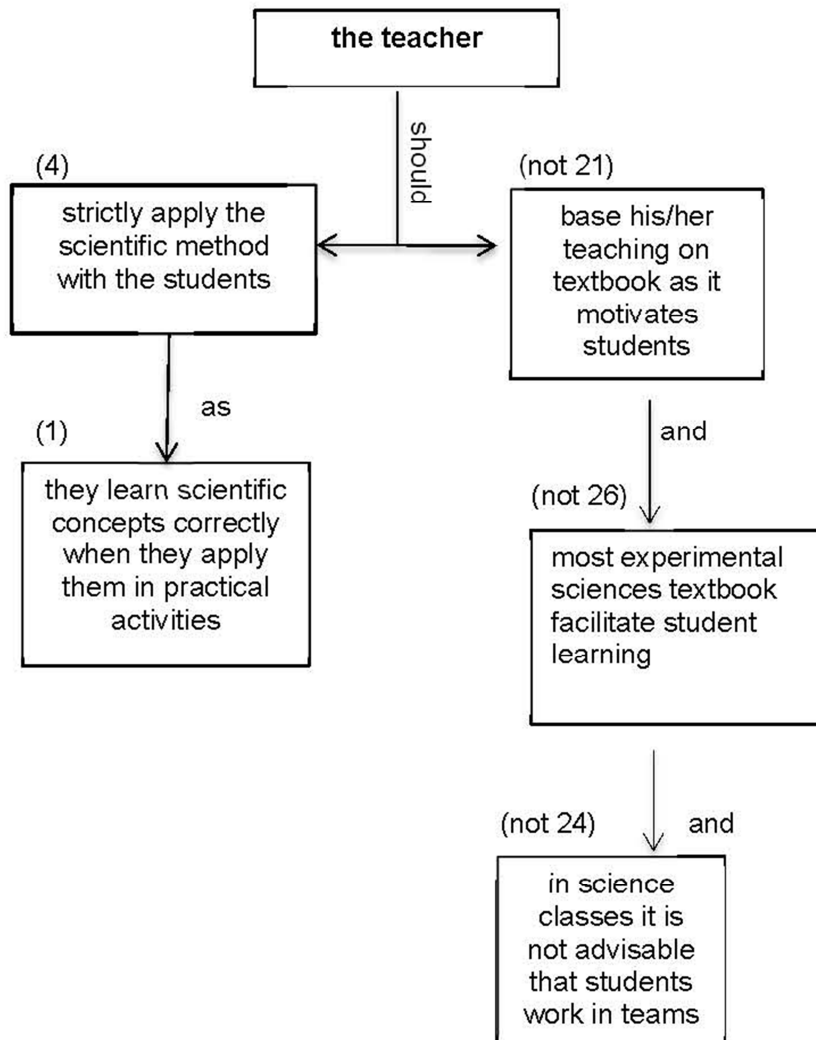


Appendix E. Teachers cognitive maps based on the INPECIP questionnaire

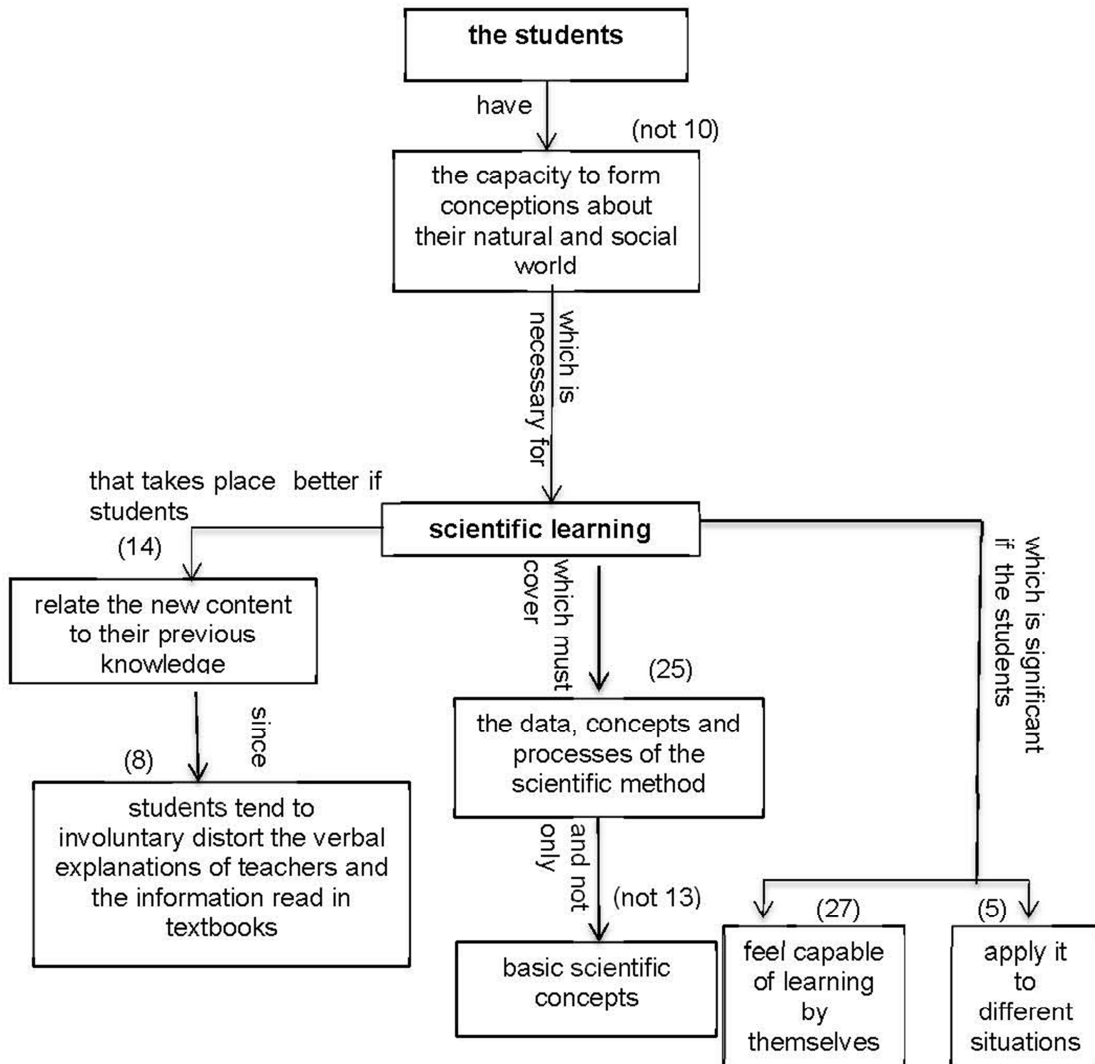
Danny's constructivist cognitive map on science teaching



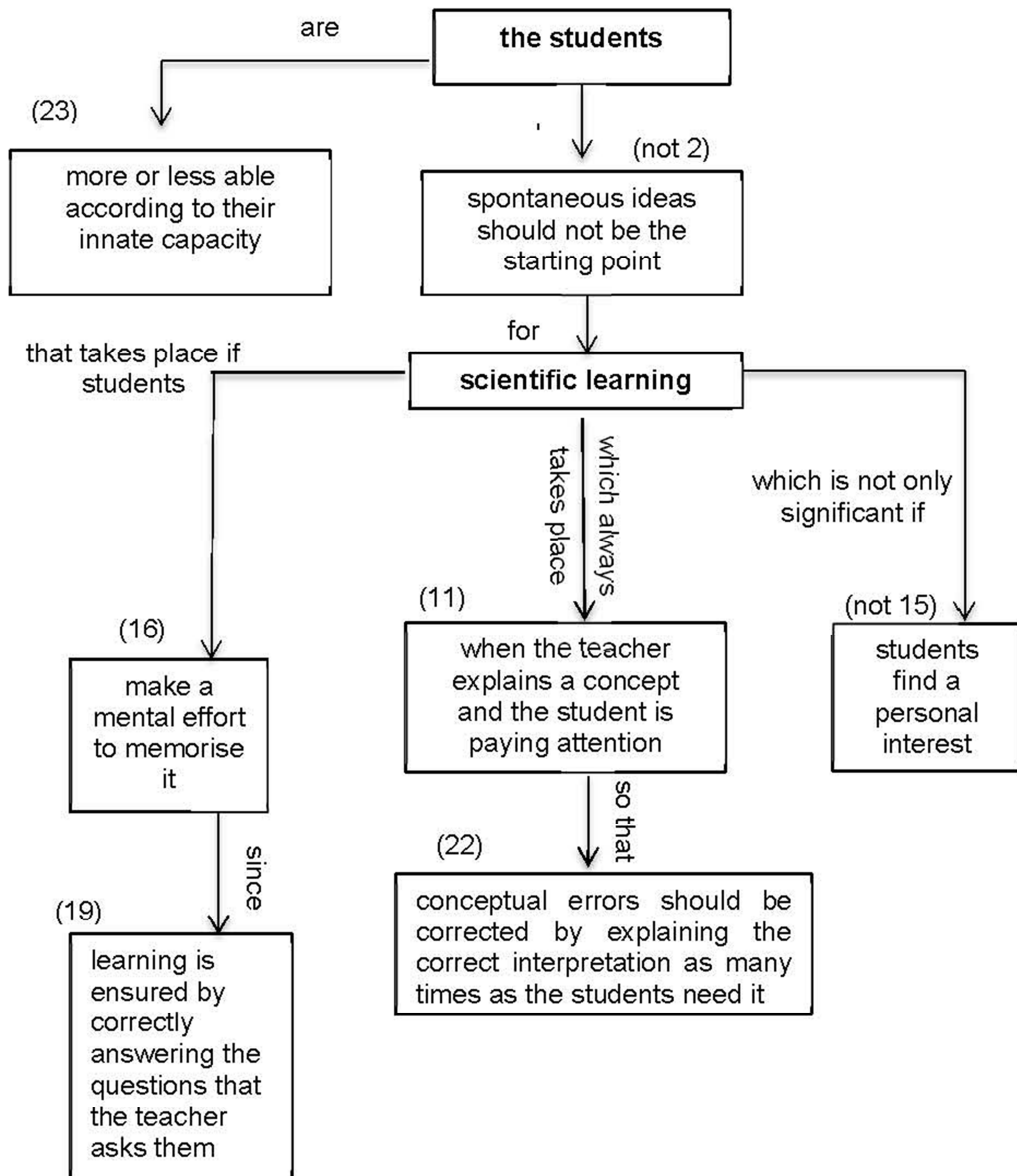
Danny's traditional cognitive map on science teaching



