The sustainable implementation of computers in school districts: A case study in the Free State Province of South Africa

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Chapter 1

Introduction and orientation

1.1 Introduction

This study investigates influences on the implementation of a computer-integrated education project, with a view to ensuring the sustainability thereof. Furthermore, the study considers influences that originate within the project, as well as influences that originate in the larger system in which the project is embedded. An understanding of the way in which all these influences are interrelated might suggest ways in which the sustainability of similar projects could be addressed during the implementation phase.

1.2 Background

Numerous studies document factors influencing the successful modelling and support of computer-integrated education initiatives at school level (Mooij & Smeets, 2001; Baylor and Ritchie, 2002; McMullan, 2002; Shuldman, 2004; Bebell, Russel and O' Dwyer, 2004; and Plomp and Pelgrum, 2005). In the first place, the emphasis in each of these studies is placed firmly on the pure implementation of computer-related technology rather than on implementation of such technology with a view to ensuring the sustainability of the initiative. In this sense, the studies represent an account of static situations rather than dynamic processes.

Secondly, such implementation initiatives are characteristically embedded in a systemically significant context, such that Mooij and Smeets (2001) identify a multi-level structure of education relevant to the implementation of computer-integrated education in schools. These structural levels range from the international, national, regional and administrative levels to the level of the individual pupil and internalised learning processes. Such multi-layered contexts provide comprehensive momentum and support for successful implementation. What is not clear, however, is the effect of a withdrawal of the momentum and support supplied by such a rich, multi-layered external context on the implementation and sustainability of computer-integrated practice in individual schools. Nor are such processes easily observed since initial contextual investments in terms of time and money usually preclude stable

investors, such as departments of education, from withdrawing support and thus risking the success of the project.

In this respect, the CALIS (Computer – Assisted Learning in Schools) Project, initiated by the Orange Free State Education Department (OFSED) of South Africa, provides a unique opportunity. The Project was originally designed to implement computer-integrated education in selected schools in the region. Deserving schools and deserving teachers were identified and trained to facilitate co-operative learning. Teachers were then supplied with enough computers to ensure that roughly one third of their class could work on computers simultaneously. The Project was officially set in motion with the presentation of the first CALIS conference (or 'expo', as it was known at the time) in 1993. The Project continued during 1994 and 1995. It was, however, officially abandoned by the OFSED in 1996 when the new government identified other priorities, thus paring down contextual support and exposing individual institutions to the prospect of ensuring the sustainability of computer-integrated education in their institutions without further assistance.

Such might be the supposition, on face value. The supposition seems to find support in the fact that many of the schools in which the Project had originally been implemented had been unable to sustain institutional computer-integrated education over time. In the narrative produced by Johan Badenhorst, he mentions, by name, ten schools where the Project had originally been implemented but where computer-integrated education could not be sustained over time. These institutions are situated, in the main, in small rural towns: Clocolan, Koffiefontein, Hertzogville, Bultfontein, Hoopstad and Viljoenskroon. Not one of the 'unsuccessful' institutions identified by Johan Badenhorst is situated in Bloemfontein, the only relatively large city in the region.

In contrast, Johan Badenhorst mentions by name 27 schools (see Appendix A) where the 'fruits of the Project' are still visible today. These schools are situated in all districts in the region. They are also situated in larger towns and cities, as well as relatively small rural towns. Maureen Dale provides supporting evidence with respect to eight schools in Bloemfontein that she knows to be presenting computer-integrated academic offerings at present.

According to all participant narratives, schools tended, over time, to move computers from the classrooms, where they had originally been installed, to dedicated computer laboratories. Such installation, claims Johan Badenhorst was followed in many schools by the appointment

of a dedicated 'computer laboratory teacher'. He is also adamant that the use of such laboratories in schools was aimed, not at computer literacy in the first instance, but rather at the integration of computers into the curriculum during scheduled academic periods. Furthermore, many schools entered into agreements with private partners such as *Future Kids*®. Such partnerships contributed towards the continued financial viability of computer-integrated education in schools.

1.3 Problem statement

Given the situation sketched in participant narratives with relation to the continued use of computer-integrated education at schools involved in the CALIS Project, a number of questions arise:

- why did computer-integrated education die out at some schools;
- why are most of the schools at which it died out situated in smaller rural towns;
- what influences or circumstances enabled some schools to continue offering computer-integrated education in their classes long after official government support of the Project had been withdraw?

Assuming that the withdrawal of government support did influence the continued existence of the Project negatively, answers to the first two questions are readily found. It might be supposed that such withdrawal of support could have had a detrimental effect on the continued existence of computer-integrated education at some schools – particularly schools situated in small rural towns where rich contextual support systems that characterise urban settings are largely absent. This much seems reasonable.

It is, however, the plausibility of such conjecture which makes the third question, mentioned above, even more difficult to answer. If the rich contextual systemic support afforded schools in urban areas plays an important role in ensuring the continued existence of such projects, why is it that so many schools situated in smaller rural towns continued offering computer-integrated education long after official support had been withdrawn? Clearly, there must have been other influences at work in bringing about continued usage. It is this puzzling aspect of the situation that led to the formulation of the research questions presented in the following section.

1.4 Research questions

In an attempt at identifying as many influences on the implementation and sustainability of the Project as possible, the main research question was formulated as widely as possible:

> ***How did influences on the implementation of the CALIS Project affect the sustainability thereof?***

Because of the breadth of this question, five sub-questions, dealing with specific aspects of the main research question, were arrived at:

> *1. How did personal qualities, possessed by people directly or tangentially involved in implementing the Project, influences the implementation and sustainability of the Project?*
>
> *2. How did elements of programmatic design (those elements of programmatic design specifically embodied in the goals of the Project) influence the implementation and sustainability of the Project?*
>
> *3. How did the availability of physical resources during implementation influence the sustainability of the Project?*
>
> *4. How did the larger systemic environment in which the Project was implemented, influence the sustainability thereof?*
>
> *5. How was the further development of the Project affected by the animated, interactional interrelatedness of the complex system infused by all of the influences mentioned above?*

1.5 Purpose of the study

The purpose of this study is to arrive at a description of the way in which various interrelated influences affected the implementation of the CALIS Project, with a view to ensuring the sustainability thereof. This description is then to be followed by an indication of important influences on sustainability to be borne in mind during the planning and implementation of similar projects, situated in similar dynamic, complex educational environments.

1.6 Objectives

Given the purpose of the study, outlined in the previous section, a number of more specific objectives may be identified. In the first place, the study sets out to confirm or contradict the notion (see Mooij and Smeets, 2001) that the educational system is characterised by the existence of a number of vertical structural levels ranging from the international level to the level of the individual learner. In addition, the study seeks to confirm / contradict the notion that the presence of 'active contributors' at each of these levels affects the sustainability of individual projects situated in the larger educational system.

Secondly, the study sets out to ascertain whether the suggested influence of active participants at the various structural levels of the educational system can be viewed as the sole kind of influence on the implementation for sustainability of computer-integrated education projects. Are there not programmatic and systemic influences on these structural levels that also influence the implementation and sustainability of such projects?

Thirdly, the study is aimed at elucidating the general characteristics of the kind of system (educational system) within which computer-integrated education projects are implemented.

Related to this objective, is the aim of establishing the way in which influences on the implementation and sustainability of such projects are dynamically entwined co-determinants of such implementation and sustainability.

1.7 The scope and context of the study

The study examines a specific computer-integrated education project, namely the CALIS Project that was implemented in the Free State Province between 1992 and 1996, with a view to describing the way in which influences on the Project affected implementation and sustainability. The study is conducted against the backdrop of a dearth of inclusive definitions of sustainability in the literature. Also, there is an absence of comprehensive treatments of influences on sustainability of such projects in the literature.

1.8 Exclusions from the study

The study does not seek to examine influences on the further sustainability of the CALIS Project, simply because post-implementation developments in individual institutional environments are likely to have proceeded in unique ways. Such unique, and often unpredictable, development is consonant with what is reported in the literature on the nature

of dynamic complex systems (Senge, 1990; Stacey, 1996; Cavallo, 2004; Fullan, 2005), Rather, the study focuses on a wide variety of influences on the implementation of the Project that enabled the unique, evolutionary development of the Project in specific host environments.

1.9 Limitations of the study

As a result of this exclusion, the study does not make predictions regarding the sustainability of the Project over time. In fact, one of the characteristics of dynamic, complex systems is the fact that long-term developments are essentially unpredictable. Coupled with this proposition is the proposition that dynamism implies evolution over time. Such evolution over time begs the question as to whether the evolved project is still substantively the same project, or whether it has become something completely different. It is therefore inevitable that sources of noise brought about by the passage of time will be discernable in the research report.
The study is thus limited to an exploration of influences on the implementation of the Project and the extent to which such influences might have enabled the evolutionary further development of the Project. The report specifically documents positive influences on the CALIS Project since the focus is placed squarely on sustainability. The reader will, however, be able to deduce from the absences in the text the role played by negative influences on the Project.

1.10 Significance and potential contribution of the study

The opportunity afforded by this Project lies in the possibility of investigating not only the process nature of the implementation, use and sustainable use of computer-integrated education in schools. It also elucidates the multi-directional, mutual causal relations that define an educational programme as complex system. The existence of such complex systems in the no-man's land between chaos and regulation (Stacey, 1996) implies that deterministic predictability at the micro-level is impossible. What is possible, however, is the drawing of multiple inferences which may be identified with in terms of varying degrees of certainty at the macro-level. An investigation into the influences on the implementation and sustainability of the CALIS Project could provide insight into the way in which similar projects, determined by common dynamics, characteristic of complex educational systems, might be implemented with a view to addressing sustainability.

1.11 Research method

. Qualitative research allows for the inferential interpretation of narratively-constructed, plural and interior realities (Patton, 1985; Miles and Huberman, 1994, p.41). In this sense, the choice of a broadly-characterised qualitative approach was the natural choice in terms of examining a complex, educational system. I have consciously avoided the use of the term 'paradigm'. It is impossible to conduct research on an indeterministic and unpredictable complex system under the banner of a particular 'paradigm', the tenets of which the system does not adhere to. Rather, the postmodernist-inspired approach to research values multi-vocality, narrative, culturally-inspired mythology, and the value of minority or previously disempowered voices (Woods, 1999; Schostak, 2002). In this way, the 'master narrative' of the selected 'paradigm', is discarded in favour of a plurality of narratives. My own narrative, in the form of this research report, is inescapably an interpretation of narratives produced by participants (Kvale, 1996). Such narratives, in turn, are an interpretation of an individually constructed reality, shaped partly by cultural mythology and metaphor. For this reason, narrative, religious and cultural mythology, and metaphor play a central role in this research project.

1.12 Research design

The CALIS Project appeared to have many of the characteristics of a case study. It appeared to be 'bounded' (Yin 2003, Merriam, 1998); it appeared to be a 'unique' occurrence (Yin, 2003, p.40; Cronbach, 1975; Merriam, 1998;); it appeared to demand an answer to a 'how' question (Yin, 2003, p6); it appeared to be situated very clearly in the past and thus fall essentially beyond my control or the control of the participants (Yin, 2003, p.7); it appeared to involve a programme or process that was inextricably linked to organisational change (Yin, 2003, p.23). In Yin's view (2003, p.8), the case study research design adds two tools to the researcher's repertoire that are not available to the historical researcher, namely direct observation and the possibility of interviewing participants. I therefore, selected the case study design as the most appropriate way of eliciting the information that I needed.

Furthermore, the situatedness of the CALIS Project within a wider complex systemic context accorded well with views expressed in the literature regarding the possibility that cases could be situated within larger cases (Yin, 2003, p.14). The view is also expressed in the literature that the embeddedness of cases provides the researcher with "an even deeper understanding of processes and outcomes of cases…" (Miles and Huberman, 1994, p.26). It was clear, from the outset, that an examination of sustainability or evolutionary development would demand a process-friendly research design. The selected research design would also have to take

cognisance of the influence of a multiplicity of contextual influences on the evolutionary development of the Project. Yin (2003, p.13) is of the opinion that the case study design does just that: "In other words, you would use the case study method because you deliberately wanted to cover contextual conditions – believing that they might be highly pertinent to your phenomenon of study".

1.12.1 Population and sampling

The broad approach outlined above also informed my approach to sampling. Just as the focus on the functionality of complex systems informs the overarching research design of this study, so also, it informs the sampling procedures followed. Miles and Huberman point out that approaches to sampling are deeply influenced, not so much by whether one conducts quantitative or qualitative research, but rather whether one seeks an understanding of a limited range of controlled variables or whether one seeks an understanding of a wide array of interactional variables that are active in a complex system (1994, p.41).

As indicated above, the intention in this study was to elucidate the interactional nature of a wide array of interrelated variables or influences in an evolving, complex system. This system takes the form of an educational project that was abruptly officially terminated, even as plans for the evolution of the project were being formulated. In this sense it represents a unique case. As Yin points out, the veracity of single case study research is validated by research studies such as Graham Allison's 30-year long study of the 1962 Cuban missile crisis (2003, p.4). Also, and perhaps more importantly, case study research should not be equated with research that demands samples as representations of universes. Such an analogy breaks down because the latter relies on statistical generalization, where samples are generalized to universes, whilst the former relies on analytic generalization, where a particular set of results are generalised to some broader theory (Yin, 2003, p.37). In this particular study, the results obtained from the examination of a single, unique case are generalized to the conceptual framework presented in Chapter 2.

Given the nature of the case, coupled with the fact that the Project had been officially terminated virtually a decade before this study began, it was clear that decisions relating to sampling strategies and sampling design would be constrained by the circumstances surrounding the case. Goodson and Sykes (2001, p.24) enumerate a number of sampling techniques, indicating that one or more of these techniques are often used in qualitative case studies involving the production of narrative accounts. In terms of these types, the sampling

techniques employed in this study might be identified broadly as purposive, snowball, homogeneous and extreme case.

In the first instance, sampling might be seen as purposive in that all participants were selected on the basis of their active involvement in the CALIS Project, either as part of the OFSED management team or as educators who implemented the Project in their classrooms. Secondly, the sampling technique referred to by Goodson and Sykes as 'snowball sampling' (2001, p.24), referred to by Glaser and Strauss (1967) and Merriam (1998) as theoretical sampling, is relevant to this study. Invariably, each of the participants approached provided the contact details of potential participants in the study – and also an indication of what the nature of their involvement of the Project had been. Thirdly, it might be argued that sampling in this study was 'homogeneous' since all the participants were selected on the basis of a common experience, namely participation in the Project. Finally, it might also be argued that the selection of Maureen Dale as participant might be viewed as an 'extreme case' since she is the only participant who is a mother-tongue speaker of English, whilst the rest are all Afrikaans mother tongue speakers.

But this is exactly where the traditional conception of sampling breaks down. Postmodernism and complex systems theory opposes the view that any two accounts of an experience can be the same. In this sense, homogeneity is impossibility. Even if participants were nominally involved in the same Project, their unique circumstances, worldviews, systemic situatedness and cultural/personal mythologies (coupled with the unique 'performances' mentioned above) meant that I would be confronted with individually unique experiences that might or might not correspond in unpredictable ways. Furthermore, extreme case sampling becomes irrelevant when one assumes that experiences and the associated narratives are unique, and thus all participants are extreme cases. Given the philosophical and theoretical difficulties associated with these sampling techniques, I decided to make use of 'snowball' or 'theoretical' sampling. The similarities between the sample constitution and the sampling techniques critiqued above are purely coincidental.

The selection of 'snowball' or theoretical sampling also meant that I could follow the approach to sample size suggested by Taylor and Bogdan (1998, p.93). Their view is that the sample size should not, and cannot, be determined at the outset but that it should be determined towards the end of the data gathering process. Miles and Huberman (1994, p.29) concur by drawing attention to the fact that within-case sampling has an "iterative or 'rolling' quality, working in progressive 'waves' as the study progresses.

1.12.2 Data collection

As indicated above, the decision to elicit narratives from participants was based on the belief that this would provide evidence of a wide array of interrelated influences on the CALIS Project. Each of the narratives was thus recorded on an audio tape recorder and transcribed as accurately as possible by myself.

I also felt that the keeping of a research journal would provide me with the opportunity of documenting insights and decisions made as the research project progressed. In this regard, I undertook to enter into the research journal my own impressions of each interview, directly after the completion of the interview itself. I further undertook to complete the electronic transcription from the audio tape directly after each interview, so that I would be able to follow any leads, produced by such transcription, in subsequent interviews.

1.12.3 Data analysis

The realization, gained at the beginning of the first interview, that participants were likely to present me with narratives rather than answers to questions embodied in a semi-structured interview format, convinced me to adopt the approach outlined below.

Firstly, I decided, on the basis of views expressed in qualitative research texts (Yin, 2003; Miles and Huberman, 1994; Merriam, 1998), that I would transcribe all of the audio-taped interviews myself. If, as is suggested, the researcher is the most important instrument in qualitative research, then it follows that the researcher, having conducted the face-to-face interviews, would be in the best position to transcribe these interviews in a manner consistent with the philosophical and theoretical presuppositions that underlie the research study. Furthermore, transcription and analysis are not to be thought of as discreet, linear processes. As Goodson and Sikes (2001, p.33) point out, researcher transcription of the interview data enables the researcher to become familiar with the data and aids analysis, in that initial ideas and themes emerge with repetitive, intensive interaction with the data.

Secondly, participant production of narratives meant that listening to the audio-taped interviews and transcribing only those expressions that I deemed to be relevant would not be the most effective approach in the case of this study. Not only would I be precluding the emergence of relevant ideas and themes on a second or third examination of the complete set of narratives, but I would also be precluding an examination of those heuristic qualities that characterise both the individual narratives and the multiple narratives as the bulk of the data

set. Such heuristic qualities of narrative embody key characteristics of complex systems, as suggested by Rodriguez (2002). On the basis of this reasoning, I decided to transcribe the audio-taped narrative *in toto*. I also decided to conduct the transcription in such a manner that it would capture my own perception of the narrator's intended meaning (see Atkinson, 1998, p.56). I thus attempted to capture as much of the spoken narrative as faithfully as possible, only adding punctuation marks and separating paragraphs in order to aid the reading of the transcribed material. As mentioned earlier, data collection, data editing and data analysis took place simultaneously.

As I edited the transcriptions, I was also involved in seeking substantive statements (Gillham, 2000, p.71); "identifying themes and developing concepts and propositions" (Taylor and Bogdan, 1998, p.141); and, "noting regularities, patterns, explanations, possible configurations and causal flows" (Miles and Huberman, 1984, p.22). In this way, an initial coding schema (Taylor and Bogdan, 1998; Giorgi, 1985; Moustakas, 1994; Price, 1999) was established in the form of a matrix of perceived categorised influences on the CALIS Project. I then proceeded with the second attempt at coding the data, and adapted the original matrix accordingly. A third round of coding resulted in further adaptations to the original matrix, as well as a set of categories that appeared to satisfy the data obtained from participant narratives.

1.12.4 Authenticity and trustworthiness

Given the approach to data capturing, data editing and data analysis outlined in the sections above, potential questions relating to the validity, reliability and generalizability of findings need to be addressed. As outlined above, the study was approached from a point of view termed "moderate postmodernism" by Kvale whereby the "notion of an objective universal truth" is rejected, while the possibility of "specific, local, personal, and community forms of truth, with a focus on daily life and local narrative" is accepted (1996, p.231). This philosophical position necessitated the use of a broadly qualitative case study design, with a focus on the use of unstructured interviews and researcher observation as the data-gathering instruments of choice. Only then could I elicit narratives that would illuminate a wide array of influences on the sustainability of the CALIS Project.

Kvale argues that modern approaches to "the legitimation question of whether a study is scientific tend[s] to be replaced by the pragmatic question of whether it provides useful knowledge" (1996, p.42). Against this backdrop, the issue of validity in this study is approached from the point of view expressed by Kvale, where validating involves: adopting a

critical outlook on the analysis of data (1996, p.242); clearly establishing the content and purpose of the investigation at the outset (1996, p. 243); and, addressing the theoretical questions raised about the nature of the project investigated (1996, p. 244). Such a general validatory approach is supplemented by an approach to the validity of narrative that emphasises the internal coherence of a person's (narrator) experience (Atkinson, 1998, p.61), and the extent to which the narrator agrees that the transcribed and edited narration conforms to or supports what was said originally (Lincoln and Guba, 1985; Atkinson, 1998, p.61). Both Denzin (1970) and Skeggs (1994) point out that narrators often disagree with, or fail to understand, the interpretation of their narratives. This is not strange since, as pointed out above, the transcribed, edited narrative is my own interpretation of the participants' interpretations of their individual and collective experiences.

After all is said and done, I was still the primary instrument and issues of instrument validity and reliability (Miles and Huberman, 1994, p.38) would have to be addressed by way of the rigour with which I documented not only the presuppositions and world view that I brought to the study, but also the decisions and interpretations made as I gathered and analysed the data. If the reliability of the study refers to the consistency of the research findings, as suggested by Kvale (1996, p. 235), then the study is reliable. If reliability refers to the way in which the research findings strike a resonant chord in terms of my own experience (Atkinson, 1998, p.61), then the research findings are reliable. But, perhaps the best indicator of reliability, in my own view, was the fact that I attempted at all times to allow for findings not specifically envisaged by myself; furthermore, I was determined to remain flexible throughout the data gathering, data editing and data analysis stages of the research study in order to prevent the kind of rigidity that would preclude me from gaining access to a wide array of influences on the CALIS Project. The kind of indeterminacy that characterises complex educational systems had alerted me to the fact that I could not possibly have foreseen all of the potential influences on the CALIS Project at the outset of the research study.

Adherence to theoretical rigour throughout the data gathering, data editing and data analysis stages of the study meant that it was easy to achieve the kind of generalizability referred to by Kvale as analytic generalization (1996, p.232). Analytic generalization is a kind of naturalistic generalization that is informed by theory (in this case the theoretical position adopted in the conceptual framework, presented in Chapter 2, regarding the sustainability of complex educational systems). Such generalization is predicated on "a reasoned judgement about the extent to which findings from one study can be used as a guide to what might occur in another situation" (Kvale, 1996, p.232; see also Kennedy, 1979).

1.12.5 Crystallisation

Literature sources documenting quantitative research methodology are replete with references to 'triangulation' as a technique designed to enhance the validity of research endeavours. This claim is, however, predicated on the implied existence of a unitary, exterior reality which can be subjected to 'measurement'. Furthermore, the term itself is a metaphor implicating the plotting of a course on a two-dimensional map. Tied to such a metaphor is the assumptional world view that comprehends the world as flat and that understands travel as the traversal of two-dimensional space. The map becomes a key to enabling the exact measurement of a universal exterior reality. But if there is no universal exterior reality such triangulation becomes meaningless. Richardson replaces the two-dimensional metaphor of the map with the three-dimensional metaphor of the crystal:

> . The crystal, by contrast, 'combines symmetry and substance with an infinite variety of shapes, substances, transmutations, multidimensionalities, and angles of approach' (Richardson 1994, p. 522).

But, the 'crystal', as stealth metaphor, readily renders up for interpretation multi-faceted surfaces, whilst concealing its compacted and solidified materiality - and these surfaces cannot represent 'the many overlapping truths operating at different levels and constantly subject to change'. These surfaces themselves are precision-patterned in such a way as to provide a mechanistic Lego-like fit. This metaphor, as embodiment of societal complexity, implodes because it seeks to figure forth multiplicity in the form of the solitary and unitary – multi-faceted though it might be.

Where does that leave my approach to post-modernist inspired qualitative research? As mentioned above, with reference to case study design, case studies cannot be expected to provide findings that can be generalised to other cases. Rather, the findings relating to single case studies must be generalised to theory (Kvale, 1996). So, rather than paying lip service to 'scientific' rigour as envisaged above, I concur with Caelli, Ray and Mill, for whom rigour in qualitative research is a deeply theoretical issue, rather than a technical one:

> Our position is that qualitative researchers need to (1) articulate a knowledgeable, theoretically informed choice regarding their approach to rigor [sic], and (2) select an approach that is philosophically and methodologically congruent with their enquiry. Researchers'

> approaches to these two issues must reflect an understanding that rigor [sic] is a deeply theoretical issue, not a technical one (2003, online).

1.13 Literature control

The literature reviewed in Chapter 2 shows evidence of extensive research having been conducted on the implementation and use of computers in schools, although such implementation and use is not always clearly defined in terms of integration with the curriculum. Other studies, whilst foregrounding such integration, address influences on computer-integrated education projects in a discreet manner, suggesting that such influences are essentially unrelated to one another. Similarly, treatments of the sustainability of such projects present influences on such sustainability in terms of a list of influences, the length of which determines the continued existence of the project.

Given the inability of the literature on the topic to address dynamic complexity, a conceptual framework is suggested that considers the sustainability of such computer-integrated education projects within the context of the larger dynamic, complex nature of the educational system within which they are defined.

1.14 Ethical considerations

1.14.1 Informed consent

The consent of the adult participants in this study was sought, both orally and in written form, after the aims, objectives, course of the study, and intended use of obtained data had been explained to them.

1.14.2 Anonymity or recognition

Both Yin (2003) and Kvale (1996) endorse the view that participants deserve recognition for the part they played in the production of research. The participants in this study, having been offered anonimity, unanimously elected to be named in the study. It is very likely that the nature of their positions in Free State society as well as the historical situatedness of the CALIS Project would, in all probability, have rendered attempts at anonimity useless. It is thus with the deepest gratitude that I acknowledge the part played by all of them in the production of this research report.

1.14.3 Withdrawal from the project

Although participants were, at the outset made aware of the fact that they were free to withdraw from the study at any time, their enthusiasm for the study, and their determination that the story of the CALIS Project had to be told, was truly inspiring.

1.15 Role of the researcher

Given the philosophical and theoretical underpinnings of the study, it is fitting that my transcription, analysis and interpretation of participant narratives remains my interpretation, just as participant narratives themselves remain interpretations of perceptions initiated over ten years ago, and worked upon by individual and collective consciousnesses in the interim. My own approach to the study, as primary research 'instrument', has been informed by the literature dealing with qualitative, case study, narrative, life history and post-modern interview research. In an attempt at describing as many influences as possible on the implementation and sustainability of the CALIS Project, I have tried, at all times, to remain flexible in my approach and to counteract the effect of my own preconceived ideas on the topic, knowing all the while that the final research report will remain my own interpretation of participant narratives.

1.16 Outline of the study

Chapter 1: Orientation

This chapter provides a general introduction by sketching the background to the study and situating the objectives of the study in the context of a broader statement of the problem addressed in the study. Subsequent derivation of the main research question and related sub-questions is addressed next, and this discussion is followed by an overview of the research methodology and research design adopted in the study. Decisions made in this regard are then related to ethical considerations, and reflection on my own involvement in the study. A brief overview of the rest of the research report concludes the chapter.

Chapter 2: Literature review and conceptual framework

Chapter 2 begins by considering broad treatments of the implementation and use of computers in schools. Subsequently, consideration is given to literature that addresses the topic of the integration of computers into classroom practice. This is followed by a treatment of literature relating to such integration in developing countries. Both topics mentioned above raise the issue of sustainability, which is examined in terms of the literature in the field.

A conceptual framework is then proposed for the treatment of sustainability as a characteristic or quality of dynamic, complex educational systems.

Chapter 3: Research methodology and research design

The conceptual framework presented in Chapter 2 necessitates a specific research methodology and research design. These topics are addressed in this chapter. In pursuing the chosen research methodology and design, sample selection and size, use of research instruments, data collection, data analysis, and issues surrounding reliability, validity and generalizability are addressed.

Chapter 4: Results: presentation and discussion

Chapter 4 presents data obtained from participant narratives in the form of integrated discussions surrounding categories of influences on the CALIS Project. The interrelatedness of categories, and the dynamic functionality of such interrelatedness, is elucidated.

Chapter 5: Conclusions and recommendations

In conclusion, Chapter 5 brings the findings presented in Chapter 4 into dialogue with the literature and conceptual framework presented in Chapter 2. This is followed by a summary of the findings of the research, the identification of anomalies recognised during the course of the dialogue mentioned above, and the subsequent adaptation of the conceptual framework originally presented in Chapter 2. This is followed by a reflection on methodological, substantive, scientific and exploratory aspects of the study. Finally, recommendations for policy and practice, as well as recommendations for further research, are made.

1.17 Summary

This chapter presents an introduction and orientation in terms of the study as a whole. The chapter is intended to be a roadmap which signposts the course of the journey through the research report. Each successive chapter will be recognised as an important landmark signposted in the introduction that is Chapter1. In this way, the journey delivers on the expectations created at the outset. But the journey has to have a point of departure and an indication of what is to be taken along. Chapter 2 addresses these issues by detailing the lay of the land at the outset of the journey – and a consideration of the accumulated knowledge and ideas that will stand the traveller in good stead during the envisaged traversal of the landscape.

Chapter 2

Literature review and conceptual framework

2.1 Introduction

The CALIS (Computer Assisted Learning in Schools) Project was operationalised between 1991 and 1996 in the Free State Region of South Africa. The Project was conceived of, planned and implemented by officials of the OFSED (Orange Free State Education Department). After the first democratic elections in South Africa in 1994, official departmental support in the form of financing, administration and overall management was abruptly withdrawn. In the absence of such support, numerous schools - with markedly different socio-economic, resource and teacher-skill profiles - continued using computers as an integral part of the taught curriculum. The question is thus: how did influences on the implementation of the Project affect the sustainability thereof?

2.2 The search for sources

Before the CALIS Project itself could be addressed, a comprehensive review of the literature would have to be presented. I began by conducting a thorough search for prospective sources. The first step was to search electronic databases, mostly via the EbscoHost service. The following databases were searched: Academic Search Premier; ERIC; SACat; SABINET; MLA International Bibliography; Humanities International Index; Biblioline – Africa-Wide (Incorporating South African Studies). The following input phrases were used: "sustainability computers schools"; "implementation ICT schools"; "integration ICT schools"; "sustainable computers in schools"; and "sustainable ICT in schools". Boolean operators were used in order to make the searches as effective as possible. These searches delivered no results of any consequence for this study. I then adapted my approach by conducting a search for journal titles that held the promise of containing source material that would be useful. A number of journals were identified in this way. Current and archived volumes of the selected journals were scoured for potentially useful source information. The following journals were found to be most useful: *Computers & Education; Educational Technology; British Journal of Educational Technology; Educational Technology, Research and Design; South African Journal of Education*; and the *International Journal of Qualitative Methods*.

2.3 Current and recently completed work in the field

A search was also conducted (NEXUS and SABINET) in order to establish what research has recently been completed, or is still in progress, on the topic of 'the sustainable use of computers / ICT in schools'. No results were found. The search was widened to include the 'implementation' or 'integration' of computers in schools. A number of studies were found that address the implementation / integration of computers into schools or the 'sustainability' of very specific programs in school where computers are not involved. Some of the topics addressed are the following: the use of computers by teachers and learners to enhance aspects of the curriculum in Gauteng schools (Nkumane, 2003); the use of computers in school management decision making (Patel, 1994); and the integration of computers into white and multi-racial school media centres with emphasis on cataloguing and circulation systems (Roberts, 1992).

2.4 Issues raised in the literature

2.4.1 Demarcating the field

It might be supposed that the literature provides clear and cogent answers to the question: how do influences on the implementation of a computer-integrated education project affect the sustainability thereof? This could, however, not be further from the truth. On the one hand, a multitude of different arguments are put forward, and, on the other hand, these arguments themselves are often marked by logicality, over-simplification, and emotively-charged content and hidden agenda. An extreme example of this kind of argumentation is presented by the polemical and virtually antithetical positions adopted by Bennett (1999) and Oppenheimer (1997) on the merits of computer-assisted learning in schools in the United States of America.

In this regard, Bennett points out that the U.S.A faces a crisis in education, evidenced by the fact that 25 million adults are functionally illiterate. He also argues that the burden of providing basic skills that should have been acquired at school now falls on business. The net result of this state of affairs, he claims, is that the present school-going generation will be the first in recent history not to surpass, or even equal, its predecessor in terms of education, literacy and economic attainment. He concludes:

> A century from now civilization will judge if the educational distress in America in the last years of the twentieth century led ultimately to profound improvement of schools, or to more terrible consequences. The latter alternative could include the end of America as a world leader (Bennett, 1999, online).

He then points out that proposed solutions thus far have emphasised increased funding; copying other nations; providing parents with the right to choose their child's school; and the use of the Internet. None of these proposals are seen as providing a solution to the perceived crisis in education (Bennett, 1999). Bennett pointedly defines education as "the transference to others of knowledge and values accumulated by humans, and the development of skills allowing students to integrate this knowledge and these values into their lives" (Bennett, 1999, online). Given this definition, he argues that learning has, in the past, taken place without schools or teachers and that neither schools nor teachers should thus be considered indispensable.

In the light of this argument he then presents his own solution to the perceived crisis in education:

> For computers to accomplish in education what they have done elsewhere, one new element is essential: they must be allowed to teach students without a human in the intermediary position between the child and the computer. This failure to allow computers to teach is the reason technology thus far has been a dismal failure in schools (Bennett, 1999, online).

The solution thus presented is predicated on the understanding that programming is limitless in its capacity to produce software that is as flexible as the human mind and thus an extension thereof. Furthermore, such flexible software will be designed to overcome the variations in intelligence and interests between pupils, as well as the dynamic changeability of one pupil over time (Bennett, 1999).

In terms of Bennett's characterisation of the crisis in education, presented above, the first point with which one might take issue is the flawed cause-effect logic that underlies his perception of the problem. He documents the fact that virtually 25 million American adults

are functionally illiterate and then implies that the direct cause of this situation is the fact that schools are not providing learners with basic literacy skills. The adult illiteracy rate in the U.S.A. is a problem situated within a complex system that lies at the meeting point of political, social, cultural, economic and historical influences, to name but a few. To imply, therefore that this illiteracy is directly caused by the inability of schools to teach pupils basic skills such as literacy is not only false logic but also a gross over-simplification of a complex, multi-faceted problem.

Such reductionist over-simplification similarly characterises his suggestion that the perceived crisis in education may be judged in posterity to have been responsible, amongst other terrible consequences, for the fact that the U.S.A. might have lost its position as 'world leader'. In addition to the fact that the terms of such 'world leadership' are not elucidated, the whole apparatus of global political, cultural and socio-economic dynamism is glibly assumed to play a negligible role in bringing about this state of affairs. Furthermore, the flawed logic, such as it is, is couched in dramatic and emotively charged terms, presumably aimed at arousing patriotic nationalist zeal.

Having pointed out the dire consequences of ignoring the perceived crisis in education, Bennett proceeds to define education as "the transference to others of knowledge and values accumulated by humans, and the development of skills allowing students to integrate this knowledge and these values into their lives" (Bennett, 1999, online). Suffice it to say that generations of cognitive psychologists, constructivists and constructionists are likely to differ from the kind of deterministic, unitary and instructionist approach to education suggested here. This definition of education is, however, the premise upon which he bases his solution to the problem.

In preparation for presenting his own solution, he lists various proposed solutions ranging from increased funding to the introduction of the Internet in all schools. The discussion of these propositions is approached from a very particular point of view: each is addressed in turn as a panacea for the ills besetting the education system. Here, once again, is the essence of the problem. Bennett (1999) never considers the proposed solutions in an integrated and supplementary fashion, and, in so doing, persists in wishing to solve a complex, multi-faceted problem in a simplistic manner.

Such over-simplification similarly characterises his own solution to the perceived crisis in education. He claims that for computers to have the revolutionary effect they have had in other fields, one element is essential, namely the removal of humans from the intermediary

position between child and computer. Let us ignore, for the purposes of this discussion, the dubious implied suggestion that the integration of computers in other fields of human endeavour can be equated with the integration of computers into education. What is striking, in the first instance, about this statement is the gross over-simplification which effectively equates the solving of the perceived crisis in education with the 'addition of one new element'. Equally striking, in the second place, is the linguistic quality of the expression, the meaning of which militates against, and, ultimately, deconstructs Bennett's solution to the perceived problem. Bennett's suggestion that 'humans should be removed from the intermediary position between children and computers' fails to take into account the full import of the term 'intermediary'. Derived from the word 'mediate', which implies the role of the teacher as interpreter in making the adult world intelligible to the pupil, is a host of finely nuanced ways in which the teacher is at once embodiment of, and guide towards, the world of the adult. There is a confusion and conflation of two distinct roles here. The mediating role played by the teacher might, almost incidentally, be that of technological enabler in terms of guiding learners in the use of computers, but that is not the teacher's primary mediatory role. The teacher's most important mediatory role, almost by definition, is that of elucidator and interpreter of the adult world. The presence of computers in the process is at best tangential and, at worst, incidental. So, Bennett's solution, in effect, turns out to be a technicist solution to the inability of learners to interact with computers, rather than an educational solution to an educational problem.

This utopian view of the computer as panacea for the perceived crisis in education is virtually opposed by Oppenheimer's (1997) view of the Clinton administration's spending on computers in schools as 'delusional'. Although these arguments express two extremist positions in the debate concerning the integration of computers into classroom practice, the quality of the argument in each of the two cases is very similar.

Oppenheimer begins by supporting the perception that successive rounds of technology have, in the past, failed to live up to the expectations created by their promoters. So much so, those teachers never really embraced the new tools provided by these technologies. He then concedes that a great number of teachers, however, support the introduction of computers into classroom practice. He adds that the results of a poll conducted during 1996 indicated that teachers in the U.S.A.believed that computer skills and media technology were more 'essential' than the study of biology, chemistry and physics (Oppenheimer, 1997). He then points out that the belief in the ameliorative qualities of technology is so pervasive that New Jersey "cut state aid to a number of school districts [in 1996] and then spent $10 million on classroom computers" (Oppenheimer, 1997, online). A result of this increased spending on

technology, he believes, is that the purchase of school books is stagnating and the fact that shop classes, "with their tradition of teaching children building skills with wood and metal" have been "almost entirely replaced by new technology education programs" (Oppenheimer 1997).

Oppenheimer argues further, quoting Allan Lesgold, that the 'amplificatory' quality of the computer can encourage both enlightened practices and thoughtless ones, but that there was a "real risk that the thoughtless practices will dominate, slowly dumbing down huge numbers of tomorrow's adults" (1997, online). Partly, this 'dumbing down process is seen as being brought about by the replacement of the 'real world' by a 'virtual world':

> This points to the conservative developmentalists' second concern: the danger that even if hours in front of the screen are limited, unabashed enthusiasm for the computer sends the wrong message: that the mediated world is more significant than the real one" (ibid). As proof of the dumbing down process Oppenheimer refers to a research project in which a child is unable to provide the researcher with the reasons for having manipulated a particular software programme in a particular manner: "Anecdotes like this lead some educators to worry that as children concentrate on how to manipulate software instead of the subject at hand, learning can diminish rather than grow" (Oppenheimer, 1997, online).

Given this perceived background, Oppenheimer then presents his solution to the problem. Whereas he does not go so far as to suggest the abolition of computers from classrooms, he does advocate an immediate cessation of the Clinton administration's spending on computers for classrooms:

That could free the billions that Clinton wants to devote to technology and make it available for impoverished fundamentals: teaching skills in reading, thinking, listening and other rich hands-on experiences: and, of course, building up the nation's core of knowledgeable, inspiring teachers (Oppenheimer, 1997).

Besides the fact that the 1996 poll, referred to above, is never referenced in any way which would enable further investigation and debate, the argument presented by Oppenheimer is invalid – simply because he does not compare the computer medium to an alternate medium:

rather he compares the computer medium to the content that the medium is designed to deliver, for example, the academic subjects Chemistry and Biology. In effect, he compares apples to oranges. The error is symptomatic of Oppenheimer's misunderstanding of the role of computers in classrooms as being deterministic rather than enabling. But worse still, the suggested either-or mentality adopted here characterises his approach in presenting simplistic solutions to complex problems.

One such argument is couched in terms relating to the Clinton administration's perceived belief in the ameliorative qualities of classroom computing. Oppenheimer refers to the New Jersey educational authorities who 'cut state aid to a number of school districts and then spent $10 million dollars on classroom computers'. The either-or logic adopted in this instance is clearly false, since the implication contained in the statement is the view that state aid to school districts is diametrically opposed to the acquisition of computers for classrooms. What is at stake here is surely a strategic re-alignment of state budgeting in order to meet the requirements of a changing society and a changing market place, rather than some kind of technicist conspiracy – as suggested by Oppenheimer. Besides the obvious fact that the re-alignment of schooling budgets does not, in fact, affect the amount of money spent on schools, such re-alignment is designed to make schools more effective in preparing learners for adult entry into the societies of which they are an integral part. So, Oppenheimer presents a view of computers in classrooms which is diametrically opposed to that of Bennett, and yet both arguments are similar in presenting a complex educational system in simplistic, deterministic ways.

There is yet another similarity between the two arguments. Just as Bennett uses emotive language in order to arouse patriotic, nationalist zeal, Oppenheimer similarly uses emotive language in order to arouse public indignation at the prospect of the computer 'dumbing down' successive generations of the school-going population. Oppenheimer suggests that 'the amplificatory quality of the computer can encourage enlightened practices as well as thoughtless practices'. He then argues that thoughtless practices are likely to predominate, and that this will lead to the replacement of the real world with a 'virtual world', resulting in the dumbing down of American learners. The first point to be made is the fact that the computer is seen as an agent capable of wilful action. Surely the (glibly) accepted predomination of 'thoughtless practices' is the consequence of an educational system that is incapable of training teachers to integrate computers into classroom practice effectively, rather than a consequence of the presence of computers in classrooms per se. Given this suggestion, it is not the addition of computers that is 'dumbing down' American learners, but

the inability of the system to enable teachers to fulfil their mediatory function as interpreters and elucidators of the adult world that learners are to enter.

The second point to be made is linked to the first. Virtual worlds are nothing new. The mediatory role performed by teachers in leading learners from the simplicity of childhood to the complexity of adulthood necessitates the presentation of a succession of increasingly complex 'virtual worlds' that approximate reality to various degrees. It so happens that the computer's ability to enable both simple and fairly complex simulations of real-world situations makes it a valuable tool in presenting 'virtual worlds'. The characterisation of these 'virtual worlds' as 'unreal', however, represents a gross misunderstanding of the role played by virtual worlds in education. Such worlds are not meant to replace reality – rather, they are meant to highlight a limited number of pertinent characteristics within the seemingly chaotic appearance of a complex, interrelation system. It is thus not a matter of the 'mediated world being more important than the real one'. The mediated world is a simplified approximation of the real world, designed to enable learners to grasp specific, isolated characteristics of the real world.

In this manner, both Bennett and Oppenheimer fall into the trap of presenting the role played by computers in schools as fairly simple, one-dimensional matters that can be addressed in simplistic terms. Both authors assume that computers and educational systems are discrete entities that can be manipulated at will without doing violence to either. At the heart of this view lies ignorance of the educational system as a dynamic complex system characterised by multiple, interwoven feedback loops and unpredictable lines of development.

The arguments employed by both Bennett and Oppenheimer illustrate, perhaps in the extreme, two related dangers: approaching computers in education from a technicist rather than an educational perspective, on the one hand; and the refusal to recognise educational programmes and systems as complex phenomena, demanding complex rather than simple solutions, on the other. Awareness of these dangers has informed the choice of literature to be covered in this review.

I have, in the first instance, excluded literature that debates the merits of integrating computers into classroom practice. The reason for this exclusion is simply the fact that the initiators and managers of the CALIS Project planned and implemented the Project, fully convinced of the educational merits of integrating computers into secondary school education. For the purposes of this study, the value of such integration is taken as given. Furthermore, initiators and managers endorsed the view, expressed above, that the integration, use and

sustainability of computers in secondary school education are to be approached from an educational perspective, rather than a technicist perspective. I have thus consciously excluded readings that promote a technicist perspective on the matter, rather than an educational perspective. Finally, the danger of failing to represent computers in secondary school education as situated within a complex system has necessitated the exclusion of readings that posit simple, linear and hierarchical solutions, and the inclusion of readings that seek to problematise situations in order to grapple with such complexity.

The inclusion of specific readings has also been motivated by the fact that the integration, use and sustainability of computers in secondary schools, over a number of years, has been characterised by a process of increasing insight into the sophistication and interrelatedness that is the hallmark of complex systems. For this reason, the first topic addressed in the chapter is the initial integration of computers into secondary schools. Not only is the exact definition of such integration problematised, but 'integration' and 'use', as discrete concepts, are evaluated. Since much of the literature pertains to European and North American schools, specifically, the second topic evaluates the veracity of suggestions made in such literature, in the face of the particular challenges faced by secondary schools in developing countries. Such integration and use is then situated against the backdrop of processes of change in educational systems. This discussion leads naturally to the role played by educational leadership in managing not only the integration of computers into schools, but also the wider, more complex change process. Such leadership needs to be informed, not only by an awareness of the nature of complex systems, but also by the ability of leaders at all levels of the system to formulate strategies that will enable the sustainability of such complex systems. Finally, a conceptual framework, which includes concepts drawn from complexity theory, systems theory, and the theory relating to dynamic complex educational systems, is suggested as a theoretical model capable of addressing issues of sustainability arising from the implementation of a computer-integrated education project...

2.4.2 The integration and use of computers in schools

It might appear to the uninitiated that the integration of computers into schools is a matter of hardware and software provision, and the training of staff – all of which might be accomplished during the course of a circumscribed 'implementation event'. But such an approach to integration ignores the "intertwining of complex variables" (Baylor and Ritchie, 2002) in a school environment. Furthermore, the integration of computers into schools is situated within the larger context of educational practice as a complex system and the interaction of education with yet larger and more complex systems.

2.4.2.1 Implementation and integration

Ely's research (1990a, 1990b, 1999a, 1999b), focuses on an evaluation of numerous successful implementations of computers in schools. The question posed is the following: "where innovations have been adopted and implemented, what [are] the conditions that appear to facilitate the process?"(Ely, 1999a, p.24). Consequently, Ely identifies eight conditions that are present across multiple sites: "availability of resources, dissatisfaction with the status quo, existence of knowledge and skills, availability of time, rewards or incentives, participation, commitment, and leadership." (Ely, 1999a, p.24). These findings, endorsed by Mooij and Smeets (2001) and Shuldman (2004), give an indication of the situatedness of such integration in a larger and more complex context. But the perception might still be adhered to that the 'implementation event', complex though it might be, is circumscribed and specific, rather than being process-driven.

Armstrong et al. (2004) conducted numerous case studies involving the implementation of computers and e-learning strategies in secondary schools and further education colleges in the United Kingdom. They found that, even in the absence of overall planning methodology, a "phased approach' had proven to be beneficial, particularly in the face of the ability of staff to accommodate change (Armstrong et al., 2004). Shuldman (2004) elaborates on the role played by staff reaction to change, and their adoption of innovation. Rogers' (1995) innovation-decision process is compared to and contrasted with Hall and Hord's (1987) Concerns-Based Adoption Model (specific to the adoption of educational innovation), the Apple Classrooms of Tomorrow's model of instructional evolution (Sandholtz et al., 1997), the model of instructional transformation (Reiber and Welliver, 1989), and Sherry's learning/adoption trajectory (1998). The conclusion is that the integration of computers into schools, across models, is characterised by a process beginning with the use of technology in such a way that it is "compatible with the teacher's established style of teaching" (Shuldman, 2004, p.323), and culminating in the teacher's ability to "combine idea and product technologies to encourage students to engage in deeper cognitive activity" (Hooper and Reiber, 1995, p.9). This research recognises the process nature of integrating computers and teaching-and-learning styles, but fails to situate it within larger systemic processes that drive the integration of computers into schools on the level of the individual institution – and on the level of the education system as a whole.

Thus, existing research suggests that the integration of computers into schools is greatly influenced by the extent to which staff is able to adopt, and adapt to, innovation. But the process does not end there. Such integration by individual staff members is situated within the

larger context of integration within the institution as a whole. In this regard, Mooij and Smeets (2001) identify five successive phases of ICT implementation in secondary schools:

1. incidental and isolated use of ICT by one or more teachers;
2. increasing school awareness of ICT relevance for the school, at all levels;
3. emphasis on ICT co-ordination and hardware within school [sic];
4. emphasis on didactic innovation and ICT support; and
5. Use of ICT-integrated teaching and learning, independent of time and space.

(Mooij and Smeets, 2001, p.272).

Thus, the integration of computers into schools is recognised as a complex process, co-determined by a plethora of variables, the individual influence of which is difficult to ascertain at the outset of the process. This view of the integration of computers into classroom practice, in contrast to the model presented above, suggests that successful integration is dependent on many more variables than the extent to which teachers are able to adapt teaching and learning practices to encompass the affordances of computer technology. Clearly, teacher adaptability is itself situated within complex processes that operate at institutional level. But the individual school, as complex system, is situated within larger and more complex systems, external to the school, such as "the visions and prescriptions that are reflected in (national) curriculum and national policies on (ICT in) education" (Plomp and Pelgrum, 2005). Such national curricula and policy statements are, in turn, interpreted and implemented on regional and district levels, thus complicating school-based implementation even further. Given the nature of such nested, interrelated complex systems, Mooij and Smeets (2001) argue that the implementation of ICT in secondary schools is influenced by "acting institutions or persons, or 'actors" at each of the following 10 organizational levels:

10. international level;
9. national level;
8. 'umbrella / regional / municipal level;
7. administrative / above-school level;
6. school management level;
5. location level;
4. subject-specific department level;
3. subject teacher level / form level;
2. individual pupil level / level of (small) groups of pupils;
1. developmental level / internal learning process of individual pupil.

(Mooij and Smeets, 2001, p.268-269).

In contrast to the models of integration of computers into classroom suggested in the previous paragraphs, the model presented here suggests that such integration practice takes place within a dynamic, complex system characterised by multiple feedback loops that operate upon one another in non-hierarchical, and often unpredictable, ways.

The complex process nature of such integration of computers into schools raises a related question. The studies mentioned thus far refer specifically to the 'integration' of computers into schools or the 'implementation' of ICT in schools. If we ignore, for the purposes of this discussion, the marked differences between 'integration' (generally associated with complexity) and 'implementation' (generally associated with simplicity) on the one hand, and the marked differences between 'computers' and 'ICT' on the other, then the question remains: at what point in the process does integration become 'use'? Or, in the context of the functionality of complex systems, is the question both unanswerable and irrelevant?

2.4.2.2 Use

In contrast to the studies mentioned above, there are as many studies that address the 'use' of computers in schools. Underlying the distinction drawn between 'integration' and 'usage' is the implied existence of a linear, hierarchical process, consisting of discrete, recognisable phases or steps – the completion of one step enabling the activation of the next. Not surprisingly, the literature is silent on the exact point at which 'integration' becomes 'usage'. I will argue, below, that the reason for this silence is the fact that the integration, use and sustainability of computers in schools are parallel, interrelated processes that follow complex, cyclical patterns involving multiple feedback loops and indeterminate lines of development – rather than simple linear, hierarchical processes.

This does not mean that the use of computers, per se, is viewed by all researchers in simplistic terms. As Bebell, Russell and O'Dwyer (2004, p.45) point out, exactly what is meant by teachers' use of computers, and technology in general, varies widely. In some cases such usage is defined in terms of the integration of technology into classroom practice, while, in other cases, usage is deemed to refer to the way in which teachers require of pupils to use technology in the development of products; or, the way in which teachers use technology to prepare lessons; or, the way in which teachers use technology to communicate (Bebell et al., 2004, p.45). These researchers theorised that teacher use of technology could broadly be divided into one of the following categories: "teachers' professional technology use outside of class time, teachers' use of technology during class time (including student-directed uses) teachers' assigning work that required students to use specific technology, and teachers'

communication through e-mail" (2004, p.60). After having analysed the results of a teacher survey on the use of technology by teachers, however, they were forced to differentiate between teachers' use of technology during class time, and teachers requiring of students to use technology during class time, as two distinct categories (2004, p.61). Similarly, the category relating to technology use outside class time had to be substituted by two distinct categories involving teachers' use of technology for grading, on the one hand, and, teachers' use of technology for preparation, on the other.

Whereas Bebell et al. (2004) evaluate the usage of technology in general, and computers in particular, from the point of view of the teacher as agent, Moursund and Bielefeldt (1999), having conducted a national survey on the role of information technology in teacher education in the United Kingdom, evaluate the use of computers in classroom practice from the point of view of the nature of the interaction between human and computer. On the basis of this investigation, three broad categories of computer use in schools were identified. The first category includes three uses of IT to support learning, namely computer-assisted learning, computer-assisted research and distance learning (p.6). The second category involves the use of the computer as tool, and this kind of usage is "designed to help people extend their abilities to do work" (p.6). The third category involves the use of computers by students for the study of computer and information science (p.7). The identification of such uses is driven, essentially, by a desire to understand the ways in which human beings interact with computers in many different contexts If we wish to address the effective use of computers as part of the taught curriculum in schools, the focus of the investigation will have to be considerably narrower.

Perhaps even more constraining is the fact that the use of computers in schools does not necessarily constitute effective use. Pelgrum (2001) reports on a SITES survey conducted in 26 different countries (both developed and developing), the aim of which was to establish what the most critical obstacles to the effective use of ICT in schools were perceived to be. Principals and technology experts in the schools that took part in the survey identified the following as the most critical obstacles:

1. insufficient number of computers;
2. teachers lack knowledge / skills;
3. difficult to integrate in instruction;
4. scheduling computer time;
5. insufficient peripherals;
6. not enough copies of software;

7. insufficient teacher time;
8. WWW: not enough simultaneous access;
9. not enough supervision staff; and
10. lack of technical assistance.

(Pelgrum 2001, p.163-178)

The obstacles thus identified focus very heavily on institutional and teacher characteristics as determinants of the effective use of computers in schools. Such teacher characteristics are never brought into dialogue with pedagogical practices at the schools mentioned in the survey (SITES 2006 will, specifically, address pedagogical practices – see Plomp and Pelgrum, 2005). Also, larger institutional and systemic influences on the integration of computers into classroom practice are mentioned only in a discreet, disjointed manner. Methodologically, the survey format is designed to produce exactly what has been produced in the case of this study: a list of perceived obstacles to the integration of computers into classroom practice. The survey format is not designed to elicit dialogue between disparate influences, where the dynamic interrelatedness of influences enjoys precedence over the arrival at a list of obstacles. In this way, the complexity associated with dynamic processes is not addressed and the result is that fairly simple static solutions are posited for dynamic, complex challenges.

Research on institutional characteristics influencing the effective use of computers in schools highlights the increasingly sophisticated nature of our understanding of this complex process. Pelgrum and Plomp (1993), evaluating the effective use of computers in European schools at the beginning of the 1990's, claim that the "newness' of the situation in the previous decade had precluded schools from setting clear goals (p.324). This state of affairs meant that schools often started using computers for unspecified reasons, even though there was an implicit expectation that such usage would improve the quality of education (Pelgrum and Plomp, 1993). As a result of the fact that clearly defined goals could not be set, computers were used most frequently as add-ons to the existing curriculum (Pelgrum and Plomp, 1993).

As institutional approaches to computer use became more sophisticated, however, distinctive exemplary institutions emerged. In the process, researchers became aware of the importance of pedagogical processes within which computers were to be used. Becker (1994, 2000a, 2000b) examined the differences in teaching environment between exemplary computer-using teachers and that of other computer-using teachers. He concludes that exemplary computer-using teachers are to be found in schools that have "both technology and pedagogic support, a full-time technology coordinator, teachers with an above-average level of

technology expertise, as well as staff development, access to computer resources, time, and authentic or consequential use of technology" (Shuldman, 2004, pp.326-327). In addition, Mooij and Smeets (2001) point out the vital role played by the policy and budgetary decisions made by the school board and management, as well as the importance of an ICT policy (see also Armstrong et al., 2004) that co-ordinates the purchasing of hardware and software and matches training opportunities.

2.4.2.3 Leadership

The influences on the effective use of computers in schools, as outlined above, imply strong leadership. Baylor and Ritchie (2002) believe that, even though grass-roots movements in schools can be successful, the effective use of technology-enhanced environments is, more often than not, accompanied by the presence of leaders who "have the leadership ability and vision to direct changes". The school inspectors interviewed by Shuldman (2004) feel that such leadership is more accurately characterised as leadership at three crucial levels: leadership at the level of the school inspector; leadership at the level of the school principal and administrative leadership; and, technology leadership. But leadership influences on effective institutional use of computers does not end there. Armstrong et al. (2004) claim that curriculum managers who take ownership of purchasing decisions in their own fields of expertise influence effective computer use positively. Support for virtually all of the institutional influences mentioned above is found in Pelgrum's (2001) evaluation of an international survey on the use of computers in schools.

2.4.2.4 Teacher characteristics

But, important as these institutional influences are, the literature is adamant that the teacher plays a pivotal role in the effective use of computers in the classroom. Moursund and Bielefeldt (1999) emphasize the fact that the technology proficiency of teachers begins before they actually start teaching. They point out that, in order to increase proficiency in this regard, it is essential that teacher training institutions should increase the level of technological integration in their own academic offerings.

Once teachers enter their institutions of choice, it is equally important that they buy into the institutional "vision for learning and the associated strategies for the use of ICT" (Armstrong et al., 2004). The institution, besides providing the global ICT policy within which the effective use of computers in the classroom takes place, needs to create opportunities for teachers to have regular contact with technology and technology experts. The district superintendents interviewed by Shuldman (2004) believe that the 'lack of time' obstacle in this regard stems from the fact that teachers need more 'contractual' or formal school time

(as opposed to own time) during which to gain proficiency in the integration of technology into classroom practice.

But institutional support can only go so far. Veen (1994, 1995; see also Mooij and Smeets, 2001) argues, that teacher characteristics outweigh school characteristics in explaining teachers' use of computers. Are there inherent qualities possessed by individual teachers who integrate technology successfully into their classrooms? The literature differentiates between attitudinal characteristics, on the one hand, and, acquired skills on the other.

Predictably, in terms of the situatedness of teacher use of computers within a changeable, non-linear complex system, attitudinal characteristics revolve around the ability of teachers to cope with change and innovation. Ten Brummelhuis (1995) identified 'perceived relevance of the innovation' as the most important determinant of teachers' use of computers in secondary schools. These findings are confirmed by a study conducted by ten Brummelhuis and Tuijnman (1992). Baylor and Ritchie (2002) argue that teacher openness to change is the most critical predictor of effective computer use amongst teachers. These suggestions relate to the use of computers as a lever for bringing about change. In the first place, the suggestion is that teachers need to be made aware, and convinced, of the relevance of innovation to their own practice before they are likely to adopt the innovation. But, what is not clearly implied here is the fact that the change process itself needs to incorporate changes to pedagogical practice. It is thus crucial that larger changes in the education system be linked to changes in pedagogical practice, if the 'no significant difference' situation is to be avoided.

Whereas there seems to be agreement on the attitudinal predictors of successful computer use, there is great disparity when it comes to the specific skills that teachers should acquire. In fact, the effectiveness of staff development sessions aimed at promoting the integration of technology into instruction is called into question by Mann (School Boards Association, 2000), who claims that most teachers freely acknowledge that training is virtually useless. His argument is, however, flawed by false appeals to authority and generalization – not to mention the fact that there are numerous reasons for teachers' negative experiences of such staff development sessions, not least of which might be the failure of such sessions to transfer, effectively, applicable integratory skills. In contrast, Pelgrum (2001) emphasises the need for effective staff development programmes by elucidating the complexity of such integratory skills. Teachers from 26 countries were asked to rate (in the form of a percentage) how well prepared they thought they were in each of the following areas:

- application of software to track student progress;
- didactical and organizational integration of computers in subjects;
- the use of specific programs for subjects;
- evaluation and selection of instructional software;
- use of computers for individualised learning programs;
- the use of multimedia applications; and
- adaptation of software to fit school purposes.

(Pelgrum. 2001, p.171)

Such preparedness was seen against the backdrop of planned acquisition of integratory skills ('goal') as opposed to actual acquisition of such skills ('realised'). The effectiveness of staff development programmes could then be determined by comparing averaged percentages of each of these skill sets. The discrepancy between the 'goal' and the 'realised' in the case of all of the countries involved in the survey is significant. In Canada, for instance, acquisition of skills was planned by 80% of participant institutions (lower secondary schools) but the actual acquisition of skills took place in only 17% of institutions; in South Africa the percentages were 64% and 6%, respectively. The large discrepancy between the planned and actual acquisition of integratory skills can be ascribed to numerous factors. It is quite conceivable, for instance, that the presenters of such staff development sessions did not possess the necessary technological or presentations skills to ensure the uptake of skills amongst staff. It is also possible, that such staff development sessions were predicated on the assumption that the integration of computers into classroom practice was dependent on the acquisition of a limited number of hierarchical skills that could be acquired in a very limited period of time; rather than numerous, incompletely defined skills that interacted in complex ways.

But, whether or not this is the case, it is clear that the absence of teacher integratory skills constitutes a serious obstacle to the integration of ICT into schools (see Mooij and Smeets, 2001). Moreover, the failure of staff development programmes in enabling the acquisition of integratory skills impacts negatively on teacher confidence (McMullan, 2002; Shuldman, 2004). The superintendents interviewed by Shuldman (2004), in fact, claim that "no learning outcomes of any consequence will be seen as a result of teachers' use of technology until teachers have more experience and attain a greater personal level of comfort, confidence , and skill" (Shuldman, 2004, online). McMullan's (2002) findings suggest that teacher lack of confidence is most effectively addressed by the provision of personal access to computers on the part of teachers. But personal access, important though it might be in promoting teacher

confidence, is not the most important influence on the effective use of computers in classroom practice. The most important influence, claims McMullan, is the ability of teachers to "adapt their practice to embrace the new technologies" (McMullan, 2002, p.16). The crux of the matter is thus not technological skills per se, but the way in which these technological skills can be harnessed in the service of pedagogical effectiveness.

2.4.2.5 Pedagogical practices

The relatively late focus on the importance of adapting pedagogical practices to the affordances offered by computer technology is ascribed to the fact that the development of computer-based technology infrastructure in education outpaced the integration of computer resources into pedagogical practice (Moursund and Bielefeldt, 1999). This was brought about by a situation where governments over-emphasised the importance of computer hardware provision, rather than the ways in which computers could be used to support teaching and learning effectively (McMullan, 2002). Such a pedagogically undesirable situation was further worsened by the acquisition of stand-alone computer-based coursework, which did not bring about the expected gains in student learning (Moursund and Bieleveldt, 1999). The approach by governments in the early 1990s, seen from the vantage point of complex systems, appears simplistic in the extreme. Not only was the implementation of the physical technological infrastructure seen as a sufficient condition for improved student learning, but the implementation of stand-alone computer-based courses (artefacts of the underlying hierarchical and linear approach to teaching and learning) denies the complex interrelatedness of numerous influences that co-determine the effectiveness of learning, in particular, and the nature of a complex educational systems, in general.

Towards the end of the 1990s, however, influential policy documents in numerous countries reflect a shift from viewing the learner as a consumer of knowledge to a view of the learner as active constructor of knowledge – a change that speaks of the realisation that the computer and ICT more generally, can act as a catalyst for educational reform (Pelgrum, 2001). This point of view is endorsed by Kozma (2003), who notes that such educational reform went hand-in-hand with the widespread adoption of constructivist approaches to teaching and learning. One of the possible reasons for this state of affairs is to be gleaned from the findings of a national study in the United States of America (1998) that found a negative relationship between the frequency of the use of school computers and school achievement, but, also, a positive relationship between certain uses of technology and school achievement (Wenglisnksi, 1998; Kozma, 1993).

The key to the dilemma appears to be the fact that the majority of teachers use computers and ICT to teach the standard curriculum (Law et al., 2000; Scofield and Davidson, 2002), while others use computers and ICT "within the context of complex tasks, conducted within a multidisciplinary context and extended blocks of time, and with performance-based assessment (Kozma, 2003, p.4). The actual activities in classrooms of teachers who employ this approach to teaching and learning are characterised by collaboration in pairs or larger groups, constructivist activities, research and product development (Kozma, 2003, p.5).

The centrality of active student involvement as a predictor of the adoption of new pedagogical approaches is envisaged in Pelgrum (2001) and further explored in the aims of the proposed SITES2006 international survey, which has as its main aim the extent to which ICT is used in education and how the use of ICT is associated with changing pedagogical practices (Plomp and Pelgrum, 2005). But perceptions of student influences on the effectiveness of learning have come a long way since the *tabula rasa* of previous eras. Students bring a wide variety of abilities, skills, interests, experiences and preferences to the learning situation.

There is a large body of research on differences in gender-based learning styles, for instance. The results are inconclusive, as evidenced by the contradictory findings presented by Biggs (1987) on the one hand, and Shaw and Marlow (1999), on the other. Furthermore, it would seem that differences in learning style between individual learners may well be a predictor of positive or negative ICT learning experiences (Shaw and Marlow, 1999, p.233). But innate capabilities and preferences are not the only predictors of effective computer-based learning. Holt and Crocker (2000) argue that prior negative experiences of ICT-integrated learning actually motivate learners to do better in subsequent ICT-integrated learning sessions.

The way in which the traditional pedagogic triangle, involving the teacher, the learner and the material contributes to effective computer-based learning is thus not as unproblematic as one might suppose. The matter is, however, further complicated by the fact that such interaction is situated within a wider context which forms an integral part of the education system. In the first instance, effective learning is impacted upon positively by the extent to which the institutional ICT coordinator possesses effective technological and educational skills (Pelgrum, 2001; Mooij and Smeets, 2001; Baylor and Ritchie, 2002). One might well ask whether the possession of technological and educational skills, in tandem, is not a requirement for teachers as well. It is, after all teachers who must align technological affordances with curriculum requirements and learning-and-teaching practices on a daily basis. Beyond human intervention, support influences such as the student / computer ratio

(McMullan 2002); the quality of connectivity to the Internet (McMullan, 2002); the presence of 'embedded systems' in the form of comprehensive service agreements, support and replacement costing and budgeting (McMullan, 2002) may all contribute to effective learning.

2.4.2.6 Funding

Of all of these 'support influences' on effective computer-based learning, the issue of funding is perhaps the most hotly debated. Seen in the light of suggestions that support costs are over 10 times the initial cost of the hardware and software (National School Boards Association, 2000), it is understandable that funding needs to be attracted, retained and expanded over the life of a computer-based educational initiative. Whereas schools have been supplied with ICT equipment by governments in the past, suggestions are that such strategies need to be replaced by strategies that provide incentives to the private sector to provide managed services to schools, and, the involvement of local parents, teachers and community groups in providing financial support to computer-based learning efforts (McMullan, 2002). Linked to this suggestion is the suggestion that schools lease ICT equipment, thus cutting down on major capital outlay at the time of delivery (Armstrong et al., 2004, p.4). This would alleviate pressure on financial resources in ensuring a sustained outlay over a number of years in terms of support, training and upkeep/ replacement.

It is sufficiently clear that the exact nature of what constitutes computer 'use' in schools is not only contested, but also affected by a host of influences that spring from the situatedness of such an endeavour in a complex educational system. Furthermore, if 'use' is taken to refer to the integration of computers into the teaching and learning process, the present state of affairs is far from satisfactory. Levin (2004) reports that in 2002 there were 4.8 students to an instructional computer with Internet access in public schools in the United States of America. Furthermore, 99% of all public schools had access to the Internet in 2002 and $5.8 billion was spent on technology-related matters in public schools in the 2002/2003 school year. And yet, 50% of students with computer access at school use school computers one hour or less a week (Levin, 2004). In fact, so glaring is the failure to integrate computers into classroom practice, that Armstrong et al. (2004), based on the results of a national survey in the United Kingdom, estimate that only 11% of secondary schools and further education colleges integrate computers effectively into the curriculum. Based on these findings, Armstrong et al. (2004) suggest that future national policy should encourage institutions to develop appropriate and effective e-learning strategies – both independently and collectively (p.8) They also suggest that institutions should be encouraged to move towards a "more embedded delivery model which locates computers in the classroom, or in clusters and not, as is

predominantly the case, in computer suites" (Armstrong et al., 2004, p.9). In the case of the CALIS Project, investigated in this study, this was the presupposition accepted when the Project was originally planned.

Future policy decisions will, however, be based on research conducted today. Levin (2004) argues that, although there is a growing body of literature on the use of technologies in schools, there is very little accumulated knowledge about the effectiveness of educational technology. Such 'effectiveness' is a critical determinant of the sustainability of a project over time. Furthermore, he argues that there is little information on variations in implementation of interventions or the nature of control conditions. There is thus a need for research relating to influences on the implementation of such projects, which affect the sustainability thereof. Also, there is no sensitivity in the literature to variations within and across grades and academic content areas (Levin, 2004). What Levin does not explicitly state is that all of this is true of the United States of America, in particular, and developed countries, in general. The situation is more complex yet in the case of developing countries.

2.4.3 The integration and use of school-based computers in developing countries

Commentators on the integration and use of computers in developing countries at the end of the 1980s and the beginning of the 1990s stress the inability of the process to address the educational needs of a wide variety of learners (De Villar and Faltis, 1987, 1991; Maddux and Cummings, 1987; Arias, 1990). The wide variety of learners envisaged here include: 'mildly handicapped' learners (Maddux and Cummings, 1987); language minority learners (Arias, 1990); learners from socio-economically disenfranchised backgrounds (De Villar and Faltis, 1987); and learners from different racial and cultural backgrounds (De Villar and Faltis, 1991). What is striking is that the inability envisaged above is true of the situation in American schools, at the time.

In a report on the use of computers in 'Third-World' schools, Hawkridge, Jaworski and McMahon (1990) conclude that, both in Zimbabwe and Botswana, the primary reasons for introducing computers in schools are to be found in pressures brought to bear on schools by parents, principals and teachers wishing "to be up to date, professionally" (1990, p.224). They further stress that this situation was only true of the most affluent schools in these countries.

Whilst schools in the United States were thus involved in addressing issues surrounding equitable access for all learners, selected, affluent schools in some African countries were

attempting to convince school governing bodies to introduce computers in schools, even if such introduction (in the case of Botswana) involved the use of computers for administrative purposes only (Hawkridge, Jakowski and McMahon, 1990, p.230). The reasons for the vast discrepancy between implementation and integration in developed countries as opposed to implementation and integration in developing countries are far more complex than the inability of computers to address the educational needs of a widely diverse learner body, as suggested by the abovementioned studies. Virtually a decade after the comments contemplated above, Hawkins (2002) produced a report, funded by the World Links for Development Program and the World Bank Institute, on the state of ICT and education in the developing world. Drawing on information gathered from across the globe, Hawkins postulates 'ten lessons for ICT and education in developing countries:

1. computer labs in developing countries take time and money but they work;
2. technical support cannot be overlooked;
3. non-competitive telecommunications infrastructure, policies, and regulations impede connectivity and sustainability;
4. lose the wires;
5. get the community involved;
6. private-public sector partnerships are essential;
7. link ICT and education efforts to broader educational reforms;
8. training, training, training;
9. technology empowers girls; and
10. technology motivates students and energises classrooms

(Hawkins, 2002, online).

Although a number of these lessons might seem to be applicable to educational institutions in developed countries, there are clearly influences that are developing-country specific. The monopolies that characterise telecommunication infrastructures are characteristic of smaller, developing economies. Such monopolies imply that educational computer usage is subject to higher connectivity costs. Similarly, the empowerment of girls is a particularly relevant issue in many developing countries since many traditional, indigenous cultures negate the equality of women, and thus, by extension, the access of girls to education. These influences do not stem from the characteristics of individual schools, or even national education structures; rather, they come into existence at the confluence of complex systems, such as the situatedness of educational systems within the wider context of interrelated geographical, social, political and economic systems.

Understandably, one of the most important obstacles in the path of universal computer access to learners in developing countries is the dearth of resources. In an investigation into the costs associated with computer use in secondary schools in developing countries (focusing on Zimbabwe and South Africa), Cawthera (2002) underlines the vast differences in provisioning between schools serving different socio-economic communities. But, even in the face of such differences, he is able to formulate broad recommendations applicable to schools in developing countries, in general.

- The usage of existing computer facilities is often only a fraction (average around 20-30%) of what it could be.
- Probably the best way to both reduce unit costs and increase provision is to extend usage …
- For planning effective computer provision it should be realised that the costs of equipment tend only to be a fraction of the total cost of provision over five years…
- The training of teachers in the use of ICT in schools is an important aspect of provision which may often be overlooked and under-budgeted…
- Policy makers need to be aware of the range of computer provision available. Expensive, state of the art equipment is not essential to achieving good educational outcomes.
- Careful consideration should be given to the processes involved in the provision of computers in schools so as to ensure high levels of usage…
- Where there is sufficient usage, computer labs should have a minimum of 20 computers. This will reduce unit costs by spreading the high fixed costs of training over a larger number of users.
- Benchmarks and ratios for usage and costs need to be developed against which to monitor the efficiency of computer provision …
- Schools are likely to need assistance with planning and managing income generating activities if these are seen as a way of meeting running costs…
- The cost of computer provision in rural areas need not be prohibitively expensive. Data from *Myeka High School* suggests that this could be achieved in schools without mains electricity or landline connectivity for under $20 per student per year provided there are high levels of usage

(Cawthera, 2002, p.6).

This does not mean that national governments are turning a blind eye to the dearth of resources in developing countries. On the contrary, governments, such as the South African

government, are making concerted efforts to ensure that the limited resources available for the integration of computers into schools are employed as effectively as possible. The South African *White Paper on e-Education* (2004), in fact, stresses the formulation of an approach that takes cognisance of cost-effectiveness, integration with educational and developmental demands, sustainability and the effective and efficient utilisation of computers in classrooms (Government Gazette, 2004, pp.10-11).

Laudable though such national initiatives might be, however, the expertise and political and educational will at national level is not always reflected at regional level, where national policies are interpreted, and find expression, in regional initiatives such as the E-Lapa Project in the Free State region (Thomas, 2005). In this particular case interpretation and implementation of national policy is taking place without due consideration to larger systemic complexity in the region, and sustainability of the Project over time (Thomas, 2005).

The golden thread uniting the implementation and integration of computers in schools, both in developed and developing countries, is the concept of complexity. Schools, districts, regions and national departments of education are more successful or less successful in achieving such integration, depending on the extent to which they are able to plan for, and account for, the complexity of the systems that they wish to harmonise. All of the influences mentioned thus far, however, represent only half of the complexity of educational systems, since such influences exist essentially on a horizontal, synchronic plane of interrelatedness. Already complex synchronic educational systems are also affected by processes of change that exist diachronically and that provide extra dimensionalities of complexity to the system. The following sections of this chapter deal specifically with the nature of complexity, in general, and the nature of dynamic complexity in educational systems, in particular.

2.5 Summary of issues raised in the literature

There are numerous studies that address the implementation and use of computers in schools. In the first instance, many research projects view the implementation of computers in schools as a discreet event, rather than a dynamic process. Secondly, such implementation often lacks definition and needs to be distinguished from the integration of computers into classroom practice, specifically. Furthermore, although there are many studies that address the use of computers in schools, it is not completely clear what constitutes effective use, on the one hand, and it is also not clear at which point of the process ‘implementation’ becomes ‘use’, on the other.

Both the effectiveness of implementation and the effectiveness of use are seen as subject to a number of influences. Firstly, institutional leadership in the form of the school principal and the school management team are seen as having a significant influence on the integration of computers into classroom practice. Leadership at other levels of the education system, namely district (with the exception of the superintendent level – see Shuldman, 2004), regional, national and international levels are largely ignored. Secondly, teacher characteristics (particularly attitudinal characteristics) are foregrounded. Thirdly, pedagogical practices are seen as a significant influence on the successful integration of computers into classroom practice. The literature does not address the dynamic interrelatedness between teacher characteristics and pedagogical practices. Neither does it consider ways in which these influences might be inextricably linked to larger systemic processes. The emerging picture is thus one which suggests the existence of numerous, discreet influences on the successful implementation and further sustainability of such projects. Integrated, dynamic processes affecting such implementation and sustainability at larger systemic levels are not considered, other than in a very superficial way. Fourthly, the way in which identified 'support' influences, most notably funding, are inextricably woven into the fabric of systemic functionality is denigrated by the presentation of such influences as discreet influences. Lastly, the literature draws attention to additional influences on such projects, stemming from the fact that they are implemented in developing countries rather than developed countries. In this way, monopolies on telecommunications infrastructures and the socially constructed roles assigned to girls in some societies might influence such projects significantly.

The fact that the dynamic interrelatedness of all of the identified influences might affect the implementation and sustainability of such projects, in the form of integrated systemic processes, is not considered in the literature at all. On the basis of such silence, research questions addressing this interrelatedness of influences, on both horizontal and vertical structural levels of the system, have been formulated.

2.6 Research questions

The main research question addressed by this study is the following:

> ***How did influences on the implementation of the CALIS Project affect the sustainability thereof?***

Because of the breadth of this question, five sub-questions, dealing with specific aspects of the main research question, were arrived at:

1. How did personal qualities, possessed by people directly or tangentially involved in implementing the Project, influences the implementation and sustainability of the Project?
2. How did elements of programmatic design (those elements of programmatic design specifically embodied in the goals of the Project) influence the implementation and sustainability of the Project?

3. How did the availability of physical resources during implementation influence the sustainability of the Project?

4. How did the larger systemic environment in which the Project was implemented, influence the sustainability thereof?

5. How was the further development of the Project affected by the animated, interactional interrelatedness of the complex system infused by all of the influences mentioned above?

These questions will be addressed against the theoretical backdrop provided by the following conceptual framework.

2.7 Conceptual framework

This conceptual framework encapsulates related concepts drawn from the following theoretical approaches.

Complexity theory: This approach is not so much characterised by a coherent theory – rather it is characterised by theoretical work in many different fields on the nature of complexity. Such work was made possible by an understanding of complexity significantly influenced by Prigogine's (1967) work on dissipative structures and Mandelbrot's (1983) work on fractal geometry.

Cybernetic theory: This theory, proposed by Wiener (1950) and adapted by Winn (1975) proposes a complex view of computer-based functionality, based originally on the non-linear feedback loops that are an integral feature of complex systems.

Autopoetic systems theory: This theory addresses the complex functionality that is the hallmark of complex living systems. The formulation of the theory, by Maturana and Varela (1980, 1987), was influenced, partly, by cybernetic theory.

Autonomous systems theory: This theory was developed as a direct consequence of autopoetic theory. Maturana and Varela (1979, 1992) propose that many of the functional characteristics of living systems may also be found in non-living systems.

Systems theory: Senge (1990, 2000) proposes that the functionality observed in living and non-living systems also characterises larger systems that are created by human beings. In these respect large organisations, both created by human beings and within which human beings are active, functions in ways that are characteristic of complex systems.

Dynamic, complex educational systems: Stacey (1992, 1996) recognises the education system as one such organisational system that is characterised by complex functionality. Furthermore, Fullan (2005) proposes an approach to the sustainability of such dynamic, complex educational systems. Cavallo (2004) combines the functionality of autopoetic systems with the functionality of dynamic, complex educational systems in order to arrive at a theoretical model of ecological or viral growth patterns in educational systems.

The ensuing diagram provides a visual representation of the way in which concepts from these theories are related.

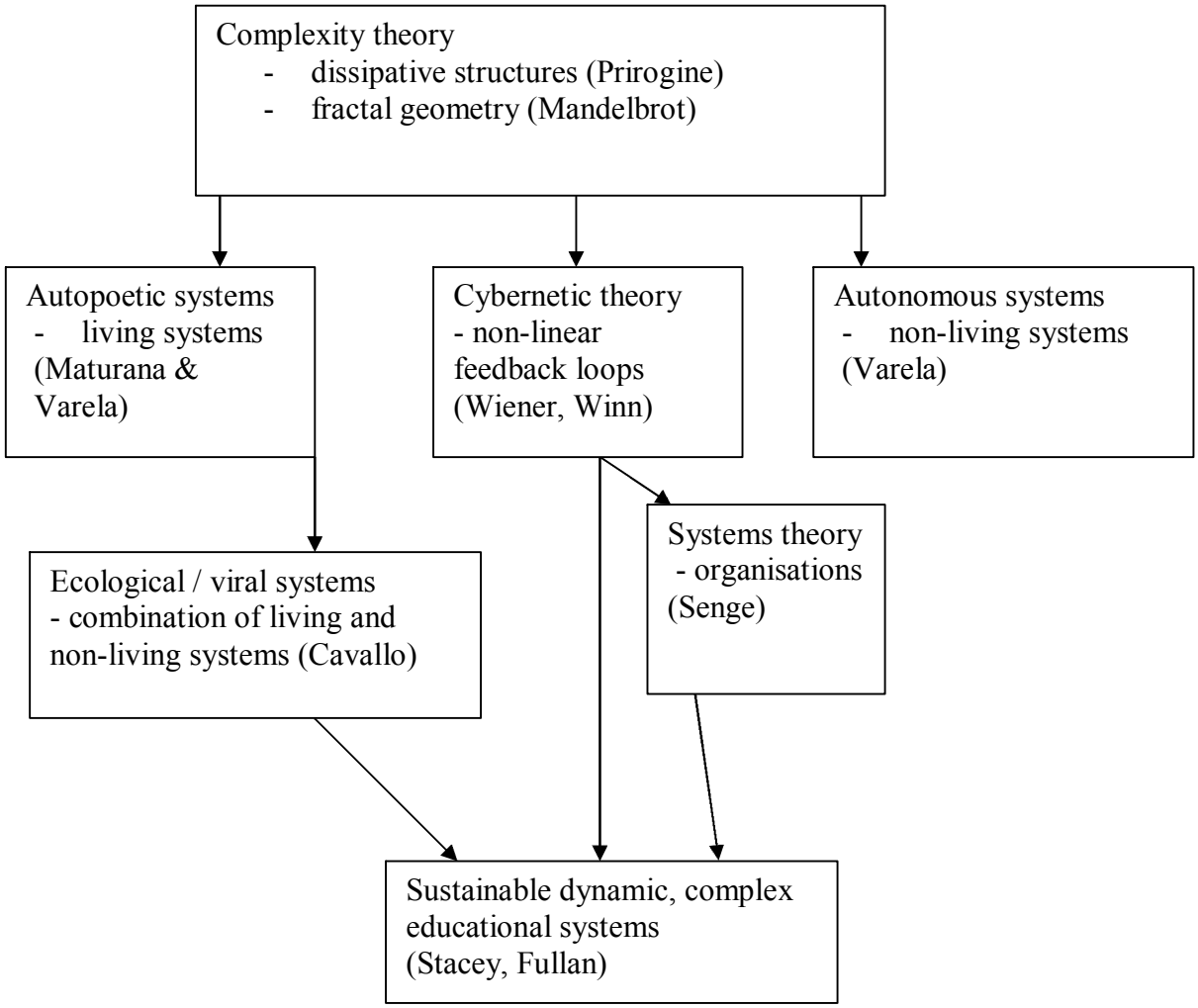

Figure 1: Conceptual Framework

In the ensuing sub-sections I will expand upon the philosophical and theoretical interrelations between these theoretical approaches.

2.7.1 Postmodernism, chaos, autonomous systems and complexity

It might be argued that, within Western philosophical tradition, a worldview begins and ends with one's conception of reality and the kind of knowledge that makes such a reality manifest to one. The very concept encapsulated in the Ancient Greek formulation of an alpha and an omega implies linear progression in the (metaphorical) form of either a passage of time or the traversal of physical space, or both. As discussed below, the metaphor of travel or journeying is particularly relevant in the context of this study.

There is about such linear progression the beginning of a positivistic determinism that finds its most eloquent expression in the Newtonian characterisation of the universe as machine. Nor is it coincidental that Newtonian physics, and later the hard sciences in general, should be the touchstone by which Enlightenment conceptions of reality and the nature of knowledge were to be evaluated. Such hard sciences provided the assurance that direct experience of an external, monolithic reality could be achieved through a replicable 'scientific method' that provided predictable evidence (in the form of 'measurement') of such a reality. The ontological and epistemological character of positivist thought is thus deterministic and predictable.

Philosophical conceptions of reality and the nature of knowledge, thus engendered and persuasively advocated by the hard sciences, found expression in other branches of human knowledge. In this way, the study of the humanities, for instance, was deeply influenced by structural linguistics (De Saussure, 1966), structuralism (Bush, 1995), and semiotics (De Saussure, 1966; Morris, 1946; Solomon, 2000). Besides the central thesis involving the existence of " a systemic 'centre' that organised and sustained the entire structure (Bush, 1995, p.2), the commonality in each of these instances was a view of reality as fixed and 'knowable' – and capable of being represented and reflected in human knowledge structures.

Ironically, physics was also the branch of human knowledge that witnessed some of the first challenges to the positivist position. The success of positivistic scientific enquiry resulted in an exponential growth in technological innovation. One of the results of such technological innovation, during the first half of the twentieth century was the ability to observe, for the first time, sub-atomic matter. Almost shockingly, the sub-atomic world, governed by quantum principles, as it was found to be, reflected a reality which was uncertain, partly unpredictable and characterised by indeterminism, generally. Furthermore, knowledge of such a reality was not unmediated and positivistic, as had been the case with Newtonian physics – rather, knowledge of such a reality was inextricably intertwined with the gaze of the observer / researcher. The birth of quantum physics signalled the birth of a philosophy of uncertainty and pluralism; the death of master narratives (Lyotard, 1984) and the beginnings of subjectively constructed, internalised realities that were 'knowable' only in terms of experience and interaction. Such ontological and epistemological indeterminism finds its most vehement twentieth century expression in the tenets of postmodernism (Lyotard, 1984; Foucault, 1980; Baudrillard, 1990; Anderson, 1995a; Jencks, 1992a; Solomon, 2000).