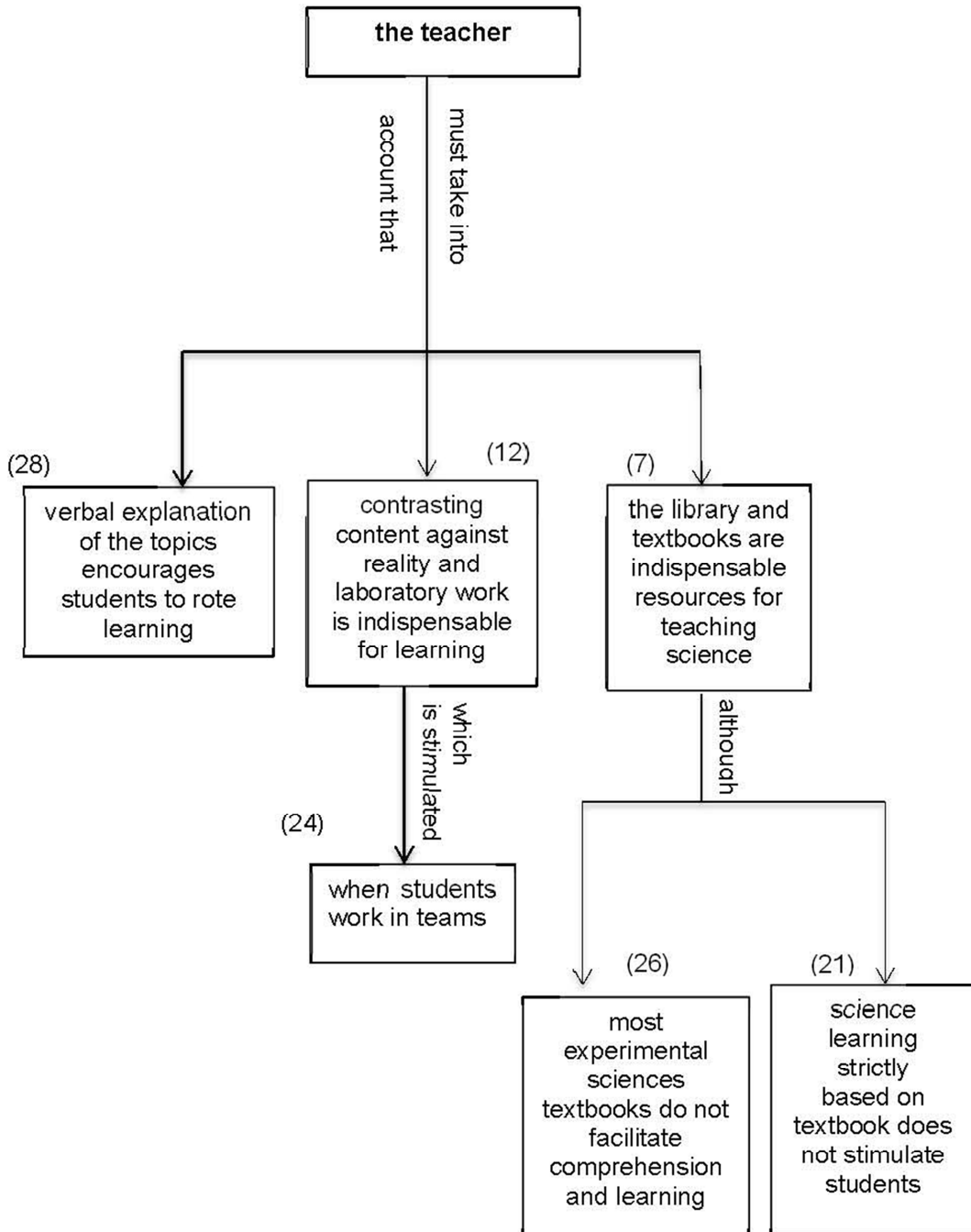
Danny's constructivist cognitive map on science learning



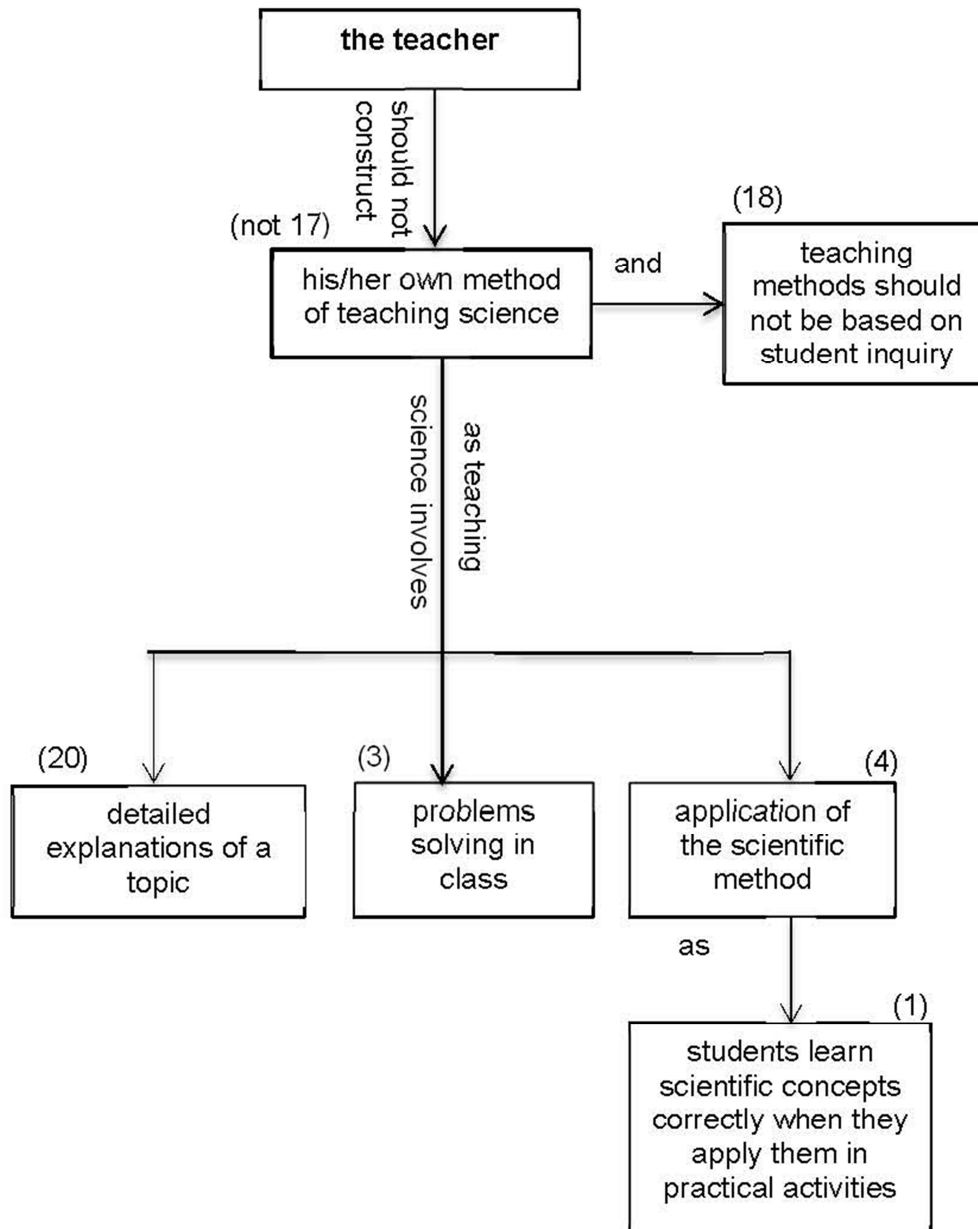
Danny's traditional cognitive map on science learning



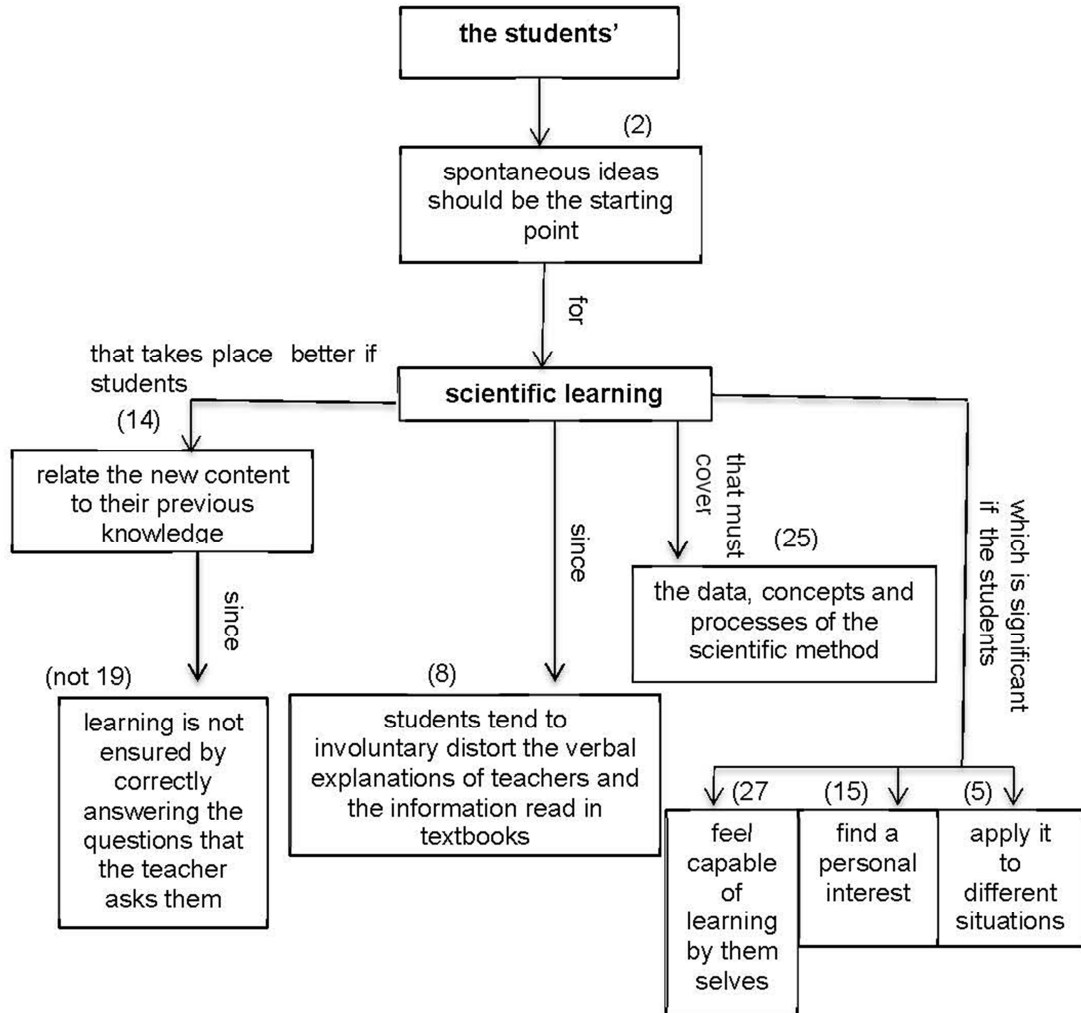
Vuyo's constructivist cognitive map of science teaching