Solomon (2000, pp.13-15) argues that post-modernism rests on eight assumptions. The first assumption is that of pluralism, which is succinctly captured in Hlynka and Yeaman's

proclamation that "if there are multiple ways of knowing then there must be multiple truths" (1992, p.3). The second assumption is that of eclecticism, which finds its quintessential expression in Derrida's insistence on artistic collage/montage as the most important form of discourse (Harvey, 1990, p.51). The third assumption, and also a fundamental tenet of post-modernism, is the belief that knowledge is constructed, rather than acquired (Bruner 1991; Papert and Harel, 1991; Wilson et al., 1995). The fourth assumption underlying post-modern practice is the belief that truth is grounded in subjective experience. In this regard, the Baudrillardian conception of the simulacrum signals the breakdown between representation and reality, thus heralding the absence of a monolithic, exterior reality (Braudrillard, 1990). The fifth assumption relates to the way in which language is centrally involved in the social construction of knowledge, such that participants are actually "shaped by particular discourse communities" (Anderson and Damarin, 1996, p.270). Related to the centrality of language, is the assumption that communication is not determined by sender and message alone, but also, importantly, by the receiver and interpreter of such a message (Levinson, 1983; Sperber and Wilson, 1986, 1995). A central assumption underlying postmodernist practice is the shift of scientific interest from the study of inanimate systems to self-organising, dynamic, living systems that "consist of non-linear processes and a high degree of feedback" (Jencks, 1992a). It is thus not surprising that the eighth assumption should suggest a view of self as pluralistic and multiple, "struggling to maker internal peace among the multiple components of their selves and the claims of the different communities to which they are connected (Anderson, 1995b, and p.128).

Just as other branches of human knowledge had embraced empiricist positivism, espoused by the hard sciences in previous centuries, other branches of human knowledge embraced the relativism of postmodernity, once again espoused by the hard sciences, in the twentieth century? Postmodernity found expression in the humanities as a worldview that superseded predecessors such as post-structuralism and deconstruction (Gottdiener, 1994).

Subsequent developments in physics have included the conception of chaos as inherent in naturally-occurring and man-made systems, from the action of waves to the performance of the stock market (Sheldrake, 1990, pp.70-71; Solomon, 2000, p.14). With the advent of computers, chaos theory evolved in a number of ways, notably cybernetic theory (iterative non-deterministic feedback loops) (Wiener, 1950; Winn, 1975; Capra, 1996, p.52); autonomous systems theory (systems as self-regulating entities based on feedback and response) (Varela, 1979, 1992; Maturana and Varela, 1980, 1987); autopoeitc theory (autonomous biological systems) (Maturana, 1970; Maturana and Varela, 1980, 1987); the emergence of fractal geometry (Mandelbrot, 1993); and, finally, complex systems theory

(Senge, 1990, 2000; Trilling and Hood, 1999). Complex systems exist on the boundary between regulation and chaos (Stacey, 1996). They are not fully deterministic, tend to be characterised by uncertainty, and develop in non-linear and unforeseen ways. Because they do not develop in a linear fashion, they are also subject to multidirectional, often mutual, causality. Systems devised by human beings, involving human action and interaction, are typically complex systems. One such system, embedded in larger and yet larger systems, is education (Fullan, 1999, 2001, 2005). In short, educational systems are indeterministic, subject to multi-causal networks of interaction and interrelatedness, and often develop in unpredictable and unforeseen ways. The study of such systems militates against the ontological and epistemological characterisation of unitary exteriority and certainty that was the bedrock of positivist thought. Rather, scrutiny of such systems demands a postmodernist approach that allows for relativism, plurality, interiority and paradoxicality.

2.7.2 Education, change and complexity

The puzzling aspect of attitudes towards the way in which computers are meant to change education is accurately captured by Papert (1997a). He argues that "the idea of school in many of its features is so deeply ingrained in people's thinking that when they look at technology to discuss it in relation to computers, they see it in a particular and very narrow way dominated by the nature of school as they've known it" (Papert, 1997a, online). Herein lies the contradiction, says Papert: people think that "the role of the computer should be to get in there [existing educational system] and improve a system which exists as a result of the technological limitations of a previous epoch" (Papert, 1997a, online). It is exactly this contradiction that leads Papert (1997b) to claim that school reform is impossible, if reform is defined as "attempts to impose a specific new form on education" (Papert, 1997b, online). Change, with relation to educational systems, he argues, is evolutionary. Given this perception of change, he argues further that the computers that will act as the levers of change will be those that are outside the control of schools and outside the "schools' tendency to force new ideas into old ways" (Papert, 1996, online). What is needed are "bold, coherent, inspiring yet realistic visions of what education could be like 10 to 20 years from now" (Papert, 1991, online). Papert's impassioned plea in favour of allowing evolutionary change rather than enforcing centrally-controlled reform is, however, only the tip of the iceberg. Evolutionary change has to be viewed in concert with issues such as the exact character of the system that is to evolve, the principles underlying such evolution, and the propensity of the human actors involved in such change processes to produce implementation and management models that are consonant with such change.

Educational change has to be understood against the backdrop of change in complex systems. Senge draws a distinction between 'detailed complexity' (characterised above as 'synchronic' complexity) and 'dynamic complexity' (characterised above as 'diachronic' complexity) (1990, p.365). He further argues that dynamic complexity (the home of change in complex systems) is characterised by a situation where "cause and effect are not close in time and space and obvious interventions do not produce expected outcomes" (Senge, 1990, p.365). Stacey, commenting on Senge's characterisation of dynamic complexity, claims that the linkages between cause and effect in dynamically complex systems, rather than being distant in time and space, in fact, disappear altogether and are "impossible to trace" (1992, p.78). Furthermore, if there is no conclusive proof that specific intended actions were not affected by chance in bringing about specific intended material changes, then success in such systems is characterised by "the discovery of patterns that emerge through actions we take in response to the changing agendas of issues we identify" (Stacey, 1992, p.124). It is this 'perpetual suspension of intentionality' that results in the paradoxical nature of organizational dynamics, whereby organizations are "powerfully pulled towards stability by the forces of integration, maintenance controls, human desires for security and certainty", on the one hand, and "powerfully pulled to the opposite extreme of unstable equilibrium by the forces of division and decentralisation, human desires for excitement and innovation, and isolation from the environment", on the other (Stacey, 1996a, p.349).

Productive educational change, powerfully influenced by the underlying forces that shape complex enterprises, similarly "roams somewhere between overcontrol and chaos" (Fullan, 1993, p.19). So, the question that now arises is the following: is it possible to develop an implementation and management model that can usefully be employed in dealing with dynamic, complex educational systems, and, if so, what would such a model look like?
As a footnote to this enterprise, Fullan cautions that educational change will always fail until we are able to produce infrastructures and processes that enable teachers to develop new understandings (2001, p.37).

2.7.3 Ecological or viral change in educational systems

In contemplating the nature of such a model, Cavallo (2004) endorses and extends Fullan's view. Cavallo claims that "real change is inherently a kind of learning" (Cavallo, 2004, p.97). The processes associated with this kind of change are not only evolutionary, as Papert suggests, but more accurately characterised, suggests Cavallo, as 'ecological', 'viral' or 'genetic'. Such characterisation endorses the view that the 'reform' approach to educational change is powerless in the face of essentially unpredictable systemic patterns of change. The

emergence of such patterns is 'ecological' (partly) in the sense that they are beyond the control of hierarchical, linear reform initiatives. It is for this reason that Cavallo urges a management approach to evolutionary, ecological change, based on pattern recognition and the flexible, ongoing development of strategies that will actively contribute to such processes (Cavallo, 2004, p.97). Such an approach to implementing and managing ecological processes of change in complex educational systems is predicated on a design methodology characterised by Cavallo as 'emergent design':

> It supposes an evolutionary model, where we are not passive observers: we design and introduce new variants along certain principles and see how well they grow. We study the fitness functions, the social niches, and the local ecologies of culture and thought. We study change itself as a process of learning. Our role as the exogenous element in conducting the learning projects is to show the existence of a new way of instantiating dynamic learning environments. We bring in powerful ideas about learning and through our practice illustrate how to put them to work. The possibility for spread and growth is not through the exact replication since the context will be different and the culture is dynamic. Rather, the goal is for the appropriation of the principles and the development of models of thinking so that the agents can adapt and apply with the ability to continually develop through reflection on the feedback and changing environmental conditions.
>
> (Cavallo, 2004, pp97-98).

Underlying such an approach to change in educational environments is the recognition that not all host environments are the same and thus " the design of learning projects evolves and changes in dialogue with personal, collective and local interests, conceptions, and needs" (Cavallo, 2004, p.98). But this approach to emergent design, consonant with dynamic change in complex educational systems, has not been recognised by educational administrators in the past – and, is likely to have a profound effect on the design, implementation and management of future educational enterprises (Beare, 2000; Venezky and Davis, 2002; McMullan, 2002; Kinelev, Kommers and Kotsik, 2004). If the emergent design of dynamically complex educational environments in the future has profound implications for school administrators, it implies a complete paradigm shift for school principals. Fullan claims that the principal of the

future "has to be much more attuned to the big picture, and much more sophisticated at conceptual thinking , and transforming the organization through people and teams" (2002, p.3). Also, since complex societies "inherently generate overload, fragmentation and non-linearity -…- effective leaders must always work on connectedness or coherence –making" (Fullan, 2002, p.8). Such school leaders, or principals, are characterised elsewhere (Fullan, 2005) as system-thinkers-in-action.

Cavallo (2004), as indicated above, postulates an ecological, viral model of change within learning environments. Such an approach values the concept of 'evolution', rather than the concept of 'sustainability'. Change in complex, living systems is characterised by growth and development, often in initially unanticipated ways. Such evolution represents the development of a unique system in response to the unique set of environmental influences that affect such a system. Sustainability, associated with concepts such as the 'maintenance' of a synchronic system
over time, is antithetical to evolutionary development which, by its very nature, equates synchronic maintenance of a system over time with stagnation and, eventually, death.

In terms of the nature of learning environments as evolutionary ecological systems, Cavallo identifies certain characteristics inherent to fertile growth environments:

- volition – people must want to do things;
- appropriation and experimentation – people need to try out their own conceptions of the ideas in their own settings based upon their own priorities;
- concrete exemplars – there is a need to experience real examples of the ideas;
- community and communication – peer-to-peer interchange of ideas, explanations from practitioners at a variety of levels of expertise and experience;
- feedback – when one experiments one must not only see the results, but also get feedback from others;
- debugging – one must get the chance to 'make mistakes' and then use those to design and implement further work;
- materials – one needs things to work with that facilitate the new paradigm, and not merely work with the tools of prior instantiations;
- language – new paradigms re-appropriate old terms for new connotations, and even invent new terms to describe things in new ways;
- bottom-up and emergent – large-scale growth comes from the basis of many little contributions;

- time and continuity – major changes do not happen overnight, as there needs to be enough continuous time to experience and develop the ideas in their full complexity;
- hope and expectations – people must come to believe that improvement is desirable and possible.

(Cavallo, 2004, online)

The crucial question arising from a contemplation of the dynamically complex change processes that characterise educational systems is the following: how is sustainability to be understood? How do we know which implementation and usage patterns of computers in schools are likely to lead to sustainability - or is the very concept of sustainability, in this context, under siege?

2.7.4 Sustainability in dynamic, complex educational systems

The sustainability of ICT in education is characterised in a number of different ways in the literature – sometimes within the space of a single article. In one such article, Batchelor and Norrish (2002, online) begin by characterising sustainability as financial cost recovery. This definition is supplemented in the same article by the view that sustainability is a complex concept, but that it must needs involve persistence over time (2002, online). The definition is further elucidated and expanded in the article by the postulation of three different kinds of sustainability: economic sustainability, involving the maintenance of a certain level of expenditure over time; social sustainability. involving the minimization of social exclusion and the maximization of social equity; and, institutional sustainability, involving the ability of existing structures and processes to perform their functions over a long period of time (2002, online).

Batchelor and Norrish reflect upon the sustainability of ICT in educational development projects one year later, and come to the conclusion that there are a number of factors that "would have to be in balance for a project to be in some form sustainable" (2003, online). The factors thus identified are:

- clear objectives held by the majority of stakeholders;
- target groups need to be clearly identified;
- ICT activities cannot be in isolation from the policy environment;
- prevailing structures and processes can continue to perform their functions over the long term;
- linkages with relevant authorities and other authorities working in connected areas;

- planning the process of an activity;
- the human capital available;
- the technology used; and
- replacement costs and cost recovery

(Batchelor and Norris, 2003, online).

In a similar vein, Cisler (online) identifies the four pillars of sustainability as social, political, technological and economic sustainability. What these shifts in definition demonstrate very clearly is the growing realization that sustainability itself is a complex concept. But, instead of elucidating the nature of such complexity, these shifts in definition simply muddy the issue in presenting a number of contributory influences on complexity in an essentially disjointed fashion. There seems to be no pattern that links these influences together in a meaningful way. Employing the metaphor of the net (or web) to characterise the myriad of nodes and links that connect integral aspects of a complex system, we may say that this approach identifies the nodes of the net as repositories of value, and thus also determiners of the sustainability of the system. But such an approach ignores the fact that the value of the net lies in the number and quality of the nodes and dynamic links that define the whole as an integrated system. In this sense, sustainability is a characteristic of the dynamic system, as a whole.

Mioduser, Nachmias, Forkosh-Baruch and Tubin (2004) suggest that the sustainability of ICT interventions in schools revolves around the integration of the innovation into school practice, so that it becomes institutionalized in the form of "rules, regulations and intensive implementation" (Mioduser et al., 2004, p.6). But the suggestion that the innovation must harmonise with the structure of the school organization, runs the risk of appropriating technological innovations in the service of existing organizational structures that are the artefacts of a bygone technological era, as Papert (1997a) points out. Also, with reference to the metaphor of the net, employed in the previous paragraph, innovation is forced to operate within liner, hierarchical structures. It would seem that the very notion of sustainability in complex dynamic systems needs to be revisited and redefined.

The title of a Becta/DfES Report (Hennessy and Deaney, 2004) on ICT-supported classroom practice captures the schizophrenic dilemma faced by educationalists wishing to address the theoretical underpinnings of ICT-integrated classroom practice: "Sustainability and Evolution of ICT-Supported Classroom Practice". On the one hand, such an approach is informed by the need to account for the upkeep and maintenance of physical hardware and infrastructure, and, on the other, the need to account for dynamic, evolutionary people-based changes in practice,

over time. Returning to the metaphor of the net employed above, such schizophrenia is the result of viewing the nodes of the net as repositories of value whilst, at the same time, coming to the realization that the ways in which these nodes are linked is evolutionary in nature. The theoretical underpinnings of ICT-integrated classroom practice, in terms of evolutionary potential, are not to be found underlying the narrow confines of either physical infrastructure, or changing human practices – or both. Rather, the theoretical underpinnings of ICT-integrated classroom practice are to be sought in the evolutionary capacity of a larger, dynamic, complex system within which these processes find expression.

Fullan (2005), in examining the relationship between school leadership and sustainability in complex educational systems, recognises the inherent inability of the term 'sustainability' to capture the complex process of evolution at work in such systems. He points out that the term is derived from the Latin 'sustineo', which means "to keep up", but this suggestion is not applicable to complex educational systems because 'sustainability 'in such systems is cyclical rather than linear (Fullan, 2005, p.25). Retaining the term, even in the face of his own criticism of it, he then defines 'sustainability' in complex systems as the "capacity of a system to engage in the complexities of continuous improvement consistent with deep values of human purpose" (Fullan, 2005, p.ix). This definition of 'sustainability' has much in common with the evolutionary ecological model postulated by Cavallo (2004), above.

In fleshing out the skeletal definition offered above, Fullan argues that sustainability in complex systems is an adaptive challenge (as envisaged by Heifetz, 2004), where 'adaptive challenge' is defined as follows;

1. the challenge consists of a gap between aspiration and reality, demanding a response outside our current repertoire;
2. adaptive work to cover the gap requires difficult learning;
3. the people with the problem are the problem, and are the solution;
4. adaptive work generates disequilibrium and avoidance

(Fullan, 2005, p.45).

In short, adaptive challenges are problems, the solutions to which are unknown. The sustainability of a complex educational system, as adaptive challenge, is considered by Fullan to consist of at least eight elements;

1. public service with a moral purpose;
2. commitment to changing context at all levels;
3. lateral capacity building through networks;

4. intelligent accountability and vertical relationships (encompassing both capacity building and accountability);
5. deep learning;
6. dual commitment to short-term and long-term results;
7. cyclical energising;
8. the long lever of leadership

(Fullan, 2005, p.14).

Given the necessary elements of sustainability outlined above, Fullan argues further:

> "the set of strategies that brought initial success [in a learning organization] are not the ones – not powerful enough – to take us to higher levels. In these cases we would expect the best learning organizations to investigate, learn, experiment, and develop better solutions… If a system is to be mobilized in the direction of sustainability, leadership at all levels must the primary engine. The main work of these leaders is to help put into place the eight elements of sustainability; all eight simultaneously feeding on each other. To do this, we need a system laced with leaders who are trained to think in bigger terms and to act in ways that affect larger parts of the system as a whole: the new theoreticians "
> (Fullan, 2005, p.27).

Such leaders, at all levels of the system, are able to alter school culture and systemic context at all levels, exactly because they are systems thinkers who "gravitate towards strategies that alter people's system-related experiences; that is, they will alter people's mental awareness of the system as a whole, thereby contributing to altering the system itself (Fullan, 2005, p.40).

Fullan's (2005) characterization of the 'sustainability' of complex, dynamic educational systems has much in common with Cavallo's (2004) characterization of change in evolutionary ecological systems. What makes Fullan's treatment attractive, in the context of this study, is the fact that he contemplates the 'sustainability' of, specifically, school-based educational systems. Also, his unique definition of 'sustainability' encompasses many of the evolutionary change processes in complex educational systems envisaged by Cavallo (2004). For the purposes of this study, Fullan's (2005) definition and characterization of

'sustainability' will be taken to encompass Cavallo's (2004) characterization of evolutionary ecological or viral change processes in complex educational systems.

2.8 Summary

Overall, much has been written in the literature about the implementation of computers and ICT into classroom practice at school level. Similarly, much has been written about the effective use of computers as integral parts of school-based curricula. A number of influences on the successful implementation and use of computers in schools have been identified. Yet other influences have been identified as playing a crucial role in the successful implementation and use of computers in schools in developing countries, specifically. Many of these influences originate in the multi-dimensional contexts surrounding such implementation and use.

The literature is silent on the difference between 'implementation' and 'use'. Furthermore, the literature does not present a conclusive theoretical model that adequately describes the relationship between the implementation, use and sustainability of such initiatives.

The failure to produce such a theoretical model is, in the first place, brought about by adherence to a definition of sustainability that negates the dynamic complex nature of educational systems and initiatives. Such a definition treats influences in a disintegrated way and is incapable of integrating static, loose-standing synchronic influences into an integrated dynamic pattern which evolves over time.

Secondly, the failure to produce a satisfactory theoretical model of computer integration into classroom practice is a result of the failure to recognise 'sustainability' as a characteristic of the larger systemic processes within which such integration takes place, rather than a characteristic of the integration process itself.

'Sustainability' as a characteristic of dynamic, complex educational systems is adequately addressed by Fullan (2005), and the diachronic, organic evolutionary nature of such 'sustainability' is adequately accounted for by Cavallo (2004).

For this reason, key concepts derived from the theoretical approaches outlined above are encapsulated in the conceptual framework presented above. This conceptual framework informs the approach to research methodology and research design explained in Chapter 3. It is clear that such an approach will have to be characterised by:

- providing participants with the opportunity of presenting evidence on influences on the CALIS Project from as wide an array of quarters as possible;
- an openness (on my part) to influences on the CALIS Project not envisaged by me;
- a flexible approach to data gathering that would avoid narrow, consensually-constructed evidence;
- an approach to data analysis that would consciously avoid a priori preconceptions regarding findings; and
- extreme sensitivity towards ways in which specific influences on the Project might be integral parts of larger, influential systemic processes.

These are the principles that underlie the choice of research methodology and research design elucidated upon in Chapter 3.

Chapter 3

Research methodology and research design

3.1 Introduction

In order to address research methodology and research design in a logical, programmatic manner, this chapter opens with a reconsideration of the research problem, the main research question and the derived sub-questions.

The literature review and conceptual framework presented in Chapter 2, together with the adherence to a particular research paradigm outlined in this chapter, inform the way in which the research problem and research questions were approached. The approach thus adopted informed the choice of strategy to follow and the design of the actual research process. The selection of a particular research design implied the use of certain sampling and data collection methods, as well as particular fieldwork practices, rather than others. These are discussed in detail below. This discussion leads naturally to a discussion of data capturing, data editing and data analysis techniques selected for this specific study. Finally, shortcomings and sources of error will be addressed.

3.2 Hypothesis, conceptualisation, definitions, key variables

Numerous studies document factors influencing the successful modelling and support of ICT (Information and Communication Technology) implementations at school level (Mooij and Smeets, 2001; NCET, 1994; Crawford, 1997; Veen, 1995). In the first place, the emphasis in each of these studies is placed firmly on the implementation of information and communication technology rather than on the sustainable use thereof. It is not clear whether implementation and sustainability can be treated discretely or whether the relationships between the two are complex and multi-causal. Secondly, the diachronic 'sustainability' of computer-based educational programmes, as construct, is never addressed, other than in a very cursory fashion. In this sense, the studies represent an account of static situations rather than dynamic processes. This study hypothesises the nature of such diachronic processes of sustainability as being essentially indeterminate, evolutionary processes characteristic of complex systems (Fullan, 2005). The definition of sustainability used in this study will thus be that drawn from Fullan's (2005) work on the sustainability of complex educational systems:

> As it turns out, "sustainability" is at the heart of all these dilemmas. Its definition is not straightforward. It is not how to maintain good programs beyond implementation. It is not how to keep going in a linear, sustained fashion. It is not how to keep up relentless energy. For the moment, let's be satisfied with a general definition: Sustainability is the capacity of a system to engage in the complexities of continuous improvement consistent with deep values of human purpose. There is a lot packed into this definition. It is not just the outcome of continuous improvement we need to observe, but we must also understand the key characteristics of systems that display dynamic sustainability (Fullan, 2005, p.ix).

For the purposes of this study, dynamic sustainability and the evolution of ecological or viral systems, as discussed in Chapter 2, are taken as being synonymous. The characteristics of systems associated with dynamic sustainability are defined as follows:

1. Public service with a moral purpose;
2. Commitment to changing context at all levels;
3. Lateral capacity building through networks;
4. Intelligent accountability and vertical relationships (encompassing both capacity building and accountability);
5. Deep, learning;
6. Dual commitment to short-term and long-term results;
7. Cyclical energizing;
8. The long lever of leadership (Fullan, 2005, p.14).

Furthermore, ICT implementation programmes in schools are characteristically embedded in a systemically significant context, such that Mooij and Smeets (2001) identify a complex, multi-level systemic educational structure. These structural levels range from the international, national, regional and administrative levels to the level of the individual pupil and internalised learning processes. Such multi-layered contexts provide comprehensive momentum and support for successful ICT implementation. The suggestion is also made that the successful implementation of specific educational programmes is dependent on the involvement of 'active participants' (Mooij and Smeets, 2001) at various structural levels of the educational system.

The first question that arises is whether the involvement of active participants is the same at all structural levels, or whether different structural levels demand different kinds of involvement? The second question is whether particular personal qualities, skill sets and attitudes might be associated with active participation at the various structural levels. This study proposes differentiated personal qualities, skill sets and attitudes at various structural levels of the educational system.

Thus far, the term 'structural levels', as used by Mooij and Smeets (2001), has been employed without comment. The impression created in their treatment of the educational system is consonant with a deterministic structural, hierarchical educational system characterised by unidirectional causation and functionality. As indicated in Chapter 2, this approach is essentially irreconcilable with the postmodernist-inspired view of educational systems as complex, often indeterminate systems characterised by multi-directional, mutual causation that is consonant with ecological or viral growth patterns (Cavallo, 2004). This study, therefore proceeds from the hypothesis that educational systems are complex systems that cannot be fully accounted for in deterministic structuralist terms (Fullan, 1999, 2001, 2005).

Furthermore, what is not clear is the effect of a change in the systemic situatedness of the individual educational programme. In complex educational systems, the effect of such a change is often unpredictable – and is often followed by systemic development in unanticipated directions. This study further proposes that the effect of such contextual perturbation is essentially unpredictable. Nor are such processes easily observed since initial contextual investments in terms of time and money normally preclude stable investors such as departments of education from withdrawing support and thus risking the success of the project.

In this respect, the CALIS (Computer – Assisted Learning in Schools) Project, initiated by the Orange Free State Education Department (OFSED) , provides a unique opportunity. The Project was originally designed to implement ICT in selected schools in the region. Deserving schools and deserving teachers were identified. Teachers were trained to support co-operative learning and teachers were supplied with a number of computers each, for use in their classrooms. The Project was officially set in motion with the first CALIS conference in 1993 and continued during 1994 and 1995. It was, however, officially abandoned by the OFSED in 1996 when the new government identified other priorities, thus paring down contextual support and exposing the individual institutions to the prospect of ensuring the sustained use of computers as isolated entities.

The opportunity afforded by this project lies in the possibility of investigating influences on the implementation of a computer-integrated education project, with a view to ensuring the sustainability of the project. It also presents the possibility of elucidating the multi-directional, mutual causal relations that define an educational programme as complex system. The existence of such complex systems in the no-man's land between chaos and regulation (Stacey, 1996) implies that deterministic predictability at the micro-level is impossible. What is possible, however, is the drawing of multiple inferences which may be identified with in terms of varying degrees of certainty at the macro-level.

Given this hypothetical background, the originally conceived influences on the Project as being essentially material, non-material and process influences had to be restated in the form of the following sub-questions.

> *1. How did personal qualities, possessed by people directly or tangentially involved in implementing the Project, influences the implementation and sustainability of the Project?*
>
> *2. How did elements of programmatic design (those elements of programmatic design specifically embodied in the goals of the Project) influence the implementation and sustainability of the Project?*
>
> *3. How did the availability of physical resources during implementation influence the sustainability of the Project?*
>
> *4. How did the larger systemic environment in which the Project was implemented , influence the sustainability thereof?*
>
> *5. How was the further development of the Project affected by the animated, interactional interrelatedness of the complex system infused by all of the influences mentioned above?*

The inferences drawn from answers to these questions would then provide evidence from which further inferences could be made, with varying degrees of certainty, regarding the main research question:

> ***How did influences on the implementation of the CALIS Project affect the sustainability thereof?***

As has been suggested above, this question cannot be addressed in a vacuum. My own worldview and philosophical orientation, as researcher, determined how the research question was approached and how it shaped the subsequent design of a particular research strategy.

3.3 Research approach

The philosophical dichotomy outlined in Chapter 2 informs, to a large extent, the difference between the dominant research paradigms in modern Western scholarship, namely quantitative and qualitative research. Quantitative research, as the name implies, seeks verification of scientific hypotheses through measurement of a unitary exterior reality. Qualitative research, on the other hand, allows for inferential interpretation of narratively-constructed, plural and interior realities (Miles and Huberman, 1994, p.41). In this sense, the choice of a broadly-characterised qualitative approach was the natural choice in terms of examining a complex, educational system. I have consciously avoided the use of the term 'paradigm'. It is impossible to conduct research on an indeterministic and unpredictable complex system under the banner of a particular 'paradigm', the tenets of which the system does not adhere to. Rather, the postmodernist-inspired approach to research values multi-vocality, narrative, culturally-inspired mythology, and the value of minority or previously disempowered voices (Woods, 1999; Schostak, 2002). In this way, the 'master narrative' of the selected 'paradigm', is discarded in favour of a plurality of narratives. My own narrative, in the form of this research report, is inescapably an interpretation of narratives produced by participants (Kvale, 1996). Such narratives, in turn, are an interpretation of an individual reality, shaped partly by cultural mythology and metaphor. For this reason, narrative, religious and cultural mythology, and metaphor play a central role in this research project.

3.4 Research design

The design of this particular research project was thus deeply influenced by the three interrelated aspects outlined above:

1. research problem: how do a plurality of influences affect the sustainability or evolutionary further development of a complex system such as an educational project;
2. philosophical underpinnings (research unparadigm): indeterminate complex systems are embodiments of postmodernist plural, interior realities;
3. Broad research approach: complex educational systems demand a broadly-defined qualitative, rather than quantitative approach.

The CALIS Project appeared to have many of the characteristics of a case study. It appeared to be 'bounded' (Yin 2003, Merriam, 1998); it appeared to be a 'unique' occurrence (Yin, 2003, p.40; Merriam, 1998;); it appeared to demand an answer to a 'how' question (Yin, 2003, p6); it appeared to be situated very clearly in the past and thus fall essentially beyond my control or the control of the participants (Yin, 2003, p.7); it appeared to involve a

programme or process that was inextricably linked to organisational change (Yin, 2003, p.23). In Yin's view (2003, p.8), the case study research design adds two tools to the researcher's repertoire that are not available to the historical researcher, namely direct observation and the possibility of interviewing participants. I therefore, selected the case study design as the most appropriate way of eliciting the information that I needed.

Furthermore, the situatedness of the CALIS Project within a wider complex systemic context accorded well with views expressed in the literature regarding the possibility that cases could be situated within larger cases (Yin, 2003, p.14), on the one hand, and the view that the embeddedness of cases provides the researcher with "an even deeper understanding of processes and outcomes of cases…" (Miles and Huberman, 1994, p.26) on the other. It was clear, from the outset, that an examination of sustainability or evolutionary development would demand a process-friendly research design. The selected research design would also have to take cognisance of the influence of a multiplicity of contextual influences on the evolutionary development of the Project. Yin (2003, p.13) is of the opinion that the case study design does just that: "In other words, you would use the case study method because you deliberately wanted to cover contextual conditions – believing that they might be highly pertinent to your phenomenon of study".

3.5 Issues of measurement and data capturing vehicles

One of the overriding difficulties of attempting to capture the influence of a wide array of evolving contextual influences on a Project that had been officially abandoned a decade ago was selecting the most effective data-capturing vehicles. Initially, I envisaged the use of the following range of data capturing vehicles: individual semi-structured interviews; focus group discussions, participant observation; content analysis (as defined by Yin 2003, Merriam, 1998) of formal project documentation, informal communications, media articles, personal diaries and the paper trail associated with the process of project management. Supplemental evidence would have been collected in the form of physical evidence, namely processes of erosion and accrual, as defined by Merriam (1998). The latter evidence would relate specifically to material resources in the form of computer hardware and related material objects.

On further investigation and reflection, however, it became patently clear that the proposed data capturing approach would not be optimally effective, or even possible. In the first place, semi-structured personal interviews would provide a fairly narrow range of stock replies to questions that reflected a narrow range of researcher-anticipated influences on the Project. If

I wished to obtain a wide range of complex contextual influences on the Project, I would have to provide participants with the opportunity of identifying wide-ranging influences not anticipated by myself. This implied the use of unstructured interviews, or even better, the eliciting of narratives that captured culturally determined networks of symbolic situatedness. Secondly, focus group discussions would tend to do exactly what the name suggests: they would channel responses in such a way that they focused on a narrow range of consensually agreed upon influences – rather than allowing for the expression of a very wide range of disparately perceived influences. Thirdly, the fact that virtually a decade had elapsed since the official termination of the Project meant that no significant documentary evidence, either electronic or paper-based, was still in existence. Furthermore, participant observation, *in situ*, was similarly impossible since many of the participants had changed careers and all but lost contact with the original settings within which the Project had been implemented. Clearly, the passage of virtually ten years also precluded any meaningful examination of processes of erosion and accrual in terms of physical resources.

It was thus clear that the participants in the study would become informants in the true sense of the word (Taylor and Bogdan, 1998, p.89). Data in the form of narratives relating individual experiences of the CALIS Project would serve as the primary data to be analysed. This data would then be supplemented by the production of a research journal that would provide my own impressions of the interviews conducted and the narratives produced – as well as a form of reflection and documentation of the research process itself.

The open-ended gathering of qualitative data from participants is described, variously, in the literature as unstructured interviewing, the eliciting of narrative, and life story research. The ensuing discussion will demonstrate how qualitative one-to-one interviewing is seen as the data gathering vehicle of choice in each of these cases.

Life story or life history research is an approach that is employed in a wide range of disciplinary settings, “from sociological to anthropological to linguistic to literary” settings (Atkinson, 1998, p.2). It has also been employed very successfully in educational settings (Goodson and Sikes, 2001; Muchmore, 2002). Goodson and Sikes point out that life history research was abandoned by many researchers under modernism’s insistence on objectivity testing and the concurrent production of statistical aggregation and arguments relating to representation (2001, 14). Current postmodernist approaches, however, have meant that life history research is able to play a fundamental role in capturing data that elucidates the “social production of individualism” (Goodson and Sykes, 2001, p.14) and the creation of shared knowledge and meanings that inform professional practice (Witherell and Noddings, 1991).

Goodson and Sikes argue that life historians use the life history method for the following reasons.

1. It explicitly recognises that lives are not hermetically compartmentalised into, for example, the person we are at work (the professional self) and who we are at home (parent/child/ partner selves), and that, consequently, anything which happens to us in one area of our lives potentially impacts upon and has implications for other areas too.
2. It acknowledges that there is a crucial interactive relationship between individuals' lives, their perceptions and experiences, and historical and social contexts and events.
3. It provides evidence to show how individuals negotiate their identities and, consequently, experience, create and make sense of the rules and roles of the social worlds in which they live (Goodson and Sikes, 2001, p.2).

The evidence revealing negotiated personal identity, mentioned above, is inextricably tied up in the construction (see Bruner, 1986, 1987, 1990, 1991) of narratives that give metaphorical and symbolic expression to cultural mythologies (Ricouer, 1991; Dannefer, 1992; Nielsen, 1999). In this way, the perceived weaknesses of life history research under modernism, namely lack of representation and subjectiveness, have become its greatest strengths under postmodernism (Munro, 1998, p.8).

In short, it was apparent to me that my approach to interviewing should be informed by the exhortation of Goodson and Sikes:

> … a researcher can never know for certain which experiences have been influential and relevant in a particular sphere of life, for sometimes connections are apparent only to the individual concerned. Conversely, it may be that events, experiences or personal characteristics, which the researcher expects to have been important, are not seen in the same way by the informant. Too tight a structure and schedule, and relevant information may be lost or,

> alternatively, may be given disproportionate emphasis by the researcher (2001, p.27).

It was also apparent that tight control over the course of the produced narrative was not only undesirable, but, quite conceivably, impossible. The undesirability thereof is eloquently argued by Goodson and Sikes above, whilst the conceivable impossibility of tight control lies in the fact that "life historians have to accept that people tell the stories that they, for whatever reason, want to tell to the person who is listening" (Sikes et al., 1996, p.51).

But the narratives produced in this study, besides focusing on evolving historical processes, were also "narratives through which people described their worlds" (Holstein and Gubrium, 1997, p.127; Silverman, 2000, p.122). A number of authors further point out that such descriptions should not be treated as participants' attempts at trying to produce accounts that are true reflections of an external reality; rather, such descriptions are to be approached in a way which opens them up for 'culturally rich analysis' (Silverman, 2000, p.123) and, in so doing, plausible accounts of the world, generated by interviewer and interviewee in tandem (Richardson, 1990, p.24; Miller and Glassner, 1997, pp. 103-104; Silverman, 2000, p.123).

One of the wider definitions of narrative is provided by Connelly and Clandinin:

> Narrative refers to the making of meaning through personal experience by way of a process of reflection in which storytelling is a key element and in which metaphors and folklore take their place (1988a, p.16).

The enculturated nature of reflections upon experience suggested in this definition mediate the process of narration, and it is exactly this mediation that precludes the 'true reflection' of reality alluded to above. A further mediation occurs once the narrative is 'performed' (Goffman, 1975, p.26), since the audience/listeners/researchers must needs engage with the proffered enculturated enactments in terms of their own enculturated, enacted experience. For this reason, Hastrup suggests that what characterises such fieldwork is not the "unmediated world of others but the world between ourselves and others"; and thus, "our results are deeply marked by this betweenness and there is no way, epistemologically, to overcome its implications (1992, p.117).

Rather than inspire terror at the inability of our results to produce 'slices of reality', such epistemological ambiguity reminds us that we are dealing with negotiated realities that find

expression in complex systems. Goffman, echoing one of the assumptions underlying postmodernist practice presented above, reminds us further that narrative involves the conception of 'multiple-selfing' (Goffman, 1975, 1981). Not only are we confronted with the self as author or relater of events, but there is also the self as protagonist and the self as animator or 'performer' (Goffman, 1975, p.517; 1981, p.144). For this reason, narratives as 'strips of personal experience' (Goffman, 1981, p.174), are performances that present the transformation of complex reality into a single strip for replaying (Labov, 1972, 1981; Cortazzi, 1993).Such transformation is informed, not by the actual historicity of events, but rather enculturated knowledge structures or scripts that provide meaningful frameworks describing the nature of specific generic events and sequences of action (Schank, 1975, p.264; Cortazzi, 1993, p.63). Because these frameworks are culturally negotiated and shared structures, it is also the case that tellers may intend that which is not explicitly communicated or said to be "understood as part of a frame, script or plan" (Cotazzi, 1993, p.66). In this regard, Rogers et al., besides identifying what they call languages of negation, revision and evasion, identify a language of the "unsayable" in terms of which silence may hint at a fear of addressing that which is unspeakable in a particular interview (1999, p.89).

"InterViews", pointedly chosen by Kvale (1996) as the title of a work on qualitative interviewing, provides evidence of the 'betweenness' that characterises a negotiated, plausible account of the way in which the world works (see also Cicourel, 1964, p.68). This conception of what constitutes knowledge is a basic tenet of both complex systems theory and of the worldview that underlies it: "In post-modern thought there is an emphasis on knowledge as interrelational and structural, interwoven in webs of networks" (Kvale, 1996, p.44).

In short, open-ended interviews that elicited a narrative account of personal involvement in, and interpretations of, the CALIS Project would provide me with exactly the finely-nuanced, enculturated wide array of perceived influences on the sustainability of the Project which I sought; and they would do so in a manner consistent with my own worldview and theoretical positioning.

3.6 Sample design and sampling methods

The broad approach outlined above also informed my approach to sampling. Just as the focus on the functionality of complex systems informs the overarching research design of this study, so also it informs the sampling procedures followed. Miles and Huberman point out that approaches to sampling are deeply influenced, not so much by whether one conducts quantitative or qualitative research, but rather whether one seeks an understanding of a

limited range of controlled variables or whether one seeks an understanding of a wide array of interactional variables that are active in a complex system (1994, p.41).

As indicated above, the intention in this study was to elucidate the interactional nature of a wide array of interrelated variables or influences in an evolving, complex system. This system takes the form of an educational project that was abruptly officially terminated, even as plans for the evolution of the project were being formulated. In this sense it represents a unique case. As Yin points out, the veracity of single case study research is validated by research studies such as Graham Allison's 30-year long study of the 1962 Cuban missile crisis (2003, p.4). Also, and perhaps more importantly, case study research should not be equated with research that demands samples as representations of universes. Such an analogy breaks down because the latter relies on statistical generalization, where samples are generalized to universes, whilst the former relies on analytic generalization, where a particular set of results are generalised to some broader theory (Yin, 2003, p.37). In this particular study, the results obtained from the examination of a single, unique case are generalized to the approach towards the sustainability of complex, evolving educational systems advocated in the conceptual framework presented in Chapter2.

Given the nature of the case, coupled with the fact that the Project had been officially terminated virtually a decade before this study began, it was clear that decisions relating to sampling strategies and sampling design would be constrained by the circumstances surrounding the case. Goodson and Sykes (2001, p.24) enumerate a number of sampling techniques, indicating that one or more of these techniques are often used in qualitative case studies involving the production of narrative accounts. In terms of these types, the sampling techniques employed in this study might be identified broadly as purposive, snowball, homogeneous and extreme case.

In the first instance, sampling might be seen as purposive in that all participants were selected on the basis of their active involvement in the CALIS Project, either as part of the OFSED management team or as educators who implemented the Project in their classrooms. Secondly, and most importantly, as indicated by the following entry in the research journal, one participant provided the contact details of the following:

> Remember the kind of sampling mentioned by Merriam: Hercules Dreyer put me onto Dr Peet Venter and Johan Badenhorst. Dr Venter put me onto Ronel Calitz, and Maureen Dale. Ronel Calitz put me onto Sarie du Plessis.

> Johan Badenhorst put me onto Igno van Niekerk (10 February 2005).

This sampling technique is referred to by Goodson and Sykes as 'snowball sampling' (2001, p.24) and is referred to by Glaser and Strauss (1967) and Merriam (1998) as theoretical sampling.
Thirdly, it might be argued that sampling in this study was 'homogeneous' since all the participants were selected on the basis of a common experience, namely participation in the Project.
Finally, it might also be argued that the selection of Maureen Dale as participant might be viewed as an 'extreme case' since she is the only participant who is a mother-tongue speaker of English, whilst the rest are all Afrikaans mother-tongue speakers.

But this is exactly where the traditional conception of sampling breaks down. Postmodernism and complex systems theory opposes the view that any two accounts of an experience can be the same. In this sense, homogeneity is impossibility. Even if participants were nominally involved in the same Project, their unique circumstances, worldviews, systemic situatedness and cultural/personal mythologies (coupled with the unique 'performances' mentioned above) meant that I would be confronted with individually unique experiences that might or might not correspond in unpredictable ways. Furthermore, extreme case sampling becomes irrelevant when one assumes that experiences and the associated narratives are unique, and thus all participants are extreme cases. Given the philosophical and theoretical difficulties associated with these sampling techniques, I decided to make use of 'snowball' or 'theoretical' sampling. The similarities between the sample constitution and the sampling techniques critiqued above are purely coincidental.

The selection of 'snowball' or theoretical sampling also meant that I could follow the approach to sample size suggested by Taylor and Bogdan (1988, p.93). Their view is that the sample size should not, and cannot, be determined at the outset but that it should be determined towards the end of the data gathering process. Miles and Huberman (1994, p.29) concur by drawing attention to the fact that within-case sampling has an 'iterative' or 'rolling' quality, working in progressive 'waves' as the study progresses.

But this begs the question: how does one know when to terminate the data-gathering process? Goodson and Sikes argue that if the aim is to reveal "shared patterns of experience" amongst a group of people who have that experience in common, then the sample size will be adequate when:

> sufficient data have been collected and saturation occurs and variation is both accounted for and understood … In qualitative research, the investigator samples until repetition from multiple sources is obtained (Morse, 1994, p.230).

The first problem associated with this approach is the fact that complex systems cannot be addressed with reference to a small number of consensually-constructed data; rather, gathered data has to reflect, in the case of this study, a wide array of interrelated influences on the CALIS Project. Secondly, eliciting this wide array of influences through the production of participant narratives implies that individually –constructed narratives should reflect individually-constructed experiences that will tend towards diversity, depth and richness of description, rather than 'repetition'. As noted above, the emphasis on 'repetition' here presupposes the ability to validate a unitary exterior reality. This approach would be contradictory to the philosophical and theoretical positioning of this study.

On the basis of the argument presented above, I decided to let the theoretical sampling technique run its course, and, in the process, identify the participants as they became known to me. In terms of sample size, I decided that I would be guided by the extent to which the data gathered provided confirmatory or contradictory evidence of the theoretical hypotheses adopted at the outset. If the CALIS Project was a complex educational system, as defined by Fullan (1999, 2001, 2005), situated within yet larger and larger complex systems, then it followed that influences on the Project would range from the macro-systemic international level to the micro-systemic level of the individual educator and the individual learner. Data gathering would thus have to take place until influences on the Project involving all structural levels (Mooij and Smeets, 2001) of the larger educational system had been accounted for.

3.7 Data collection methods and fieldwork practice

As I prepared for my first interview, I was painfully aware of the premium placed in the literature on the skills of the qualitative interviewer as key determinant of successful qualitative enquiry (Miles and Huberman, 1994). I was also painfully aware of my own inexperience. I resolved, however, that the eliciting of a wide array of influences on the Project would demand of me as interviewer the ability to be flexible and adaptable (Kvale, 1996) in terms of interaction with the participants. Bearing this in mind, I designed an interview schedule in English (Appendix A) consisting of a number of questions that I perceived to be open-ended.

I had been informed that Hercules Dreyer had played a very important part in the planning and implementation of the CALIS Project. I subsequently telephoned him and explained the nature of the research project and the modus operandi that I wished to follow. On being asked to participate, he willingly and enthusiastically agreed to take part.

Armed with the interview schedule, an audio tape-recorder and writing materials, I conducted the first interview of the research project with Hercules Dreyer at the offices of the software company for which he works in Pretoria on 09 July 2004. Within the first five seconds of the interview I was reminded of Kvale's (1996, p.84) warning that the qualitative interviewer has to make many "on-the-spot" decisions.

I ceremoniously asked the first question from the interview schedule, whereupon Hercules asked me whether he could answer the questions in Afrikaans. It was clear that the use of his mother tongue would make him feel more comfortable and effective in communicating potentially sensitive and emotional personal experiences. Also, I would gain access to his own situatedness within social and cultural networks that had no doubt influenced his own experience of reality. Furthermore, my own bilingualism and the fact that I had formally studied both languages at university level gave me the confidence to believe that I would be able to identify finely-nuanced meanings of words in Afrikaans. I decided there and then, that all other participants would be able to answer questions in either English or Afrikaans.

Within the next second of the interview, I had to make another major decision concerning my approach to the research project. Hercules began answering the first question with the words:

> "Laat ek begin by die begin."
> Let me begin at the beginning.

It immediately struck me that he wanted to tell me his story. He wanted to narrate, so that he himself could make sense of his own experience. I decided that the kind of narration that he was likely to produce would provide clues to influences on the CALIS Project that I had not foreseen. I thus decided to let him narrate for as long as he chose to do so. At the end of the narration, I would then ask the questions on the interview schedule that he had not covered. At the end of the narration, all proposed questions in the interview schedule had been covered. I decided that all subsequent participants would be shown the interview schedule before the interview so that they would be aware of the major concerns of the research project. They would then be invited to 'tell me the story of their own involvement in the

Project'. I would give them the floor, only interrupting in order to clarify or extend my own understanding of their involvement in the Project.

As indicated above, the decision to elicit narratives from participants was based on the belief that this would provide evidence of a wide array of interrelated influences on the CALIS Project. I also felt that the keeping of a research journal would provide me with the opportunity of documenting insights and decisions made as the research project progressed. In this regard, I undertook to enter into the research journal my own impressions of each interview directly after the completion of the interview itself. I further undertook to complete the electronic transcription from the audio tape directly after each interview, so that I would be able to follow any leads, produced by such transcription, in subsequent interviews. Detailed entries made in the research journal, directly after interviews with participants had been conducted, are presented in Chapter 4.

3.8 Data capturing, data editing and data analysis

The realization, gained at the beginning of the first interview, that participants were likely to present me with narratives rather than answers to questions embodied in a semi-structured interview format, convinced me to adopt the approach outlined below.

Firstly, I decided, on the basis of views expressed in qualitative research texts (Yin, 2003; Miles and Huberman, 1994; Merriam, 1998), that I would transcribe all of the audio-taped interviews myself. If, as is suggested, the researcher is the most important instrument in qualitative research, then it follows that the researcher, having conducted the face-to-face interviews, would be in the best position to transcribe these interviews in a manner consistent with the philosophical and theoretical presuppositions that underlie the research study. Furthermore, transcription and analysis are not to be thought of as discreet, linear processes. As Goodson and Sikes (2001, p.33) point out, researcher transcription of the interview data enables the researcher to become familiar with the data and aids analysis in that initial ideas and themes emerge with repetitive, intensive interaction with the data.

Secondly, participant production of narratives meant that listening to the audio-taped interviews and transcribing only those expressions that I deemed to be relevant would not be the most effective approach in the case of this study. Not only would I be precluding the emergence of relevant ideas and themes on a second or third examination of the complete set of narratives, but I would also be precluding an examination of those heuristic qualities that characterise both the individual narratives and the multiple narratives as the bulk of the data

set. Such heuristic qualities of narrative embody key characteristics of complex systems, as suggested by Rodriguez:

> Compelling narratives push us to look holistically at the world by urging us to make connections and identify complex and nonlinear relationships. They force us to understand how our ways of being bear upon the condition of the world (2002, online).

On the basis of this reasoning, I decided to transcribe the audio-taped narratives *in toto*. I also decided to conduct the transcription in such a manner that it would capture my own perception of the narrator's intended meaning (see Atkinson, 1998, p.56). The following entry in the research journal elucidates the reasoning behind this decision:

> I must be careful to document all decisions made in the transcription from audio to written – initial transcription captures all spoken language as accurately as possible – pauses and actions only indicated if they are related to the discussion or might be held to provide extra insight into the interviewee's motivations, state of mind or levels of emotional reaction to the question (19 January 2005).

I thus attempted to capture as much of the spoken narrative as faithfully as possible, only adding punctuation marks and separating paragraphs to aid the reading of the transcribed material.

As mentioned earlier, data collection, data editing and data analysis took place simultaneously. In my addressing of these interrelated activities, I followed the postmodernist-inspired approach of Kvale:

> A first step is when subjects describe their lived world during the interview … A second step would be that the subjects themselves discover new relationships during the interview, … In a third step, the interviewer, during the interview, condenses and interprets the meaning of what the interviewee describes, and "sends" the meaning back … In a fourth step, the transcribed interview is interpreted by the interviewer,

> either alone or with other researchers. Three parts of this analysis may be discerned; first, structuring the often large and complex interview material for analysis; … The next part consists of a clarification of the material, making it amenable to analysis; … The analysis proper involves developing the meanings of the interviews, … When the researcher has analyzed and interpreted the completed interviews, he or she may give the interpretations back to the subjects (1996, pp. 189-190).

Having completed the initial transcription of the audio-taped interviews, I carefully reviewed the completed transcriptions. It was immediately apparent that the decision to capture the spoken language as accurately as possible, whilst providing accuracy of expression, also provided narratives that were disjointed and were difficult to evaluate heuristically. The following entry in the research journal documents the data editing decision made after this first appraisal of the completed transcriptions:

> After a first rebooking at the data I have decided to punctuate and divide stream-of -consciousness dictation into grammatically correct sentences – ums and ahs have been omitted since I am interested in communication at propositional level and beyond in terms of pragmatic theory, and Relevance Theory in particular. I will also divide into paragraphs only where there is a very clear transition in terms of the subject of discussion. – the actual smaller units for categorisation will take place during a second reading – possibly utilising Relevance Theory (for metaphor) – not only in actual analysis of data but also in the process of choosing what constitutes the individual units of communication and analysis – propositional level (25 July 2005).

The paradoxically of data analysis in studies such as this one is embodied in the contradictory notions that qualitative researchers analyse data with minimal commitment to *a priori* theories and assumptions (Glaser and Strauss, 1967; Taylor and Bogdan, 1998) on the one hand, and the notion that all researchers bring background knowledge and assumptions to their research (Miles and Huberman, 1994; Kvale, 1996), on the other. Miles and Huberman,

in fact, argue that "not to 'lead' with your conceptual strength can be simply self-defeating" (1994, p.17). But, if an essentially postmodernist, complex approach is adopted, paradox is something with which one must be comfortable. Ever aware of my own presuppositions in approaching the analysis of the transcriptions, I was comfortable with the idea that these presuppositions were consonant with the characteristics of complex educational systems.

As I thus edited the transcriptions, I was also involved in seeking substantive statements (Gilliam, 2000, p.71); "identifying themes and developing concepts and propositions" (Taylor and Bogdan, 1998, p.141); and, "noting regularities, patterns, explanations, possible configurations and causal flows" (Miles and Huberman, 1984, p.22). In this way, an initial coding schema (Taylor and Bogdan, 1998; Giorgio, 1985; Moustakas, 1994; Price, 1999) was established in the form of a matrix of perceived categorised influences on the CALIS Project. This initial matrix was documented as follows in the research journal:

Matrix of perceived influences after initial reading and sentence shaping of raw data. (02/08/2005)								
	INT	NAT	REG	DIS	INST	CLA	EDU	LEA
PHILOSOPHICAL (PHI)								
STRUCTURAL (STR)								
PROGRAMMATIC (PRO)								
HARDWARE (HAR)								
SOFTWARE (SOF)								
PERSONAL (PER)								
RELATIONAL (REL)								
WORLDVIEW (WOR)								
INT=INTERNATIONAL								
NAT=NATIONAL								
REG=REGIONAL								
DIS=DISTRICT								
INST=INSTITUTIONAL								
CLA=CLASS								
EDU=EDUCATOR								
LEA=LEARNER								

Table 1

The categories documented from left to right essentially constitute the structural levels identified by Mooij and Smeets (2001) as influential in shaping an educational system. The categories documented from top to bottom emerged from an initial analysis of the transcribed narratives. Initial coding of the data revealed that the emergent categories were in need of editing. Firstly, the categories 'philosophical' and 'world view', originally designed to elucidate differences between formal educational philosophy and informal, individual world views, overlapped considerably. It was clear that both could be subsumed under the category 'philosophical'. Secondly, the categories 'personal' and 'relational' were originally intended to enable differentiation between personal qualities possessed by participants, on the one hand, and the way in which they interacted within social networks, on the other. Once again, the degree of overlap and uncertainty in terms of boundary prompted me to subsume both under the category 'personal'. It further struck me that the categories relating to the availability of 'hardware' and 'software' were too specific and that these could be subsumed under the category 'physical', relating to the availability of physical resources. Lastly, I wanted to draw a fairly clear distinction between influences on the successful implementation and sustainability of the CALIS Project that had been envisaged as outcomes of the Project, and influences on the Project that were elements of the larger system, but which had not specifically been envisaged as outcomes of the Project. In order to make this distinction clearer, I decided to recast the categories 'programmatic' and 'structural' as 'programmatic' and 'systemic'. A second, improved version of the influences matrix was documented in the research journal, as follows:

Matrix of perceived influences after second reading and sentence shaping of raw data. (02/08/2005)									
Revised 11/08/2005									
	INT	NAT	REG	PROJ	DIS	INST	CLA	EDU	LEA
PHILOSOPHICAL (PHI)									
SYSTEMIC (SYS)									
PROGRAMMATIC (PRO)									
PHYSICAL (PHY)									
PERSONAL (PER)									
INT=INTERNATIONAL									
NAT=NATIONAL									
REG=REGIONAL									
DIS=DISTRICT									
INST=INSTITUTIONAL									
CLA=CLASS									
EDU=EDUCATOR									
LEA=LEARNER									
PROJ=PROJECT									

Table 2

I proceeded with the second attempt at coding the data. Although the improved categories seemed to accommodate the data more effectively, the improved matrix was still not altogether satisfactory. I realised that the category 'philosophical' was redundant:

> Have been using the second version of the coding system and it seems to work much better than the first but the category "philosophical" does not work – too much overlap and have thus decided to scrap it for the next version of the coding schema (Research Journal, 14 August 2005).

But my discomfort with the perceived categories was deeper than this. The categories provided a useful way of isolating individually perceived influences on the various structural levels of the educational system. What the categories did not do was indicate the way in which individual influences were interrelated within categories and across categories. If the Project represented a complex educational system, these connections existed. I had noticed,

having read the transcripts a number of times that the metaphoric patterning across narratives had been strangely consistent. I was reminded of Schostak's characterisation of metaphor as 'stealth object':

> The metaphor of the iceberg can be reconceptualized as a stealth structure, part seen, part hidden. Stealth architecture occurs if there is something to be obtained in a context of contesting and concealing voices. Stealth technology and architecture hides more than it reveals. There is thus a surface which is open for observation but also a bar or barrier to seeing the whole of the stealth architecture. For the architect or designer, the object is to present a misleading surface. One may think of those glass-coated skyscrapers which reflect the buildings opposite and the sky and clouds above, thus at least partially disguising their own shape … (2002, pp.109-110).

It also appeared to me, however, that the perceived 'bar' to understanding the stealth structure *in toto*, at least within the inferentially-determined Relevance Theory approach to the interpretation of metaphor, was none other than the self. If interpreting metaphor is a matter of inference, based on an individually constructed, conceptually determined context or world view, then the stealth structure, as complete whole, is unknowable. But, just as the behaviour of individual elements in chaotic or complex systems does not necessarily make the system as a whole chaotic and totally unpredictable, so also the seemingly unknowable use of a metaphor as stealth structure does not mean that metaphoric patterning within and across narratives is similarly unknowable. Although 'knowability' of the stealth structure as whole is precluded by individual interpretability, socially and culturally negotiated inferences may be arrived at.

Very similar metaphors had been used across narratives to describe certain events and affective reactions to events. On examining these metaphors from a Relevance Theory perspective (Sperber and Wilson, 1986, 1995; Pilkington, 2000), it appeared that these metaphors could be grouped together in emergent patterns relating to 'personhood', 'journeying', 'ecology' and 'energy'. Taken together, the patterning provided a cultural-mythologically inspired meta-narrative that interrelated the individual categories across structural levels of the system. The networked complexity of the system had been captured in what I have termed the language of complexity.

In this way, the very act of coding was simultaneously an analysis and interpretation of the data, as predicted by Miles and Huberman (1984, p.22), Taylor and Bogdan (1998, p.141), and Silverman (2000, p.143). The final version of the matrix of perceived influences on the Project was reflected as follows in the research journal:

Matrix of perceived influences after third reading and sentence shaping of raw data. (02/08/2005)									
Revised 11/08/2005									
Revised 15/08/2005									
	INT	NAT	REG	PROJ	DIS	INST	CLA	EDU	LEA
SYSTEMIC (SYS)									
PROGRAMMATIC (PRO)									
PHYSICAL (PHY)									
PERSONAL (PER)									
METAPHOR(MET)									
'Personhood'									
'Ecological'									
'Journeying'									
'Energy'									
INT=INTERNATIONAL									
NAT=NATIONAL									
REG=REGIONAL									
DIS=DISTRICT									
INST=INSTITUTIONAL									
CLA=CLASS									
EDU=EDUCATOR									
LEA=LEARNER									
PROJ=PROJECT									

Table 3

3.9 Validity, reliability and generalizability

Given the approach to data capturing, data editing and data analysis outlined in the sections above, potential questions relating to the validity, reliability and generalizability of findings need to be addressed. As outlined above, the study was approached from a point of view termed "moderate postmodernism" by Kvale whereby the "notion of an objective universal truth" is rejected, while the possibility of "specific, local, personal, and community forms of truth, with a focus on daily life and local narrative" is accepted (1996, p.231). This philosophical position necessitated the use of a broadly qualitative, case study design with a focus on the use of unstructured interviews and researcher observation as the data-gathering instruments of choice. Only then could I elicit narratives that would illuminate a wide array of influences on the sustainability of the CALIS Project.

Kvale argues that modern approaches to "the legitimation question of whether a study is scientific tend to be replaced by the pragmatic question of whether it provides useful knowledge" (1996, p.42). I, similarly, find the term 'scientific' to be 'loaded' with connotations or associations relating to quantitative methodology specifically, and the positivist-inspired enquiry that characterised the Enlightenment Project, more generally.

One is confronted with concepts such as the 'triangulation' of data, itself a metaphor implicating the plotting of a course on a two-dimensional map. Tied to such a metaphor is the assumptional world view that comprehends the world as flat and that understands travel as the traversal of two-dimensional space. The map becomes a key to enabling the exact measurement of a universal exterior reality. But if there is no universal exterior reality such triangulation becomes meaningless. Richardson as quoted by Woods replaces the two-dimensional metaphor of the map with the three-dimensional metaphor of the crystal:

> The emphasis here is not so much on 'getting it right' (in the sense of representing one objective reality) as getting it 'differently contoured and nuanced' (Richardson, 1994b, p.521). There is not one truth, not one single explanation of anything, but many overlapping truths operating at different levels and constantly subject to change. Richardson consequently feels that 'crystallization' is a more useful validating concept than triangulation. The latter assumes a fixed point, a single truth; it is too rigid and two-dimensional for the many-sided complexity of social life. The crystal, by

> contrast, 'combines symmetry and substance with an infinite variety of shapes, substances, transmutations, multidimensionalities, and angles of approach' (Richardson 1994b, p. 522) (Woods, 1999, p.5).

But, the 'crystal', as stealth metaphor, readily renders up for interpretation multi-faceted surfaces, whilst concealing it's compacted and solidified materiality. These surfaces cannot represent 'the many overlapping truths operating at different levels and constantly subject to change' since these surfaces themselves are precision-patterned in such a way as to provide a mechanistic Lego-like fit. This metaphor, as embodiment of societal complexity, implodes because it seeks to figure forth multiplicity in the form of the solitary and unitary – multi-faceted though it might be.

Where does that leave my approach to postmodernist inspired qualitative research? As mentioned above, with reference to case study design, case studies cannot be expected to provide findings that can be generalised to other cases. Rather, the findings relating to single case studies must be generalised to theory (Kvale, 1996). So, rather than paying lip service to 'scientific' rigour as envisaged above, I concur with Caelli, Ray and Mill, for whom rigour in qualitative research is a deeply theoretical issue, rather than a technical one:

> Our position is that qualitative researchers need to (1) articulate a knowledgeable, theoretically informed choice regarding their approach to rigor [sic], and (2) select an approach that is philosophically and methodologically congruent with their enquiry. Researchers' approaches to these two issues must reflect an understanding that rigor [sic] is a deeply theoretical issue, not a technical one (2003, online).

Against this backdrop, the issue of validity in this study is approached from the point of view expressed by Kvale, where validating involves: adopting a critical outlook on the analysis of data (1996, p.242); clearly establishing the content and purpose of the investigation at the outset (1996, p. 243); and, addressing the theoretical questions raised about the nature of the project investigated (1996, p. 244). Such a general validatory approach is supplemented by an approach to the validity of narrative that emphasises the internal coherence of a person's (narrator) experience (Atkinson, 1998, p.61), and the extent to which the narrator agrees that the transcribed and edited narration conforms to or supports what was said originally (Lincoln

and Guba, 1985; Atkinson, 1998, p.61). Both Dentin (1970) and Skaggs (1994) point out that narrators often disagree with, or fail to understand, the interpretation of their narratives. This is not strange since, as pointed out above, the transcribed, edited narrative is the researcher's interpretation of the participants' interpretations of their individual and collective experiences.

After all is said and done, I was still the primary instrument and issues of instrument validity and reliability (Miles and Huberman, 1994, p.38) would have to be addressed by way of the rigour with which I documented not only the presuppositions and world view that I brought to the study, but also the decisions and interpretations made as I gathered and analysed the data. If the reliability of the study refers to the consistency of the research findings, as suggested by Kvale (1996, p. 235), then the study is reliable. If reliability refers to the way in which the research findings strike a resonant chord in terms of my own experience (Atkinson, 1998, p.61), then the research findings are reliable. But, perhaps the best indicator of reliability, in my own view, was the fact that I attempted at all times to allow for findings not specifically envisaged by me; furthermore, I was determined to remain flexible throughout the data gathering, data editing and data analysis stages of the research study in order to prevent the kind of rigidity that would preclude me from gaining access to a wide array of influences on the CALIS Project. The kind of indeterminacy that characterises complex educational systems had alerted me to the fact that I could not possibly have foreseen all of the potential influences on CALIS Project at the outset of the research study.

Adherence to theoretical rigour throughout the data gathering, data editing and data analysis stages of the study meant that it was easy to achieve the kind of generalizability referred to by Kvale as analytic generalization (1996, p.232). Analytic generalization is a kind of naturalistic generalization that is informed by theory (in this case, the theoretical propositions contained in the proposed conceptual framework).It is predicated on "a reasoned judgement about the extent to which findings from one study can be used as a guide to what might occur in another situation" (Kvale, 1996, p.232; see also Kennedy, 1979). Such inferences are guided by an analysis of the extent to which different situations exhibit similarities and differences. A striking example of the way in which a single case study can be generalised to a number of situations is Graham Allison's (1971) study of the 1962 Cuban missile crisis, the findings of which have been generalised not only to "foreign affairs … broadly, [but to] a whole variety of complex governmental actions (Yin, 2003, p.4). If, as Fullan suggests (2005), educational systems are complex systems, then generalisation in the case of this study involves the generalisation of findings to this theoretical approach, and by extension, to situations that can readily be seen as involving complex educational systems.

3.10 Shortcomings and sources of error

One of the potential shortcomings identified in qualitative research is that the success of the research project relies heavily on the skills of the researcher (Yin, 2003; Taylor amd Bogdan , 1998). The reason for this state of affairs is the fact that the qualitative researcher is the primary research instrument. Consequently, researcher inexperience and researcher bias potentially affect the reliability of the findings. Whilst admitting to inexperience, every precaution has been taken during the course of this study to ensure that my own world view and preconceptions are clearly stated and accounted for. Furthermore, every precaution was taken to ensure that no predetermined approach to either inteviewing or data analysis would constrain the data to reflect a particular point of view or approach. In fact, the use of theoretical sampling, in conjunction with the elciting of narratives, was purposefully employed in order to allow for the widest possible identification of influences on the CALIS Project.

A further potential shortcoming, seen from the point of view of quantitative research, is the fact that qualitative case study research focuses on a very limited number of cases (often, as in this study, only one case). Quantitative research seeks to generalise from samples to populations. Such generalisation is impossible in single case studies. As Kvale (1996) points out, however, the expectation that single case studies should be able to generalise in this fashion is based on a very limited conception of generalisation. In effect, the findings of single case study research enable us to generalise from case study to theory. In this particular study the findings of the research study are generalised to the theoretical position outlined in the conceptual framework (Chapter 2).

Finally, qualitative research renders findings which are subjective, rich and thick. Arguing that such findings are not as useful as measurements of an exterior reality denies human agency in the world. In the first place, the existence of a single, monolithic, extrior reality is contested. Secondly, as the title of Kvale's (1996) study ("InterViews") aptly demonstrates, the dynamism of complex systems is determined by the nature and quality of systemic inter-subjectivity, rather than the static nature of discreet subjects or objects.

3.11 Conclusion

The research method and research design outlined in this chapter rendered the analysis and presentation of findings possible. An examination of Chapter 4 will reveal whether the chosen method and design have enabled the identification of a wide array of influences on the CALIS

Project. Furthermore, the evidence presented in Chapter 4 will reveal whether the study has been successful in elucidating the dynamic processes that integrate influences on complex educational systems.

Chapter 4

Results: presentation and discussion

4.1 Introduction

The CALIS Project began long before it began and might not have ended at all when it ended. Such is the systemically complex interrelatedness of a computers-in-education project with the synchronic, diachronic and metaphoric dimensionalities of the context within which it is situated. It is virtually impossible to isolate individual reasons for the continued use of computers in schools, after government support had been withdrawn, from the contextual network within which they are integrated.

Bearing in mind this interconnectedness, it was apparent from the beginning that Mooij and Smeets' (2001) framework for the successful integration of computers in schools would form a useful point of departure in examining the influences supporting the implementation of computers in schools with a view to ensuring sustainability. This framework accentuates the role played by active participants from the macro- or international level, through the national, regional, district, institutional, and educator levels to the micro-level of thought processes experienced by the learner. The framework presents synchronic interrelatedness fairly effectively but is silent on the diachronic situatedness of a particular state of affairs. Furthermore, complexity of the systemic kind related to educational systems, as intimated by Fullan (1999, 20012001, 2005), needs to be accounted for.

Diachronically, educators and project managers brought certain historically defined character traits and experiences to the project. The institutions at which the Project was implemented were historically-situated in terms of their philosophical, structural and financial make-up. The interrelationship between the department of education and the district, and region, in which the Project was implemented, was characterised by a strong Christian National ethos which found expression in the image of the pioneer farmer who had escaped the tyranny of the British occupation of the Cape Colony and who had been entrusted with a sacred mission as one of God's chosen few. This must be seen against the national backdrop of a country at odds with itself and in the midst of radical social and political change. The international situation with regard to computers was equally

significant at the time, since the decade heralded not only a massive growth in the sales of personal computers worldwide, but also the emergence of the Internet as public domain.

It is clear that any framework aimed at indicating systemic complexity as a one-dimensional, synchronic explanation is destined to failure since it ignores the two-dimensional complexity that inhabits a synchronic /diachronic plane. But the full, three-, or four-, or five-dimensional picture is more complex yet. The synchronic/diachronic matrix cannot capture the full complexity of a living project that develops in autonomous and often unexpected trajectories, much like the strange attractors that characterise chaos theory. But what can, and does, capture such complexity is the use of metaphor that is able to activate a wide range of often indeterminate weak implicatures. Such implicatures operate in both standardised and highly individualised ways.

For this reason, the structure of this chapter will mimic the evolutionary process of increasing complexity. Initially, the participants who experienced and who interpret the project will be introduced. Thereafter, the synchronous interrelatedness of macro- and micro-level complexity, both within and surrounding the Project will be discussed. This will be accomplished by focusing on personal, physical, programmatic and systemic interrelatedness. Finally, the inadequacy of these dimensions as fully determinate will be demonstrated in the light of the multi-dimensionality of metaphoric interconnectedness.

This systemic interconnectedness will be examined by means of a Relevance Theory approach to the analysis of metaphoric patterning in the narratives presented by participants. In this regard, the initial impressions made by the various participants may provide valuable insights into their own synchronic and diachronic situatedness within specific contextual frameworks. Such insights are useful in shedding further light on their actions, motivations and world views.

4.2 The participants

Dr Peet Venter is an urbane, distinguished-looking gentleman who exudes confidence and who possesses an imposing presence, even though he is not physically imposing. He lives in an affluent suburb of Bloemfontein and is officially retired. He was appointed Director of the Computer Section of the pre-1994 Orange Free State Education Department (OFSED) in 1991 and stayed on until the end of 1995. First impressions, as recorded in a reflective journal after the meeting with him on 14 July 2004, indicate that he is clearly “a

planner and a thinker and [that he] still has a finger on the pulse of technology in education". This impression is supported by the fact that he is presently involved in a consultative role with Sacred Heart College, an NGO that facilitates the implementation of the *Intel Teach to the Future* programme in secondary schools in the Free State region. He is also involved in delivering ICDL (International Computer Driving Licence) training to officials of the present OFSED. He seems to be critical of the motives of some of the officials appointed in the post-1994 OFSED. He is also adamant that the officials responsible for ending the CALIS Project were short-sighted and did not appreciate the full potential of the Project to alleviate the digital divide that had already been entrenched in the pre-1994 era.

If Dr Venter is seen as the visionary strategist who engineered the design logic of the CALIS Project, then Hercules Dreyer must be seen as the tireless weaver of miracles for whom no challenge seemed in any way insurmountable. On meeting him in the plush boardroom of a successful software merchandising company in Pretoria, it was immediately clear that he possesses certain specific qualities relevant to the CALIS Project:

> Hercules is a very intense person and very passionate about integrating ICT into the curriculum. He is clearly a self-starter and someone who is committed to excellence. Also, Hercules is willing to go the extra mile. He is intelligent and articulate and seems to be a born educator. Hercules seems slightly disenchanted with his present job (software sales) and longs to get back into teaching. He is very interested in the research and very willing to help in whichever way he can. (Research Journal, 9 July 2004).

Although his diminutive physical stature contrasts strongly with his namesake of classical antiquity, it is also clear that he shares many qualities with the Ancient Greek demi-god in terms of tireless effort and steely determination. Hercules was a teacher at a secondary school in Bloemfontein and acted as school administrator of the FRESAD programme. In this capacity, he got to know Johan Badenhorst, who was the person responsible for the administration of the FRESAD programme at the OFSED. The perception at the time was that capacity building in this role was required and Hercules was appointed as Johan's assistant. Later, after the appointment of Dr Venter, in 1991, Hercules became intimately involved in the CALIS Project and eventually managed the entire project whilst Dr Venter was involved in the FRETEL and FRENET initiatives. Hercules was offered a

post in the private sector shortly before the final withdrawal of government support in 1996, and he subsequently moved to Pretoria.

Johan Badenorst, who was originally the administrator of the FRESAD programme in the OFSED, was already in the employ of the Department before the arrival of Dr Venter. As such, he is able to bear witness to initiatives relating to the use of computers in secondary schools dating from 1986. As explained below, such initiatives focused largely on the dual purposes of enhancing computer literacy amongst school teachers and embedding administrative applications in schools as a pre-cursor to full integration of computers into the curriculum. Johan is currently the Director of the Centre for e-Learning and Educational Technology at the Central University of Technology, Free State. Our meeting took place in his office at the Centre on 22 February 2005. Johan bears a startling physical resemblance to Hercules Dreyer. He is not physically imposing and is also soft-spoken, but the intelligent eyes mirror forth a thinly-veiled passion for the role of computers in education (Reflective Journal, 22 February 2005). Johan is a doer and someone who is not in the habit of tolerating unfinished business. He stayed on at the OFSED longer than anyone else involved in the Project and was finally appointed at the Central University of Technology, Free State in 2001. His frustration at the lack of closure relating to the CALIS Project, precipitated by the abrupt withdrawal of government support, is evident in the unfolding of his narrative.

Whereas the previous three participants were involved in the management of the Project at the OFSED, the following four participants were teachers who were actively involved in the implementation of the Project in the classroom. Of these four participants, three eventually became involved in the management of the Project, either directly or tangentially.

Possibly the most colourful of the four, Maureen Dale is currently the Headmistress of Eunice Primary School in Bloemfontein. She was appointed Headmistress of the school shortly before the Project was implemented at Eunice Primary School. She was approached by Johan Badenhorst and Dr Peet Venter to organise and present two of the annual expos at Eunice. She was thus actively involved in the integration of computers into the curriculum but also became tangentially involved in the management of the Project when she agreed to organize and host two of the annual expos.
I met Maureen on 14 February 2005 in the Headmistress's office at the school. Eunice Primary is one of the most prestigious schools in the city and has a long and distinguished history. The luxurious wood panelling in the spacious office occupied by the headmistress

and the ample furnishings bear testimony to the school's relatively affluent status. Maureen immediately strikes one as someone who is confident in her ability to manage and control (Reflective Journal, 14 February 2004). She is petite and physically unassuming but her mellifluent voice has a strength and depth that suggest authority. She appears to be very confident of the veracity of her beliefs and exudes determination and a sense of purpose. What is also patently evident in her narrative is her own passion for computers in education.

Maureen's involvement in the management of the Project, though crucial to the continued existence of the Project, was at best structurally tangential. In contrast, Igno van Niekerk and Sarie du Plessis were initially involved as teachers who became involved in the active integration of computers into classroom practice, but who ended up being drafted into the management structure of the OFSED management team.

Igno van Niekerk is currently employed in the Training Division of Liberty Life and is involved in corporate computer-based training. Interestingly, he works in the same Division as Louis du Plessis, Sarie's husband. His involvement with the CALIS Project began when he was employed as an English teacher at Voortrekker High School in Bethlehem. Hercules Dreyer visited the school in order to introduce the CALIS Project, and, in the process, Igno decided to become involved. Subsequently, he was awarded first prize for the best computer-integrated module at the first annual expo and was given the opportunity of attending the international WCCE (World Conference on Computers in Education) in Birmingham in 1996. On his return he was appointed by the OFSED to manage the FRETEL Project (a CALIS – related Project, as discussed below), after Hercules Dreyer had resigned from the Department.
I first met Igno in what can best be described as an interview cubicle in the offices of Liberty Life in Bloemfontein. The feel of the interview is best captured in the words used in the Research Journal entry, dated 19 May 2005:

> The interview takes place in a generic customer service room with a round table and basic chairs – nothing on the wall but a piece of plastic piping on the table – austere – one of those 'don't-waste-my-time rooms – I have exactly five minutes for you. Yet his smile is warm and genuine. He is obviously more than willing to tell his story – how long has he been waiting for someone to listen to his story? There is almost a need to tell – to justify – boasting about achievement.

Igno, though diplomatic and cautious, gives the impression of someone who embodies the dictum: 'the truth will out'. He seems determined to make known the positive effect of the Project, not only on his own life, but also on the wider community: regional, national and even international. He is also at pains to point out what the Project might have achieved if it had been embraced by the post-1994 OFSED.

Sarie du Plessis, in contrast, is currently employed by the OFSED and works in a monolithic structure known as the C.R. Swart Building. At the time of the implementation of the Project, Sarie and her husband, Louis, were teachers at the Primary and High Schools in Clocolan, respectively. After having been involved in the CALIS Project for a year, they decided to relocate to Bloemfontein and Sarie was subsequently appointed by the OFSED to assist Igno in the management and operational functioning of the FRETEL Project.
I met Sarie on 19 May 2005 in her office, overlooking the skyline of Bloemfontein. The following transcript from the Research Journal entry, dated 19 May 2005, best captures the nature of that meeting:

> She smiles the whole time. She is unwilling to commit herself to an opinion on the withdrawal of government support in 1994 because she is in the belly of the beast. The interview takes place on the twelfth floor of the C.R. Swart building, which houses the Orange Free State Education Department. The smile is playful and deceptive. She will not be drawn into committing occupational suicide but she very badly wants to tell me that she despises their decision. She is presently involved in setting up the same structures and the same system ten years later and is unable to comment – I get the idea that the smile signifies that there is no need to comment: the disjunction, the passage of ten years and the implied silence of this passage shout louder than she could – this is what the smile says.

Ronel Calitz is the only participant who was not appointed by the OFSED, as a member of Dr Venter's team, subsequent to her implementation of the CALIS Project in the classroom. She is currently employed by the OFSED as a coordinator of Learning Facilitators in the General Education and Training Phase (G.E.T) and is stationed in Sasolburg. Ronel is also the only participant who is not presently directly and actively involved in some kind of computer-integrated education. She is, however, indirectly involved through the Roos Reading

Programme for Foundation Phase learners. This programme had been developed before the implementation of the CALIS Project and might well still be in use in some of the schools in the Free State Region.

Ronel is an intelligent, imposing person who seems to be strong-willed and determined. She is also slightly disenchanted with the context in which she presently finds herself:

> Ronel works for the Department of Education in Sasolburg. The building is situated in a suburb and is clearly a converted school. Her office, though spacious, is situated on the top floor at the end of the left wing of the building – symbolic of her own perception of her marginalisation: she studied the M.Ed. in Computer-integrated Education at the University of Pretoria but is presently employed in an administrative function. She feels bitter that the people presently engaged in strategising the implementation of e-learning in the Free State seem not to have the requisite training or skills. She feels that she might have been consulted on these issues, rather than having been employed in a purely administrative role. The fields outside the ex-school building are withered and worn and add to the feeling of dilapidation and despondency (Research Journal, 31 March 2005).

4.3 Synchronic, diachronic and metaphoric systemic structure

As indicated in Chapter 3, after an initial analysis of the narrative data, it appeared that the systemic interconnectedness hinted at in Mooij and Smeets (2001) at various levels of structural complexity might be a good starting point in terms of further analysis. The structural levels thus identified were broadly classified as follows:

a) international;
b) national;
c) regional;
d) project;
e) district;
f) institution;
g) educator; and

h) learner.

It also appeared, however, that the identification of interventions at various levels of structuration was too simplistic to capture the complexity of the networked nature of the sustainability of computers in schools. The interventions at various systemic structural levels would have to be supplemented by a second dimension that cut across all structural levels. Such a dimension was found to address the following broad categories of determining influences:

a) personal;
b) physical;
c) programmatic; and
d) Systemic.

The personal category relates specifically to those personal traits and characteristics possessed by various people at various structural levels of the system, and more specifically, the traits and characteristics affecting the Project directly. The physical category describes the availability of physical resources such as buildings, classrooms, audio-visual equipment, computer hardware, computer peripherals, computer software and other physical resources. The programmatic category attempts to address those systemic and structural attributes that were specifically engineered by the creators and managers of the Project in order to fulfil specific purposes. In contrast, the systemic category attempts to address those systemic and structural aspects of structural levels that were not specifically engineered by the creators and managers of such levels with the express purpose of achieving preconceived goals and objectives.

Further analysis of the data reveals, however, that the two-dimensionality of the approach adopted above, though an improvement on the initial approach, suffers from two important shortcomings. The first, as discussed below, is the difficulty, if not the impossibility, of isolating specific categories and separating off these influences in a contrived and forced manner from the influences dynamically connected to them.

The second, related, shortcoming is that the dissection of influences outlined above, almost by implication, precludes insight into the dynamic, fluid and interrelated functioning of the system as a whole. A Relevance Theory (Sperber and Wilson, 1986, 1995; Pilkington, 2000) perspective on the interpretation of metaphor provides revealing insights into such functionality. It does so because interpretation of metaphor under Relevance Theory is geared

towards the activation of a wide range of strongly and weakly held implicatures and assumptions about the world. Such implicatures and assumptions are partly implicated by the speaker but are also partly supplied by the hearer who must choose a context, or contexts, within which these implicatures are to be interpreted. The emergent picture is thus a complex compound of dynamically interrelated implicatures and assumptions that give life to the full gamut of influences that interact on, and across, various structural levels of the system - and that dynamically link personal, physical, programmatic and systemic influences.

The ensuing discussion, analysis and interpretation of the data will thus examine each of the identified categories, namely personal, physical, programmatic and systemic in terms of the structural systemic levels initially identified namely international, national, and regional, project, district, institution, educator and learner. Finally, the metaphorical patterning woven into the participant narratives will be examined in terms of its systemically animating functionality.

4.3.1 Personal influences

The role played by individual actors at different systemic structural levels in bringing about the integration of computers into classroom practice is outlined clearly by Mooij and Smeets (2001). What is not immediately clear, however, is whether character traits required at the different structural levels are generic or whether very specific character traits are required at different structural levels. Furthermore, it is not certain whether such character traits associated with integration are necessarily the same character traits associated with the sustained use of computers in schools. Finally, how is the diachronic influence of character traits in the integration phase separated off from the influence of character traits on the sustained use of computers? Or, put more simply, how can we be sure that character traits influencing integration do not also influence sustainability?

An initial analysis of character traits at the various structural levels addresses only part of the answer. The situation of these character traits within interconnected, dynamic metaphorical networks provides the complexity needed to address the issue in its entirety.

4.3.1.1 International

Although it is very difficult to find evidence at the international structural level of personal attributes that influenced the sustainable use of computers in schools, after the withdrawal of government support of the Project, it is conceivable that such personality traits and

characteristics might well have motivated international corporations to become involved in the propagation of educational computing in South Africa. No specific reference is made, however, in any of the participant narratives to such personal traits and the matter can thus not be discussed in any further detail.

4.3.1.2 National

Although specific people in the National Department of Education might be suspected of having had a significant systemic influence on promoting the sustained use of computers in schools in the Free State region, the most significant influence at national level came from an academic programme associated with the Faculty of Education at the University of Pretoria.

Reference is made in the narratives to the significant role played by the existence of the M.Ed. in Computer-integrated Education (C.I.E.) programme at the University of Pretoria. Dr Venter relates how the enquiries he made convinced him that the programme offered at the University of Pretoria was superior to any similar programmes offered at other South African institutions.

What is particularly evident in a number of the narratives is the personal attributes associated with Professor Johannes Cronje who, during the course of the CALIS Project, was both a student presenter and later coordinator of the programme. In the ensuing passage, Dr Venter comments on the establishment of the working relationship between the OFSED, represented primarily by himself, and the unit offering the M.Ed. in C.I.E. (the numeral next to the translated quotation corresponds to the same numeral next to the original Afrikaans quotation in Appendix):

> *(1) So we drove up [to Pretoria] one day and saw them, and asked them whether they would want to enter into some kind of partnership with us – with our little team in the Free State. They could advise us and conduct research here; they could use their students to do the work here and, in this way, we could gain knowledge from them. They were anxious to help, and kind and we formed a wonderful group (Peet Venter).*

Particularly noteworthy is Dr Venter's perception of the attitude of the people in Pretoria as being 'pleasant and eager to help'. Although no mention is made here of specific people, it is clear that the attitude of the Pretoria contingent was instrumental in contributing to the establishment of the working relationship between the two groups.
The identification of character traits relating to Professor Cronje, specifically, is evident in a number of narratives. The references are made, particularly, in the context of annual expos, where Prof Cronje's presentations were experienced as being animated and inspirational:

> *(2) And at the very first one [expo] that I attended, Professor Cronje was one of the students who accompanied their lecturer; they arrived and he [Professor Cronje] delivered an outstanding presentation with a great deal of gusto – an inspiring kind of performance (Igno van Niekerk).*

> *(3) Well, interesting, I think, if one reflects – and this is not because the study is being done for him – but Johannes Cronje's enthusiasm at the very first CALIS expo drew much attention….That enthusiasm, that eagerness, that interest is one of the things I remember (Igno van Niekerk).*

> *The most wonderful guest speaker was Johan - and for the life of me I cannot remember what his surname as….*
> JOHANNES CRONJE
> *That's it.*
> HE'S MY SUPERVISOR.
> *Is that so? He was a great guy – absolutely splendid and also brought to me and introduced to me by Johan Badenhorst, but you couldn't wish for a better chap – you're lucky, you are very lucky. I mean he can keep an audience enwrapped like no- one can (Maureen Dale).*

The suggestions here are to be interpreted within the context of the expos where teachers were made aware, most of them for the first time that computers could be employed in the classroom as an integral part of classroom practice. The personal qualities of Professor Cronje highlighted in these extracts are 'enthusiasm' and 'inspiration'. The context in which these suggestions produce the most rewarding contextual effects for the least processing effort

relate to assumptions regarding the position of teachers who experienced Professor Cronje's presentations as an introduction to the concept of integrating computers into the curriculum.