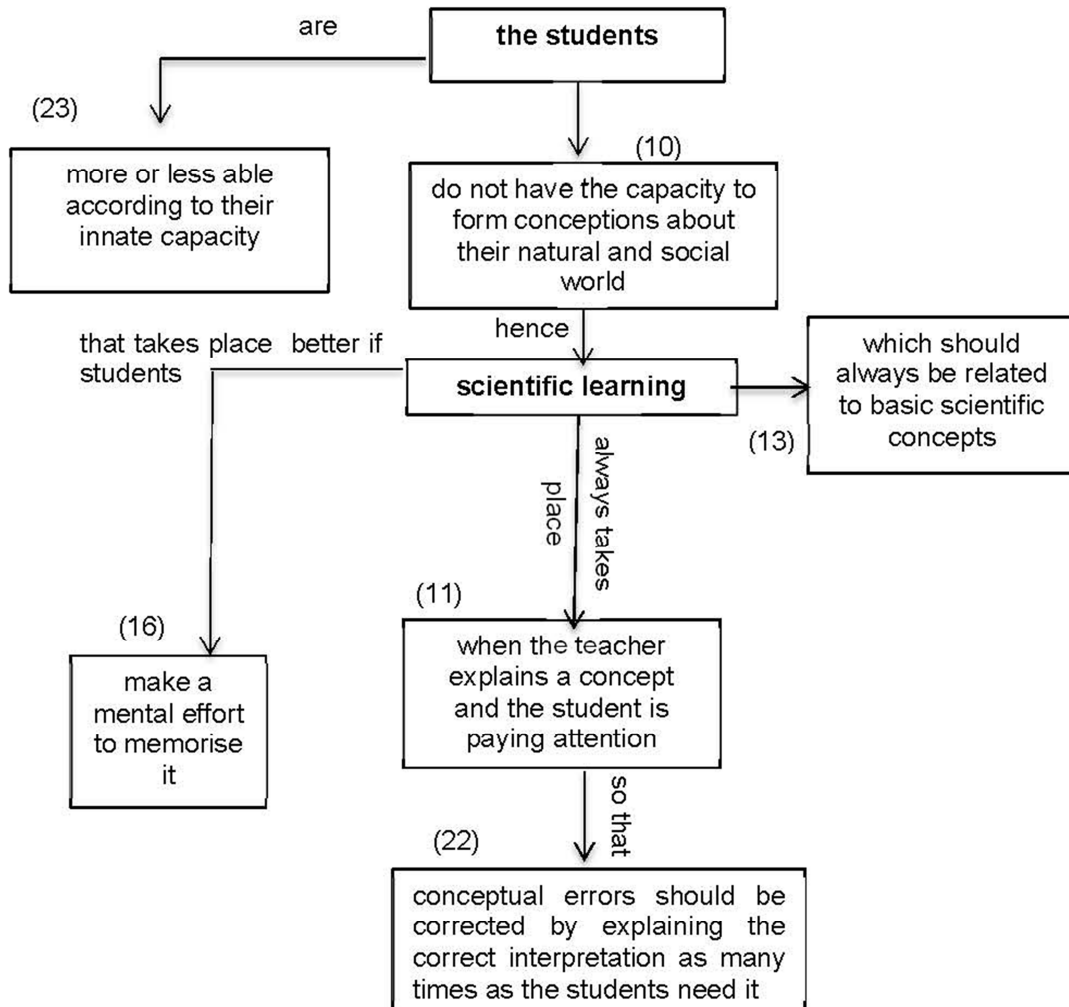
Vuyo's traditional cognitive map for science teaching



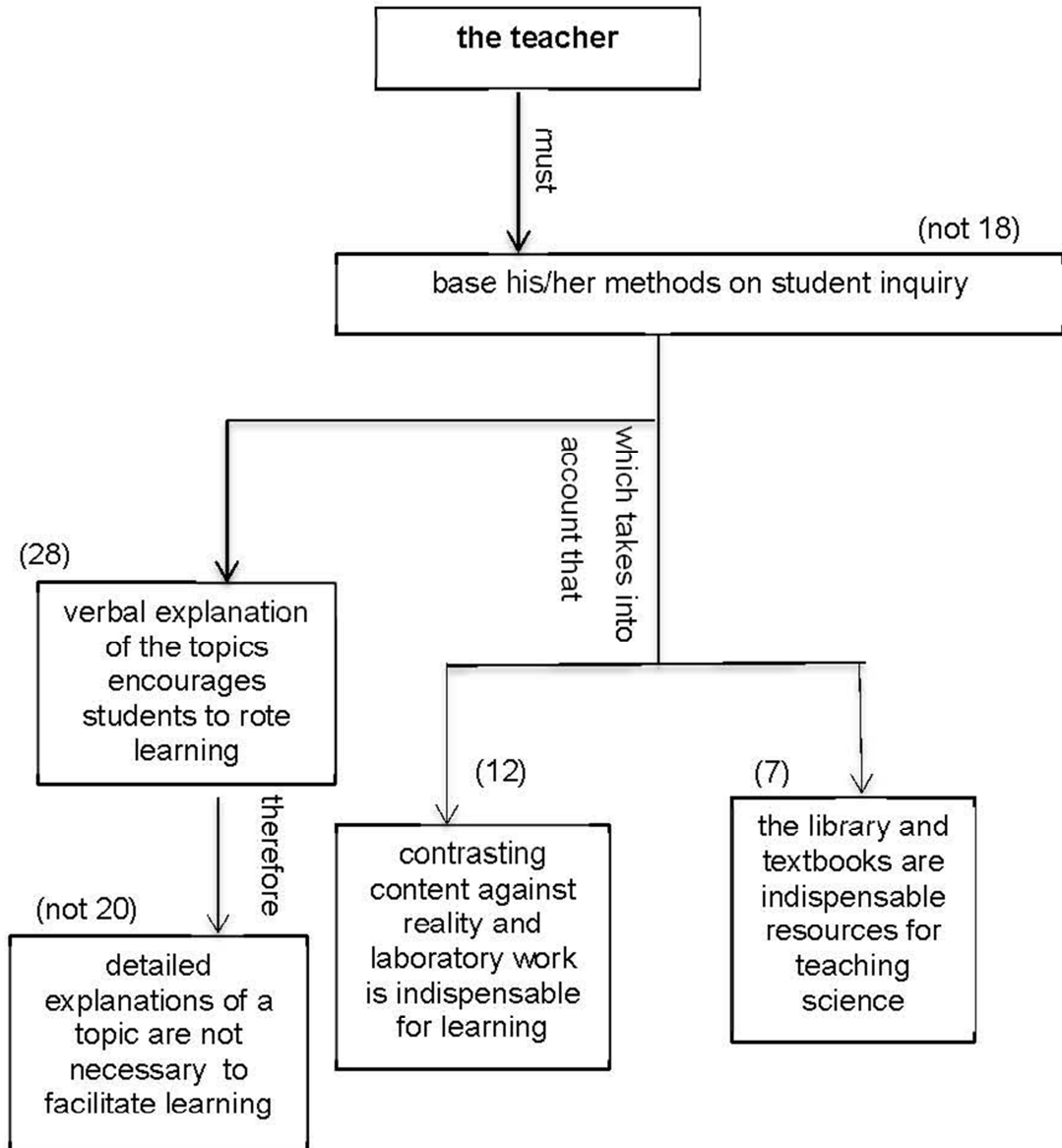
Vuyo's constructivist cognitive map on science learning



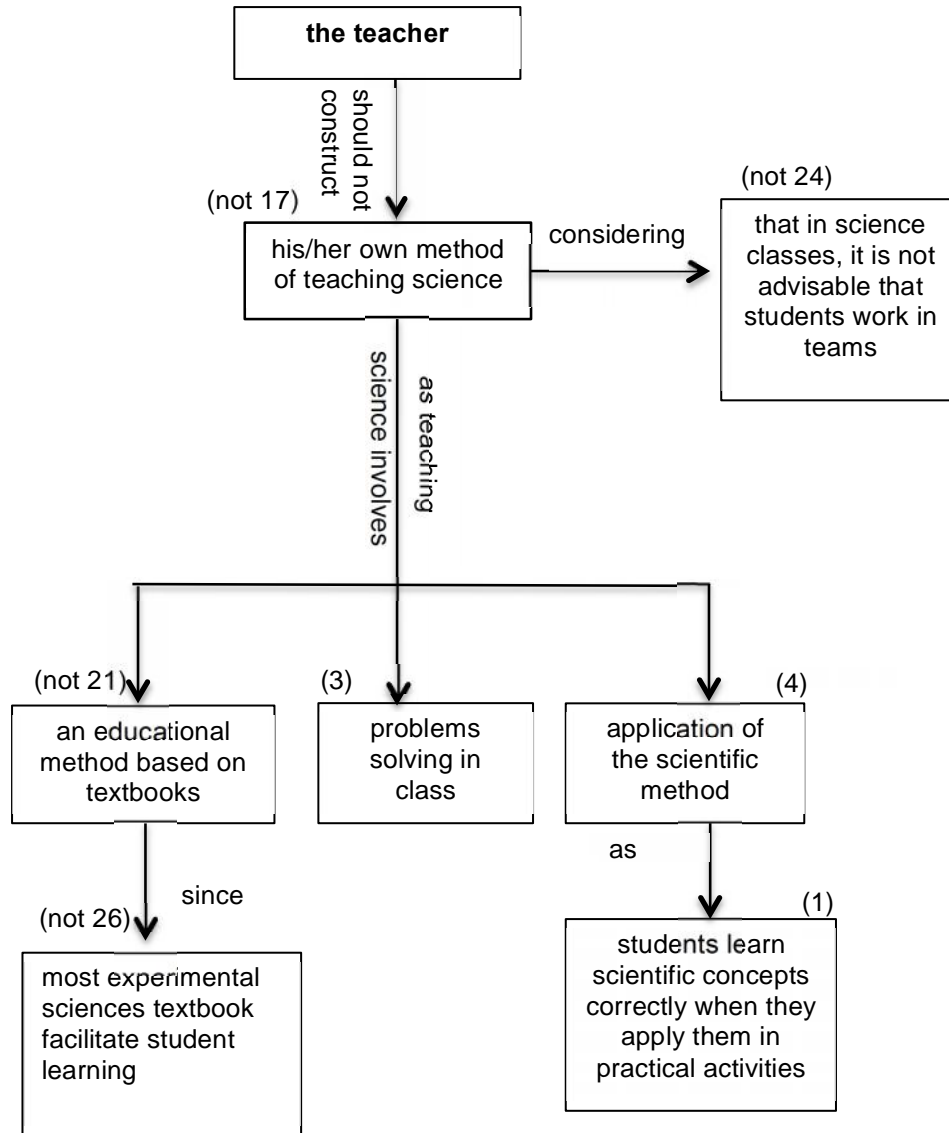
Vuyo's traditional cognitive map on science learning