At the time, the school curriculum was rigid, content-driven and geared towards instructionist practice. There were, however, initiatives afoot designed to break this mould. The launching of the Project happened to coincide with the introduction of the problem-centred approach in Mathematics and more social constructivist interaction in the languages, as documented below. The assumptive contextual framework of the teachers hearing Professor Cronje's address are thus likely to have included assumptions relating to 'new-fangled approaches' and the difficulty of implementing these approaches given workload and time constraints. Professor Cronje's enthusiasm would have captured the attention of these teachers and what would have been truly inspiring would have been the twin realization that the computer could be integrated into classroom practice, but also the fact that such integration could present the teacher with a valuable ally and tool in adopting a radically different approach to teaching and learning (as indicated by Igno van Niekerk below).

4.3.1.3 Regional

Although specific people in the National Department of Education are not seen as having influenced the Project in any meaningful way, the opposite can be said for the regional OFSED. At the time of Dr Venter's appointment, Dr Gert Heyns was the Director General of Education in the Free State. Mr Heyns is described by Dr Venter as being a very competent strategist, financial manager, and, more importantly, someone who envisioned a critical role for computers in education in the region:

> *(4) So, his vision for computers in education helped a lot – his attitude and his unbelievable financial management skills – he was unbelievable. He would come across a few things and would draw our attention to them: 'Why did you make the decisions you did? Why did you not do the following?' Then we would answer that we had made the following decision. Then he would say: 'no, you can look in the following files and you will see that our decision was different' He was very particular about things like that. But that ability of his helped us to do a number of things very quickly (Peet Venter).*

Mr Heyns's vision for the role that computers could play in primary and secondary education, coupled with his managerial skills and financial management clearly played a major part in establishing the kind of protective institutional mandate required to provide a secure environment for the fledgling Project. The context in which the comments above are to be interpreted is influenced strongly by assumptions derived from a comment made by Dr Venter, which is analysed in more detail in a later section of this report. According to Dr Venter and Hercules Dreyer, Mr Heyns would, at the end of each financial year, determine how much budgeted money had not been spent in various sub-departments within the OFSED. Such monies would then be assigned to Dr Venter's Project for the express purpose of supplying schools with computer hardware and software. The result was that infrastructural development of the Project proceeded fairly rapidly during the short period characterized by Departmental support. The result was that, when Departmental support was withdrawn, the hardware and software infrastructure in schools was virtually in place. In this sense, the personal characteristics of Mr Heyns seem to have played a pivotal role in furthering the aim of implementing the Project for sustainability.

In terms of the categories in use in this study, the artificial disjunction between personal qualities and physical resources finds visible expression in the case of Mr Heyns's involvement. His intellect, attitudes and values, which are classified here as personal attributes, were directly responsible for his actions in providing the physical resources that fed the establishment of the hardware and software infrastructure. The infrastructure thus created provided a solid foundation for the continued use of computers in the classroom. This kind of dynamic causality that characterises a complex system cannot be explicated in terms of the two-dimensional synchronic and diachronic view presented here. It will, however, be addressed in ensuing sections relating to the use of metaphor in the various narratives.

4.3.1.4 Project

In terms of the Departmental team that implemented the CALIS Project, it is clear that character traits played a major role in ensuring the sustainability of the Project. It is noteworthy that both Dr Peet Venter and Hercules Dreyer possess exactly those qualities that were crucially relevant to the respective roles that they played in the Project.

Dr Peet Venter

The single most commonly encountered quality with reference to Dr Venter in the narratives produced by the other participants is that of 'visionary':

> *(5) The knowledge, the information that they had – the vision that those guys had been unbelievable – it changed my approach in the classroom completely (Igno van Niekerk).*

> *(6) Dr Peet Venter was a guy with an unbelievable vision - .....(Igno van Niekerk).*

> *(7) I think the vision that he had at the time was simply fantastic (Igno van Niekerk).*

> *(8) When I think about it, I think that Dr Venter made one aware of horizons which one never thought existed – definitely. You were never aware of it, but, through your involvement with CALIS, you became aware and you became involved (Sarie du Plessis).*

Although the exact nature of the vision that he possessed is not enlarged upon in these excerpts, it is apparent that teachers who observed this quality first-hand were enthused and found his approach to the role of computers in the classroom inspiring:

> *(9) Ok, the first thing was the fact that Dr Venter and his team inspired one (Sarie du Plessis).*

Dr Venter himself provides the most compelling evidence of the nature of the 'vision' that he possessed with regard to the Project. In the first instance, there is evidence to suggest that Dr Venter conducted extensive research into the integration of computers into classroom practice in other countries:

> *(10) He wants us to begin considering the use of computers in the classroom. The computer is not used as a resource in the classroom. He had conducted extensive research*

> *overseas and had come to the conclusion that it [the computer] could be a wonderful resource (Hercules Dreyer).*

Secondly, his understanding of the socio-political situation in the country, and the way in which it would subsequently develop, coupled with his understanding of the way in which technology, and computers in particular, could be employed in leveraging educational change, enabled him to identify the impending political change as a significant opportunity to contribute towards the enrichment of educational environments both in affluent and in previously disadvantaged societies, throughout the system:

> *(11) I thought at the time – and it doesn't take a rocket scientist to know this – that, where we had 180 schools, we would suddenly have 1800 or 2000 schools in the new dispensation in the Free State. We have problems communicating with fewer than 200 schools – slightly - how will it work with 1800 schools? The schools will be situated in outlying, inaccessible areas. Here is something we can pilot and see whether it works (Peet Venter).*

Based on the premise that there would be one, unified department of education after the elections in 1994, Dr Venter needed a way in which he could ensure that effective channels of communication were established between the Department of Education and all schools at various levels, not only in terms of management, but also in terms of communication between learning facilitator and subject teacher. Dr Venter's reaction to Absa's offer of satellite television broadcasts is telling:

> *(13) And not one of the other provinces was interested in it but we were anxious to use it because I personally felt, at the time, that the ideal communication channel was that between the Department and the school; from the LF's [learning facilitators] to the teacher (your big challenge) and thus effective dissemination of knowledge, management training and curricular knowledge could be accomplished (Peet Venter).*

But Dr Venter's vision was not merely vision in the abstract. His vision was accompanied by his ability to plan strategically:

> *(14) He and I drove to schools in the car – I used to have a little recorder just like that one – then I remind myself: 'Remember to do that' – we wrote things down – we were always planning – those plans have to be made- you need guys like Peet Venter – the teachers have to be motivated consistently -... (Hercules Dreyer).*

The plan that emerged was one that recognised the importance of ensuring the acquisition of basic computer skills as a prerequisite for the acquisition of skills necessary for the integration of the computer into the curriculum, but in such a way that the acquisition of these skills would not be invasive or demotivating. The idea was that teachers were to acquire basic computer skills with the express purpose of using these skills in creating computer-based lessons:

> *(15) But I do believe – perhaps slightly old-fashioned – together with e-learning and Intel – I still believe – that it is much easier to use Intel [Intel Teach to the Future Programme] and things like that if you have basic word processing, Excel, PowerPoint and similar Internet tools. I think the truth lies somewhere between the two: you have to acquire some basic skills but these should not be unconnected – there has to be a purpose, a goal that will be reached by using these skills (Peet Venter).*

The overarching systemic plan found expression in action plans that incorporated the introduction of learner-centred constructivist, and to a large extent constructionist, learning. This focus supported and enriched the problem-centred approach to Mathematics and the social constructivist approach to the languages, introduced at virtually the same time as the CALIS Project.

> *(16) And you can use one group by saying to them: 'You will be working on the computers today'; and to another group you say: 'you will continue with work in your desks'; and to a third group you say: 'I want you to work in close proximity*

> *to the teacher'. This was aimed particularly at the primary school. So he saw that there was a need for the use of computers in this way (Hercules Dreyer).*

So, Dr Venter's vision for the integration of computers into classroom practice found expression in innovative action plans relating to classroom implementation. But the innovative and inspirational quality of his leadership did not end there. He was situated, at the time, in an education system strongly aligned to the philosophy of strict hierarchical and vertical functionality – the educational equivalent of a command economy. In this context, his leadership and managerial style were not only unorthodox but positively inspiring. His approach to the management of people amounted to the systemic energizing of people, at various levels of the system, and, in the process, the empowerment of such people to become masters of their own fate:

> *(17) If you have the right people and you bring together the right kind of energy, then you don't have to manage from the top and control the whole time: 'Do this, do that; send in this report'. You only have to guide them in the right direction and create the opportunities for them; and you have to say to them: 'That is how it works. There are guys doing this. Find out what is going on. There are enough guys with the right attitude and those guys will lead and will draw the others after them. And that was our idea at the time. We succeeded fairly well in doing in this in our own small context, and in our own small way (Peet Venter).*

In the process of such empowerment, he envisioned the creation of a network of practice that, in the tradition of viral or ecological networks, was able to become an autonomous system. On the occasion of the last expo, Dr Venter delivered a short address to the delegates, knowing that the particular expo would be the last one of its kind and that Departmental support of the Project was destined to be withdrawn. His vision for the continued existence of the Project is presented below:

> *(18) And that last expo was a very large expo and a bit of a sad one for me because I realized that that would be the last one… I can still remember very clearly the little speech I delivered at the opening… where I told them that that expo*

> *would in all probability be the last one, but they were not to think that that would be the end. It was only the beginning – they simply had to ensure that they kept up to date. The Internet and everything else was in place – there was nothing that could stop them. The new guys [post-1994 OFSED] could do whatever they wished. All the teachers had to do was carry on – the new Department would be such a massive organization – we were a very small department – which they wouldn't even realize what was being done. All they had to do was carry on. They had to realize that they were on their own (Peet Venter).*

The Project had, thus, in his own mind taken on a life of its own. The educators had been empowered, by means of an energizing process, to function effectively within the context of the Project system that had been created. Dr Venter's belief that there was 'nothing that could stop' the educators from implementing the Project speaks of an inevitability – the view that some kind of 'critical mass' within the system as a whole had been reached. The point is taken up in Chapter 5 in relation to Fullan's (2005) postulation of a 'critical mass of leaders' required altering the context within which a particular system is situated.

Hercules Dreyer

Dr Venter possessed qualities directly related to the successful management of the Project, and thus also the system in question, namely vision; the ability to think and plan strategically; the ability to translate strategic thinking into action plans that could be implemented in practice; and the ability to inspire and manage people in such away as to energize them.

In contrast, and almost prophetically, Hercules Dreyer, drafted into the team as an implementer, is possessed of an almost indefatigueable willingness to work. Igno van Niekerk, commenting on their collaboration in bringing the FRETEL Project to fruition, emphasizes not only Hercules's capacity for work, but also his indomitable determination and self-belief.

> *(19) Hercules Dreyer – Hercules and I often drove through the night to Johannesburg and back – hardworking. He was the kind of guy – you know I am the kind of guy who sometimes wonders whether I can accomplish something – Hercules used to say that he was capable of doing something*

before he even knew how it worked. And you sometimes need someone like that (Igno van Niekerk)

What is it that drives someone to work incessantly, without the promise of any immediate financial reward? Hercules is adamant that it is passion alone, a quality clearly observed and attested to in the fabric of the narrative that he offers. Dr Venter offered Hercules the opportunity of organising the first expo, knowing full well that the task would be approached with enthusiasm and dedication:

(20) You know, I become excited when I speak about it. That was one of the happiest periods of my life – I often worked throughout the night to get that thing organised but it was wonderful (Hercules Dreyer).

(21) That was the most enjoyable job I ever had (Hercules Dreyer)

(22) That kind of thing gave me the biggest kick and with one event you made such a difference right across the Free State (Hercules Dreyer).

(23) The other thing that we had there – can you see how excited I get about this – as I said, if they offer me a post now, I will go back immediately. If only the Free State said that they were aware of these things and asked I to get them started (Hercules Dreyer).

There is, in these comments, a sense of absolute joy and satisfaction. There is also the sense that he approached the organisation of the expo from a personal perspective: failure of the expo would have been interpreted as personal failure. The extent of this commitment is adequately and eloquently captured in his comment relating to the role that the Project played in his own life, and the traumatic effect that the withdrawal of Departmental support, and his subsequent resignation, had on him. :

(24) I become terribly excited about this whole Project because it was my entire life at the time. I think we had many successes at the time and we enjoyed it because we could see the difference we were making. When I left for the private

> *sector it was as if a limb had been cut off. I have never again had that feeling – that feeling of satisfaction (Hercules Dreyer).*

Throughout the narrative presented by Hercules there are references to the centrality of the educator's dedication and motivation as catalysts and necessary pre-conditions for the implementation of the Project, but also for the sustainability of the project. The strategic and action plans devised by Dr Venter demanded that educational imperatives determine technological solutions rather than technology providing the *raison d'entre*. In Hercules Dreyer, Dr Venter found someone who subscribed wholeheartedly to this philosophy, and lived it:

> *(25) Facilities are necessary but that can come later. Your teacher is the most important thing. You can build the most impressive schools but if you don't have the teachers it won't help. So, that was the difference (Hercules Dreyer).*

> *(26) You need someone like Intel, like Microsoft, but you need teachers to drive the thing. That is what it amounts to (Hercules Dreyer).*

Dr Venter's belief in the efficacy of 'energising' educators was greatly aided by the fact that he could hardly have found a better embodiment of the concept than Hercules Dreyer. Part of the inspirational quality of Dr Venter's philosophy was the fact that educators could observe and experience, at first hand, what energy, dedication and passion looked like. The personal qualities possessed by Hercules Dreyer acted as perfect foil for those possessed by Dr Venter. Furthermore, each set of qualities was perfectly matched to the role to be fulfilled by each of them in terms of systemic functionality.

Johan Badenhorst

The Project is most often identified by participants as having been initiated and implemented by Dr Peet Venter and Hercules Dreyer. There is, however, another employee of the computer section of the Department of Education at the time who played a major role in providing support to educators. Johan Badenhorst was, in fact, the last member of the original Departmental CALIS implementation team to leave the Department. Though less vociferous and more reticent than either Dr Venter or Hercules Dreyer, he is someone who is possessed of the same passion for computers in education that characterises the former men. On being

asked to indicate why he became involved in the Project in the first place, he responds as follows:

> *(27) Ok, on the one hand, I became involved because it was my job; on the other hand, it was my passion – out and out…..(Johan Badenhorst)*

Not only does Johan indicate his own passion for the Project, but the implication contained in his reference to some of the other members of the Departmental team in this particular context, indicates a kind of golden thread in terms of personal dedication to the cause of integrating and sustaining computers in classroom practice. This particular golden thread runs through the motivations of active participants in the Project at all levels, and will be taken up below in the discussion of the role played by educators involved in the Project.

There is, however, another aspect to this passion that is not evident in the narrative presented by Dr Venter or Hercules Dreyer. Both of the latter bemoan the short-sightedness of the Department in withdrawing support, but Johan is positively taken aback and hurt by the Department's implied mistrust of their motives in implementing the Project:

> *(28) The result is that all of that equipment simply disappeared and nobody allowed one to use it or to do anything else with it – it is probably in a storeroom somewhere. That is the pity of it. One of the questions relates to how one felt about this. Naturally, one's reaction was negative because you planned the thing with the intention of contributing to the betterment of all in South Africa, and all your good intentions were simply ignored (Johan Badenhorst).*

> *(29) No, that was a wonderful time and it was enjoyable – we enjoyed it very much and it remains a tragedy that the thing [Project] could not be done because I don't think either the principles upon which it was founded or the motivation for it can be doubted. These were pure (Johan Badenhorst.)*

Johan's reaction here is a conglomerate of pride in what had been achieved and a sense of sadness at the thought that their motives had been mistrusted by the Department. There is

about this sadness a depth of emotion, evident in the repetition of the point made in the extract above, which speaks of moral uprightness and pride in the adherence to principled action. This same uprightness is evident in the actions taken by both Dr Venter and Hercules Dreyer, but is not expressed as emphatically by them.

Further testimony to the important role played by Johan in implementing and actively pursuing the continued life of the Project is provided by Maureen Dale:

> *Johan Badenhorst was a big factor – he was actually the gentleman who came to me and approached me with Peet Venter and said will I do it (Maureen Dale).*

Whereas Dr Venter and Hercules Dreyer were the flamboyant face of the Project, Johan was the efficient support system that ensured the smooth operation of the Project. He acted as the interface between educator outreach and programmatic functionality at the Department. Once again, Johan's altruism and dedication to the cause of integrating computers into classroom practice aligns well with similar qualities in his colleagues at the time. His own unique contribution as interface between the public outreach and the programmatic functionality of the Project required exactly the quiet dedication to duty that characterises his words and actions.

The situations of Maureen Dale, Igno van Niekerk and Sarie du Plessis provide good examples of the systemic complexity of a Project of this nature. Although they first became involved in the Project as educators, their involvement later evolved into a more direct role in the Project. It would thus be fitting to include a discussion of their qualities here. Their respective decisions to become involved in the Project were, however, taken while they were educators in the classroom. For this reason, discussion of their specific qualities takes place under the 'Educator' sub-section.

4.3.1.5 District

In terms of personal qualities or attributes possessed by active contributors towards the implementation and sustainability of the Project, no mention is made in the narratives of such qualities.

4.3.1.6 Institution

The involvement of individual schools in the Project will be discussed in more depth when consideration is given to the programmatic and systemic aspects of the Project. What does need to be mentioned here is the initial impetus for the implementation of the Project at particular schools. Both Dr Peet Venter and Johan Badenhorst stress the fact that the possibility of becoming involved in the Project was communicated to all schools, but that the decision to become involved in the Project rested with the school. The implication is that there must have been a person or persons, either in the form of the principal or a member of the senior management team, whose initiative and vision sparked the decision to become involved:

> *(30) Schools were invited to apply for such computers or to become part of the Project. Schools were evaluated on the basis of their suitability (Johan Badenhorst).*

> *(31) Schools that wanted to, that saw the need - the need for information technology, for computer literacy, for expertise and the possibilities that technology encompassed – those schools continued on their own initiative, appointed people and developed their own projects (Johan Badenhorst).*

The extract from Dr Venter's narrative further indicates that the initial decision to become involved in the Project eventually evolved into a model for sustainability, designed by individual institutions. The question that arises is the following: how was such implementation and sustainability inspired, designed and encouraged?

A first suggestion, supported by the narrative and actions of Maureen Dale, is that the principal, as chief operating officer of the school, would have been ideally placed to fulfil this role. In answer to the question regarding the driving force behind the Project at her own school, she had the following to say:

> *It was the principal's hobby (Maureen Dale).*

> *My own school, when I arrived here, they had one computer in the office block with a very tiny hard disk and one other*

computer that had a double floppy – nothing else. I mean, today you are looking at a school with in excess of 130 computers – all of good, good quality . Next year I replace 40 of them in one fell swoop so all my staff ,excepting for four, are totally computer literate - and that is a staff of just on 40 people. I am speaking about assistants, secretarial people – all inclusive. At one stage, only the secretary could use FRESAD and that was what it was – lock, stock and barrel. So the interest level is there – we had in-service training at school – when they saw what could be done by them, it created a thirst (Maureen Dale).

So, the principal's passion and vision in terms of the possibilities that computer-integrated education offered, is one suggestion as to why the Project succeeded at individual institutions. But it is also clear that Maureen possesses the necessary management skills commensurate with her position as principal of the school, to have ensured that the implementation and sustainability of the Project could be achieved.

The principal of a school certainly plays a major role in introducing and sustaining new programmes at a school, but it is essential that support come from the heads of departments, or senior management team as it is now called. In this regard, Dr Venter highlights the horizontal, networked functionality within the Project in terms of cooperation between individual heads of departments across schools:

(32) What did possibly survive was individual subject heads at schools that helped each other (Peet Venter).

But the important role played by the heads of departments was not only horizontally effective, but also vertically effective. Ronel Calitz was the equivalent of a head of department at her school and was tasked with the management of the Foundation Phase. What is immediately apparent is the importance of vertical accountability (Fullan, 2005):

(33) In the end, we simply got hold of old computers and put them in all the Foundation Phase classes (Ronel Calitz).

(34) And that was a kind of threat, also because they were not computer literate and because they dissociated

> *themselves from computers. But, as we progressed, the situation improved and those teachers at Taaibos – the Foundation Phase people – were never really computer literate and yet they used computers in their classes (Ronel Calitz).*

Once again, the vision and initiative of the head of department is strengthened by management skills. The full extent of these management and inter-personal skills will become more apparent in the discussion of Ronel's approach as educator.

In terms of institutional uptake, it is to be expected that the personal qualities possessed by principals and heads of departments should have influenced the success of the Project. What might not have been expected to play a role is the marital relationship between individual actors at various structural levels. Ronel's husband was, at the time, and is, the headmaster of a nearby school. He decided to implement the Project in his school :

> *(35) No, but he implemented the same project at his school and it worked exceedingly well – even today (Ronel Calitz)*

The fact that the Project was implemented and sustained simultaneously at the two schools can only have been influenced positively by the horizontal marital relationship between Ronel and her husband.

Further evidence of the horizontal functionality of such marital relationships is provided by Sarie du Plessis:

> *(36) I was responsible for the primary school and my husband, Louis, was at the high school. We taught there [Clocolan] together. He was at the high school – responsible for the senior classes – and he was more involved in computer literacy rather than support in a particular learning area (Sarie du Plessis).*

The fact that Sarie was responsible for the implementation of the Project in the primary school and her husband for the implementation of the Project in the high school, suggests that horizontal networking and mutual support strengthened the vertical implementation of the Project at the school. Once again, systemic interrelatedness precludes simple cause-effect

conclusions regarding the success of the Project at institutional level. Marital relationships are a systemic influence that lies beyond the pale of that which could have been designed programmatically. Similarly, such relationships are not synonymous with the personal qualities (*per se*) possessed by individual people involved in the Project. Rather, such relationships form the fabric of a systemic network or web that demands attention to complexity and multiple causality and effect.

In this regard, it is also difficult to ascertain the extent to which the personal qualities possessed by educators involved in implementing the Project, can be separated off from institutional and other systemic influences. What is overwhelmingly evident from the narratives produced by participants in the study, however, is that the personal qualities possessed by educators involved in the Project are perceived to have had a very meaningful influence on the implementation and sustainability of the Project at individual institutions.

4.3.1.7 Educator

From the perspective of the people involved in the planning and implementation of the Project for the OFSED, it was decided from the beginning that educators should not be compelled to take part; in fact, access to the Project for individual educators was purely voluntary. This decision was not coincidental. It was felt that educators keen to take part in the implementation of the Project would possess exactly those personal qualities and attributes that would be crucial to the success of the Project.

> *(37) We identified the schools and they then identified the teachers – look, they could then decide which teachers were keen to be involved. We did not want to oblige anyone to do it. We were adamant from the beginning that it would not help to force people to do things in particular ways. We told the school what we would give them and it was up to them to identify a teacher who was interested and in whose class the computers could be placed. So, the initiative came from the schools (Hercules Dreyer).*

Although institutions were selected for participation in the Project on the basis of having satisfied a number of criteria, the most important criterion, namely the passion, interest and drive of the educators involved, was addressed by way of self-selection.

> *(38) There were a whole number of factors that played a role but I think one of the most important factors upon which successful participation depended was, in the final analysis, the teacher's dedication – commitment – to the Project; whether it was positive, and, of course, the teacher's enthusiasm – the teacher's drive was a very important factor because if it is simply dumped on a teacher, you can forget about it (Johan Badenhorst).*

The efficacy and eventual wisdom of this decision, in terms of the success of the Project, is emphasized by Hercules Dreyer:

> *(39) It is incredible what guys can do but the teacher needs the energy. And unbelievable teachers came to the fore – notably Sarie and Louis whom we later moved to the studio – they were in ….I will have to guess… Clocolan was where they taught (Hercules Dreyer).*

But the perception was not, simplistically, that specific positive qualities possessed by individual educators would guarantee success. It was accepted, from the inception of the Project that such qualities functioned dynamically within larger systems – systems that were likely to evolve and change character over time. One such immediate interrelationship was perceived to be that between human qualities and hardware / software infrastructure.

> *(40) The next phase – great, now we have the infrastructure. We had had computers placed at schools. The large corporations simply delivered them – who was going to drive the Project? Who ensures that lessons are designed on an ongoing basis, and that energy is maintained – that the thing even gets off the ground? That is where the thing works – that is sink or swim. That was why I worked through many nights – to evoke the energy. You have to motivate guys (Hercules Dreyer).*

In terms of evolution of the system, the expectation was that the Project would develop, change and expand in accordance with viral or ecological models (Cavallo, 2004) of

sustainability, where the activities and successes of individual educators would inspire those closest to them to embrace the implementation of the Project. These educators would then inspire those closest to them. In this way, horizontal networks of practice would come into being:

> *(41) What enabled these schools to do this? Drive. It is the drive provided by teachers who are enthusiastic that enables things to run (Johan Badenhorst).*

> *(42) You will not be successful, and the intention from the start was to involve the enthusiastic teacher and to get him into the system, and in this way you could involve your other teachers who would become aware of the successes of the first teacher (Johan Badenhorst).*

> *(43) If those funds dry up and there are no longer people who do it – here and there where something had been planted in fertile soil, it might have persisted (Hercules Dreyer).*

The enthusiasm of educators for the Project and the time and energy that went into the implementation and sustaining of the Project, beg the question as to what might have motivated educators to become involved in the first place. The introduction of computers into classroom practice not only presented educators with novel ways of enhancing learning, but also acted as motivational tools in terms of the learners' engagement with the various curricula. In this way, the Project encouraged something that educators had consistently striven towards achieving: the awakening of curiosity amongst learners, and even excitement at the prospect of engaging with learning materials.

> *(44) I think that the most important achievements, successes that we managed are related to this issue. In the end, the most important success is when you … see a child sitting in front of a computer and his face suddenly lights up and he gets a different expression on his face - that is where the teacher's reward lies and, for us, that was the success of the Project (Johan Badenhorst).*

Even after the decision had been made by the OFSED to withdraw support from the Project, Johan Badenhorst received many queries from educators – indicating that withdrawal of official support had not been synonymous with cessation of activity on the part of educators:

> *(45) We still received many queries and, because I was the only one who was left, I had many queries and I tried to give guys advice, as far as were possible, but only so far as I was permitted to help. But that was not nearly as much support as we should have given (Johan Badenhorst).*

The managers of the Project at the OFSED, in the form of Dr Peet Venter, Hercules Dreyer and Johan Badenhorst are thus unanimous in their appraisal of educator drive as a major contributing factor that led to the sustainability of the Project. This point will be addressed in more detail in the section relating to metaphoric patterning. The question which now arises is the following: what role do educators themselves perceive educator drive to have played in the implementation and sustainability of the Project?

Igno van Niekerk

At the time of the Project's implementation, Igno van Neikerk taught English at Voortrekker High School in Bethlehem. His interest in the Project was sparked by the enthusiasm of Hercules Dreyer, who visited the school at the time. But that was not the primary reason for his decision to become involved in the Project. In the ensuing extract, he identifies 'natural curiosity' as the driving force behind his decision to embrace the Project. This quality is also mentioned in Sarie du Plessis's narrative as one of the essential attributes of educators who embrace technology, and change in general:

> *(46) Why did we get involved? I think it was the involvement of Hercules Dreyer – and something I wish teachers today still have: the desire to know more (Igno van Niekerk).*

Igno wistfully bemoans the fact that present-day educators seem to have lost this crucial characteristic. He does, however, admit (later in the same narrative) that the CALIS Project was also only embraced by a handful of educators who were 'hungry' for improvement:

> *(47) What I found very sad was the fact that it was only a small group of teachers who were involved and who were*

enthused, but there was a large group of teachers who were not involved and who were not enthusiastic (Igno van Niekerk).

The full effect that involvement in the Project had on Igno is described in the extract below. This effect was not only a change of attitude towards technology in general and computers in particular, but amounted to much more than this. His involvement in the Project positively changed the way in which he approached his teaching. Furthermore, his interest in the relationship between computers and education, sparked by the Project, eventually led to his appointment in the training section of Liberty Life.

(48) I mean the fact of the matter is that I had a very positive experience. I learnt an unbelievable amount (Igno van Niekerk).

(49) That is how I see it – how it changed my life. My life changed completely as a result of one CALIS Project (Igno van Niekerk).

Igno's involvement was not only cerebral or intellectual. It was not only academic. Just as Dr Peet Venter, Hercules Dreyer and Johan Badenhorst had been imbued with a passionate determination to make a success of the Project, evidence of emotional involvement is also expressed in the following extract from his narrative, detailing his sense of loss at the studio that is seen as having gone to waste:

(51) It is sad – I think the teachers' centre, the studio does not necessarily exist anymore, neither the expensive camera nor stuff (Igno van Niekerk).

Such emotional involvement coupled with the kind of determination, echoed by the willingness to go to some lengths in ensuring the continued existence of the Project (extract below), suggest determination and a personal commitment to the success of the Project.

(52) So Sarie and I started playing the following game: when the teachers' centre was in trouble, we worked for the Department, and when the Department was in trouble, we worked for the teachers' centre (Igno van Niekerk).

There is also consistency between the qualities visible in Igno's actions and the opinions expressed by him on the subject of the qualities to be possessed by educators who were likely to make a success of the Project. He tacitly acknowledges the systemic interrelatedness of different, specific skill sets at different structural levels of the system. Not only is there a place for the visionary strategist (Dr Venter), but such vision has to be supported by principals at individual institutions who are willing to translate strategic thinking and action plans into concrete implementation. Also, educators who choose to become involved in this kind of project, are, in the first instance, pioneers (to be discussed in greater detail in the section involving metaphoric patterning); they are, furthermore, possessed of a 'good eye', or sound judgement. This quality could also be interpreted as referring to the ability to comprehend the systemic value of a seemingly isolated Project:

> *(53) It's the old story – you always have your visionary, and if he can only provide the vision, then you will have a few pioneers who can take things further (Igno van Niekerk).*

> *(54) It all depended on the principal, and then someone on the staff with the drive and a good eye (Igno van Niekerk).*

Beyond these qualities, Igno is adamant that the only reason for the continued existence of the Project after the withdrawal of government support was the hunger, energy and drive possessed by educators in the classroom. The extracts presented below, in fact, imply that this single contributing factor to the sustainability of the Project is often underestimated:

> *(55) What made schools carry on? There is only one thing that enables a school to carry on with computers: one teacher with the guts and the enthusiasm. You have one guy who has the drive and the energy and the enthusiasm. And he does it in spite of the syllabus, and he does it at any time: he does it in the afternoon; he does it at night (Igno van Niekerk).*

> *(56) A person should never underestimate the ability of one teacher with energy at a school, and that is the thing. You know, when you slice open an apple, you can see how many*

> *seeds there are, but when you only have seeds, you do not know how many apples there are. I think they planted many seeds and we don't even know what happened to those apples (Igno van Niekerk).*

He is also of the opinion that such motivation and drive can be linked to the willingness to be engaged in lifelong learning. It is an internalized quality that not everyone possessed.

> *(57) The perception at the time was that after four years you obtained your H.D.E [Higher Diploma in Education] and that you had finished studying, and the idea at the time was that we had to resurrect the concept that you had to become a lifelong learner. But that was something that had to be internalised – it was not something that people simply had (Igno van Niekerk).*

Expanding on the nature of this motivation or drive, Igno claims that such drive is an expression of the educator's view of his classroom intervention as a calling rather than merely a job. The point here is that educators experience their success in terms of the perceived difference they make to the lives of learners, rather than in material terms.

> *(58) But there is still your teacher for whom it is a calling – people who realise that you can make a difference to the lives of children (Igno van Niekerk).*

Even when Igno does speak of incentives he would like to see modern-day teachers provided with, the incentives are couched in terms relating to improved learning and teaching rather than the personal enrichment of educators themselves.

> *(59) If I consider that kind of teacher – I would look at a system that rewards the guy with a computer in his class, or something like that (Igno van Niekerk).*

In this sense, the sustainability of the Project was ensured by the incorporation of computer-integrated classroom practice into the mainstream of the learning-and-teaching programme by educators of this nature. It follows that educators appointed subsequently at such institutions

would have accepted, possibly unconsciously, the use of computers in classroom practice as an integral part of the academic programme.

> *(60) So, yes, I would say that many of them carried on using it [Project] – I don't think they would say that they used it consciously – some of them don't even know what CALIS is (Igno van Niekerk).*

In this way, qualities possessed by individual educators, according to Igno, played a major role in guaranteeing the successful implementation of the Project and subsequent sustainability thereof.

Maureen Dale

Maureen Dale's situation, as far as the participants in this study are involved, is unique on two counts. The first is the fact that she is speaks English as a home language, whereas the other participants speak Afrikaans as a home language. The second is that she was the principal of Eunice Primary School when the Project was implemented there. Mention has already been made of the central role played by the principal in the implementation and sustainability of the Project. In Maureen, the motivation and drive mentioned by Igno is complemented by the organisational and managerial competencies associated with principalship. On being asked why the Project had succeeded at Eunice Primary School, her answer was unequivocal:

> *And I am afraid that's the bottom line. It – I love computers. It's what I taught – it's what I did best – so for me it was so! exciting to impart that knowledge to other people and to let them see what excited me so - and the bug – they all took it . If I had been a pen-pusher and not been as computer- literate as I personally was, I wouldn't have been that interested in getting it off the ground – so the interest level on the – being the principal of the school at that time was accidental. They approached the person and asked me to do it (Maureen Dale).*

Coupled with the motivational drive and managerial capability, was a determination to ensure that the Project succeeded not only in individual classrooms, but throughout the systemic

functionality of the school as a whole. Contained in the account presented below is an evaluation of the Project as a means of addressing personal growth, irrespective of age:

> *They could physically walk from stall to stall to see what there was available and what they could be doing – and hell – I can't – and I want to! The oldest member on my staff, and I am only speaking – specifically - from a Eunice point of view, the oldest member learnt to use a computer when she was 68. She was my bursar – she had never used one before. She could type, and when she left here she had the entire inventory on computer. So she really- she could do it. And the wonderful feeling of achievement and success. I mean, you'll never take that away from her (Maureen Dale).*

It was quite possibly this unique combination of personal attributes that influenced Dr Venter's decision to approach Maureen regarding the hosting of the annual expo at Eunice. In this way, the energy, drive, determination and organisational expertise that had characterised the implementation of the Project at Eunice informed the larger system of the Project as a whole.

> *(61) As I said, Maureen Dale was involved in the enrichment programme at the teachers' centre for a number of years. We worked together very closely and knew each other well. I knew that if you gave her half a chance she would make a success of something. As a result the last expo was at Eunice – we sort of knew that that would be the last one as a result of the new guys coming in (Peet Venter).*

> *(62) And she can organise something very well – she is a livewire as far as that is concerned (Peet Venter).*

She embraced her new role and the expo was approached with the same gusto that had characterised the implementation of the Project at her school.

> *And because of my interest level at that stage. I would have moved heaven and earth to get the things that I wanted to see*

and we brought them here and it was a rip-roaring success (Maureen Dale).

I upgraded the infrastructure of the hall – we actually got days off of school so that the pupils didn't have to come to school that day because we used their classrooms as well – which was quite nice for them (Maureen Dale).

The full extent of Maureen's commitment to systemic functionality is, however, best testified to in a comment made by Igno. On having his presentation lesson at the expo chosen as the best lesson (after Ronel Calitz was unable to take up the prize she had won), Igno was awarded an all-expenses paid visit to the WCCE Conference in Birmingham in 1996. Maureen co-sponsored this trip:

(63) ...with people like Maureen Dale, who is an unbelievable character (Igno van Niekerk).

(64) I will never forget Maureen Dale since she provided the funds that enabled me to go overseas (Igno van Niekerk).

Maureen's focus was thus not merely her own school, her own district or the region in which she found herself. She embodies, in her actions and attitudes (as do the other participants in this study), the kind of systems-thinking-in-action described by Fullan (2005).

Sarie du Plessis

Just as both Igno and Maureen were initially involved as educators at individual institutions but later became involved in the regional functioning of the Project, so also Sarie was initially involved in the Project as an educator at the primary school in Clocolan. She was later drawn into the regional functionality of the Project. On being asked why she decided to implement computers into her classroom practice, she identified a very specific personal attribute which she views as a prerequisite for educators wishing to do this. There are echoes here of the 'natural curiosity' mentioned earlier by Igno, but there is the added appreciation of that which is new and innovative. There are also echoes here of the metaphor employed by Igno, in terms such educators as 'pioneers'.

(65) The other reason was that I found it interesting – something new. It was something different – that's why I decided to do it (Sarie du Plessis).

(66) But I think that it has to come from inside – one must be fond of new things. In other words, you must have the ability to explore. New things should not cause you stress. You must be able to say: 'Ok, let's see what we can do with it'. I think if you have those qualities, you can progress. They don't have to drive you – you have to be able to motivate yourself and you have to be able to design your own projects. You have to be able to see that a ,b and c will work in the classroom situation and then you have to implement that (Sarie du Plessis).

In addition to this appreciation of innovation is the, by now, familiar emphasis on the drive and commitment of the individual educator as an important contributing factor to the successful implementation and further sustainability of the Project.

(67) Yes, I think what makes it possible for a school is the fact that you really have to have a committed teacher (Sarie du Plessis).

In the view of Igno van Niekerk, Sarie does not merely espouse such qualities but quite literally embodies them. Such commitment has enabled her to weather the withdrawal of government support of the Project in 1996 and has ensured that, even today, in her daily functioning at the OFSED, she actively strives for the integration of computers into classroom practice across the region.

(68) …and what has to be said is that Sarie has an inner drive…(Igno van Niekerk).

(69) Old Sarie still does this kind of thing today. She does programmes and that kind of thing. If it had not been for those kinds of people, things would simply have come to a dead end (Igno van Niekerk).

Once again, it is not the promise of material gain or financial enrichment that motivates the educator. Sarie endorses the view expressed earlier by Johan Badenhorst that motivation for educators such as her lies in the perceived difference made to the lives of learners.

> *(70) Why did they carry on? I think there was great inspiration – you could see the difference that it made to the lives of the children (Sarie du Plessis).*

The kind of motivation, determination and energy possessed by educators such as Sarie also influenced some of them in previously unforeseen ways. After his return from Birmingham, Igno was offered a position at the OFSED and was seconded to the FRETEL Project. When this Project was officially abandoned by the Department, he applied for a post at Liberty Life in their training section. Just as Igno had been appointed to the training section at Liberty Life, Sarie's husband, Louis, was appointed to the same division. Sarie herself later joined the Computer Planning Section of the OFSED and was seconded to the FRETEL Project, where she worked with Igno. All of these roles have one thing in common, namely the use of technology in education and training environments.

> *(71) I don't know. I don't know whether there are still those who use computers.[Are you aware of any of the originally selected schools or teachers who still use computers effectively today?] Yes, I think many of the teachers who were involved in CALIS use computers today (Sarie du Plessis)..*

> *(72) He [Louis, her husband] works with Igno. And I would say that both Louis and Igno have CALIS to thank for the careers in which they find themselves today - that was where they started. I went from CALIS to the Department, first in an administrative role and later with Hercules as part of FRETEL. When he left, Igno and I carried on with FRETEL. Currently, I am with ELITS, Education, Library and Information, where I produce videos. But I am also involved in computer training. So CALIS opened up new horizons for me (Sarie du Plessis)..*

Ronel Calitz

Like Igno, Maureen and Sarie, Ronel Calitz was first introduced to the CALIS Project as an educator at a school in Sasolburg. Unlike the former, she never became directly and officially involved in the management of the Project at the time. But, as is the nature of systemic interrelatedness, her pedagogical interest in developing a reading programme for the Foundation Phase, though only tangentially related to the official concerns of the management of the Project, was later to play a major role in ensuring the sustainability of the Project.

Ronel conducted extensive research into the existence of remedial reading programmes after it became clear to her that the learners in the Foundation Phase at her school were not showing the necessary progress in reading. The problem is that the traditional approach to addressing shortcomings in literacy, involving written exercises, could not be employed at all in the Foundation Phase. An alternative solution had to be found.

> *(73) In 1992 we developed a reading programme for the computer – it worked really well (Ronel Calitz)*

> *(74) Because we were involved in the Foundation Phase we were not able to let children write compositions and things like that (Ronel Calitz).*

Ronel's research led her to the discovery of a programme that addressed remedial reading by way of a projector and slides. It was at that point that she approached her brother, who was a computer enthusiast, to enquire whether the programme could not be redesigned for computer delivery.

> *(75) I was never a Foundation Phase teacher but was involved with the Grade Fours, Fives and Sixes. They could not read and that drove me mad. You know, I could not handle that. So I started doing research on reading and possible reasons why children could not read, etc, etc. At the time there was a programme on the market – you used a projector that flashed words. I went to the University of Potchefstroom because they were the experts who used or marketed that programme. And I visited Dore Human at the University of the Free State since she used certain programmes. These were electronic projector programmes.*

> *When we started with computers I approached my brother who was a computer boffin. And I said to him: 'Man, this stuff that is projected – surely it can be put onto computer' And so, with all the knowledge I had accumulated over the years regarding remedial reading, and his computer expertise, we developed the programme. And the programme thus had greater potential and was actually much better than the programmes that made use of projectors. You had much more freedom. And that was how the CALIS Project became part of my lessons – part of my lesson planning. I presented a reading lesson with different reading stations, of which the computer-based programme was one (Ronel Calitz).*

The computer-based programme was duly developed and it was in marketing the computer-based reading programme that she became aware of, and became involved in, the CALIS Project.

> *(76) You know how I became involved? I was already in the process of marketing the reading programme (Ronel Calitz).*

Whereas the simultaneous marketing of the reading programme and the initial implementation of the CALIS Project must have been fortuitous from Ronel's perspective, Igno is of the opinion that the quality and usefulness of the reading programme was such that schools would have purchased the programme irrespective of whether the CALIS Project had been implemented or not.

> *(77) Ronel was personally involved but she carried on with the Roos Reading programme on her own. She used dongles in order to ensure that the programme could not be copied. She marketed it and it was something that schools would have purchased in their private capacities (Igno van Niekerk).*

From the perspective of her own involvement in the CALIS Project as an educator, there are two factors that play a significant role. In the first instance, the development of the reading programme had made her critically aware of the integration of computers into classroom practice, and, in the second instance, Ronel had decided to enrol for the M.Ed

Degree in Computer-integrated Education at the University of Pretoria. In this sense, she was well-prepared to take up the challenge of implementing the CALIS Project at her school.