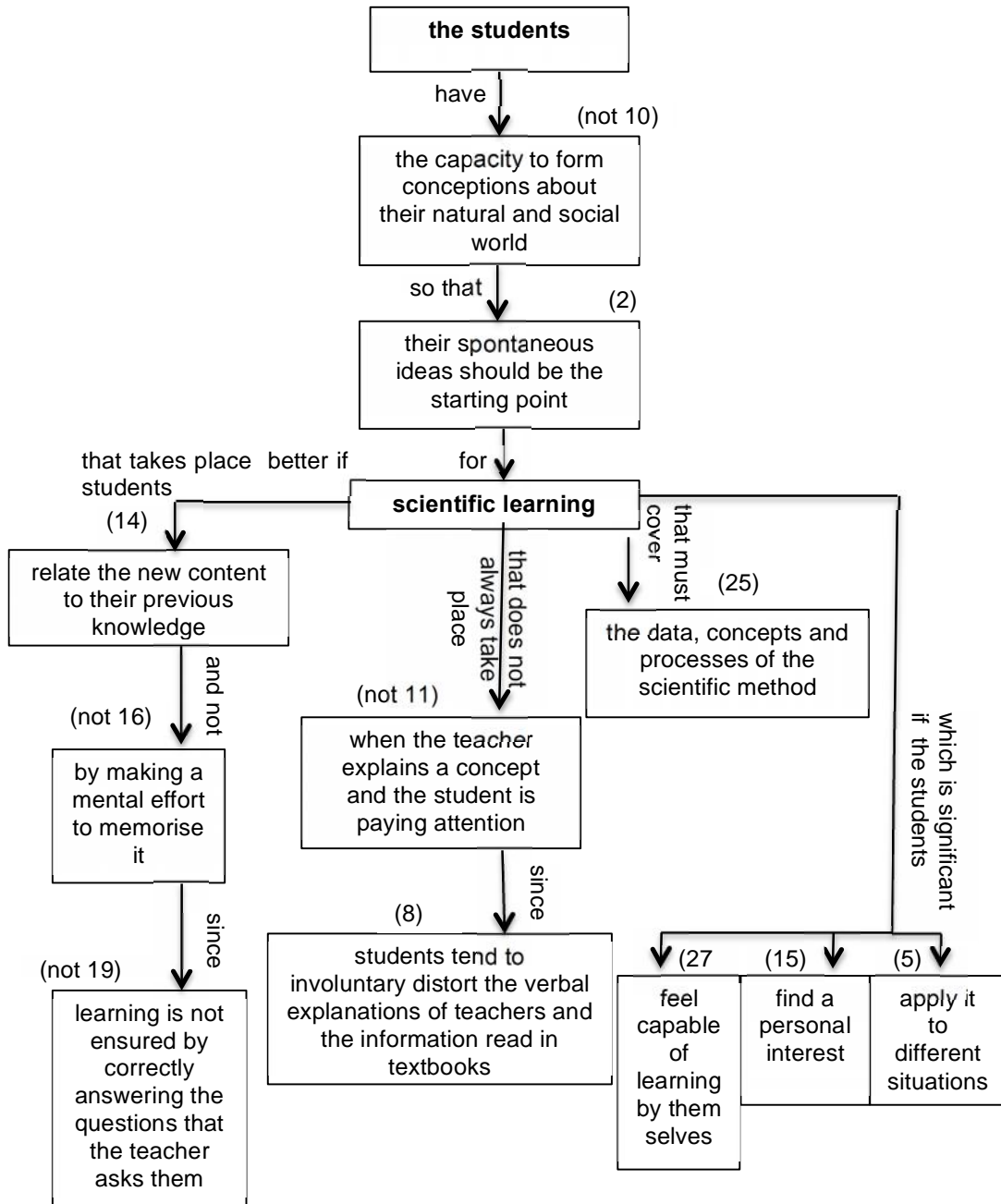
Pirindha's constructivist cognitive map of science teaching



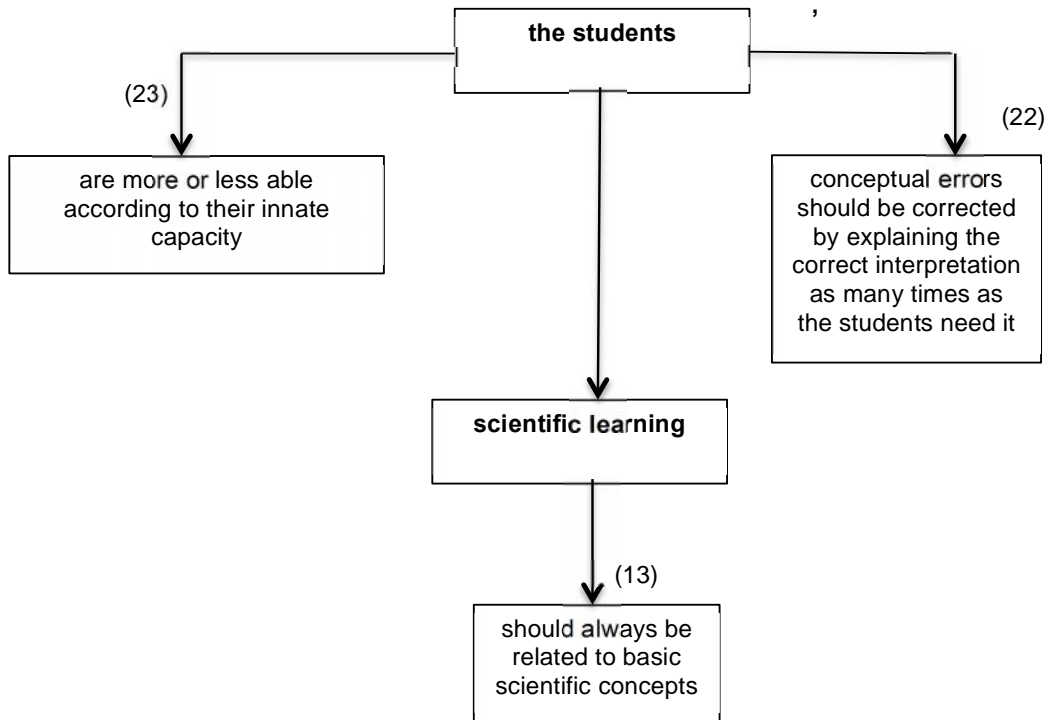
Pirindha's traditional cognitive map of science teaching



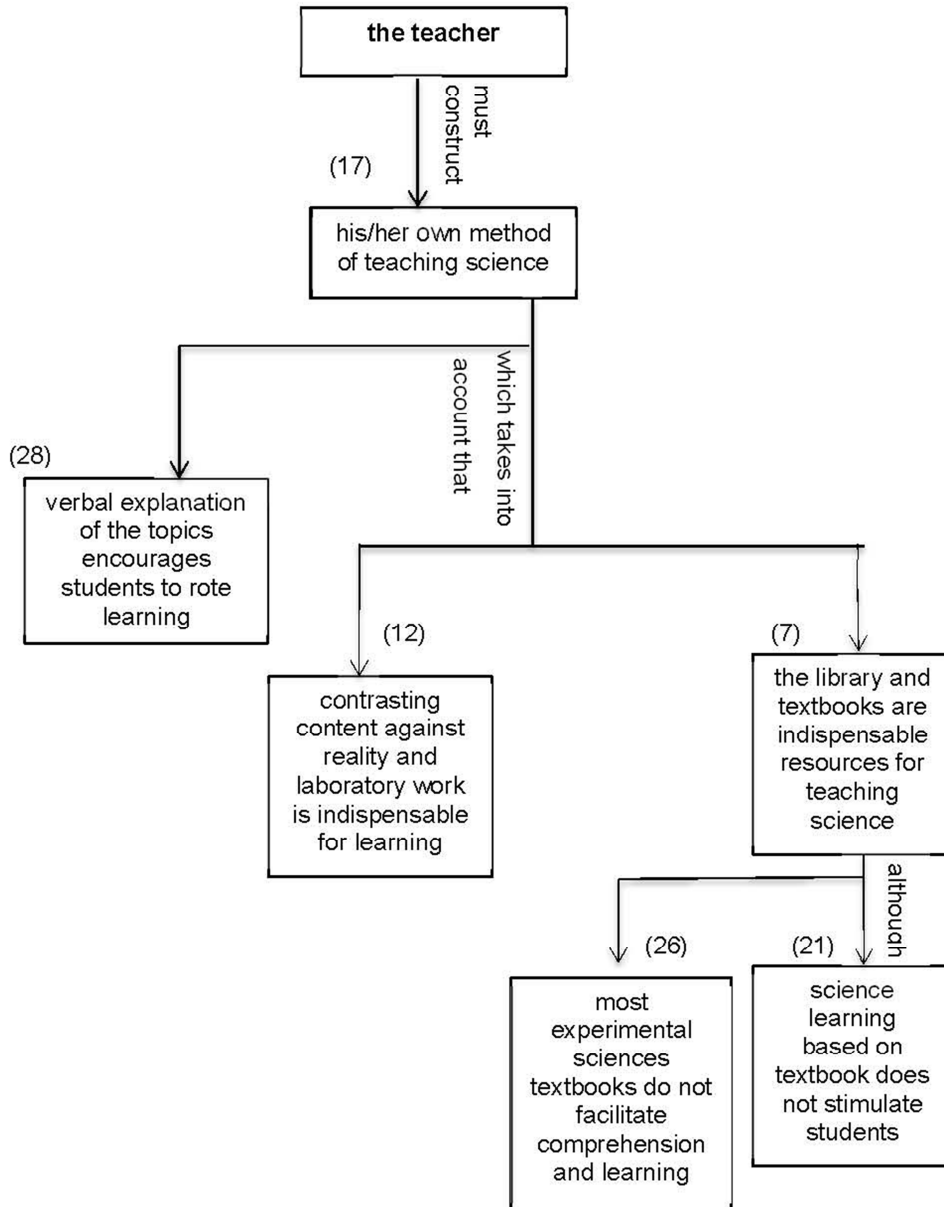
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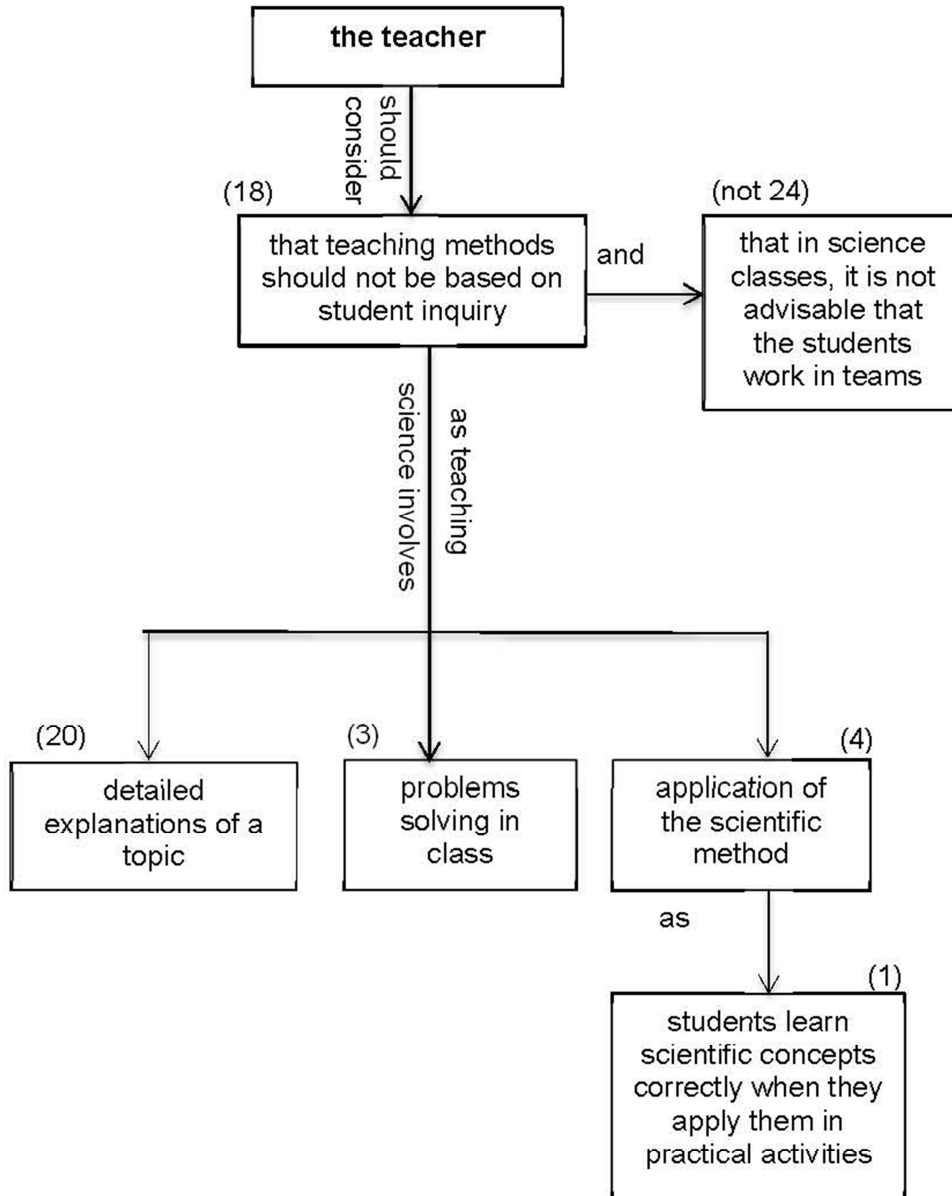
Pirindha's traditional cognitive map of science learning