> *(78) At that stage I worked a lot with integration – computer integration but also integration in general (Ronel Calitz).*

> *(79) You see, for me it was a great success because, at the same time, I was recruited to do Johannes's master's programme. I did it and enjoyed it very much (Ronel Calitz).*

The inquisitive and entrepreneurial spirit that first sparked her interest in conducting research into and developing the computer-based reading programme is only one of the qualities that Ronel sees as contributing to the successful implementation of the Project at her school, Taaibos Primary. Igno's description of 'natural curiosity' and Sarie's emphasis on innovative thinking find support in Ronel's narrative:

> *(80) It was always people enjoyed experimenting with new things. I am one of those people and Linda is also one of those people. And as it always goes, people have to buy into the idea (Ronel Calitz).*

Allied to these qualities, Ronel reiterates the importance of personal commitment to the success of the Project, on the part of the individual educator, as a prerequisite for success.

> *(81) Nowadays, there are computer centres in many of our black schools and they are white elephants since many of the schools have nobody to drive the process (Ronel Calitz).*

But, as might be expected of someone responsible for the organisation and management of the Foundation Phase at her school, personal commitment and drive are not seen as the only necessary prerequisites for success. Determined action has to go hand-in-hand with careful planning, coordination and a thorough and deep knowledge of one's subject matter. So, successful and sustainable integration of computers into classroom practice depends as much on academic/pedagogical and managerial competence as it does on personal qualities relating to motivation, curiosity and inner drive.

(82) You need to plan very carefully if you want to apply [computers] in the curriculum (Ronel Calitz)

(83) If you want to work in a structured way you have to have incredibly good organization in such a classroom. It really has to be someone who knows his subject (Ronel Calitz).

(84) You could not expect people to do it because it was a skill – it was really a skill, and it was the same at his school [her husband's school]. And he, as principal, could not expect of teachers to present structured group work in their classes involving the computer (Ronel Calitz).

Further proof of the veracity of comments relating to the importance of personal qualities possessed by the individual educators concerned is provided by Ronel's departure from the school. The Project, initially implemented at Taaibos at the same time as other schools in the region (1992-1994), continued functioning successfully even after the withdrawal of official government support. When Ronel left the school in 1998, however, the Project fell into disuse and was eventually abandoned. Ronel's departure coincided with the appointment of a new principal and deputy-principal who were not sympathetic to the learning –and –teaching strategy employed by the school at the time. This particular learning-and-teaching strategy will be discussed in more detail in the section dealing with programmatic characteristics of the Project.

On being asked whether she thinks the Project would have had a longer life at the school had she stayed, there is no hesitation at all in the answer.

(85) Once I had left, there was nobody to oversee the upkeep of the computers (Ronel Calitz).

(86) It was in 98..99 – somewhere in that region. I think it was in 98, and so, in the end, it did not work anymore (Ronel Calitz).

(87) DO YOU THINK, AND THIS IS A DIFFICULT QUESTION TO ANSWER, THAT THERE WOULD

HAVE BEEN SOMETHING LEFT OF THE COMPUTER INFRASTRUCTURE AT THAT SCHOOL, HAD YOU NOT LEFT?
O yes, definitely. Definitely (Ronel Calitz).

Once again, Ronel exhibits an interest and a focus that extends, systemically, well beyond the bounds of her individual classroom. Not only was the computer-based reading programme intended as a solution for learners across the country in need of remedial reading interventions, but she also instituted a revolutionary approach (at the time in South Africa) to involving parents in the education of their children. The adoption of the learning-and-teaching strategy advocated by Hercules Dreyer was implemented with the help of needy parents who could not always afford school fees, but who were willing to give of their time in acting as monitors in the Foundation Phase classes. The effect is poignantly captured in the words of one of the mothers who acted as one of these monitors:

(88) Anna: O, a lot. It gave me back my dignity. Ok, you don't know my history but it made me human again and I tell you my self-image was much, much better. And with the computer courses under my belt I feel tops. I can say that it gave me an injection…(Anna: Ronel Calitz).

Ronel's husband was the principal of a nearby school at the time and was similarly involved in implementing the Project at his school, although his implementation strategy in terms of learning and teaching was totally different to the one followed by Ronel. The socio-economic make-up of the learners at his school, coupled with a dearth of resources, necessitated (in his view) a radically different approach. Although the Project steadily lost ground at his school and finally disappeared altogether, as mentioned earlier, the marital relationship between them, though not directly characterised as a personal quality, is recognisable as a quality of the network of relations within which personal attributes find expression. The strengths of these relationships are likely to have affected the successful implementation and continued sustainability of the Project.

(89) His was one of the first integrated schools – transformed schools – and the crisis was the large differences between the children (Ronel Calitz).

(90) He then used these computers and he used games to stimulate the children – because there are certain basic things – and I am also a big supporter of computer games – like hand-eye coordination and that kind of thing (Ronel Calitz).

(91) The children did not know computers and he made them available during the afternoons and during breaks and the children was crazy about them – you can imagine (Ronel Calitz).

The narratives thus produced by the participants in the study provide a small number of very clearly defined personal characteristics or attributes associated with educators who were able to implement and sustain the CALIS Project in their respective schools, namely motivation; drive; appreciation of innovation; curiosity and the willingness to explore; organizational and managerial expertise; and a passion for contributing towards the success of the Project.

In terms of the structural levels identified at the beginning of this chapter, all have been addressed, except one – the learners. Were there any personal attributes or characteristics possessed by, and associated with, the learners that might have contributed to the success of the Project?

4.3.1.8 Learners

Hercules Dreyer and the mother who had acted as a monitor in Ronel's classroom agree that there is one quality that contributed actively to the success of the Project. This quality is perceived to be universal, however, and is not seen as having been possessed by participating learners only. Children are naturally inquisitive, but this natural curiosity is not tempered by the fear of failure as is the case with adults. Children explore wholeheartedly and fearlessly, and this was exactly the quality with which to confront the strange and precipitate appearance of computers in their classrooms. The perception amongst learners was that they were having fun, and not that they were necessarily involved in learning. There was thus no lack of intrinsic motivation.

(92) I even recorded video material of the Project. I remember walking into a teacher's class in Parys and saying

to her:' Let's quickly load these programmes for you.' And they were simple freeware programmes and the children were Grade Twos. The children were small and had never worked on computers before, but within half-an-hour they were playing on the computers. They were completely at ease. The thing about little ones is that they are not afraid – they don't worry. The teacher stands and worries and worries, and you just have to say to him: 'You know, you just have to ask the children – they will show you. Don't worry' (Hercules Dreyer).

(93) Anna: Yes, and when you arrive there, you tell them to sit down so that you can switch on the computers. When you look again, the computers are on and they are typing on the keyboards. They say: 'Lady, don't worry', and they press F! or F4 or something else. And they simply continue (Anna: Ronel Calitz).

(94) Anna: O, they used to fight – they used to beg us: 'Can't we please go on for a little while. We want to read, or we want to fill in words or we want to do Mathematics – can't we work for a little while on tables and counting and…(Anna: Ronel Calitz).

It therefore comes as no surprise that the Project is seen as having been a resounding success in terms of learner motivation and performance.

(95) Anna: Definitely, the computer training – or should I say the training that they had there – really helped. Truth is told, my children also received the training and I tell you it really helped them – gave them a wonderful boost (Anna: Ronel Calitz).

At the beginning of this section a number of questions were posed regarding the influence of personal character traits on the implementation and sustainability of the Project.

In the first place, it is not possible to separate implementation from sustainability. It is impossible to establish when Ronel's implementation of the Project ended and when her efforts towards sustainability began. What we can say, however, is that the Project failed at her school when the principal, the deputy-principal and Ronel Calitz left the school. We can also point out that Maureen Dale is still the principal at Eunice Primary School and that the integration of computers into classroom practice has flourished at her school.

Secondly, the preceding discussion of the character traits possessed by individual people at the various structural levels of the system indicates clearly that the requisite character traits on each structural level are not generic. Furthermore, in the case of the CALIS Project, the personal qualities possessed by the particular people on each level happened to coincide with exactly the qualities demanded for the success of the Project.

Finally, the preceding discussion reveals that, given the complexity of systemic interrelatedness, the participants in this study do have one quality in common: the ability to think and act both locally and systemically. Their strategies, plans and actions are suggestive of a commitment to the sustainability of the system as a whole and not only a commitment to the sustainability of their immediate contexts. Such commitment found expression in the programmes they developed.

4.3.2 Programmatic influences

Programmatic influences on the implementation and sustainability of the CALIS Project are defined earlier in this chapter as those influences relating to the Project that had been planned and implemented, with the specific goal of contributing to the success of the Project. On the face of it, this definition seems to be fairly unproblematic. Again, systemic interrelatedness precludes any such simplistic teasing out of individual, unitary influences.

The first complicating relationship is that between the CALIS Project and the existence of a pre-established programmatic infrastructure geared towards bringing about the computer literacy of all white educators (pre-1994 OFSED) in the Free State. This computer literacy programme was to be presented at education centres throughout the Free State. These centres had previously been established so that learners wishing to study Computer Science as subject could receive such tuition at the centres, since the relevant expertise did not exist at schools at that time. The question arises as to whether these initiatives, programmatic in nature – according to the definition provided above, did not have such a direct influence on the implementation and sustainability of the Project that they must needs be considered part and

parcel of the programmatic influences addressed in this section. The extrication of programmatic influences from the systemic network in which they are situated, as presented here, is thus artificial.

Secondly, the oversimplification of systemic interrelatedness is further exacerbated by the nature of the Project itself. The CALIS Project must be viewed within the wider context of the programmatic strategising around the integration of computers into schools at the time. As discussed below, the intention had always been to introduce computers into schools as administrative tools (via the Orange Free State Administration Database or FRESAD), as a precursor to introducing computers into classroom practice. The CALIS Project was thus the programmatically determined next step in terms of ensuring a more sophisticated use of computers in terms of learning and teaching. Furthermore, the implementation of CALIS coincided with the implementation of two other programmes that were designed to support the Project, namely FRENET and FRETEL. FRENET (Free State Education Network) was designed to connect all schools in the Free State to the Internet and thus also to the OFSED. The idea was that communication between individual schools, and between the OFSED and individual schools, could take place effectively and cost-efficiently. FRETEL (Free State Educational Television) was a satellite-based television network that connected education centre across the Free State with the OFSED in Bloemfontein. Not only was the network to be used as a management tool, but the idea was also that quality educational programmes could be broadcast to distant resource-poor rural areas.
Once more the question arises as to whether CALIS can meaningfully be separated off from FRENET and FRETEL in terms of programmatic influence, as defined in this study.

The approach followed thus far in this chapter, relating to the various structural levels at which influences might be identified, will serve as a useful way of identifying tangential programmatic influences on the implementation and sustainability of the Project. The focus will, however, still fall on the CALIS Project itself.

4.3.2.1 International

When Dr Venter was appointed by the OFSED to the position of head of the computer section, he was instructed to bring about the full integration of computers into learning- and-teaching at schools throughout the Free State. He was to build upon the positive attitudes towards computers that had been fostered amongst principals by the implementation of the FRESAD programme. It was clear, however, that the full integration of computers into the

curriculum is far removed from the use of computers for administrative purposes in schools. The implementation and sustainability model would have to be designed anew.

As mentioned previously by Hercules Dreyer, Dr Peet Venter, ever the strategist and planner, decided to embark on extensive research into the viability of equivalent programmes in other countries. Such research was supplemented by a visit to institutions in the United Kingdom and the United States of America where similar programmes had already been implemented. The delegation, of which Hercules Dreyer was a member, also attended a conference in the United States, aimed specifically at addressing the integration of computers into the classroom. As indicated in the ensuing extract, the purpose of the visit was to test the hypothetical planning that had taken place prior to the visit against the reality of implementation in other countries.

> *(96) We spent a few days in London and then visited Newcastle – there was a university that did quite a bit of work. At the time they had Archimedes computers and they wrote software specifically for those computers. We visited them to see what they were doing. Then we travelled to America where we attended the National Computing Conference – a massive conference with 3,5 thousand delegates. The theme of the conference was the use of computers in the classroom. The most important thing that I brought back from the Conference (we visited a number of schools throughout America) – the Internet had just got going and we had to phone guys to make contact. We visited software development companies that ran various projects and learnt very, very interesting things there. My feeling on returning to South Africa was that we were slightly ahead of England in terms of our ideas and the things we wanted to implement, and on a par with America. The things they wanted to do and the things we wanted to do were the same. The only difference was that they had the money and we did not yet have enough money at that stage (Hercules Dreyer).*

The conclusion reached by Hercules Dreyer was that the planning that had preceded the overseas trip had been endorsed by that which had been observed at the National Computing Conference and the various institutions that they had visited. The insights provided by the trip

thus convinced the delegation that the theoretical underpinning envisioned for the ensuing CALIS Project had been tested by way of practical implementation and found to be sound. They were not oblivious to the important contextual differences between the implementation in these countries and the situation in South Africa. As mentioned, the most visible difference was seen to be the availability of funding.

But there were also other, less glaring but equally crucial, differences. Because of adequate funding, it is likely that institutions in the United Kingdom and United States of America did not need to compete for funds. This meant that there was no competitive barrier to cooperation and sharing across institutions. The willingness to share and the kind of secure environment in which educators felt at liberty to make mistakes were attributes of the system, underlying the implementation of similar programmes in the United States. This immediately made an impression on Hercules Dreyer – exactly because the system underlying the proposed implementation of CALIS in the Free State in South Africa was completely different.

> *(97) - because that is the second thing I wanted to say just now: what I realised in America was that guys didn't mind sharing and they didn't mind making fools of themselves (Hercules Dreyer).*

One of the challenges faced by those who were to implement the CALIS Project was the fact that the culture of cooperation and sharing, motioned above, was precluded from the South African context by the competition for scarce resources. It was a culture that would have to be addressed if the CALIS Project was to be sustainable in terms of systemic, networked functionality.

4.3.2.2 National

Just as Dr Venter had conducted research on the integration of computers into the curriculum in other countries, he evaluated the South African context in terms of similar expertise. The conclusion reached, as indicated earlier, was that the University of Pretoria programme in Computer-integrated Education represented the most advanced expertise in the country. With this in mind, the trip to Pretoria was undertaken and the cooperative agreement, mentioned earlier, was sealed. So began an agreement that had far-reaching influences on the implementation and sustainability of the Project, as has already been mentioned.

> *(98) We them travelled up to Pretoria one day in order to visit them. We asked them whether they would be prepared to enter into a kind of partnership with us - with our little group in the Free State. They could advise us and conduct research in the Free State; they could use their students to do the work in the Free State and we could then benefit from their knowledge. They were very anxious to help, and very pleasant, and we then formed a very nice group (Peet Venter).*

> *(99) We did the same thing again – Johannes presented a number of keynote addresses in his own brilliant way – as is usually the case (Hercules Dreyer).*

Ronel Calitz claims that her approach to learning-and-teaching, and more specifically the methodology that she adopted concerning cooperative learning, was gained as a result of her enrolment in the M.Ed. in Computer-integrated Education at the University of Pretoria.

> *(100) I learnt a lot – also because it was so closely related to what we were doing, and also cooperative learning and stuff like that. Everything I know about the methodology of cooperative learning I learnt from Johannes and his colleagues (Ronel Calitz).*

The cooperative agreement reached between the OFSED and the CIE programme at the University of Pretoria represented a programmatic attempt at providing lateral or synchronic, systemic support to the CALIS Project in terms of the national context in which the implementation of the Project was to take place.

Regional systemic support occurred both diachronically, in the form of the preceding drive to ensure the computer literacy of educators in the Free State, and synchronically in the form of the FRETEL and FRENET projects.

4.3.2.3 Regional

The programmatic planning involving the integration of computers into all aspects of school functioning began as far back as 1986, when Dr Venter's predecessor, Berend Wessels, first formulated the idea that computers should be introduced into schools in a planned, systematic and evolutionary way.

> *(101) I know that the person who was my predecessor at the time, Berend Wessels, was actually a South African pioneer in terms of bringing the computer into teaching (Peet Venter).*

On assuming office, Dr Venter took up the challenge and instituted a planned, incrementally evolutionary plan for the full integration of computers into schools. The received wisdom (essentially, communicated by Berend Wessels) at the time suggested that computers should initially be introduced into schools as administrative tools only. The idea was that principals would come to appreciate their value and cost-effectiveness in expediting school administration. In the process, principals would come to hold a favourable opinion of the value of computers in education in general. The following step would be the introduction of a programmed infusion of computer literacy skills amongst educators in the region. This was to serve as preparation for the implementation of the CALIS Project, which would finally establish the use of computers in classroom practice.

> *(102) I think it would be good if we documented these things in some way or other. I don't know what your study encompasses – whether it involves writing down all of these things, or whether – I would like to see you focus not only on the CALIS Project but would like to see you focus on the FRENET Project and the administrative component as well. Because we never thought of CALIS as a separate project; we always saw it as an integrated approach involving the coming together of the three legs in influencing the school environment in its totality: to involve the administration, the teachers and the children in information technology – that was the overarching goal. There was never a project simply for the sake of a project - ... I think they were fairly*

successful in preparing the way for the integration of computers into the classroom. Their philosophy was that they first wanted to establish the use of computers as administrative tools in schools. They felt that, if the school management experienced the value of computers in administration, the implementation of computers in classrooms would be approached more easily and enthusiastically (Peet Venter).

(103) Ok, the whole process started in 1986 when we began with two sides of the same thing – two aspects: one aspect was the training of teachers in the use of computers – in the use of word processors, spreadsheets and database applications. This was very elementary at the time (Johan Badenhorst).

(104) The second leg was the administrative side, where we initiated FRESAD [Orange Free State School Administration Database] training for principals and secretaries, or teachers involved in doing the work (Johan Badenhorst).

The following comments provide further evidence of the introduction of the school administration programme (FRESAD) prior to the introduction of CALIS.

(105) At that time computers were fairly well-established in white schools, but only in terms of administration. The FRESAD Programme was running successfully in many of the schools and the secretaries and management of schools (principals and deputy-principals) had also been fairly well-trained in the use of word processing (Peet Venter).

(106) The aim was to get principals to take cognisance of technology so that they could become involved, could realise the value of technology and could shake off the attitude that they were incapable of achieving anything (Johan Badenhorst).

(107) I know that there were secretaries who only used FRESAD for the generation of reports and that was all they used it for (Hercules Dreyer).

The introduction of the school administration programme seems to have been a success, as widespread use of the programme before the introduction of CALIS is reported in the narratives presented in this study.

The next phase in the process was the implementation of a programme that would seek to achieve widespread computer literacy amongst the educators in the Free State. Fortunately, as already mentioned, education centres had previously been established in certain towns across the Free State for the express purpose of offering Computer Science tuition to learners. These centres could now be used as educator training centres in terms of the delivery of computer literacy skills.

(108) What I do know is that there were established computer centres across the Free State at that time. The people at those computers centres presented Computer Science – teachers did not present the subject at that time Igno van Niekerk).

(109) And then we said that one of the things that made us very strong in the Free State was a Project called the 'Computers in Teaching and Learning in Schools Project'. And you will remember – no, it was before your time – that many years ago all teachers received computer literacy training at these computer centres ... When we started this project [CALIS] 97% of teachers in the Free State had been trained and were computer literate – far more than in any other province (Hercules Dreyer).

(110) The idea at the time was that one should begin with word processing – at the time it was 'Framework'. My predecessor and his colleagues installed 'Framework' in as many schools as possible so that teachers could at least make use of word processing software in generating their own examination papers (Peet Venter).

(111) At the time, something that was instituted together with the CALIS Project was 'Framework'. 'Framework' was a word processing and spreadsheet package. We all went on 'Framework' courses – and I mean the whole staff was there. You were 'Framework'-literate. I think I still have the certificate - and we could all type our own examination papers (Igno van Niekerk).

We also used to go to all the various centres inside and outside of Bloemfontein and do computer courses with teachers who came from satellite groups to one centre. And I taught them how to use a computer inside of a classroom, and what to do with children on a computer (Maureen Dale).

The implementation strategy in terms of integrating computers into education arose essentially from the perception that it embodied best practice at the time. There was, however, another reason for Dr Venter's insistence on the veracity of the Project. Exhibiting the kind of thought and action characteristic of systems- thinking- in- action (Fullan, 2005), Dr Venter realized that the infrastructure created by way of the chosen implementation strategy, and more particularly the capacity created by the CALIS Project, would be invaluable in fostering sustainability during, and after, the inevitable amalgamation of different education departments in the Free State. Furthermore, the language in which this realisation is couched, suggests very strongly the implicit adoption of a viral or ecological (see Cavallo, 2004) approach to the sustainable growth of the Project.

(112) Look, from 1991 we realised that it was a matter of time before we became one big department, and we honestly believed that the CALIS Project could establish skills and knowledge growth points across the province, in such a way that these growth points could feed schools in previously disadvantaged areas and could help them to integrate in this way (Peet Venter).

In terms of diachronic context, this is the system within which the CALIS Project was envisaged. But the diachronic context was enriched by a synchronic context that included the implementation of the FRENET and FRETEL programmes.

The FRENET (Free State Education Network) Project had as one of its objectives the stimulation of the kind of co-operative , sharing culture that had made such a lasting impression on Hercules Dreyer during his visit to the United States of America. The idea behind the Project was that the connection of the OFSED and individual schools to the Internet afforded not only a more effective and efficient medium of communication, but also the opportunity of sharing instructional and other educational resources.

> *(113) What happened simultaneously – and this is not widely known – was that there was a project geared towards using the Internet in enabling teachers to share lessons (Hercules Dreyer).*

> *(114) In teaching, the most important thing, as you know, is matriculation exam results. So, if you had a really good idea about how to teach organic chemistry, or any other part of the syllabus, you kept it to yourself since it was your secret and you did not share it. That was rubbish! What I preached at the time was that teachers had to abandon that approach – they had to share things because you know what will happen: that great lesson of yours will be returned to you in three months time – in a greatly improved format. We had to start sharing – that was the whole idea (Hercules Dreyer).*

> *(115) This network that we wanted to launch – this whole FRENET thing – I don't know whether you have heard of it: the Free State Education Network. That was the idea: to get these things networked so that we could start exchanging things. That was our vision at the time – 1993! Do you know how long ago that was? (Hercules Dreyer).*

> *(116) Dr Peet Venter attempted to get the whole thing going from the 21st floor of the C.R. Swart Building, using modems,*

so that teachers could communicate via modems and e-mail and things like that (Igno van Niekerk).

The establishment and implementation of the FRENET Project was thus far more than the creation of a networked environment in which effective communication could thrive and sharing of materials could take place. It was, in fact, an attempt at changing the systemic context (Fullan, 2005) in which learning and teaching were to take place. Although the FRENET Project, as such, was effectively halted by the withdrawal of official government support, the evolution of the larger systemic triad (CALIS, FRENET and FRETEL) into a viable, sustainable programme continued to exist at the time, and exists today in a myriad of different guises.

The FRETEL Project came into existence as a result of an opportunity offered to the OFSED at the time. Absa Bank had installed a satellite-based television training initiative that was to be employed by the Bank across the country. There were, however, times when the network was not in use and departments of education across the country were offered the use of the network for educational purposes. The cost involved was negligible. Here, then, contributing to the sustainability of the larger triadic Project, was the first instance of a private concern investing seriously in the proposed technology-in-education initiative (Fullan, 2005).

(117) And, together with CALIS in schools, we had another project – I don't know whether Hercules told you about it – the television. Absa came to see us in 1990/1991 – I think it was someone called Claassen from their head office. I think he approached all the departments in the country and told them about the private Absa network that had been established in order to broadcast to all Absa banks. Every morning between a quarter-to-eight and eight, the CEO would address all personnel and so forth. They used it for training but there were times when the network was idle and we were offered the opportunity of using the network – virtually for free! (Peet Venter).

(118) They sold it to a number of companies and they spoke to departments of education. They also spoke to Peet who was at the launch in Bloemfontein. He called me and said that that was something new just for us. And we then started

looking at what we could do and how we could best use this thing. We then entered into an agreement with them, whereby we were given an hour per week at very good rates indeed. We then started preparing lessons. That was my job (Hercules Dreyer).

(119) I went to a computer centre and Hercules Dreyer and I started looking at FRETEL. We made the first recordings after having come up to speed on video technology. This was an initiative that had been undertaken in collaboration with Absa. Absa took over the old SABC studio in Johannesburg (Igno van Niekerk).

The OFSED was the only department of education in the country to take up the offer. Dr Venter, immediately aware of the potential value of satellite-based training and communication, accepted the offer gratefully. He reasoned that it would be possible to establish two reception centres in each of the 50 municipal districts across the Free State. In this way, no school would be further than 50 kilometres from a reception centre. Educator training initiatives could then be conducted more efficiently and cost-effectively.

(120) Our ideal was to establish one or two points in each of the 50 magisterial districts in the Free State to which we could broadcast, via Absa. We plotted the distances on a map and saw that no school would be further than 50 km from such a reception point. Then, instead of the training they do nowadays where guys from all over are put up in grand hotels (they spend millions of rands on the dissemination of knowledge now), they could make use of that network (Peet Venter).

(121) But you can have LFs' [learning facilitators'] offices at the seventy points and if you then want to train or make known a new policy, like OBE [outcomes based education] then you first train these guys centrally, face-to-face and you then tell them that further training will take place via broadcast, and you explain exactly how that will work. You

then explain to them how they have to facilitate courses at each of the seventy centres (Peet Venter).

Dr Venter also envisioned a further use of the satellite-based television network in terms of the communication of management information. The efficacy of the traditional means of communicating from the OFSED to schools across the region was in serious question at the time. Not only was there a sizeable time lag between the issuing of the communication by the Department and the reception of such communication by the individual institution, but the message itself was often corrupted along the way. How much more complex and difficult would the situation be in the new dispensation where the Department would have to communicate with 2000 schools, rather than 200? Dr Venter realized that the network presented a unique opportunity in terms of creating communication channels for the fast, accurate dissemination of management information.

A television studio was duly equipped in a suitable venue at the Teachers' Centre in Bloemfontein. There television broadcasts were recorded and the tapes couriered to Johannesburg (Absa had purchased the old SABC studios in Commissioner Street) and the programmes were then broadcast to schools across the Free State region.

(122) My experience at the time was that it was an ideal set-up with brilliant people who were told exactly what to do. When they have to implement, however, it is something completely different that is implemented. There was a distortion of the message as it was communicated down the hierarchy. And, besides that, you could talk to people once, twice, three times every day of the week. The managers could talk to all the principals in the province at three o'clock of an afternoon and explain to them: we have the following problem and you need to approach it in the following way – not in this or that way. And it was interactive – they could ask him questions while he was on air and he could answer them. It was an incredible management tool and it would have saved them many rands while they could have implemented more effectively. We had it – the satellite dishes were in place and the first broadcasts had already taken place (Peet Venter).

(123) Behind where Brebner Primary is today we had a studio with good equipment that had been donated to us by Absa. Then Gert Heyns, for instance, would arrive and we would make a recording. We would then courier the tape to Johannesburg and it would be broadcast the next morning. Or, as often happened, they would organise it themselves. They were more often in Pretoria than here. They could then simply go to the studio and initiate a live transmission aimed at principals, or learning facilitators, or teachers or curriculum managers (Clinton D' Oliviera and his colleagues). They could then sit and answer questions live, for example, a lack of certainty concerning OBE documentation, and then they could talk about it, you know (Peet Venter).

The satellite-based television network was soon harnessed to enable the delivery of a more sophisticated, though predictable, service, namely instructional and educational programmes. Once again, as had been the case with the FRENET Project, an opportunity was identified for educators across the region to be exposed to material of the highest quality.

(124) I am going to tell you about that now: did you know that we built a whole studio at the teachers' centre that enabled us to broadcast to points no further than 30km from individual teachers? Later we installed televisions and satellite dishes- at that time there was no such thing as satellite. The thing grew so fast that it no longer involved only computer-integrated education in schools, but also involved showing in a studio how to present individual lessons. They could broadcast these lessons to teachers and ask them to implement the lessons the following week (Hercules Dreyer).

(125) Let me tell you a little about where FRETEL originated – it was Free State Educational Television - …(Hercules Dreyer).

(126) We visited schools and we saw how teachers did certain things. In Welkom there was a new way of teaching children how to read and write. It was called 'embodied experience'. They took the children outside and they then placed sticks and hoopla hoops on the ground in the shape of a letter, for instance a 'b'. the children were then required to walk over the outline of the letter, exactly as it would be written. In this way they experienced the creation of the letter with their whole bodies. We had to come up to Johannesburg, for example in 1996 – the year before I left, where we got the examiners of matric papers to speak to all the Physics teachers or all the Maths teachers about the previous year's paper. They were told where problems were experienced and what teachers had to beware of for the following year's paper. They could speak to all the teachers simultaneously – where else is that possible? And those centres had been opened across the Free State (Hercules Dreyer).

(127) The dream that Dr Venter had was that one would be able to broadcast to schools – that was the ideal. Absa would have sponsored it. I think, and I speak under correction, but I think Absa would have sponsored 52 black schools as far as the installation of equipment in schools in the location was concerned. Plus, Dr Venter's idea was that some of them would have been able to take part in the specific educational situations by being granted access to Absa branches (Igno van Niekerk).

This was the immediate context within which the CALIS Project was situated. The Project had never been intended to function in isolation but had been intended to operate as an integral part of a systemically larger triad of interrelated projects.

(128) So, together with CALIS, FRENET and FRETEL, we believed that we were correctly positioned in the Free State to get teachers computer literate and improve the standard of teaching tremendously within a period of five years. Also, we

felt that the gap that had opened up as a result of Bantu Education should be closed as quickly as possible. I believe that we were in the starting blocks and ready to implement (Hercules Dreyer).

The approach thus adopted was seen as the best vehicle for the delivery of computer-integrated classroom practice. This triad, in turn, was situated within the larger systemic network of diachronic and synchronic influences that impacted directly upon the CALIS Project. In this sense, an analysis of the CALIS Project in isolation cannot claim to do full justice to the kind of complex causality that characterises the system as a whole.

4.3.2.4 Project

The narratives produced by participants in this study indicate that the primary objective of the CALIS Project was the full integration of computers into classroom practice across the Free State region. Such integration was always to take place subject to the principle that technology, as such, was not the primary objective. The computer was to be used as yet another tool in the quest for the most effective teaching-and-learning strategy, given the specific contexts of schools in the region. As an enabler and as a lever for educational and instructional change, the computer was going to be a means to an end. This integration was also to be achieved in the most efficient and cost-effective way possible.

(129) Now, those were the first phases of this thing – the next phase was where we started taking computers into the classrooms. We move away from the phase focusing on getting teachers computer literate and we worked towards using the computer in the classroom. And that was where CALIS came into being – you know that was the project that targeted the use of the computer in the classroom. We were going to use it as a tool, a resource in the class. The idea was never that it should replace the teacher but rather that it should help the teacher (Johan Badenhorst).

(130) The second facet was that, together with the computer as resource, we addressed computer literacy - but that was a bonus – it was not the primary objective. So, our primary

goal was not to teach the child to use a word processor, but rather to teach the child Afrikaans, or Geography, or whatever, and then, as the need arose, teach him the computer skills required in the process (Johan Badenhorst).

(131) And the plan was to involve the child, in the end. That was why we began with the teachers and the administration , and ended with the child (Johan Badenhorst).

(132) What I learnt was important - and now I speak of that which I remember - was that I never saw the forms that they saw, but their goal was to teach us that you could use computers as resources in the class (Igno van Niekerk).

(133) And the mind shift that they made us undergo was that you could let a class of forty English children chat in a group (Igno van Niekerk).

(134) And I think the mind shift, after CALIS, was that the important thing was not the syllabus. All of these things were tools that became part of the syllabus, and that was the point of departure (Igno van Niekerk).

(135) I think, even today, any project that wants to succeed should still have the same goal, because, if the goal is simply technology for the sake of technology, then it will become a white elephant after a year or two (Johan Badenhorst).

A secondary objective, seen as a concomitant outcome inextricably linked to achieving the primary goal, was universal computer literacy amongst educators and learners in the region.

(136) The whole idea behind the planning was that we would have the same level of computer literacy amongst all teachers in the Free State as soon as possible - that was what we wanted (Hercules Dreyer).

(137) You have to aim at computer literacy and, once you have that, the other things can become add-ons. But I think that you have to use the computer as a tool (Sarie du Plessis).

A further secondary objective was perceived to be the fact those learners were being prepared for a post-school world of work where computers would be all-pervasive.

(138) Between Typing and English and Afrikaans, and that kind of thing, the vision was that we would be prepared for the market and the world of work (Igno van Niekerk).

Given the objectives of the CALIS Project, the initial response to the challenge of integrating computers into classroom practice was to ensure that implementation was grounded in the best possible theoretical framework. Recognising the dearth of expertise in the OFSED at the time, Dr Venter established that the necessary expertise did exist in the country. Subsequently, the decision was made to seek the assistance of those involved in the CIE (Computer-integrated Education) Programme at the University of Pretoria.

(139) And, together with Mr Hercules Dreyer, we held a first planning session and we felt that we knew too little to really implement the thing [computers] in the teaching-and-learning situation (Peet Venter).

(140) And then we did a bit of research and we realised that Johannes Cronje and his colleagues at Tukkies (University of Pretoria) were by far the leaders in this field at university level in the country (Peet Venter).

(141) So we drove up [to Pretoria] one day and saw them, and asked them whether they would want to enter into some kind of partnership with us – with our little team in the Free State. They could advise us and conduct research here; they could use their students to do the work here and, in this way, we could gain knowledge from them. They were anxious to help, and kind, and we formed a wonderful group (Peet Venter).

On the basis of the insights gained in this way, and on the basis of insights gained during the visit to schools in the United States of America, a strategy emerged. The five district-level education centres, originally established to enable the tuition of Computer Science as subject, were to be equipped with computer laboratories. In addition, a district facilitator was appointed in each of these centres in order to propagate and support the implementation of the proposed model to be used by individual institutions.

> *(142) From departmental side we encouraged them by way of the five centres and our five coordinators. Plus, Hercules Dreyer used the knowledge they had gained from Johannes Cronje and his colleagues to further the dissemination of knowledge in these areas, and to help people to conduct their business (Peet Venter).*

As indicated previously, institutions were invited to apply to be included in the Project. There were certain criteria (no participant has access the full list anymore) that had to be met by participating institutions, one of which is almost certainly to have been the nature of educator capacity in terms of computer literacy.

> (143) *You know, my husband was very involved in FRESAD at that time, so he supported FRESAD strongly at the school and in the region as a whole, and, as a result of his involvement and the fact that Johan Badenhorst worked with Peet Venter at the time, Johan Badenhorst said that it would be a good school in which to launch the Project since there was someone who knew something about computers. I think we were identified as a school that could implement the Project successfully on these grounds. Also, we were a very small school – 300 / 350 children in Grades 1 to 12 – so twenty computers would be enough for so few learners (Sarie du Plessis).*

The fact of the matter was that a great deal of thought and planning had gone into the selection of specific schools as participants in the Project, not least of all from the point of

view of the impending amalgamation of the various departments of education in the region. The implementation of the Project was to ensure the establishment of growth points across the region. These growth points would foster viral or ecological expansion that would ensure the sustainability of the enterprise, to the benefit of all departmental schools in the new dispensation.

> *(144) But schools were chosen on the basis of their distance from each other since they were to act as growth points for the cluster kind of approach. Our idea was that there had to be clusters- and schools that received computers from us did so on the specific condition that they were to involve other teachers in the vicinity so that these teachers would be stimulated and the multiplication effect would be achieved. And, you know, that is what happened at schools. But the fact of the matter was clusters – Hercules had a computer graphic which illustrated the effectiveness of this multiplication. (Peet Venter).*

> *(145) The decision as to which schools we should choose: in the past it often happened that we said we would take the big schools first because they had the money anyway. But we looked at the situation and realised that the new South Africa was upon us and we knew that circumstances would change and that we would become one department of education. Part of tee CALIS Project, besides establishing centres in schools to get the teaching and learning going, we had to plan centres in such a way that, when we inherited the black teachers, they would be close to such centres so that the Project could continue and teachers could be trained and made computer literate. And that was why there were centres such as Tweeling, Kestell, Warden, and I think Memel and Vrede – widely spread across the Free State. We wanted to ensure that guys at farm schools were also within easy reach of a centre. The idea was that we would have all teachers computer literate within five years of the establishment of the new department of education (Hercules Dreyer).*

What is clear is that schools were given very specific instructions as to the way in which computers were to be integrated into the curriculum.
Firstly, it was stated unambiguously that the computer hardware and software donated by the Department (the exact nature of this arrangement will be discussed under the section dealing with physical influences) was to be used solely for academic purposes and not for school administration.

> *(146) The only condition was that the hardware could not be used for administration – it had to be used for teaching and learning by the learners. We also checked up in order to ensure that the stuff was being used for that purpose (Peet Venter)*

Secondly, the understanding was that educators who decided to become involved in the Project would be tasked with the responsibility of training other educators at the same institution in terms of computer literacy and the integration of computers into the curriculum.

> *(147) We also had to train the teachers. That was also one of the conditions: teachers had to be trained during the afternoons in order to make them competent in the use of the computer – and competent in the use of the various things [applications] (Sarie du Plessis).*

The learning-and-teaching approach favoured by the departmental Project team seems to have been informed by two broad approaches. The first approach valued cooperative, resource-based constructivist learning above the traditional instructivist approach in general usage at the time. The second broad approach, in contrast to the narrow cognitive, academic focus found in schools at the time, emphasized the development of a wide range of skills including cognitive, emotional, connative and sensori-motor skills.

> *(148) We adopted, to a large extent, the model of cooperative learning and this model found expression in our classroom practice. The first implementations we did took place in a class of thirty children, for example, with the idea that eight or ten computers provided access to a third of the class, while a third were kept busy by the teacher and a third*

were involved in practical work or an assignment or something (Johan Badenhorst).

(149) We then visited schools and we saw how teachers did certain things. In Welkom there was a new approach to teaching children to read that was called 'embodied experience'. They took the children outside. They then took sticks and hoopla hoops and arranged them on the ground in the shape of various letters, for example a 'b'. Then the child would have to walk over the outline of the letter, in the same manner as it would be written. In that way the child experienced the idea outside in an embodied fashion (Hercules Dreyer).

These approaches found expression in particular practices relating to the integration of computers into classroom practice at individual institutions. Schools at which the Project was implemented were supplied with a number of computers. Narrative reports differ in terms of the exact number of computers supplied to each school. The instruction given to schools was that enough computers were to be installed in the classroom of a participating educator to ensure that a third of the class could work on the computers concurrently. The rationale for this decision, as opposed to placing all of the computers in a computer laboratory, is explained by Hercules Dreyer:

(150) What we tried to move away from was the typical computer laboratory … - I drove around in the Free State to see what schools were doing with their computer laboratories. It looks fantastic; there you have thirty computers, but spend a little time there and you soon see what they do: you will notice that they have little programmes like Mathematics revision programmes or pictures and the like. Then the children sit and practice thousands of Mathematics problems and the teacher simply sits and watches – so that was the ideal opportunity for the teacher to catch up on some marking, since he has the laboratory period in which to do it. So, he would chase the children into the laboratory and whether they practiced anything or learnt anything was all the same to him. At least

he would be able to mark his books and the children would be involved in revision (Hercules Dreyer).

The educators were also given very specific instructions as to how these computers were to be utilised. At the time, the class size in most schools controlled by the Department was in the region of 25 to 30 learners. Educators were advised to divide the class into three groups. Each group would be engaged in a different activity. One of the groups in the class would be engaged in working on the computers while another might be interacting with printed resources and the third might be engaged in interaction with the educator. It is not difficult to espy in this particular organisation of the learning experience the influence of the group work-based, problem-centred approach to Mathematics that had been implemented at the learning enrichment centre in Bloemfontein by Dr Venter before he had been appointed head of the computer section of the Department.

(151) You divided up your class and a group would work on the computers, a group would work on their own and a group would be involved with the teacher. The children on the computers had to be involved in doing something stimulating, not silly little exercises. The children really had to do something different. And that was our model (Hercules Dreyer).

(152) The first schools in which we implemented the Project consisted of classes of thirty children, for example, and the idea was that eight or ten computers would give access to a third of the class, while a third were involved with the teacher and a third were busy with practicals or an assignment or something (Johan Badenhorst).

Although the instructions given to the schools might, at a first glance, seem draconian, educators were in fact encouraged to be flexible in their usage of the computers – given the understanding that such usage should take place within the spirit of the learning-and-teaching approach outlined above.

(153) The idea was also – it could also happen – that children used the computers individually, particularly in the

situation where the class was divided into two groups that were busy with different activities. It all depended on the circumstances, and it was much easier in situations where there were fewer than eight computers available (Johan Badenhorst).

The fact that the broad learning-and-teaching strategy outlined above represented a radical departure from the established practice at schools in the region, meant that the development of new learning materials would have to be developed and disseminated in the most efficient and cost-effective manner. The FRENET Project was seen as providing a solution to this problem. Not only would educators be able to create and exchange learning materials, but they would also be able to communicate regularly with each other, and, in that way, counteract the debilitating sense of isolation imposed by the dispersed nature of their physical situation. The kind of cooperation and collaboration envisaged by Hercules Dreyer included the establishment of working groups that could address the development of learning materials in a structured manner.

(154) The idea was that, as you studied, you created Internet-based groups so that guys could begin to exchange lessons – such that you could say to a guy: you prepare that particular part of the syllabus (Hercules Dreyer).

Such cooperation and collaboration was, however, not merely to be structured in terms of content. The idea was that the material developed in this way would be developed by specialist, talented educators who would be able to produce learning materials of the highest quality for dissemination to all institutions in the region.

(155) You have to update every year – 'but we don't have the time to update' – So I say, let's have a look at the guy who was the best teacher last year, and let's ask him to update the first three months' work – and let's use that teacher who is an expert on this piece of work. This guy is a brilliant literature teacher and the children are mesmerised in his class. Let's ask him to update the second term's work. This guy does that, and we all share everything – and we thank this guy and we pay him for the work he has done. You prepared those lessons, and, instead of buying new textbooks

> *worth 15 million Rand, we thank you, we disseminate these lessons via CD ROM and we pay you five thousand Rand for your trouble. The printing of the CD ROMs costs R20 000 and next year everyone teaches the way you did – they have the video clips of you presenting your lesson (Hercules Dreyer).*

Furthermore, such development (traditionally conducted at Grade 12 level) was to take place at primary school level and to be introduced gradually at higher grade levels. The reason for this decision is provided, once again, by Hercules Dreyer.

> *(156) We only do Standard Two this year and we work hard and ensure that we get the best lessons for Grade Fours. Next year we do Grade Five and the following year Grade Six - because it doesn't help to spend millions of Rands on helping matrics. We begin with the Standard Twos, the Grade Fours. If you begin with Grade Four Mathematics and Science – in fact, all the subjects – and you train teachers properly, imagine what potential this thing would have (Hercules Dreyer).*

What kind of learning-and-teaching strategy, advocated by the managers of the Project, could have been so revolutionary and innovative that it demanded the development of completely new learning materials? As mentioned above, the educational philosophy underpinning the teaching-and-learning strategy at the time was essentially instructivist. The implicit supposition informing this view is the concept of the educator as source of all knowledge and the view of the learner as passive receptacle into which such knowledge is to be poured. The educational philosophy underpinning the CALIS Project was radically different in that learners took centre stage as the active creators of knowledge. The role of the educator was to change from source of all knowledge to that of facilitator and guide.

> *(157) One of the things we always preached was that, in the past, we thought that you had so much knowledge and you had to impart some of it to the learners – that was what we were taught. I know everything about Mathematics that you need to know and I will teach it to you. But the computer and the Internet suddenly opened up a whole new world for the*

> *children with which you were unable to keep up. You can't possibly keep up with everything, and I told teachers at the time that they are only facilitators in the classroom. Facilitate the learning process – but create the freedom for the learner to read and progress. Allow the child to surpass you in knowledge. If he knows more than you do, great! That's wonderful! I spoke to teachers at the time and told them that the computer would not replace them – it was like an overhead projector. An overhead projector can't do things for you – you simply use it as resource. Instead of writing everything on the blackboard, and wasting a lot of time in the process, you can prepare things beforehand. In the same way, the computer enables you to do certain things. Computers can even do things for you while you are not present, but you still have to prepare. You have a role to play in the process, and that was the crux of the matter (Hercules Dreyer).*

This change in role, and the attendant removal from a position of power in terms of knowledge, must have unsettled many educators who perceived therein an erosion of their authority and a threat to discipline. Coupled to this disturbing development was the introduction of computers as active aids in classroom practice. Many educators were only too conscious of the fact that, not only were they themselves computer illiterate, but some of the learners in their classes were likely to be completely at ease in their interactions with the computer. It was these fears, amongst others that Hercules Dreyer had to address on his visits to the various districts and schools across the region.

> *(158) You soon identify the bright spark in the class. Tell him: It is your job to see that the software is loaded – you have to get things going. The bright child then takes over. So, that was one of the mind shifts that we had to engineer. I remember how I sat at the teachers' centre with a host of teachers in front of me and very time I would come back to this picture: just give the guy the opportunity – don't worry about the fact that they know more than you do (Hercules Dreyer).*

. From the inception of the Project, both Dr Peet Venter and Hercules Dreyer were adamant that educators had to be provided with as much active support and motivation from Departmental representatives as was humanly possible.
What was the experience of educators in terms of the extent and quality of the Departmental support on offer?

On the one hand, Igno van Niekerk believes that his involvement in the Project was a direct result of an inspiring visit to the school at which he taught, undertaken by Hercules Dreyer.

> *(159) Initially, I was very busy and as these things sometimes happen, I would not have been involved in the CALIS Project had it not been for the fact that Hercules arrived at the school one day and said that he had come to see what I was doing. So it was really a matter of their going out to teachers with the Project and tasking specific teachers with involvement (Igno van Niekerk).*

On the other hand, the experience of Sarie du Plessis was that, after the initial implementation of the Project, she was largely left to her own devices.

> *(160) Then Hercules Dreyer began CALIS – computer-assisted learning. But, at the time, they really didn't visit us very often. There isn't much – you were left to your own devices. There wasn't a syllabus and you had to take the initiative. You could pretty much do what you wanted to do (Sarie du Plessis).*

On the part of Dr Peet Venter and Hercules Dreyer, the visits to districts and schools, though perceived to be essential in terms of ensuring sustainability of the Project, were not enough. There had to be another way of inspiring and motivating educators by exposing them to excellent examples of computer-integrated lessons and the latest offerings in terms of hardware and educational software. It was Hercules Dreyer's vivid memory of attending the National Computing Conference in the United States of America that first sparked the idea of a regional expo.

(161) With that which I had seen in America [the computer conference], I had the idea to get things started in South Africa. And what we did was to advertise it throughout the Free State and we presented it at the teachers' centre, where we had a number of keynote speakers. Renate gave a talk and a couple of other guys, and her students, of whom Johannes was one. Her students had to present lessons in classrooms that were subject-specific and, in that way, you had the languages following one stream and the science subjects another. So teachers went along to these classrooms to see what these guys did with computers in the classroom. It was that that planted the seed (Hercules Dreyer).

(162) At the time, the CALIS- related exhibition exposed us to things like programmes that were syllabus-driven (Igno van Niekerk).

Once again, the assistance of the people involved in the CIE (Computer-integrated Education) Programme at the University of Pretoria proved invaluable.

(163) One of the methods we used was to present expos where some of Johannes's students – postgraduate students who were teachers – presented demonstration lessons in order to show teachers how computers could be implemented in the classroom (Peet Venter).

Besides invitations sent out to practitioners in the field of computer-integrated education, private firms in the business of selling computer hardware and educational software were approached to exhibit their goods at the expo, with the result that systemic networking took place across the boundaries that traditionally separated public educational institutions and private business concerns.

(164) Our teachers who attended the expos, besides all the hardware, software and programmes that they saw there, - we involved firms in the field - ... (Peet Venter).

The success of the first expo as an inspirational and motivational tool is evident in the comments made by some of the participants in the study. The influence of the expo on the educators who attended seems to have been profound.

> *(165) They organised a CALIS week where they then demonstrated best practices and I experienced that as very supportive because you could see what other teachers were doing (Sarie du Plessis).*

> *(166) But the big thing that we really wanted with the demonstration lessons was for teachers to experience the opening up of a whole new world for them. And that ignited the fire, and guys started implementing things in the schools (Peet Venter).*

After the first expo had run its course, it was immediately apparent that it should become an annual event. Hercules Dreyer was given full responsibility for the organisation of the second expo which took place a year later. Dr Venter had worked with Maureen Dale at the Education Centre in Bloemfontein when both had been involved in enrichment education. He was well aware of her enthusiasm for computers and her organisational abilities. Maureen was thus approached to host the second expo at Eunice Primary School.

The second expo was, however, not to be an exact copy of the first. A number of educators in the region had enrolled in the CIE Programme at the University of Pretoria, after having been introduced to their work at the previous expo. Such educators had thus gained expertise that would enable them to present computer-integrated lessons at the second expo. In order to entice them to do so, a competition for the best computer-integrated lesson was launched and the presentation of the best lessons, as well as the prize giving ceremony would take place during the second expo. Hercules Dreyer went to great lengths to ensure that the prizes on offer would attract the best teachers in the region.

> *(167) And we repeated the expo the following year and Hercules was the organiser of that expo – it was really an unbelievable catalyst that released the energy … (Peet Venter).*

(168) What we did the second time was we decided that we were not going to get other guys to present the lessons as we had done during the first expo. We said to teachers, right, the next expo will be at Eunice and there is a competition where teachers will be presenting lessons themselves. You are going to show us what you have learnt from Johannes and his colleagues – there were a number of guys who had registered for courses like the M.Ed. and B.Ed. at the University of Pretoria, and they were well on their way. They were going to prepare the lessons. And Peet and I decided that we were going to give big prizes for the best lessons. The third prize would be a laser printer, the second prize a laser printer and a top-of-the-range computer, and the first prize would be a trip overseas to one of the big computer conferences, like the National Computing Conference – one of the big overseas conferences involving computer-teaching (Hercules Dreyer).

I also, at the same time, sent out the documentation and said, ok, if you write a programme, submit it- and it had to be of educational value - and we would then assess the programme and you could win 'one of the following'. So there was something for them there as well and we used to sometimes get up to 80 – 120 people who actually sent in their programmes (Maureen Dale).

The competition for the best computer-integrated lesson conducted during the course of the second expo affected two of the participants in this study directly. Ronel Calitz was adjudicated to have won first prize and Igno van Niekerk was placed second. The first prize in the competition was an all-expenses paid trip to the World Conference on Computers in Education, to be hosted in Birmingham (1995). Unfortunately, Ronel was unable to undertake the journey and it was decided that Igno would attend the Conference instead. The full extent of the exposure that the CALIS Project would get on the international stage was unlikely to have been foreseen by those involved in the Project

(169) What I did experience was that there was a nice competition at the second one, and the aim was to get

teachers involved. So, where the first one focused on training teachers, the second one was more a matter of involvement (Igno van Niekerk).

(170) I also made a presentation there and I won second prize, which was a computer. I also had the wonderful privilege – and I am eternally grateful for this – that Ronel Calitz was unable to use her first prize – a trip overseas (Igno van Niekerk).

(171) They held the main event, with keynote speakers, at the end and that was where they conducted interviews with us. And, suddenly, the CALIS Project from Bloemfontein appeared on the international stage and the teachers from South Africa were applauded – those who were involved in this Project (Igno van Niekerk).

Igno was, however, clearly made to understand that he was attending the Conference not only for the purposes of self-enrichment but also because he would be expected to re-invest that which he had learnt in the region, district and institution in which he functioned.

(172) So it happened that a guy from CALIS ended up in Birmingham in England and it was an unbelievable privilege. But it also brought down incredible responsibility upon one, because one of the prerequisites was that one had to return and plough back what one had learnt - and, I think, even Johannes Cronje encouraged us to plough back what we had learnt. And so it happened that I ended up at Dr Peet Venter, Hercules and FRETEL. We ploughed back what we had learnt into FRETEL, and sent out the information into the world (Igno van Niekerk).

The competition was extremely effective and played a significant role in ensuring that the expos popularity grew from year to year, in this way stimulating interest in, and ensuring the sustainability of, the integration of computers into classroom practice.

As already mentioned, Dr Venter's perception, expressed in a speech he delivered at the last expo, was that the CALIS Project had entrenched the integration of computers into classroom practice to such an extent that, when official Departmental support was finally withdrawn, the practice had taken on a life of its own in the midst of contextual and systemic support that would ensure its sustainability. These sentiments are supported by comments made by other participants in the study.

> *(173) Once again, CALIS produced value far beyond the weekend on which it happened, since a school was able to enter into an agreement with a private company five, six, eight years later. But Brebner also invested a lot in those computers (Igno van Niekerk).*
>
> *(174) CALIS ensured that an ordinary school could have a centre, and the principal was given the responsibility of upgrading it (Igno van Niekerk).*
>
> *(175) There are definitely schools that have continued with the Project to the present day. As to why they have done this, it was not for the sake of the Project as such, or simply because the money was available. The Project was not only feasible, but it also had meat about it. The Project was not launched for the sake of technology, but for the sake of the child in its totality (Johan Badenhorst).*
>
> *(176) Yes, and, as a result of that issue, it can be one of the biggest frustrations because the governing body and the parents had to fork out a lot of money and now it has to implemented. The Project was so successful at schools in which it had been implemented that a number of schools contacted me – Merriespruit, for instance, invited me to tell them what they were supposed to do with their computer centre. I told them that the solution was very simple : they had to take the thirty computers, place them in three classrooms, and break down the computer centre (Hercules Dreyer).*

(177) Ok, you asked the question whether there were school teachers who continued to use computers after support – yes, I think there definitely were schools. I think schools began relying far more heavily on their own initiatives and they started training teachers , individually, and, in the end, there were very meaningful programmes (Sarie du Plessis).

4.3.2.5 District

The strength of the regional and project-based initiative was such the regional head office was inextricably linked to the district centres and the schools themselves. For this reason it is very difficult to identify a programmatic district initiative that was not also a regional programmatic initiative.

4.3.2.6 Institution

Even though very clear guidelines for the implementation of the CALIS Project, regarding the integration of computers into classroom practice, were communicated to participating schools, the implementation of the Project at individual schools was often conducted in ways which recognised the unique contextual and systemic situation of each institution. In this way, the generically- defined guidelines were concretised in a context-sensitive manner. This had a marked influence on the evolution and sustainable use of computers as part of classroom practice.

The principal, as chief operating officer of the school, played a major role in interpreting the proposed guidelines in ways that could be implemented effectively within the particular context in which the institution was situated.

Now can I add something there – in 1994 I put 5 computers into each senior primary class and the whole project failed dismally. Do you know why? The teachers weren't computer literate. What I did was, after 2 years, they gave it up. I took them out of the classrooms and I put them into a computer lab and then I gave the staff in-service training and, from me, they graduated to better and better skills and one or two were motivated enough to go off and have courses elsewhere,

and I've never put them back into the classroom. I kept them in the computer lab and the people have upgraded their skills phenomenally and they're using them. It's wonderful – but it was an absolute, absolute failure – now the same teachers are coming back to me, after ten years, and saying to me I must have been ahead of the times – saying to me now "Please can I have computers in my class' . They are completely, completely literate (Maureen Dale).

But the principal alone could not ensure the institutional sustainability of the Project. As indicated in the extract from Maureen Dale's narrative, the educators at individual institutions had to be motivated to buy into the Project, initially, and to ensure the sustainability of the Project over the medium to long term.

Furthermore, support from school governing bodies played a crucial role in ensuring the financial sustainability of the Project in terms of the upkeep of physical resources and the appointment of personnel. Such support would have found expression in a planned, programmatic approach to the integration of computers into classroom practice.

(178) *Now, some of these centres still exist at schools – there are many of them that eventually appointed teachers to keep the thing going (Johan Badenhorst).*

(179) I was in their facility at the time. It was a very beautiful facility and was a product of the Project. And that was essentially own initiative and not something that the Department provided – and it was taken up in the high school as well and found expression in things like Computyping and that kind of thing (Johan Badenhorst).

The involvement of school governing bodies, in terms of financial sustainability, though crucial in ensuring parent support for the Project, was often not enough. The result was that institutions had to find innovative, and often creative, ways of either raising funds or cutting down on costs.

One of the initiatives, mentioned below, involved the establishment of an Internet Café (run entirely by learners) in the school computer centre. Another initiative involved the

establishment of a printing press at Eunice Primary School where learning materials, in support of the CALIS Project, were to be printed.

> *But no, my people here: we opened our own printing press – we had got to that stage – being able to produce learning material (Maureen Dale).*

Programmes initiated by individual institutions thus tended to address the financial sustainability of the Project. Although governing bodies, principals and educators played a central role in contributing to such sustainability, their contribution was supplemented by support from the wider systemic network in which they were situated, as will be discussed in the section on systemic influences, below.

4.3.2.7 Educator

Although financial sustainability was crucial to the success of the Project, it was clear from the beginning that the Project would stand or fall on the strength of its ability to deliver a learning-and-teaching strategy that paid educational dividends in the classroom. In this regard, the educator implementer had to fulfil a vital role. Once again, regional, district and institutional guidelines had to be interpreted in such a way that the unique situation of a particular classroom inhabited by particular learners could be addressed effectively.

An example of an educator- initiated programme designed to address specific needs in the classroom, and the wider institutional and systemic context, was that designed by Ronel Calitz. The school at which she was the organizer of the Foundation Phase, Taaibos Primary, attracted learners from a socio-economically disadvantaged community. A fairly high rate of unemployment, poverty and poor family environments characterised the community. Furthermore, many of the learners attending the school experienced learning impediments. Given this context, the implementation of the Project in her classroom included unique features, such as the use of mothers as monitors who would be assigned to each of the three groups in each classroom. These mothers were often parents who could not afford school fees and who were then given the opportunity to give of their time. The upholding of their dignity and self-respect was also supplemented by the acquisition of computer skills that could stand them in good stead in the world of work.

(180) You know, something that was very interesting was the fact that we got parents – I was at a school that served a disadvantaged society: there was terrible unemployment etc., and parents were unable to pay school fees. You know, people like that counted out the school fees. So we approached some of those parents and asked them whether they would be prepared to help at the school. They were placed at the work stations and asked to monitor the little ones – it was very cute, and they did fantastic work. We provided them with basic training in how to treat the children. We also held weekly meetings with them to discuss problems that they experienced in their classrooms. In the beginning the teachers also found it strange to have parents in the classes with them – but that was a project within a project (Ronel Calitz).

The reaction of the mothers involved in the implementation described above seems to have been very positive. Soon more mothers became involved and all Foundation Phase classes were able to enjoy parent monitoring. One of the mothers involved in the Project claims that her involvement had a profound effect not only on the kind of learning that took place, but also on her own well-being.

(181)Anna: Ok, there were different groups - one was Mathematics and the other was languages. Let us say that one of the groups went to Ronel for Afrikaans. They would also go to the computers and learn about them. You would then have one group in the corner and they would physically read from a book for you. The other group – we were always two moms – went onto the computers. Then we would show them how the thing worked – how you switch it on. Oh, the kids loved it! We basically monitored their activities and awarded marks – we couldn't save everything since they were old computers with small brains, so we had to write down the kids' progress…
It gave back my dignity to me. Ok, you don't know my past, but it made me human again and, I tell you, my self-image improved very, very much – and, with the computer courses

behind me, I can almost say that I am top of the world (Anna: Ronel Calitz).

So, the way in which regional, district and institutional guidelines were interpreted by individual educators found expression in very specific programmatic offerings in individual classrooms.

Such offerings also encompassed, however, the kind of cooperative, social constructivist approach to learning and teaching that Dr Peet Venter and Hercules Dreyer had originally envisioned. The narratives of Hercules Dreyer and Johan Badenhorst contain numerous references to innovative ways in which specific educators used computers to enable this learning-and-teaching approach.

(183) The kind of application that was used in the primary school, for instance, as where one had to write an essay, but, instead of writing it in one's book, one wrote it on the word processor. In the languages they had examples where they had omitted words and the child had to fill in the correct word or had to cut-and-paste the correct word. Or, the words were above open spaces in the sentence and the child had to cut the correct word from the list and paste it in the correct space below. In this way, the child would learn to cut-and-paste while learning the correct spelling of a word. Or, in the case where two words had the same pronunciations but different spellings, the learner would have to choose the correct one and delete the incorrect one (Johan Badenhorst).

(184) Then, in the case of Geography, there was the example of average rainfall, where the child had to take the project home and physically measure temperature and rainfall over the course of a month. The child would then record the results on a spreadsheet and would generate a graph from the data. There is the geographical component, but there is also the mathematical component relating to averages, as well as graphs, that was integrated into the project (Johan Badenhorst).

(185) What they did with an Afrikaans class in Standard Eight or Standard Nine, was the typography of a poem, in terms of the actual appearance of the poem on the page. What the teacher did was explain to the class that she had typed the poem on a word processor using text wrap, which captured the whole line. She then divided them into groups and explained that the layout of a poem on a page could contribute to the meaning of the poem. She then asked them to alter the layout that she had created in such a way that it contributed to the meaning of the poem. They would then have to explain to the class why they had chosen the specific layout that they had selected (Hercules Dreyer).

(186) One of the lessons that were devised was, for example, where the teacher typed a piece and the children had to insert capital letters and punctuation marks in the right places. So the teacher went along and simply typed a whole lot of lower case letters and it was very easy to mark. We saw how one could simply do a document comparison in Word, and then one could mark the piece in that way. You can immediately see whether the two documents are the same, or where they differ. They used spreadsheets for Mathematics lessons. One of the most interesting lessons I saw was where a teacher dealt with straight line graphs, circle graphs and parabola. The teacher decided to use a spreadsheet because the child plays with the spreadsheet, and, in so doing, realizes what determines the incline (Hercules Dreyer).

4.3.2.8 Learners

Many of the lessons produced by educators in this way seem to have been innovative and creative but at the same time, they embodied the learning-and-teaching approach endorsed by the Project. This certainly seems to be the perception expressed in the extract above. The question that arises at this point is whether the learners who took part in such lessons experienced them in an equally positive way.

In the first place, learners seem to have been energized and motivated by such innovative approaches.

> *(187) Do you have any idea how badly the children wanted to take out their books in order to see what the poet had done – how the poem had been printed on the page. They couldn't wait. They asked the teacher whether they could look but she said that she had to see all of their contributions first. How many children do you get who cannot wait to open their books in order to see what a poem looks like? So that was the kind of thing that we did. The change that it brought about in the classroom was incredible – also in relation to the pictures that the little ones could draw. Suddenly the creativity was visible because there were no restrictions on what they could do with their hands (Hercules Dreyer).*

Such motivation, experienced in classrooms where computer use came to be associated with innovative learning strategies, evolved fairly quickly into a perceived need for computer-integrated learning. This, in turn, inspired learners to express their views in situations where computer-integrated learning was not taking place, creating a demand-driven 'micro-economy'.

> *(188) I think the children force one to go on with computers. You cannot stop because there is a demand – a demand has definitely been created, so you have to address the demand – and it was an excellent demand (Sarie du Plessis).*

Learners were, however, not only motivated to express their need for computer-integrated learning in words; they also initiated and became involved in innovative programmes that were designed to ensure the sustainability of such learning.

> *(189) A further development at the high school was that they had an active Computer Club. The children themselves ran the club, which had an Internet café. This was at Ladybrand High School (Johan Badenhorst).*

It is clear that the CALIS Project, though envisaged, planned and implemented programmatically at the regional and district structural levels, spawned the development of tangentially related and systemically integrative programmes at the institutional, educator and learner structural levels that played a significant part in contributing towards the sustainability of the Project.

4.3.3 Physical influences

The programmatic determination of the Project at all structural levels relied heavily on the nature of physical resources that could be harnessed and employed in the effective delivery of computer-integrated education. For the purposes of this study, physical resources will be deemed to refer specifically to those resources created via human intervention that could have influenced the implementation and sustainability of the Project either directly or tangentially. Consideration of the system, defined in this study as consisting of different interrelated structural levels, begins with an account of various influences on the international level. In the case of physical influences, the existence of certain technologies at the international level, and the paucity of alternate technologies, resulted in physical realities within which the Project was to be determined.

4.3.3.1 International

The learning-and-teaching strategy upon which the Project was founded has already been addressed. The idea that there should be enough computers in a classroom to ensure that a third of the class could interact with them at any given time is said to have had its roots in an educational philosophy informed, partly, by cooperative learning principles and those relating to social constructivist practice. Once again, learning-and- teaching strategy cannot be separated off from the realities of available physical resources. Johan Badenhhorst suggests a far more mundane, pragmatic reason for installing eight computers in a classroom.

> *(190) I think the reasoning behind having eight computers in a classroom was based on the fact that you could connect eight computers to a printer (Johan Badenhorst).*

So, programmatic aspects of the Project, geared towards successful implementation and sustainability of the Project, cannot be extricated from the physical context within which they found expression - without doing damage to the network of interrelated bonds that characterise a complex system.

But the complexity of the system does not end there. Just as computer hardware and connectivity directly influenced the success of the Project, so also financial means, though less directly visible, influenced the success of the Project at all structural levels. The interface between financial means and computer hardware and software is perhaps most clearly visible on the structural level of the individual institution.

With the advent of *Windows*, the need for more expansive computer memory intensified, but, possibly because economies of scale had not yet been established, the price of computer memory was still exorbitantly high. The OFSED, suffering as it did from the financial constraints already documented, was unable to purchase computer memory for individual institutions. Consequently, institutions had to purchase such memory from their own funds. At this point, the Project ceased to be a purely departmentally-driven initiative since institutions had gained a vested interest in the successful implementation and sustainability of the Project.

> *(191) I remember that when schools' computers were upgraded, at the time, they had to pay the R1000-00 for 1 meg of memory out of their own pockets so that Windows could be loaded on their computers. How many megs do we put into a computer nowadays – R1000-00 for 1 meg of memory! (Hercules Dreyer)*

It was not, however, the programmatic aspect of the Project alone that was affected by the availability of physical resources. The arrival of *Windows* heralded the appearance of the graphical user interface that was far more intuitive and user-friendly than the intimidating Dos-based interface. This, in itself, would have made computers more attractive to users, amongst whom the educators in the Free State region of South Africa. But the advent of *Windows* heralded something else that was a far more powerful lever for encouraging users to embrace the new technology – the multimedia personal computer. At this point, says Igno van Niekerk, educators found the allure of computers irresistible.

> *(192) I bought my first multimedia computer while I was at Voortrekker High School – it took the technician two nights just to get the sound to work. That was Windows 3.1 – with 2 meg RAM. We thought it was wonderful. When that thing made music for the first time, it was wonderful, and it was at*

that point that teachers could no longer resist computers (Igno van Niekerk).

So, the existence of particular hardware and software at the international structural level nudged individual institutions and individual educators, at different structural levels, towards the adoption of the new technology. Similarly, the regional and project levels of the system were influenced directly by physical realities. If the advent of *Windows* and multimedia computing encouraged individual institutions and educators to embrace computers on the basis of possibilities relating to site-based functionality, then the concurrent emergence of the networked computer and the Internet encouraged the managers of the Project to investigate the possibilities posed by computers for wider systemic functionality. In this connectivity, as expressed by Dr Venter above, they saw the possibility of enabling effective communication, not only vertically from Department to educator, but also horizontally within the various structural levels of the system.

(193)At some point, they went overseas to look at modems and that type of thing (Igno van Niekerk).

The developments in the physical environment mentioned above influenced the use of computers in education in general, since they affected essentially hardware and operating systems. Although such developments enabled more effective and user-friendly access to the computer, there was still a relative paucity of educational software applications that supported the express learning-and-teaching strategy advocated by the architects of the Project. This necessitated the development of suitable software by educators in the region. A good example of such software was the Foundation Phase reading programme developed by Ronel Calitz. Although these applications are possibly primitive by today's standards, they must have fostered a sense of self-reliance – referred to by Dr Venter in his short speech at the last expo.

(194) That was, naturally one of the problems in the computer world: if you look at the curriculum, most of the software packages had to be used for drill and practice. Now, she and Ronel – and there's a woman for you – developed programmes – but these were essentially drill and practice. In those days it was difficult to encourage self-directed learning – it wasn't that easy (Peet Venter).

The existence of software, in the international arena, that could be employed by educators involved in the Project must be seen against the backdrop of software packages that were freely available and in use in South Africa at the time.

4.3.3.2 National

National physical influences on the implementation and sustainability of the Project, as addressed by participants in the study, focus on the availability and widespread use of a number of software packages. Most of these packages were inexpensive or free shareware applications.

> *(195) And then I saw – wow – you could look at certain programmes in English, for instance, and there were software exhibitions. The Rose Reading Programme was there and the person who developed the programme was Ronel Calitz, I think. The software that they had and that I was interested in was shareware that I could get for free. That was on an old floppy disc. The Internet did not exist at that stage. Tim Berners Lee was still very busy on his little computer somewhere. So what we did was I took some floppies and got about 50 programmes for R100.00 to R150.00 from shareware libraries. And then you played with the shareware (Igno van Niekerk).*

But two specific software applications seem to have played a very particular role in enabling computer-integrated education. True to systemic functionality and the interrelatedness of influences, the initial impetus for the use of these packages sprang, not from a desire to integrate computers into classroom practice, but rather from the need for administrative tools that promised to free educators from onerous, time-consuming activities. *As Easy As* was a spreadsheet application and *Framework* a word processing application, used specifically by educators to manipulate learner marks and type examination papers and notes. In this way educators became computer literate in the process of going about their daily tasks.

> *(196) At the time, they worked on the 'As Easy As' spreadsheet, and it was very inexpensive to show them things (Igno van Niekerk).*

> *(197) So, after the Commodores, the Microsoft stuff arrived. That was when the first IBM-compatibles arrived and we started working with a programme like 'Framework', which enabled teachers to type their own notes and examination papers. Teachers were encouraged to do this. So, the application and the training were to the advantage of teachers themselves (Johan Badenhorst).*

Partly because of the paucity of educational software packages, and partly because spreadsheet and word processing software was widely available to educators in the region, Hercules Dreyer approached Renate Lippert, head of the CIE Programme at the University of Pretoria, to advise the managers of the Project on best practices in using the available software to enable computer-integrated education.

> *(198) Let me go back one step: what software were we supposed to use? Nobody knew. The software that was in use was American or British and did not really work in our schools. So what we did, with the help of Renate Lippert, was examine how we could use standard software such as a spreadsheet and a word processor. These normal programmes were used to develop computer-integrated lessons, and the most incredibly interesting things were developed. They started swapping lessons amongst each other (Hercules Dreyer.)*

In this way, the unpredictability of mutual intra-systemic causality was seized upon by the managers of the Project as an opportunity to turn the state of affairs to the advantage of computer-integrated education. The reaction of educators to the use of available software packages is attested to by Sarie du Plessis.

> *(199) The computer itself is really a valuable resource: you have the calculator; you have Paint; you have all those different things. So, I really think one can do quite a bit without all those grand programmes (Sarie du Plessis).*

4.3.3.3 Regional

Yet another physical influence, the nature of which could not have been predicted fully at the inception of the Project, was brought about by the commitment of Dr Gert Heyns to the Project.
Mention has already been made of the fortuitous predisposition of the Director General Education (Free State region) in favour of the use of computers in the classroom. The attitude of Mr Heyns had a tangibly positive influence on the acquisition of physical resources for the Project. He was in the ideal position to provide the Project with the financial resources that enabled the purchase of hardware and software for schools.

> *(200) We were in the perfect position because we were a small department and top management were well-disposed towards the Project. If there was any money available – and there was very little – usually by the end of January, Mr Heyns (who was the director at the time, and who was a very good financial manager) saw that there were certain sections that would not be able to spend their money by the end of the financial year. Then he would call me and tell me that we had to transfer those funds very quickly. In this way we were able to buy a few computers and install them in schools. Some of the expos were also financed in this way (Peet Venter).*

4.3.3.4 Project

It was this financial commitment to the sustainability of the Project that went a long way towards enabling the infrastructural setting up of the Project in terms of the delivery of hardware and software to schools.

> *(201) On the other hand, from the department's side, we provided as much hardware and software (Microsoft programmes) for the schools as we could. Every year, for a period of four or five years we provided ten or fifteen schools in each of the districts with a few up-to-date computers. I*

can't remember the exact numbers, and, unfortunately the paperwork does not exist anymore (Peet Venter).

It was, however, not merely a matter of the OFSED supplying hardware and software and the targeted schools accepting the gift. Schools were also required to commit themselves financially to the Project. As it turns out, such commitment was a powerful lever for ensuring the sustainability of the project after the withdrawal of Departmental support.

(202) But then we realised that we would not be able to buy enough computers. We wanted a commitment from the schools. We then said that we would not be buying computers, but rather subsidizing schools. So we told schools to get a quotation from local IT suppliers and, in the process, we would be supporting them too. They had to get a price per computer. Whatever the price was, it was lower than the state tender price, since prices had dropped. By buying computers locally, it would be much cheaper and we would be able to buy more with our limited funds. We then promised schools that for every five computers they purchased, we would purchase ten. We told them that they would have to raise the funds for five computers. In this way, we could install far more computers in schools than would otherwise have been the case (Hercules Dreyer).

Furthermore, when Departmental support for the Project was withdrawn in 1996, the delivery of physical resources in the form of hardware, software and Internet connectivity to the targeted schools had virtually been completed – not only in terms of the CALIS Project but also in terms of the inextricably related FRENET and FRETEL Projects.

(203) Here, at head office, we had a large system where we connected everything by means of modems – all at the incredible speed of 14 400 baud. And, at the centres, we had dial-up modems and cabling that enabled the schools to communicate, and to which schools could connect. The idea was that we would have a complete e-mail system, but also that we would eventually have Internet access (Johan Badenhorst).

(204) The infrastructure was unbelievable – towards the end, virtually all the CALIS schools were connected to the department. By 1993, we could communicate with all the CALIS schools by e-mail, and we were able to send out information very quickly (Peet Venter).

(205) At the end of 1993 or the beginning of 1994 we were 100% ready to activate FRENET. FRENET, which stands for 'Free State Network', was a project which was developed alongside CALIS. The project was planned in such a way that we used what we called 'hubs'. These were the places to which schools connected (Johan Badenhorst).

But it was not only the OFSED that provided the financial means for the Project to be implemented and sustained. Absa Bank had instituted a satellite-based training system and found that they had bandwidth to spare. The Bank offered use of the system to all departments of education in the country at very affordable rates. As mentioned above, Dr Venter immediately recognized the potential of such a means of communication. He duly accepted the offer of use. FRETEL was brought about in this way. The involvement of Absa Bank was thus crucial to the success of the FRETEL initiative, and tangential though it was to the CALIS Project, to the success of this Project as well.

(206) In all these little places I said that they should provide the venue and that we would provide the television. At that time there were no satellite dishes, like DSTV. At that time we received a signal from Absa Bank via an ISDN antenna. As long as there was an Absa Bank, we could receive a signal via that antenna, and they were then able to receive a signal at the schools. That was the FRETEL Project, and it was great (Hercules Dreyer).

(207) We did recordings in the studio. The money for this was donated by Absa and it never cost us a cent (Peet Venter).

As far as the CALIS Project itself was concerned, invaluable exposure of educators to the latest available educational software was facilitated at the annual expos. Maureen Dale estimates that there were more than eighty local, regional and national exhibitors at the last expo that she organized.

> *I got, I think it was just on, – oh, such a long time ago – 80 exhibitors from all over the country who actually came (Maureen Dale).*
>
> *They were hearing top-class lectures and they were being exposed to phenomenal software, at the same time (Maureen Dale).*
>
> *Look at what's on offer and it was good stuff – really good. I mean we used – the entire hall was filled with exhibits right across the stage, down the sides, everything – the staff room was filled with exhibits – the library was filled with exhibits – certain classrooms were filled with exhibits – ... (Maureen Dale).*

For many of the educators from rural areas who attended the expos, this exposure to the latest software packages would have been extremely informative. Educators who taught in the larger urban centres, more particularly Bloemfontein, Kroonstad, Welkom and Bethlehem, would have had some access to software vendors, and the added luxury of surrounding schools that could share information in this regard. Educators who taught in Bloemfontein had the further advantage of having access to higher education institutions that could be approached for information and help.

4.3.3.5 District

Because of the concentration of economic activity and resources in the larger centres, it is also not surprising that schools in these areas were able to negotiate much higher school fees than their rural counterparts.

> *But, if you take into consideration school fees, you must remember that if your school – if your parents are paying fees, and the fees are a little bit higher, you must be able to provide them also with*

the requirements that modern-day education needs – and the computer is part and parcel of that (Maureen Dale).

The result was that, when Departmental support was withdrawn, these schools were able to bring financial resources to bear in such a way that the financial sustainability of the Project could be ensured.

4.3.3.6 Institution

Given this state of affairs, the impression might be created that no rural schools were able to sustain the Project financially. Paradoxically, this is not the case, as Johan Badenhorst indicates.

(208) Let me see: are there any schools that managed to do this in the absence of extensive material resources? Yes, yes there were schools that literally did things in the classroom with one or two computers. As I said, there were schools that used one or two computers particularly effectively in the remedial classroom. There were people who did very good things with only one or two computers (Johan Badenhorst).

Other influences, both personal and programmatic, played a much larger role in ensuring the sustainability of the Project in the case of some rural schools. The critical role played by personal influences in the case of Ronel Calitz and Sarie du Plessis, both of whom taught at physically under-resourced schools, is documented above.

In fact, management teams at schools in the relatively larger urban areas, even though they had access to some financial resources, had to be creative and disciplined in order to supply the evolving, resource-hungry Project. Maureen Dale relates how she used income obtained from hosting the annual expos to feed the Project in her own school.

You won't believe me. I sold the stalls – they bought stalls from me and they were prepared to pay to bring their wares here, and so we made a little bit of money on the sideline – not much – and all of the money that was made, I bought computers with for the school. So it wasn't vast sums but it

was enough to let me buy 20-25 computers and, each year, I would add, and, every now and then, the Department gave me one or two to give me the kick-start in the beginning (Maureen Dale).

(209) And on the grounds that the expo was held there [Eunice Primary School], the Department gave them a couple of computers and equipped the school. She [Maureen Dale] could then keep the computers and continue with the Project. And, because of the good working relationship we had at the teaching centre, we chose her (Peet Venter).

Once more, it is not possible to isolate the role played by physical influences, in ensuring the sustainability of the Project, from personal and programmatic influences discussed above.

4.3.3.7 Educator

Although extensive use was made of generic, available applications like word processing and spreadsheet programmes, the perception amongst participants in the study is that there was a dearth of educational applications on the market. In the same breath, however, participants proceed to explain, as Igno van Niekerk has been quoted as saying, that free or inexpensive shareware that catered for particular subjects and learning areas was available. Besides locally-developed software, like Ronel Calitz's reading programme, there were clearly proprietary packages that could be implemented within the South African context, even though they had been developed in other countries.

(210) But, in general, one of the biggest problems that we experienced was that there wasn't any software (Ronel Calitz).

(211) In English there was a programme called "Willie Beamish", which was about a little boy. I am not sure whether you know the programme. That was the first animation programme about a little boy who rode on a skateboard. He explored various places, and, in this way, the learners were taught how to spell. Then there was another programme called "My Grandmother and Me", where the learners would click on a shell, for instance, and the shell would

then 'announce' that it was a shell. At the end of the exercise there would be a comprehension test – after they had read a little piece. Those were the programmes we used for English (Sarie du Plessis).

(212) I used a little programme called Explorapedia and the learners could do a search, for instance, on farm animals. It was actually a wonderful little programme, and he [her husband] installed it in his classes. But, because he had very old computers, he was limited to using specific software programmes (Ronel Calitz).

The use of particular software packages at particular schools was, of course, critically dependent on the extent to which these institutions could leverage financial resources, either through the collection of school fees or entering into partnerships with external organizations. Ronel Calitz explains how the computer-integrated education effort at the school of which her husband was principal, eventually came to an end as a result of their inability to ensure financial sustainability.

Such financial sustainability, however, is virtually inextricably linked to the kind of adaptive management at institutional level that enabled some institutions to evolve in new directions after the withdrawal of Departmental support.

(213)There was also the problem of trying to keep those things in a good condition. You can get many miles out of an old computer – but only up to a point, and then it becomes impossible. And that was what happened there. He [her husband] never had enough money to upgrade and so his whole little project slowly came to an end, as a result of lack of funds (Ronel Calitz).

So, once again, it is not possible to separate physical influences from other intra-systemic influences such as personal and programmatic ones. In terms of the definitions offered of these influences earlier in this chapter, it may be noted that all of these influences were brought to bear upon the project with the specific purpose of attaining initially-defined goals. But, true to complex systems, influences are not fully determinate and predictability is variable. Were there not also systemic influences that contributed positively to the success of the Project that had not specifically been brought to bear upon the Project with the stated goals in mind?

4.3.4 Systemic influences

In terms of variable systemic influences on the CALIS Project, one of the most important influences must be the emergence of the *Windows* operating system at the international structural level.

4.3.4.1 International

The timing of the CALIS Project was fortuitous in the sense that it coincided with the advent of *Windows* and the resultant explosive growth in computer sales to households. The user-friendly quality of a graphical user interface meant that the computer, previously viewed as the domain of computer programmers working for large corporations, became a household appliance. In this way, the attitude of society towards computers, as essential appliances and not luxury items, was shaped.

> *(214) It might sound ironic and far-fetched now, but Bill Gate's vision was a desktop on every desk in every home in the world. His vision started becoming a reality directly after CALIS was initiated, when guys in South Africa began buying their own home computers (Igno van Niekerk).*

> *(215) That was why the Project developed further: the prominence and development of technology in society-at-large, meant that guys were forced to take notice (Johan Badenhorst).*

> *(216) CALIS's timing was perfect in terms of integrating with the further development of computers, in general (Igno van Niekerk).*

> *(217) It was the early nineties and Office wasn't really in place yet. It was put in place at a later date and we then allowed the children to play with the programmes (Ronel Calitz).*

The influence of computers on society was thus not a specifically South African occurrence but an international phenomenon. The Project managers, as disclosed by the participants in

the study, were introduced to the international situation by way of exploratory, conference-driven tours, aimed at seeking best practice in computer-integrated education. There was also the further goal of benchmarking efforts in South Africa against efforts in other parts of the world. There seems to have been a clear perception of the importance of horizontal, synchronic networking across the whole system. Hercules Dreyer relates how, on their first exploratory visit to the United States of America, he became aware of two very important shortcomings in the South African learning-and –teaching strategy, namely ineffective use of existing technologies, and the crucial need for sharing expertise and resources.

> *(218) The first basic technology that they could not believe we didn't have was a telephone in each classroom.*
> *They said: "How many telephone lines serve each school?"*
> *I answered: "Maybe one or two."*
> *And then they asked: "How does the teacher contact the parents? A teacher has to be able to contact them from the classroom. How does the teacher gather information that has to be transmitted to the learners in the classroom?"*
> *Right at the beginning of the process, they said that this was the first basic technology that we had to have. We still have a number of schools that don't have telephones. It's very interesting (Hercules Dreyer).*

> *(219) A woman stood up and explained how she did it. I thought that she was on the wrong track but I assumed that it was because I was South African. I felt that her suggestion could never work but I didn't say anything – as you know, we are very proper. As soon as she had finished, the hands shot up and her own teachers started suggesting that her method could never work. And then she would respond: "Why do you think so?". He would then explain. She would write down the comment and exclaim: "Wow, good idea! I'll do that!" Another guy would then stand up and disagree with the first. Just because she had the temerity to present her idea, she eventually left there with a great lesson. Imagine what would have happened if she had simply not said anything and kept her idea to herself (Hercules Dreyer).*

Some time later, Johan Badenhorst visited New South Wales in Australia with the express purpose of benchmarking the FRENET efforts with regard to educational television against programmes that had been instituted in Australia. His perception was that the right decisions had been made and that the timeframes adopted had been realistic.

> *(220) What I can say, with reference to FRENET, is that I visited New South Wales in October 1994, and, at that stage, we were a year ahead of them in terms of implementation. They were still in the planning phase while we had already implemented (Johan Badenhorst).*

Besides exploratory and benchmarking expeditions to other countries, the Project also gained international exposure through the prize offered at the last expo. Such exposure created an understanding of the importance of what was being attempted in the Free State. Igno van Niekerk not only attended the WCCE Conference in Birmingham in 1996, but was also interviewed on British television. His experience motivated him to employ what he had learnt at the Conference in furthering the aims of Project.

> *(221) So, in terms of reaching people, there was an international impact – not a very big impact, but in those days we hadn't heard of globalization. It was different then (Igno van Niekerk).*

4.3.4.2 National

Needless to say, the infiltration of computers into society at the international structural level presaged the same process in South African society. But it was not only the advent of *Windows* and the drive for household computing that spurred the process on in South Africa. The creation of the Internet and its concomitant promise of connectivity and communication would have been heralded with great enthusiasm in a country where great distances separate communities. In this regard, the media became aware of the potential influence of computing and connectivity on the South Africa society. At this point, computer-integrated education was transformed from an essentially foreign idea to an extended use of an appliance that had come to be accepted as a necessity.