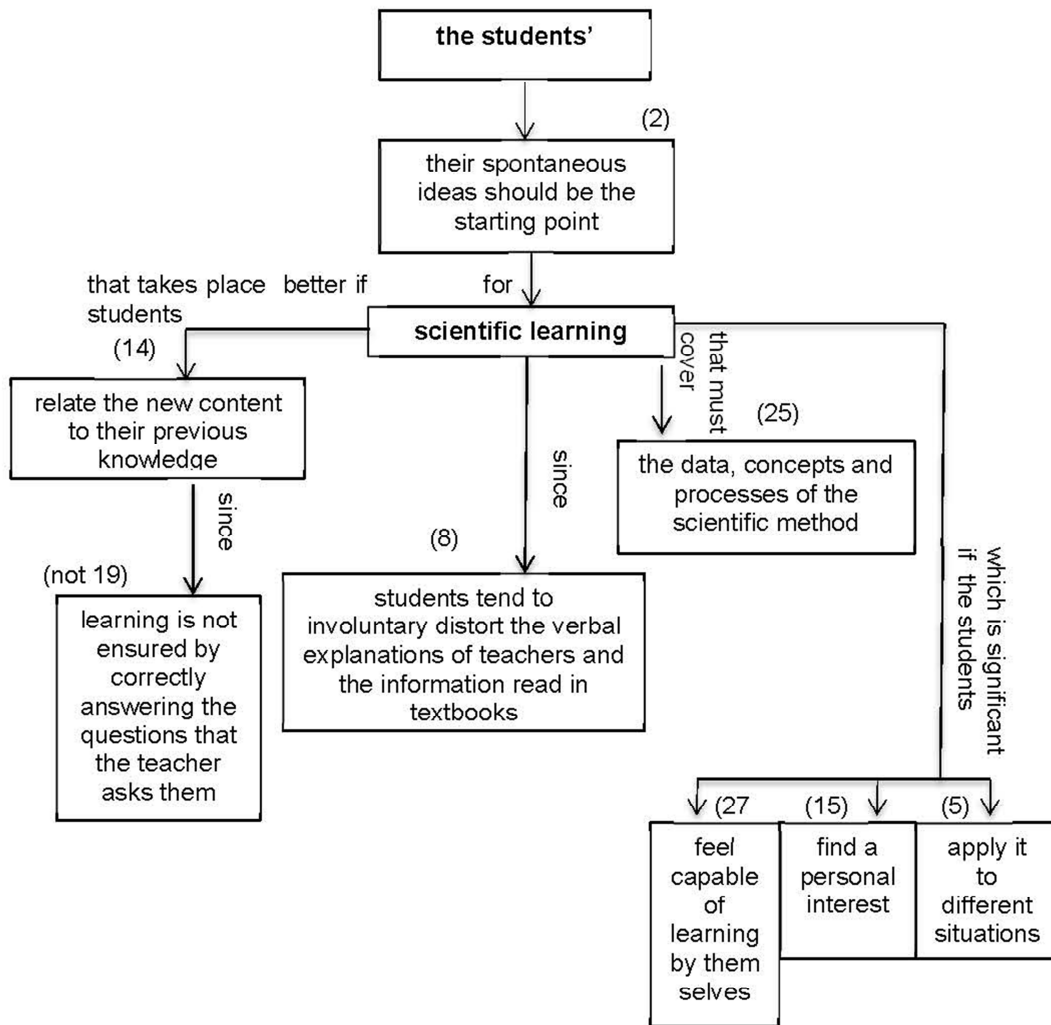
Samantha's constructivist cognitive map of science teaching



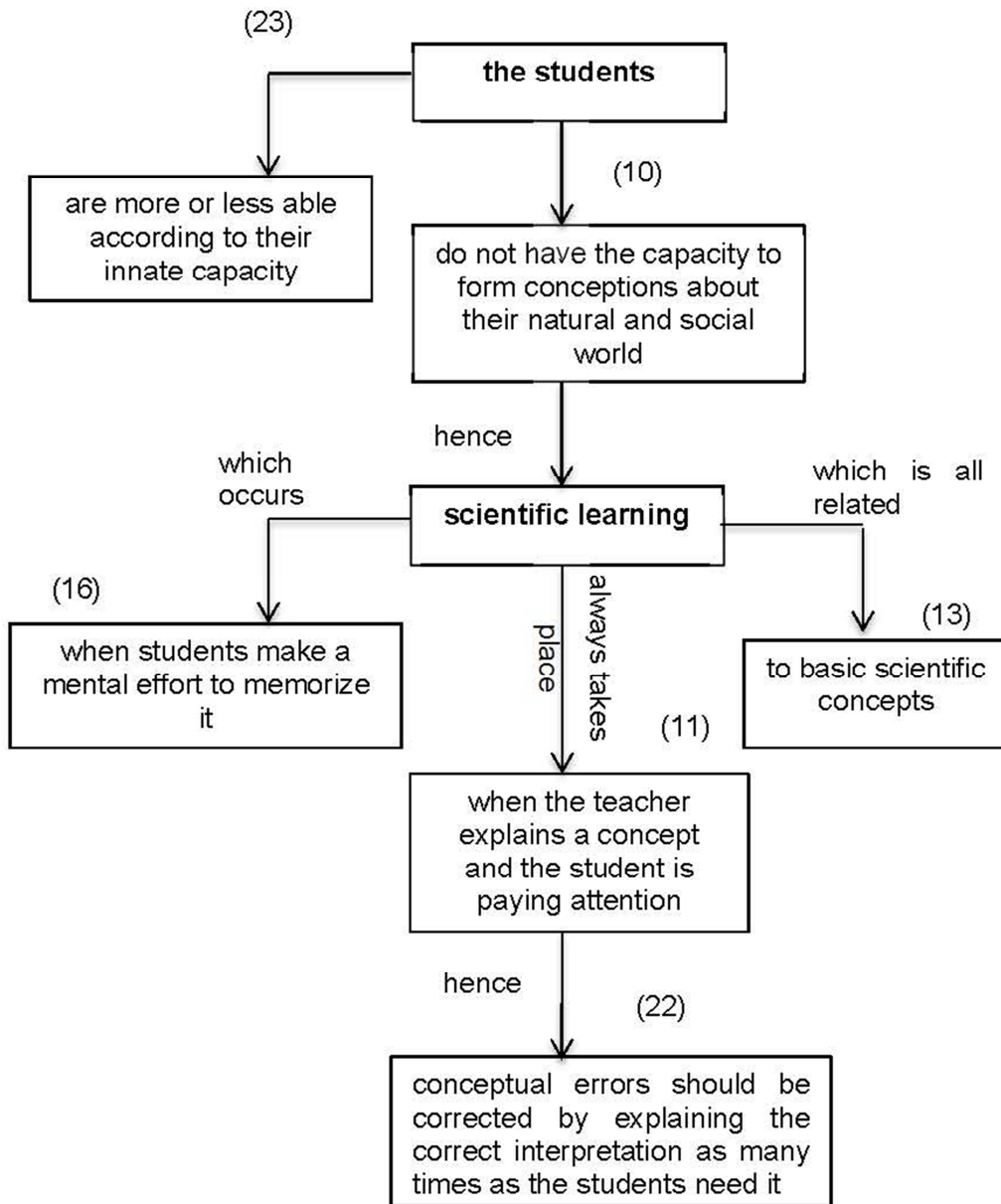
Samantha's traditional cognitive map of science teaching



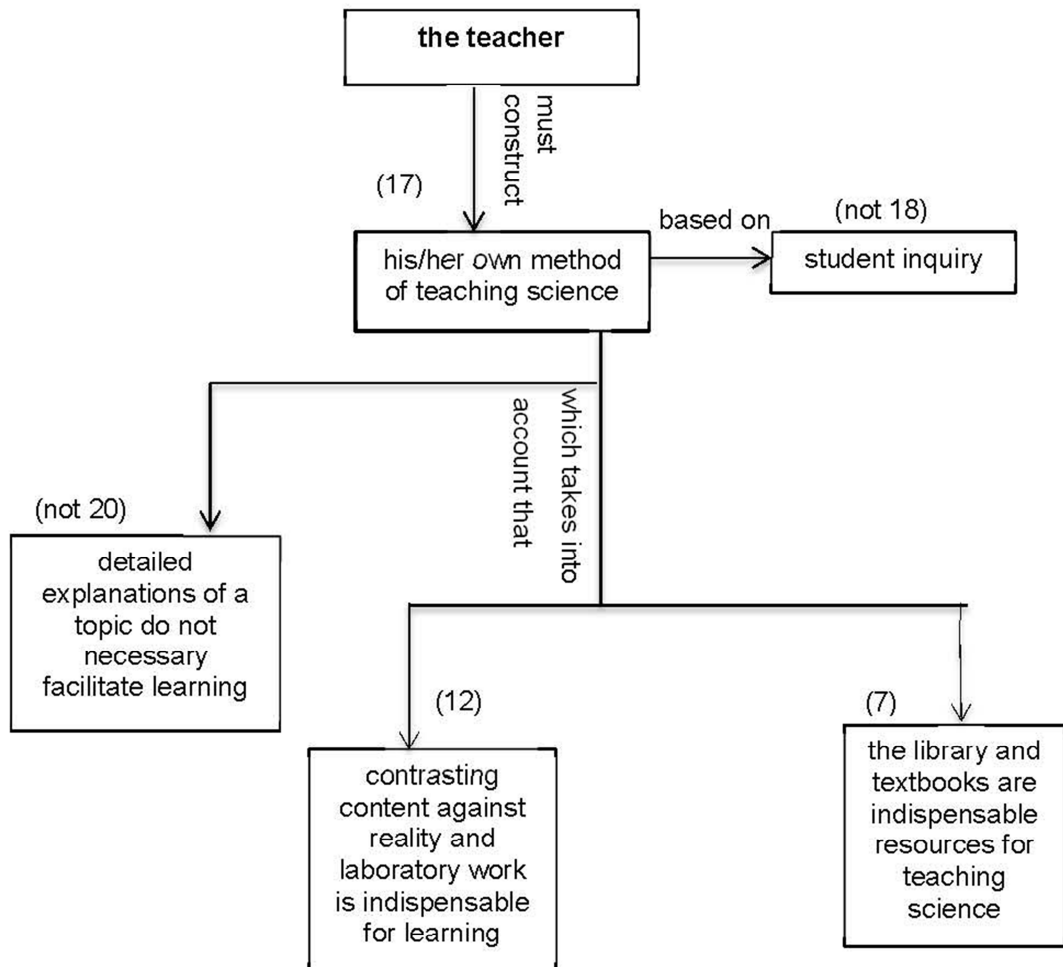
Samantha's constructivist cognitive map of science learning



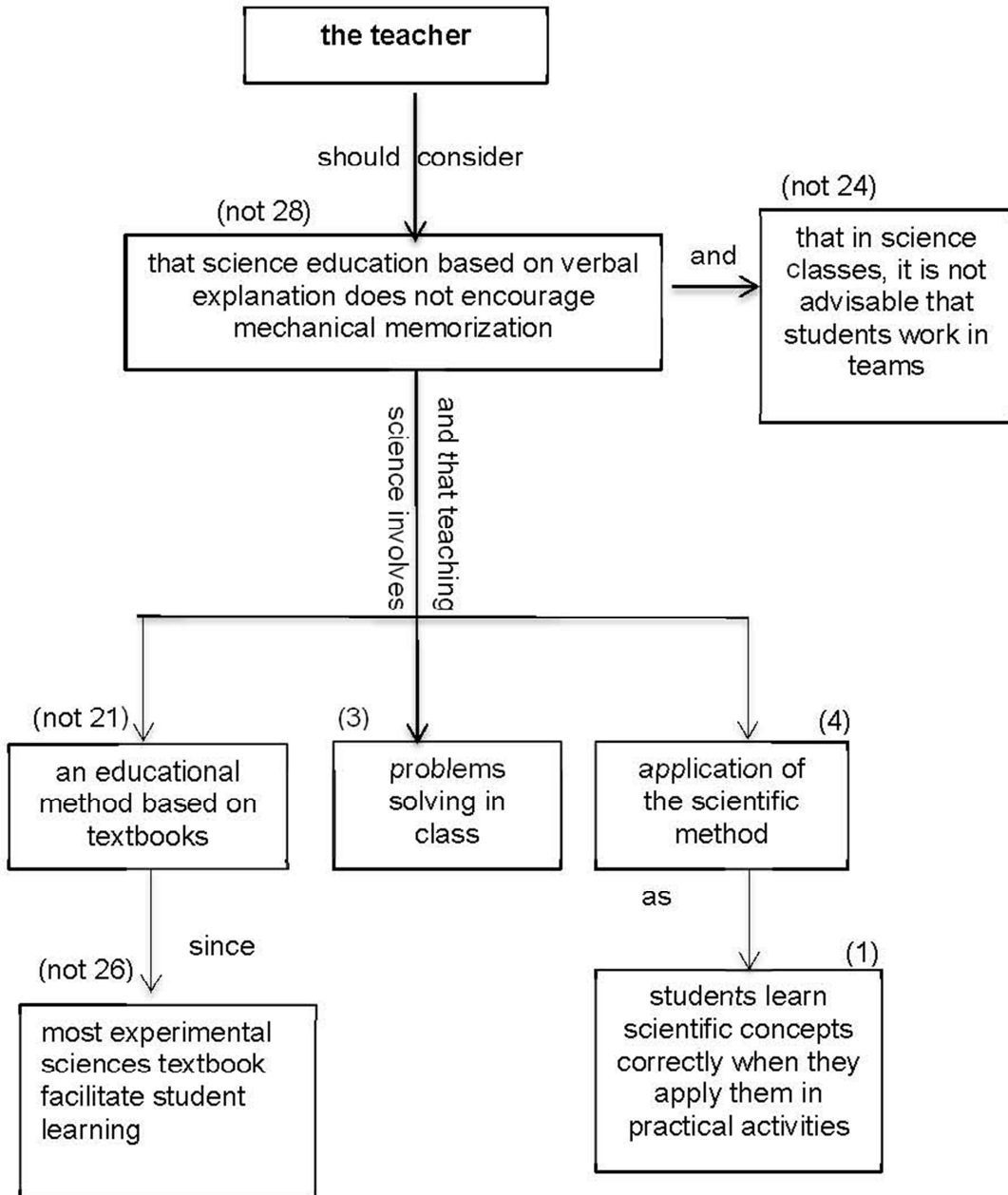
Samantha's traditional cognitive map of science learning



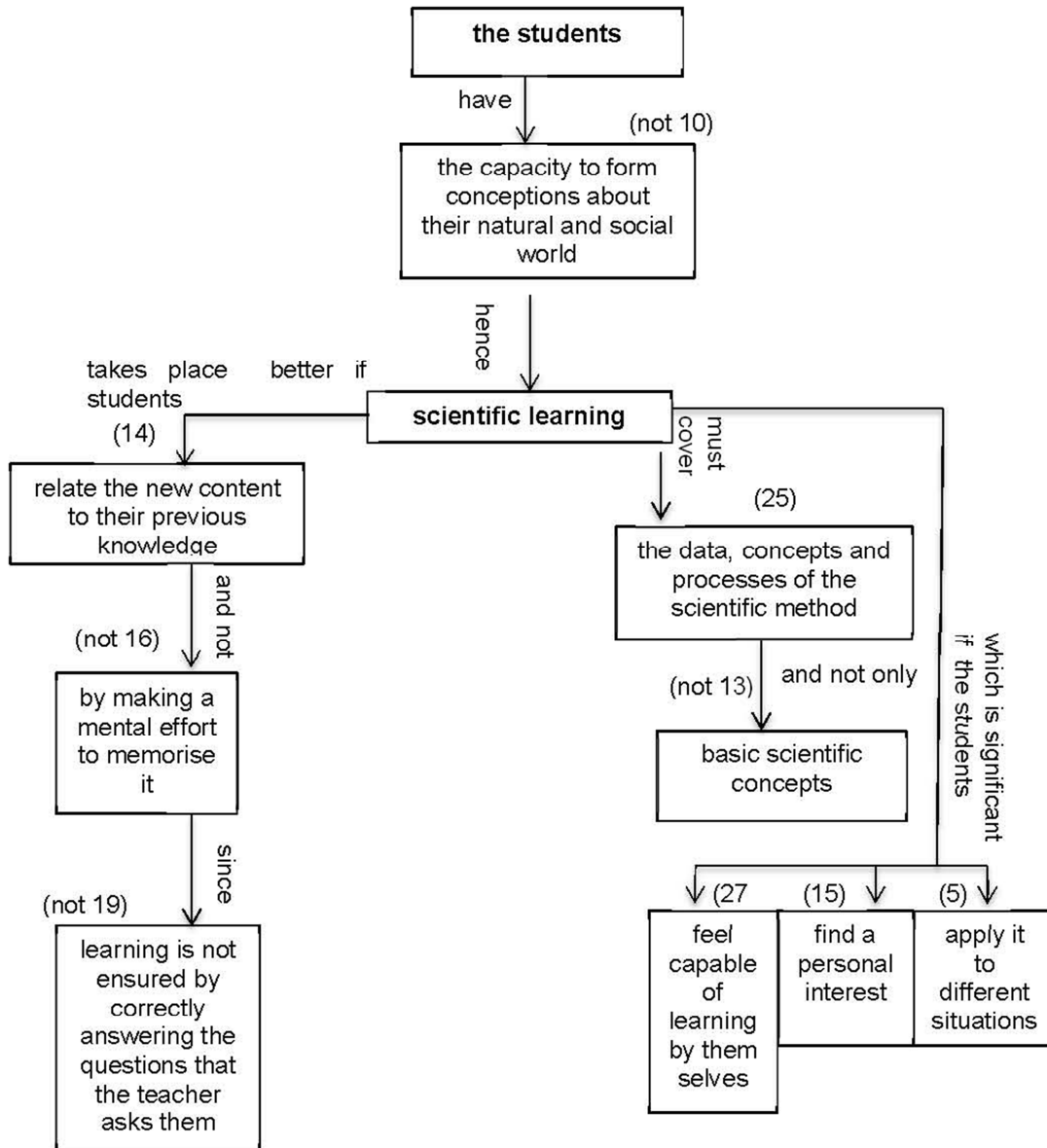
Marie-Anne's constructivist cognitive map of science teaching



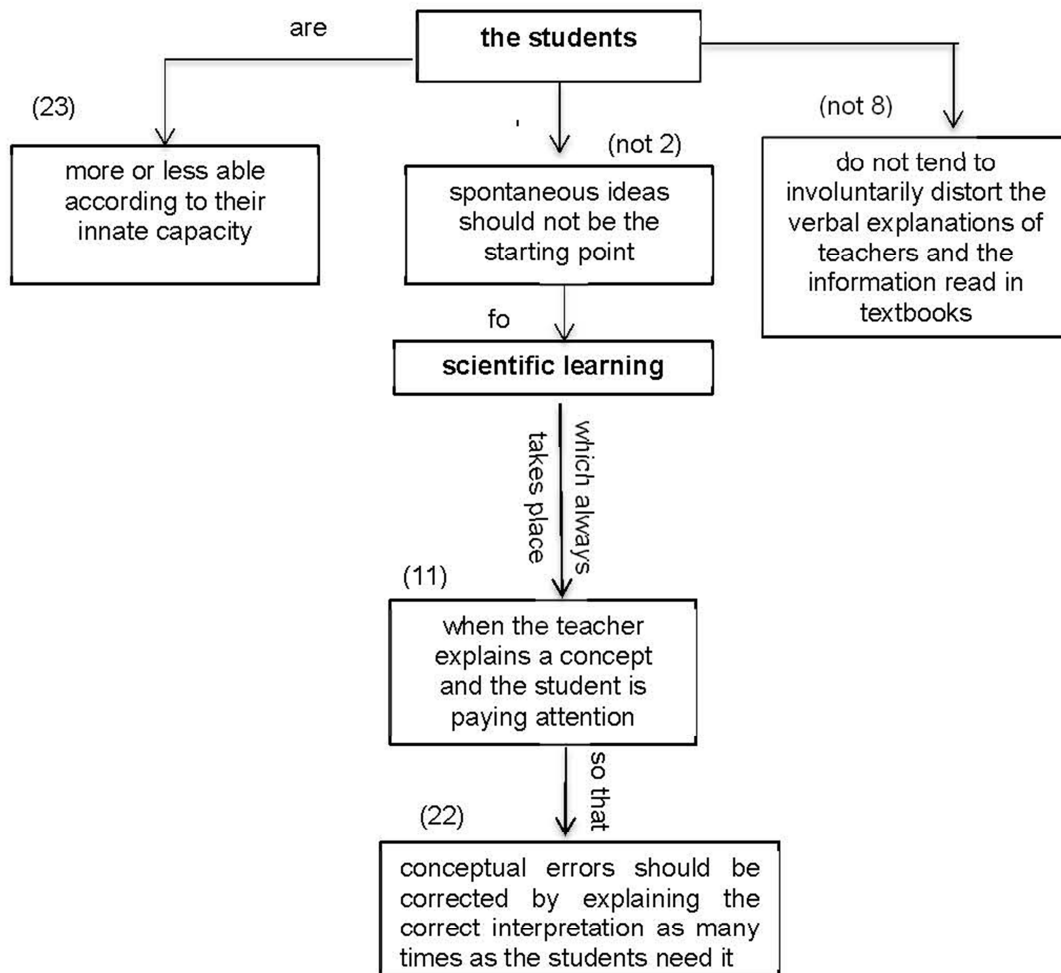
Marie-Anne's traditional cognitive map of science teaching



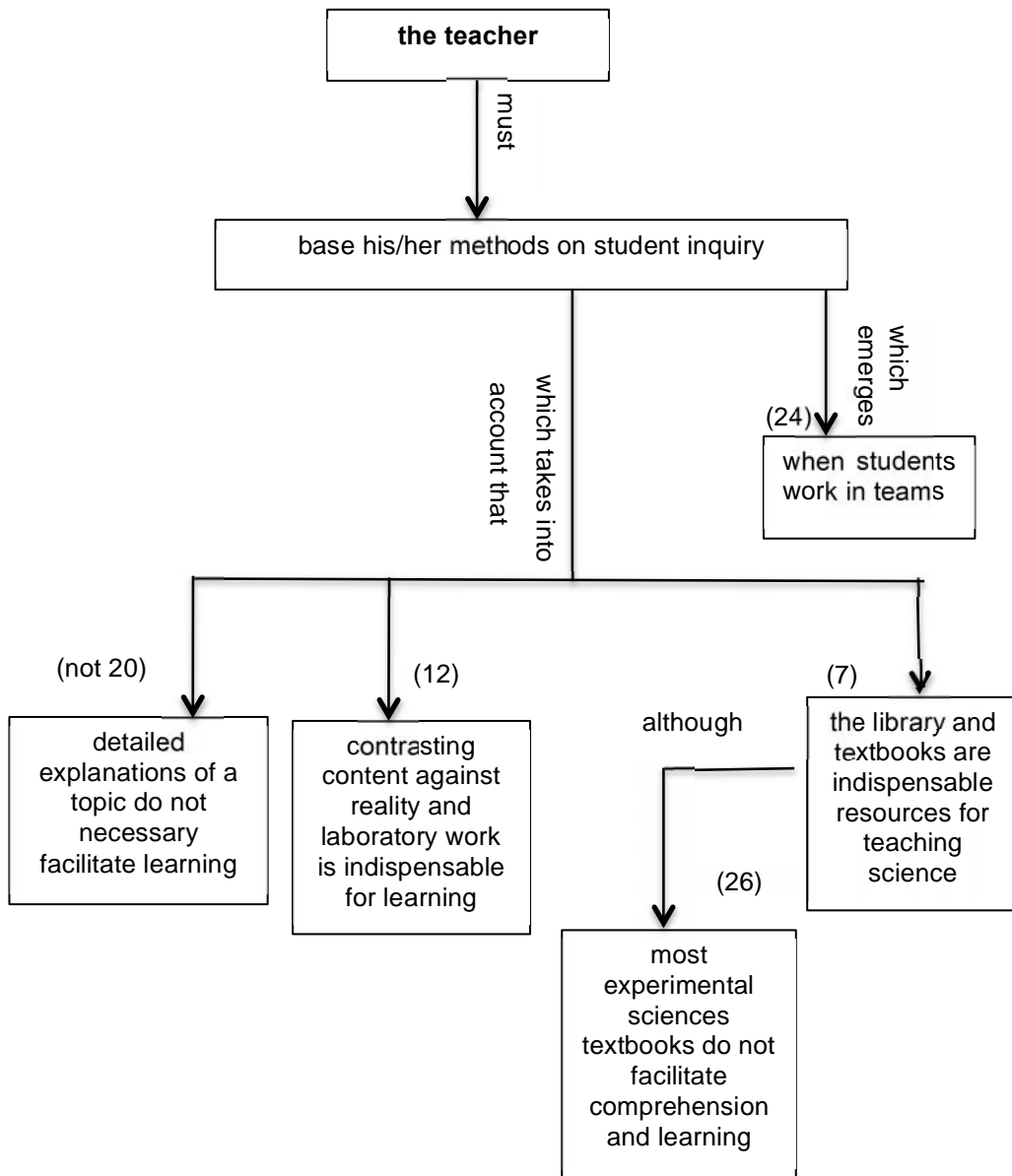
Marie-Anne's constructivist cognitive map of science learning



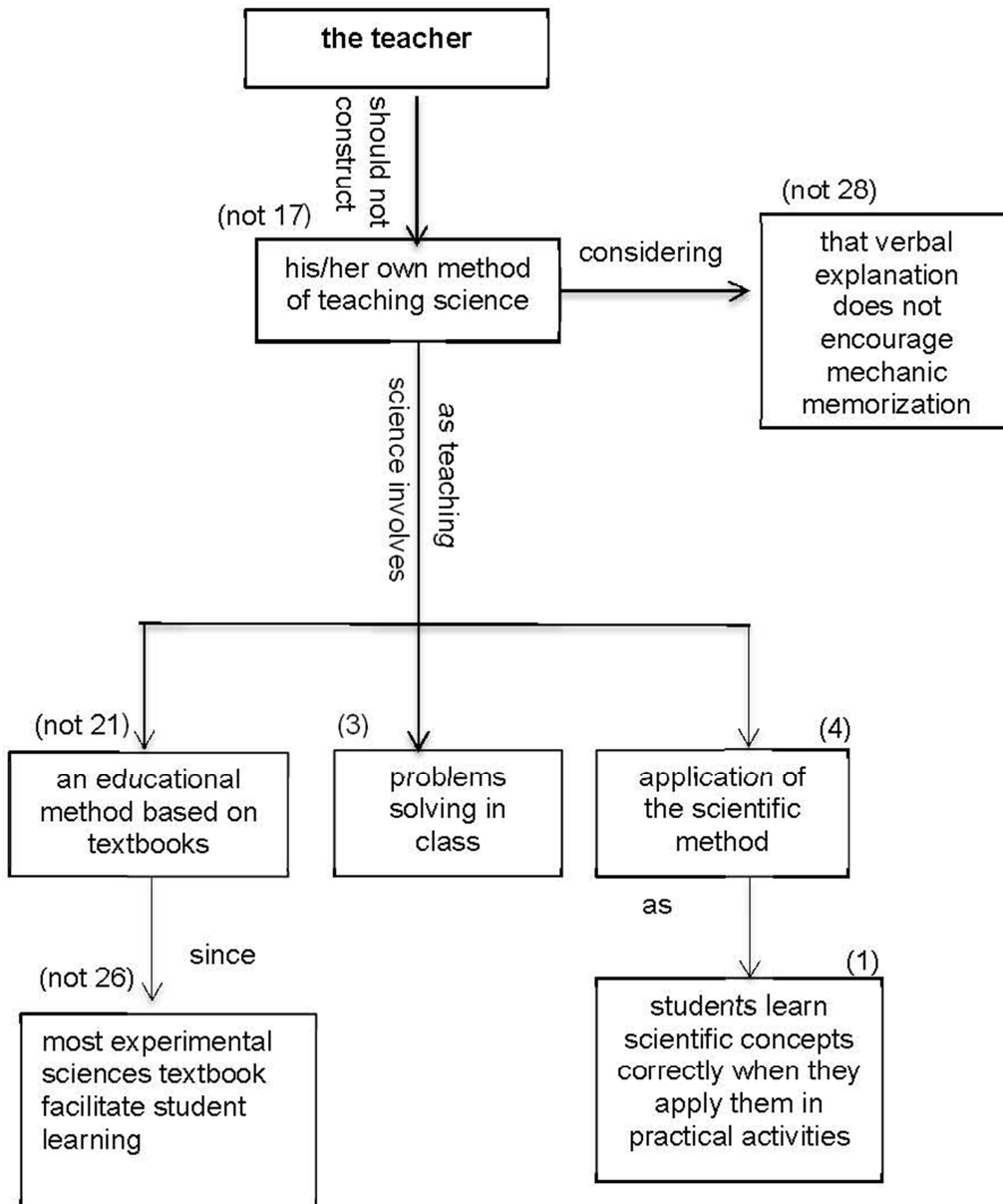
Marie-Anne's traditional cognitive map of science learning



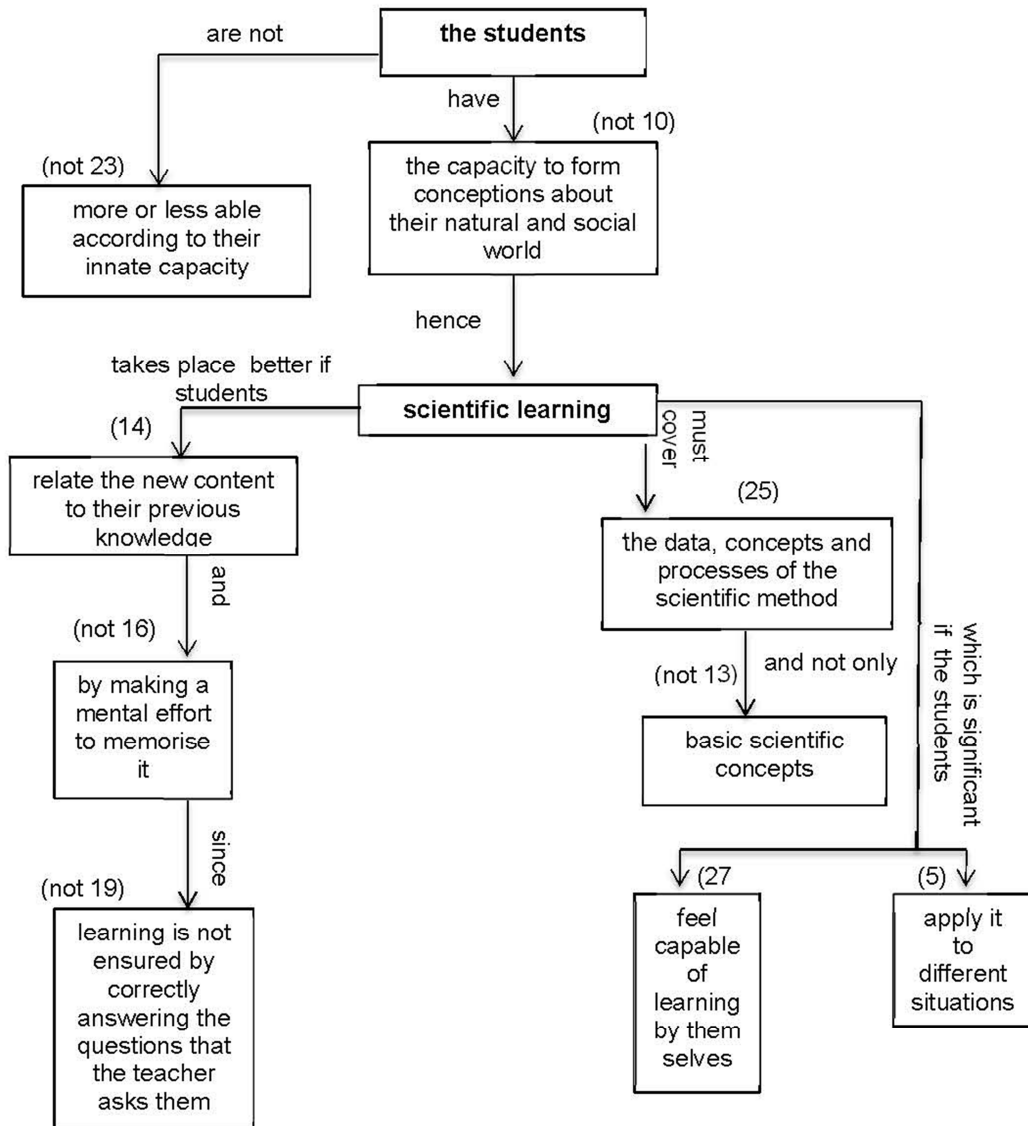
David's constructivist cognitive map of science teaching



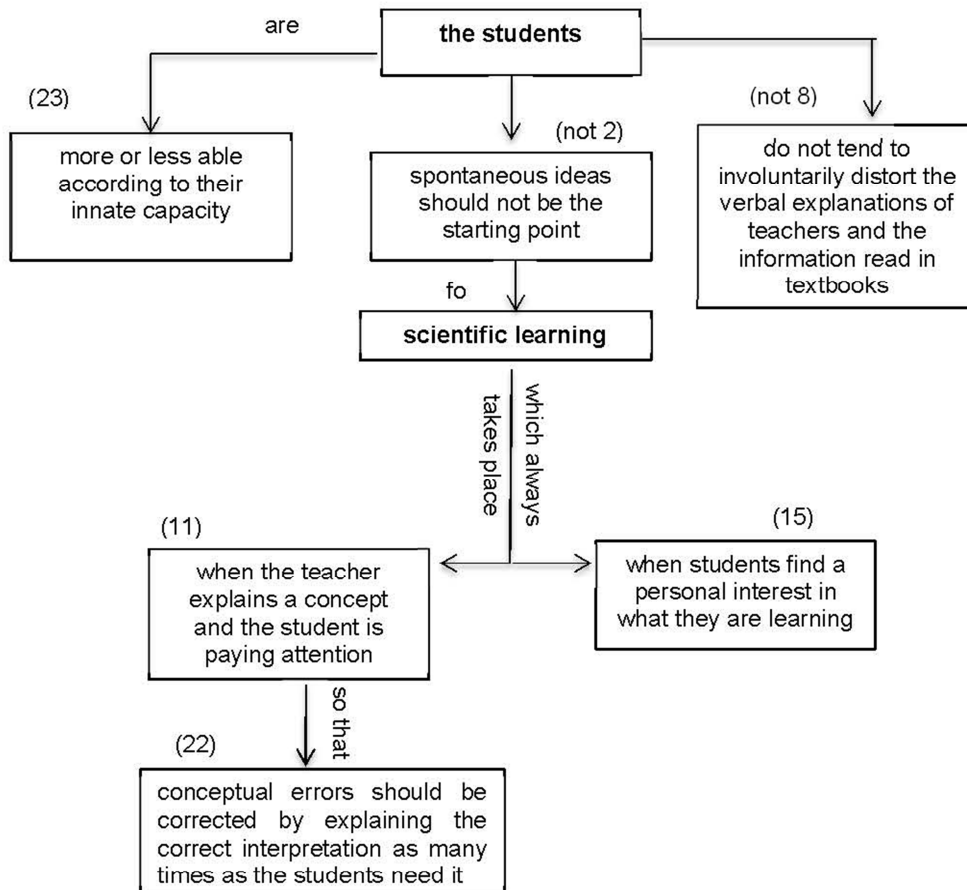
David's traditional cognitive map of science teaching



David's constructivist cognitive map of science learning



David's traditional cognitive map of science learning



**Appendix F. Measure of Acceptance of the Theory of Evolution
questionnaire (MATE)**

SD= Strongly disagree; D= Disagree; U= Undecided or not sure; A= Agree; SA= Strongly agree

1. Evolution is a scientifically valid theory.	SD	D	U	A	SA
2. Organisms existing today are the result of evolutionary processes that have occurred over millions of years.	SD	D	U	A	SA
3. The theory of evolution is based on speculation and not valid scientific observation and testing.	SD	D	U	A	SA
4. Modern humans are the product of evolutionary processes that have occurred over millions of years.	SD	D	U	A	SA
5. There is a considerable body of data that support evolutionary theory.	SD	D	U	A	SA
6. Most scientists accept evolutionary theory to be a scientifically valid theory.	SD	D	U	A	SA
7. The theory of evolution is incapable of being scientifically tested.	SD	D	U	A	SA
8. The theory of evolution cannot be correct since it disagrees with the Biblical account of creation.	SD	D	U	A	SA
9. With few exceptions, organisms on earth came into existence at about the same time.	SD	D	U	A	SA
10. The age of the earth is less than 20,000 years.	SD	D	U	A	SA
11. The theory of evolution brings meaning to the diverse characteristics and behaviors observed in living things.	SD	D	U	A	SA
12. Evolutionary theory generates testable predictions with respect to the characteristics of life.	SD	D	U	A	SA
13. Organisms exist today in essentially the same form in which they always have.	SD	D	U	A	SA
14. Evolution is not a scientifically valid theory.	SD	D	U	A	SA
15. Much of the scientific community doubts if evolution occurs.	SD	D	U	A	SA
16. Current evolutionary theory is the result of sound scientific research and methodology.	SD	D	U	A	SA
17. Evolutionary theory is supported by factual, historical, and laboratory data.	SD	D	U	A	SA
18. Humans exist today in essentially the same form in which they always have.	SD	D	U	A	SA
19. The age of the earth is approximately 4–5 billion years.	SD	D	U	A	SA
20. The available evidence is ambiguous as to whether evolution actually occurs.	SD	D	U	A	SA

Appendix G. Publications and presentations

Presentations

Samson, AH and Dempster, E. (2012). Learning to change: curricular changes and teachers' continuing professional development. 1st SA Basic Education Conference. Durban, South Africa.

Publications

Samson, AH and Dempster, E. (submitted). Whispering professional development policies in two contexts of educational change. In the process of publication.

Samson, AH and Dempster, E. (2012). Curricular changes and teacher's continuing professional development. Proceedings of the University of KwaZulu-Natal College of Humanities postgraduate conference. UKZN, Durban, SA.

Samson, AH and Dempster, E. (2012). Learning to change: curricular changes and teachers' continuing professional development. Proceedings of the ProPEL (Professional Practice, Education and Learning) International Conference. Stirling University, Stirling, UK.

Appendix H. Ethical authorisations to perform research



11 March 2011

Mrs. A Samson (209542176)
School of Education and Development

Dear Mrs. Samson

PROTOCOL REFERENCE NUMBER: HSS/0110/011D
PROJECT TITLE: Learning to change: A comparative study of continuing teacher development in South Africa and Québec-Canada in a context of educational reform

EXPEDITED APPROVAL

I wish to inform you that your application has been granted Full Approval through an expedited review process:

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Professor Steven Collings (Chair)
HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE

cc. Supervisor – Prof. E Dempster
cc. Prof. M Deniger
cc. Ms. T Mnisi/Mr. N Memela

Postal Address:

Telephone:

Facsimile:

Email:

Website: www.ukzn.ac.za

Founding Campuses:

■ Edgewood

■ Howard College

■ Medical School

■ Pietermaritzburg

■ Westville

Please note that the necessary ethical approvals were also obtained from the KZN Department of Education and the Québec school boards, as well as from the school principals and teachers, both in KwaZulu-Natal and in Québec. They are not included here for confidentiality purposes.

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