> *(222) Why did schools continue using it after support was withdrawn? On a systemic level, you must remember that between*

> *1993 and 1995 The Star newspaper published a supplement on computers. That was about the time when Windows 3.1 became known. Suddenly computers became important. I remember sitting with Louis du Plessis at the teachers' centre when we went onto the Internet for the first time. Internet Explorer replaced Netscape Navigator. You could download it free of charge – so the whole system virtually kicked in at that time and, suddenly, computers started featuring in the press (Igno van Niekerk).*

> *(223) The reason why they carried on using them [computers] was simply because they suddenly became a necessity rather than a luxury (Igno van Niekerk).*

The preceding account must not be viewed as the reflection of a process that took place overnight. In fact, Igno van Niekerk identifies a South African cultural stereotype that might well have hindered the integration of computers into South African society, but, paradoxically, seems to have worked in favour of the implementation of the CALIS Project.

Prior to 1994, boys and girls in South African schools were offered a choice of subjects from Grade 10 onwards. Traditionally, girls chose subjects such as Home Economics and Typing (for typewriters), in keeping with the culturally-constructed view of girls as prospective employees in a very narrow range of careers. Consequently, boys who chose Typing as a subject were often seen as being effeminate. With the advent of computers, very few male teachers could thus type. When the CALIS Project was launched, however, sanctioned as it was by the OFSED, the opportunity to escape such cultural stereotyping presented itself.

> *(224) Remember that we are talking about 1993-1995: if you were a male teacher and you could type, you were labelled a homosexual. Nowadays, it would be more acceptable but, in those days, it was different. So nobody could type (Igno van Niekerk).*

Just as the coinciding of the CALIS Project with the further development of computers on the international structural level had been fortuitous, so also the coinciding of the CALIS Project with developments in the field of curriculum design on the national structural level was fortuitous.

The first of these developments involved the languages. An attempt was made to introduce a learning-and-teaching strategy that encouraged cooperative learning through effective communication. Also, communication was emphasized above knowledge of formal language structures. In terms of the proposed learning-and-teaching strategy that informed the Project, the two approaches seem to have complemented one another admirably.

> *(225) But what was very interesting at that stage, and something that worked for me, was that we had just introduced the communicative method in English. The children could make a noise in class. Also, we had just come to the realization that children did not have to work on computers in a one-to-one situation (Igno van Niekerk).*

A second development relating to curricular design was the implementation of the problem-based approach in Mathematics. Dr Venter, who had been the head of the enrichment centre in Bloemfontein before he had been appointed head of the computer section in the OFSED, was directly involved in promoting the new approach to Mathematics. The approach advocated the precedence of knowledge application in practical settings over the mere memorization and regurgitation of theoretical concepts. Here too the learning-and-teaching strategy advocated by the Project presented practical implementation guidelines for educators who found the new methodology intimidating.

> *(226) He [Peet Venter] was very involved in the problem-based approach to Mathematics that they set up in the Free State. That was what he got going in primary schools. As a result of that project, he realized that there are alternative methods of teaching. Part of this was the use of group work, where you divided the class into groups and each group was given a different activity (Hercules Dreyer).*

> *(227) I know that many of the teachers who were involved in Peet's problem-based approach to Mathematics also used computers in their classrooms because the two went well together. You simply give the children a problem to solve and they solve it on the computer (Hercules Dreyer).*

(228) Their visit focused more on the problem-based approach in Mathematics, because that happened at the same time (Ronel Calitz).

In addition to these developments in curriculum design, the cause of integrating computers into classroom practice was enhanced by the way in which remedial teaching was approached in South Africa at the time. Remedial teaching took place in a one-to-one situation, where the learner was withdrawn from the academic programme and was then attended to by the remedial educator. The virtually simultaneous emergence of the Project and the reading programme developed by Ronel Calitz, presented remedial teachers with the opportunity of addressing some of their most pressing needs. Thus, remedial teachers were amongst the first to embrace computers as an integral part of classroom practice.

(229) In that regard, it is surprising how many remedial teachers embraced the technology and used it in their single little classrooms where they worked with the learners individually. It was particularly the reading programme – the Rose Reading Programme – that was used very effectively, but that was not all. There were many Mathematics programmes that were used very effectively. We even developed special programmes ourselves (Johan Badenhorst).

(230) The only workstations we came across were in remedial classrooms where people used this reading programme [Rose Reading Programme] specifically for remedial purposes (Ronel Calitz).

4.3.4.3 Regional

Naturally, national systemic influences found expression in regional planning and functioning.
The communicative approach in English and the problem-based approach in Mathematics, documented above, provided contexts within which computer-integrated education could take place effectively.

(231) You have to remember that there were very few support resources for the syllabus at the time. You had to find support

materials and integrate these into the syllabus. There were many things that one would have liked to use. For me, teaching English as I was, it was very easy because the syllabus encouraged communication amongst learners (Igno van Niekerk).

Regional systemic influences were, however, not fully determined by national policy and directives. The regional structural level was defined partly by attributes or characteristics that were specific to the Free State. At the inception of the Project, there were already five centres in different districts of the Free State that were being used for computer-based education. The reason for this state of affairs was the fact that Computer Studies had been introduced as a subject at secondary school level, but there were very few qualified educators at individual institutions. Furthermore, most schools did not have the necessary infrastructure to enable educators to present the subject on campus. Learners would thus travel from schools to the five centres in order to receive Computer Studies tuition. It was evident to Dr Venter that the centres could serve as district and support centres for the CALIS Project. In fact, the centres could be modified to serve as district contact centres for the proposed FRETEL Project.

(232) At the time, five computer centres had already been established and placed under my control: one in Bloemfontein; one in Welkom; one in Sasolburg; one in Kroonstad; and one in Bethlehem. These centres were used for the teaching of Computer Science in the various districts (Peet Venter).

The regional systemic influence of Computer Studies does not, however, end there. After hardware and software had been installed in schools taking part in the Project, the tuition of Computer Studies could take place on campus. In fact, Computer Studies was, at the time, revised and subsequently presented on both higher and standard grade levels. The popularity of the subject grew, and was further enhanced by the addition of Computer Typing to the curriculum. The latter replaced Typing as a subject. These systemic developments meant that computer-integrated education had become entrenched in the curriculum. In this way, almost inadvertently as far as the planning of the Project was concerned, regional systemic influences contributed to the sustainability of the Project.

(233) There were many high schools that continued using computers, and, soon afterwards, subjects such as Typing and Computyping, as well as Computer Science Standard Grade, were

introduced in schools. Many schools followed that route (Johan Badenhorst).

Regional systemic influences also originated from the larger context within which the Project was implemented. The crucial role played by regional businesses that were prepared to invest in the Project has already been mentioned. Although regional businesses were approached, as part of the programmatic planning of the Project, the extent to which these businesses were willing to support the Project, must also be recognized as a systemic influence not specifically planned for by the Project team. Evidence of the level of their commitment can be found in the number of exhibitors who supported the expos, and in their willingness to sponsor the prizes on offer for the best computer-integrated lessons at these expos.

(234) We also awarded prizes. I can't remember what those prizes were but the reasoning behind the prizes was not to recognize something as the best; rather, we wanted to reward effort and hard work. We always managed to convince companies to sponsor these prizes (Peet Venter).

(235) We contacted the railways and asked them whether we could use their network and we also spoke to Telkom to find out how we were going to get telephone lines to schools (Hercules Dreyer).

Such commitment by regional businesses was not only limited to financial and product contributions towards the success of the expos. Their involvement also encompassed service beyond the norm in ensuring the successful installation of hardware and software at schools. One must assume that this synergy of efforts on their part stemmed, partly, from the perception that the burgeoning infrastructure presented the prospect of new markets for their products.

I got a place like - what was it called? –TechRoss. They were the initial company that gave me a lot of support in supplying computers to schools so that the other companies could load their software onto them, so that everybody didn't have to travel from all over the show. They could just pack their disks into a box and come down - fly down - and not have to cart computers and everything. I actually was able to put workstations at the various places and they could load their material onto them (Maureen Dale).

4.3.4.4 District

Although the development of context-specific software was envisioned as one of the further ways in which the CALIS Project would develop, some districts approached such development in a concerted and organized manner, whereas others did not. One such coordinated effort was the production of a Mathematics application for use in the Foundation Phase.

> *(236) Here in Sasolburg, we had a Mathematics programme for the Foundation Phase that also worked very well. It was developed by the children – under our guidance – and they enjoyed it very much (Ronel Calitz).*

The developers and managers of the Project foresaw that the development of educational software might well flow from the implementation of the Project but they might not have foreseen that such development would have taken place on the district level. There are hints here of the self-organization that characterizes dynamic, complex systems.

A systemic influence on the district level that was predictable was the fact that the Project was more likely to be sustainable in resource-rich, financially stable districts rather than those that were not. In the Free State region, the richest district in this regard was the Bloemfontein district. It is thus not surprising that Maureen Dale should have had no hesitation in naming the schools in her district (invariably well-resourced) in which the Project had survived and evolved.

> *Yes, Grey College, St Michael's, St Andrew's, Oranje - I don't know how well Oranje's has taken off; Brebner, both higher and primary, and I would say most Model C schools – I really would say most Model C schools. The magnitude and the number vary from school to school and the expertise would vary from school to school (Maureen Dale).*

4.3.4.5 Institution

One of the most important institutional systemic influences demonstrates, once again, the paradoxical nature of complex systems, which often develop and evolve in unexpected ways. Hercules Dreyer, as indicated above, often advocated the importance of the creative renewal

of learning materials, almost on an annual basis. Igno van Niekerk, in contrast, demonstrates that the systemic stasis that dictated the passing on of learning materials from one educator to the next in particular institutional environments, assured the continued use of software, and the continued use of computers.

> (237) *Remember, you become the first guy to use 'Framework'. You then become knowledgeable, and the next thing that happens is that you have to teach someone else to use the programme. So you learn more and more, and, eventually, you gain confidence (Igno van Niekerk).*

> *(238) Remember what the spin-off is: I use the computer, and then a new teacher arrives at the school. I use' Framework' to type examination papers. That is the process that we use; that's the way things are done. So the new teacher follows suit (Igno van Niekerk).*

This does not mean that stasis was a common characteristic at all schools on the institutional structural level. The system as a whole was evolving, and one of the ways in which the withdrawal of Departmental support influenced such involvement was the fact that in many institutions computers in individual classrooms were withdrawn and placed in venues that later come to be computer centres. One of the important drivers for the process was the realization that financial sustainability of the Project now had to be guaranteed by individual institutions themselves. This meant that school governing bodies and school principals had to take ownership of the computers on the premises, and, by implication, the Project. The implication was thus also that principals had to prove to school governing bodies that the investment in such computer centres was justifiable. One of the ways in which this could be achieved was to enter into partnerships with private computer training companies. Such institutions, however, did not lose sight of the original goal of the Project, namely the integration of computers into the curriculum.

> *(239) It happened in schools that the school itself took the initiative and the governing body and management of the school decided what would become of the computer laboratories (Sarie du Plessis).*

(240) One of the consequences of the CALIS Project was that principals of schools had to take on the responsibility of using the computer centres (Igno van Niekerk).

(241) Many of the projects that were initiated in schools mutated into computer centres as a result of the withdrawal of support that went hand-in-hand with the establishment of the new dispensation. Many schools entered into partnerships with private companies such as Future Kids, but the primary concern remained the integration of computers into the curriculum (Johan Badenhorst).

The involvement of school governing bodies and principals in planning for financial sustainability was recognized as the necessity that it was after the withdrawal of the OFSED from the Project. Although the active involvement of the parent body in ensuring the eventual success of the Project at individual institutions is systemically evident, it is not necessarily the case that all institutions pursued such involvement equally vigorously. It is also true that parent involvement must have depended, partly, on the willingness of parents to be involved. Participants do, however, vouch for parent involvement as an important institutional systemic influence on the sustainability of the Project. Hercules Dreyer relates a vignette wherein the principal of a school compares the acquisition of a computer centre to the purchase of an expensive cricket bat, the owner of which was often looked upon by his pupils with respect and fear.

(242) I think that the parents were made aware of the Project. Merriespruit, a school in Virginia or Welkom, for instance, invited me to address the parents. The parents and staff were invited, and I will never forget the night. The principal had a cricket bat on stage. It was a V-500 or something like that. I know nothing about cricket but, apparently, it was an impressive bat, in those days. He then related a vignette that involved the playing of a cricket match the previous week. Apparently, one of the members of the opposite team had stood up to bat, and the principal's team members were absolutely terrified. On being asked what the problem was, they explained that the opposite batsman was

going to bat with a V-500. At that point the principal broke off the story and said that he wished to inform the parents and staff that the school now had a V-500. Of course, he was referring to the new computer centre. So, some schools definitely involved the community (Hercules Dreyer).

(243) The parents were invited to many of the talks so that they could be informed of the new approach to teaching and the way in which technology was going to be used (Hercules Dreyer).

Parental support is often perceived as passive – passive in the sense that their time is not devoted to school matters, with the exception of the odd meeting. It is known to involve moral support and even passive financial support. Often schools require either fundraising from parents or direct financial contributions in order to maintain facilities and programmes. But what were schools to do that served communities who were, by and large, unable to contribute financially? An example of such a school was Taaibos Primary, where Ronel Calitz had taught. Here, parents were invited to act as monitors in the Foundation Phase classes during the course of the CALIS Project. Each of the three groups in a class would have a parent monitor who would perform administrative and control tasks. In exchange, parents (most of who were not employed) had a certain percentage of the children's school fees waived. In addition, they received basic computer literacy training, and some training in terms of educational interaction.

(244) Some of those parents were approached and asked whether they would be prepared to help out at school. Because we were working with littler ones, the parents were asked to monitor workstations in order to keep an eye on the children. It was very sweet. They did fantastic work. We trained them in general skills relating to the management of children. We also held weekly meetings with them in order to discuss the problems that they encountered in their classrooms. In the beginning, the teachers also found it strange having parents in their classrooms – but that was a project within a project (Ronel Calitz).

> *(245) Very thorough reporting was done by the parents, and later by the children, and we really had excellent results (Ronel Calitz).*

Ronel indicates that there was also a secondary reason for drawing parents into the Foundation Phase classrooms: by allowing parents to witness, at first hand, the interaction between learners and computers, she could convince them of the efficacy of the Project.

> *(246) One of the reasons why I involved the parents at Taaibos was because it is not easy to convince parents [of the merits of the Project] (Ronel Calitz).*

This form of parent involvement eventually evolved into incorporating parent help in other administrative tasks in the school programme.

> (247) *Anna: I started out as classroom assistant but, because the school shrank in size, I was transferred to the book room. There I had to run everything. In the end, I assisted in the school office when the lady was not there. I did all their typing, including the typing of examination papers. (Anna: Ronel Calitz).*

As mentioned above, one of the systemic influences on national, regional and district levels that actively contributed to the successful implementation and eventual sustainability of the Project, was the way in which remedial teaching was approached at the time. Remedial teachers found that their learners could pace themselves on the computer and that different students could thus happily co-exist in the same class. On mentioning the role played by remedial teaching in the successful implementation and sustainability of the Project at other schools, Ronel replied as follows:

> *(248) That was the real reason why it worked so well at Taaibos: the whole class was really a remedial class as a result of the disenfranchised background from which they were drawn (Ronel Calitz).*

There might well be many reasons why the Project eventually came to an end at Taaibos Primary, but Ronel is adamant that, besides her departure from the school, a major contributing factor was the arrival of a newly-appointed principal and deputy-principal pairing who were not in favour of parents being actively utilized in the official school programme.

> *(249) When I left, a new principal and deputy-principal were appointed, and they didn't like the idea of having parents in the classrooms (Ronel Calitz).*

It would thus seem, consistent with systemic functionality, that parent involvement was a major institutional systemic influence on the sustainability of the Project.

4.3.4.6 Educator

On the structural level of the educator there may well have been myriad systemic influences that contributed towards the success of the Project, but the following are specifically emphasized by the participants in the study.

In the first place, mention has already been made of the fact that the implementation of the Project at a specific institution empowered educators at that institution to type their own notes, tests and examination papers – as opposed to the time-consuming, and often messy, process of using a roneo machine in combination with wax sheets. In this sense, a systemic driver, though tangentially related to the central concerns of the Project, came into being.

> *(250) Suddenly, I could type my own examination papers and I could add pictures. This is something one should not lose sight of with relation to the CALIS Project. So, I can't say that teachers ever stopped using it. I think many of them continued enjoying the fruits of the CALIS Project, albeit unknowingly (Igno van Niekerk).*

In the second place, the implementation of the Project at institutions led to the discovery of educational simulation software. It soon became apparent that such simulations, particularly those related to Biology, Physics and Chemistry, held the promise of significant savings in terms of purchasing expensive instrumentation and chemicals used in the classroom.

(251) Even if you are only able to put one or two computers in each classroom, do you know what you are able to do? Do you know how much money you can save on science experiments? There are so many simulations that enable this. You don't need expensive equipment anymore. Much of the equipment in school is outdated or broken. We should give them simulations so that the child can do the experiment; so that the child can see what happens and how these things work (Hercules Dreyer).

But, beyond such financial considerations, there were substantive educational systemic drivers that had not specifically been foreseen by the planners and initiators of the Project. One of the most difficult challenges encountered in primary schools related to the assessment and remediation of reading in the Foundation Phase. As indicated above, Ronel Calitz's reading programme addressed exactly these issues, but, because the programme was computer-based, it meant that those educators who wanted to use the reading programme, would by implication, become involved in computer-integrated education.

(252) I was teaching a Standard Two class when Ronel Calitz developed the reading programme [Rose Reading Programme]. My problem was that I found it very difficult to assess children. It is difficult to assess the child's standard and, as you know, we had to assess throughout. So we started using the reading programme, particularly in Grade Four, and that was how I became involved. Later I started using little shareware programmes. The reason I became involved was to be able to assess the children, and to develop their reading abilities – that was important to me (Sarie du Plessis).

(253) Working with Ronel was amazing. She was a pioneer who opened up a whole new world for me. At the time there was a reading laboratory at the University [of the Free State] but I felt that her programme made it manageable in the classroom situation. That was how many amazing projects started (Sarie du Plessis).

The diverse nature of the three systemic influences at the level of the individual educator mentioned above indicates that a treatment of such influences can never be fully determinate. It is merely an indication of the diverse range of systemic influences that are likely to have influenced the success of the Project.

4.3.4.7 Learners

The existence of centres in various districts of the Free State at which Computer Studies was presented has been discussed above. Another aspect relating to the systemic influence of such centres, not addressed yet, is the fact that learners who attended Computer Studies classes at such centres were introduced to computer-integrated education. Dr Peet Venter claims that learners embraced these classes enthusiastically. Might it not be the case that such an introduction to computer-integrated education, systemically, could have had an influence on the attitudes of certain parents towards the prospective implementation of the Project at the schools attended by their children?

> *(254) The idea was that the learners could go to those centres after-hours and the staff member on duty would present Computer Studies classes. That was fairly popular amongst learners (Peet Venter).*

In this way, the success of the CALIS Project was influenced by systemic factors not necessarily foreseen by the planners and implementers of the Project. An attempt has been made in this chapter thus far to indicate the artificiality of separating off individual influences within a systemically complex, vibrantly interconnected and constantly evolving entity. The discussion has consciously attempted to isolate individual influences for the sake of identification and evaluation, all the while indicating the difficulty of such isolation.

4.3.5 Metaphoric patterning

In this section attention is given to the metaphoric patterning evident in the narratives presented by participants. Such patterning, viewed through the lens of Relevance Theoretic weak implicature, illuminates the connections that define the system as a complex, evolutionary whole. In this sense, metaphoric patterning performs a function even more critical than the evocation of affective states envisioned by Sperber & Wilson (1995) and Pilkington (2000). It makes manifest exactly the quality of complex systems that is difficult to capture when one uses language characterised by the presence of explicature and a narrow range of fully determinate implicatures, namely complexity itself. Just as complex systems

are, in essence, simpler systems that have evolved in complex (often indeterminate) ways, so also metaphor is, in essence, normal language usage that has evolved from explicature and determinate strong implicature to the activation of a wide range of concatenated weak implicatures that are not fully determinate.

One of the perplexing questions that has dogged Relevance theorists regarding the use of metaphor is the following: if metaphor is, in essence, no different from everyday language usage, why would speakers require of their hearers the extra processing effort required to interpret a wide array of fairly indeterminate weak implicatures? Suggestions in the literature have focused on the communication of affective states inextricably bound to the relevant explicatures concerned (Lakoff and Johnson, 1980). It is the thesis of this argument that metaphor performs an even more critical function in communication. It elucidates, and, in fact, embodies the very nature of the complexity that it seeks to communicate.

If the discussion of influences thus far in the chapter has indicated the elements of narrative such as character, theme, setting and chronology in a seemingly disconnected way, then the discussion of metaphor provides the plot that ties these disconnected elements together and animates the whole.

4.3.5.1 Patterning of personhood

The first metaphoric pattern that emerges from the narratives is one relating to personhood – that which constitutes humanity in all its complexity, and the way in which this humanity is situated in wider contexts. But the pattern is also more than that: it presents the humanity of the narrators (perceptive, feeling individuals) as occupying a position on one end of a continuum and the Project itself as a living entity on the opposite end of the continuum. This presentation of the Project as a living entity is emphasised further in patterning related to 'journeying', discussed below.

In terms of metaphors relating to the participants and their active participation in the Project, a number of metaphors relate to the perceptive abilities of humans as part-definition of their personhood. The metaphors presented below relate specifically to vision. There is a clear dichotomy in the implicatures evoked by these metaphors. In the case of the first group of metaphors, suggestions relating to sight and clear vision are implicated.

> Dit het alles van die hoof afgehang en dan iemand op die personeel met **dryf** en 'n **goeie oog** (Igno van Niekerk)

*It all depended on the principal and someone on the staff with the necessary **drive** and **a good eye** (Igno van Niekerk).*

En elke keer **hierdie prentjie** vat – gee net die geleentheid vir die ou –moenie worry daaroor dat hulle meer weet as jy nie (Hercules Dreyer).
*And the **picture** that I always sketched was the following: give the guy the opportunity; don't worry if they know more than you do (Hercules Dreyer).*

So dit is iets, as jy gaan kyk na die geskiedenis van die wit departement, dan lyk dit soos 'n **blik op twee naweke (Igno van Niekerk).**
*So, if you look at the history of the white department, it looks like a **snapshot** of two weekends (Igno van Niekerk).*

H**y maak net op die grafiek so twee kurwes** (Igno van Niekerk).
*All you see is **two curves on the graph**. (Igno van Niekerk).*

So ek wil sê uit ROLIS het daar vir my 'n nuwe beroep **oopgegaan** (Sarie du Plessis).
*So, CALIS **opened up** a new career for me (Sarie du Plessis)*

The second group of metaphors, however, implicate the prevention of sight or clear-sightedness.
Such prevention is either characterised as agentless or as a direct result of human intervention. Such intervention, though couched in terms relating to acting, weakly implicate human duplicity and the express purpose of obscuring clear-sightedness.

En hulle het so een na die ander het hulle nou maar - het dit **weggefade** [computers used in the project] (Ronel Calitz)
*And so they **faded away**, one after the other [computers used in the Project] (Ronel Calitz)*

> Ek is nou indirek betrokke en ek kan dit nou nog nie waag om **openlik** en direk met die beplanning hier in die departement betrokke te raak nie (Peet Venter).
> *I am indirectly involved at the moment but I still cannot be seen to be **openly** involved in departmental planning (Peet Venter).*

> Op indirekte wyse**, agter die skerms**, help ek hulle beplan met hulle e-learning strategie en so aan (Peet Venter).
> *Indirectly, **behind the scenes**, I help them with the planning of their e-learning strategy (Peet Venter).*

> *He can keep an audience **enwrapped** like no one can (Maureen Dale).*

In contrast to the dichotomy presented above, there are metaphors implicating the visionary qualities of people such as Dr Peet Venter (as discussed above). Such implicature transcends the dichotomy presented above in the sense that clear-sightedness thwarted by human intervention is overcome by 'the ability to see beyond the immediately visible'.

> Dis maar die ou ding – jy het altyd jou **visionaris,** en as hy net die **visie** kan daar kry, kry jy 'n paar pioniers wat dit kan verder vat (Igno van Niekerk).
> *It's always the same: you always need **a visionary**, and, once the **vision** is estasblished, you get a few pioneers who implement (Igno van Niekerk).*

Such metaphoric patterning suggests the plot-like progression from a situation of physical clear-sightedness, through one characterised by active obscuring of such clear-sightedness, to a situation characterised by the transcendental quality of visionary sight. Such three-part plot-like progressions are visible in a number of metaphoric patterns, as discussed below.

But personhood is characterised by far more than perception enabled by the senses. Personhood encompasses, and is defined by, the quality of mental representation and the world of ideas that transcends the merely physical.

Visionary sight which transcends physical vision is merely an instance of mental representation that transcends perceived physical reality.

> Die **droom** was gewees… (Hercules Dreyer).
> *The **dream** was … Hercules Dreyer).*

> Ons het ‘n **droom** gehad (Hercules Dreyer).
> *We had a **dream** (Hercules Dreyer).*

> Ek dink rerig ons het soort van ‘n **wen idée** gehad (Peet Venter).
> *I really think we had a **winning idea** (Peet Venter).*

This does not negate the physical situatedness of humans within particular physical contexts. Humans are very clearly an integral part of physically-constituted systems. The metaphor implicating life as circus (below) activates further weak implicatures that capture the ambiguity of the human condition embodied in the clown as tragi-comic construct, an image used so dexterously by Shakespeare in his presentation of the clown as Lear’s alter ego.

> Persoon X het altyd gepraat van die **kinders oorkant die treinspoor (Igno van Niekerk).**
> *Person X always spoke about the **children from the other side of the railway tracks** (Igno van Niekerk).*

> So, toe is daar nou ‘n wonderlike **sirkus (Igno van Niekerk).**
> *So then there was a wonderful **circus** (Igno van Niekerk).*

But humans are also situated within wider non-physical contexts and systems – systems that often resemble the evolutionary complexity of life itself. In this way, the participants in the study use metaphors that clearly emphasize their own humanity and, almost in the same breath, implicate the living quality (and even personhood) of the Project itself. Thus, in the context of the wider Project as system, it becomes impossible to tell where the participants (as individual humans) end and the Project as supposedly discrete entity begins.

> En nou, na tien jaar, nou probeer hulle die goed weer **op die been** kry (Peet Venter).

> *And now, after ten years, they are trying to **get the thing up and running again** (Peet Venter).*

> Ek sou graag wou gehad het Prof Cronje hulle moes nou betrokke gewees het want hierdie ding het nou 'n **langer lewe** voorentoe (Peet Venter).
> *I would have liked Prof Cronje to be involved now because this thing is likely to **live longer** (Peet Venter).*

Within the context of such interconnectedness, human agency and action takes on a far greater significance. Not only is it an indicator of personhood, but it also determines, to some extent, the direction in which the system as a whole evolves. Given the social, cultural and religious situatedness of the participants and the central role played by Christian symbolism in South African society, it is not surprising that Christian metaphors appear in the narrative produced by participants. One such symbol plays an important role in the ecological patterning of metaphor discussed below. It is, however, the nature of such metaphors that bears closer scrutiny.

In the discussion of educator motivation above, the concept of the educator for whom the profession is a calling was mentioned. That particular concept is taken up and extended in the following metaphors. These metaphors envision the propagators of the Project, not merely as those responding to a calling, but extend this view to include the concept of propagators as both pioneers and missionaries. In Christian terms, such implicatures embody the action of believers who spread the Word (the teachings presented in the Bible). But the 'Word', in Christian terms is not merely 'the living Bible'. It is also a nomen adopted by Christ who the 'living Word' is made flesh, and the Redeemer of humanity. If , under such implicature, the propagators of the Project are equated with Christian missionaries, then further weak implicature might well reveal the identification of the Project as being equated with notions of redemption. But whether such weak implicatures are recovered or not, implicatures relating to the Project as living entity seem to is slightly more strongly implicated.

> Dis maar die ou ding – jy het altyd jou **visionaris,** en as hy net die **visie** kan daar kry, kry jy 'n paar pioniers wat dit kan verder vat (Igno van Niekerk).
> *It's always the same: you have your **visionary** and, once the **vision** is established, you have a few pioneers who implement (Igno van Niekerk)*

Maar nou, daar is nog jou **geroepe onderwyser** (Igno van Niekerk).
*But you still have teachers for whom it is **a calling** (Igno van Niekerk).*

Jy moes hulle nog eers **bekeer** het lat rekenaars kan werk (Ronel Calitz).
*You first had to **convert** them to the idea that computers can work (Ronel Calitz).*

Wat ek **gepreek** het daai tyd was kom net los van daai – kom ons deel die goed (Hercules Dreyer).
*At the time I **preached** in favour of the sharing of things (Hercules Dreyer).*

Een van die goed wat ons altyd **gepreek** het… (Hercules Dreyer).
*One of the things we always **preached** was… (Hercules Dreyer).*

But if human agency and human action are presented above as essentially altruistic, there are numerous metaphors which accentuate the human capacity for violent action, induction of pain and even causation of death. In this way, the dichotomy characterising the metaphors relating to human vision is echoed in the dichotomy relating to human action.

The metaphors presented below exhibit another relevant dichotomy. Metaphors involving violent actions initiated by participants in the study are characterised in an affectively positive way.

… maar wat verskillende vakke **getakel** het in die proses (Johan Badenhorst).
*… but which **tackled** various subjects at the same time (Johan Badenhorst).*

Hoe meer ons die **stryd gevoer** het, hoe meer het ons begin agterkom maar die nuwe onderwysdepartment laat nie hierdie tipe projek toe nie (Hercules Dreyer).
*The longer **the battle raged**, the more aware we became of the fact that the new department would not allow this kind of project (Hercules Dreyer).*

Jy blaas 'n klomp inligting in en wat daarmee gebeur, gebeur daarmee (Igno van Niekerk).
*You **blow** a lot of information in and what happens to it, happens to it (Igno van Niekerk).*

… en gedink die ouens sal dit **aangryp** (Hercules Dreyer).
*... and thought the guys would **grab** the opportunity (Hercules Dreyer).*

… as **inligting uitgestamp** die wêreld vol (Igno van Niekerk).
*... and **pushed it out** as information into the wide world (Igno van Niekerk).*

Ek het geweet as jy vir haar net 'n **halwe hand gee gryp sy**… (Peet Venter).
*I knew that if you **gave her a hand**, she would **grab it** ... (Peet Venter).*

*I would have **moved heaven and earth** (Maureen Dale).*

Jy **klim net in** en jy sê, ok, hier is rekenaars en hier is hierdie nice programme (Sarie du Plessis).
*You simply **climb in** and start using the computers and the nice software programmes (Sarie du Plessis).*

On the other hand, the violent actions of people not involved in the Project (particularly those of the incoming OFSED) are presented in an affectively negative way.

> Geen van die ou Vrystaat onderwys depatement se inisiatiewe is erken nie – dit is geïgnoreer en dit was **van die tafel afgevee** (Johan Badenhorst).
> *None of the intitiatives of the old Orange Free State Education Department were recognised – they were simply **wiped off the table** (Johan Badenhorst).*

> Soos ek sê, hulle het ons nie getrust nie en hulle moes eers daardie goed soort van **afvee van die tafel af** (Peet Venter).
> *As I said, they did not trust us and they had to sort of **wipe everything off the table** (Peet Venter).*

> Hy het nou die laboratoriumperiode so hy **jaag** die kinders daar in (Hercules Dreyer).
> *He has the laboratory period so he **chases** the children in (Hercules Dreyer).*

> Hulle rus die resource centres baie goed toe met rekenaarlokale, maar hulle gaan maar **bietjie hals-oor-kop** te werk (Peet Venter).
> *They supply the resource centres with computer venues but they tend to do things **head-over-heels** (Peet Venter).*

This dichotomy finds even more forceful expression in metaphors implicating the concept of participants as victims. In fact, the recovery of further weak implicatures characterises them as the victims of persecution, induced supposedly by the post 1994 OFSED. Such metaphors embody concepts not merely relating to violent action in general, but the specific inducement of bodily harm. Bearing in mind, the religious and social situatedness of the participants in the study outlined above, the recovery of further weak implicatures suggest an extension of the concept of participants as missionaries to include the concept of participants as suffering persecution.

> Hulle het rêrig hulself **in die voet geskiet** wat dit aanbetref (Peet Venter).
> *I think they **shot themselves in the foot** as far as that is concerned (Peet Venter).*

Hulle kon nie meer daardie werk doen nie as gevolg van hulle kon nie ry en by die plekke uitkom nie – in effek is hulle **gesny** (Peet Venter).
They could not do their work anymore as a result of the fact that they could not ride out to the places – in effect, they had ***been cut off*** *(Peet Venter).*

My gevoel is daar het niks oorgebly nie want dit is **keelaf gesny** (Hercules Dreyer).
I felt that that nothing was left since it had been ***garrotted*** (Hercules Dreyer).

Dit was asof dit 'n **ledemaat is wat afgesny is** (Hercules Dreyer).
It was as if I had had a ***limb amputated*** *(Hercules Dreyer).*

Toe ek daar weg is in die privaatsektor in sou die begroting **gesny** het (Igno van Niekerk).
When I left for the private sector, they were on the point of ***cutting the budget*** *(Igno van Niekerk).*

You know, the ***heartbreaking*** *thing is I'm afraid I think it has actually been discarded (Maureen Dale).*

As mentioned above, the continuum of life reflected in the metaphors involving personhood includes the presentation of the Project , not only as a living entity, but also as a person. The metaphors quoted below suggest, firstly, that the Project as person suffers the ultimate violence in the form of death, and, secondly, that the death of the Project is brought about by deliberate human agency. In this sense the Project is 'murdered'.

En nou dat **hy dood is**… (Ronel Calitz).
And now that ***he is dead*** *... (Ronel Calitz).*

Die projek het … **gesneuwel** op daai stadium (Johan Badenhorst).
The project ... ***perished*** *at that point (Johan Badenhorst).*

Dit is maar dieselfde dinge wat hulle daai tyd **doodedruk** het (Peet Venter).
*But it is the same thing that they **crushed** at that time (Peet Venter).*

Ek dink hulle het nie besef wat hulle daai tyd **doodgemaak** het nie (Peet Venter).
*I don't think they realised what they **killed** at that time (Peet Venter).*

… en het dit liewers **doodgedruk** (Peet Venter).
*... and rather **crushed** it (Peet Venter).*

Nou, nadat hulle alles **tot niet gemaak** het, … (Peet Venter).
*Now, after everything has been **destroyed**., ... (Peet Venter).*

… sentrums van ons het hulle tot **niet gemaak** (Peet Venter).
*... they **destroyed** those centres of ours (Peet Venter).*

My gevoel was die ding is besig om 'n **stadige dood** te sterf. (Hercules Dreyer).
*My feeling is that the thing was **slowly dying** (Hercules Dreyer).*

Ek dink hulle wou net **sy legacy doodmaak,** om een of ander rede (Igno van Niekerk).
*I think they wanted to **kill his legacy**, for some or other reason (Igno van Niekerk).*

Hulle het 'n Mnr Mopedi aangestel as die hoof daar, en ek dink hy was 'n **slagoffer** (Igno van Niekerk).
*They appointed Mr Mopedi as the head, and I think he was the **fall guy** (Igno van Niekerk).*

And **that's where it died,** basically (Maureen Dale).

> Toe was dit 94 en die verkiesing, en toe het die projek uitgefaseer- of nie uitgefaseer nie – ek dink hy het maar net **stilweg doodgegaan** (Sarie du Plessis).
> *And then the 1994 election followed and the Project was phased out; actually, it wasn't phased out – it simply **died in silence** (Sarie du Plessis).*

The recovery of further weak implicatures in the context of the preceding discussion suggests parallels with the history of Christ, as presented in the Bible. Christ has to die in order for the sins of the world to be forgiven. In the process, the Holy Spirit, inextricably linked to God the Father and Christ the Son in the Holy Trinity, is sent out into the world in order to invest human life with hope, faith and charity. So Christ, in dying, is resurrected in the hearts of humans as the Holy Spirit. In similar vein, the Project, offering new hope in terms of pedagogical innovation and excellence is terminated, but from such termination results an evolution of the Project into a different guise, fuelled, as it were, by different forces, as discussed below.

4.3.5.2 Ecological patterning

Whereas the metaphors involving personhood focus very strongly on that which defines personhood and the immediate context of society as distinct from other systems, the metaphoric patterning involving ecological systems emphasises connectedness and situatedness. Here too there is somewhat of a dichotomy. On the one hand, systemic influences shape and determine systemic evolution, but, on the other hand, human intervention (metaphorically embodied in the figure of the farmer) also plays a part in shaping systemic evolution.

Ecological metaphors relating to the systemic functionality of nature emphasise, in the first instance, the concept of nested systems, as indicated in the metaphor used below.

> So vir my was dit 'n groot sukses gewees in die klein ou **dammetjie** – in die klein ou **poeletjie** waarin ek geswem het (Ronel Calitz).
> *So, for me, it was a great success – in the **little pond or pool** in which I swam (Ronel Calitz).*

Such nested systems are, in the second instance, characterised by very particular patterns of growth. Metaphors relating to the growth of ecological systems embody quite vividly Cavallo's (2004) conception of educational systems as 'ecological' or 'viral' systems. The metaphors employed in the narratives in this regard also reinforce the central growth thesis adopted by the managers of the Project, namely the establishment of regional 'growth points' that would stimulate further uptake of the Project, as discussed above. In this way, the Project becomes a plant that, almost rhizomatically (following the definition posited by Deleuze and Guattari, 1988), becomes self-sustaining.

> … kundigheid oor die provinsie sort van tot stand bring wat dan in die nuwe bedeling as **groeipunte , voedings-gebiede** van die agtergeblewe skole kon dien (Peet Venter).
> *... created know-how throughout the province, so that [these centres] could serve as **growth points or feeder centres** in the new dispensation (Peet Venter).*

> Ek dink dit kan ek nogals sien as een van die groot **uitvloeisels** gewees van hierdie projek (Sarie du Plessis).
> *I think that it can be seen as one of the important **consequences** [**'outflowings'**] of this Project (Sarie du Plessis).*

> **Die wortel –** die feit dat ons onderwysers gehad het wat die tools verstaan het (Igno van Niekerk).
> ***The root** of the issue was the fact that we had teachers who knew how to use the tools (Igno van Niekerk).*

However, as some of the other ecological metaphors emphasise, such a 'self-sustaining' system is also an integral part of a yet larger system. The metaphor of funds as water, employed below, implicates a view of the Project as an integral part of a larger system upon which it is dependent for its survival.

> As daai fondse **opdroog** … (Hercules Dreyer).
> *If those funds **dry up** ... (Hercules Dreyer).*

It might seem, given the metaphors viewed thus far, that the metaphorically envisaged ecological systems are stable and fully determinate. There are, however, metaphors that affectively implicate, not only the potential indeterminacy of ecological systems but also the possibility that such systems do no preclude the possibility of destruction or stagnation. So, by way of recovered weak implicatures, the Project as ecological system is neither fully determinate nor immune to either destruction or stagnation.

> … want dit sou in ‘n **donker poel** ingegaan het (Igno van Niekerk).
> *... because it would have disappeared in a **dark pool** (Igno van Niekerk).*

> Wat ek wel weet is dat Persoon X en Persoon Y, wat toe hoof van onderwys was, is toe **onder ‘n wolk** by die onderwysdepartement weg na aantuigings van korrupsie in die koerante en so (Igno van Niekerk).
> *What I do know is that Person X and Person Y, who was the head of education at the the time, left the Department of Education under a **cloud of suspicion** after allegations of corruption in the media (Igno van Niekerk).*

> … in stede van **gestagneer** het (Igno van Niekerk).
> *... instead of **stagnating** (Igno van Niekerk).*

In fact, not only is the ecological system indeterminate and prone to destruction and stagnation, but it is also prone to evolutionary production of atypical and undesirable results. The Project, as ecological system, is, by way of contextually-driven recovery of weak implicature, prone to the same dangers.

> Dan word dit na ‘n jaar of twee ‘n **wit olifant** (Johan Badenhorst).
> *Then it becomes a **white elephant** after a year or two (Johan Badenhorst).*

> Jy kan nie daai ding soos ‘n **wit olifant** hou nie want al wat jy weet van ‘n rekenaar is hoe langer hy staan, hoe minder word hy werd (Igno van Niekerk).

> *You can't keep that thing locked away like a **white elephant** because the one thing you know about a computer is the longer it stands the less it is worth (Igno van Niekerk).*

So, what at first appears to be a self-sustaining system (the Project), is in fact part of larger and yet larger systems (structural levels within which Project is situated). But even this situatedness cannot make the smaller system impervious to indeterminacy, destruction, stagnation or the production of atypical and undesirable results. In short, the sustainability of the Project as ecological system cannot be guaranteed by intra-systemic functionality alone.

In this way, human agency, so consistently implicated in the metaphoric patterning relating to personhood finds its way into the larger contexts of nested systems. Not only that, but the recovery of weak implicatures from the metaphor employed below (in conjunction with the socio-religious context outlined above) suggest that such human agency takes the form of custodianship over the natural world, as envisaged in God's directive to human beings in the Bible. The Project, as ecological system, is also subject to human custodianship.

> Jy weet, as iemand vir my 'n **hond in my huis aanbring**, dan moet ek die hond **kos gee en hom groot kry** – hy sal my nou half **beskerm** op die ou einde maar ek kan nie die hond los - net daar - lat hy vrek nie (Igno van Niekerk).
> *You know, if someone **gives me a dog**, I have to **feed it and nurture it** – it will in all likelyhood **protect me**, eventually, but I can't simply leave the dog there to **die** (Igno van Niekerk).*

Such human custodianship of the natural world, given the history of South Africa in general, and the Great Trek in particular, finds embodiment in the image of the pioneer farmer. In the first instance, the pioneer farmer (besides fulfilling the role as missionary) must tame the wild, as indicated in the metaphor employed below. This implicates the turning of teachers away from the classroom practices to which they had became accustomed and preparing them for computer-integrated education.

> Dit was die jare wat jy die mense **getem** het (Ronel Calitz).
> *Those were the years when you had to **tame** people (Ronel Calitz).*

But this was not where it ended, as indicated below. The propagators of the Project, viewed as pioneer farmers, had to intervene actively in systemic functionality in order to ensure that desirable outcomes were reached.

> Daar is nie meer mense wat dit doen nie – hier en daar waar ‘n ding in **lekker grond geplant** was gaan hy dalk aangaan (Hercules Dreyer).
> *There aren’t really still people who do it. Here and there, where something has been **planted in fertile ground**, it might still persist (Hercules Dreyer).*
>
> Dit het toe nou die **saadjie geplant** (Hercules Dreyer).
> *That was what **planted the seed** (Hercules Dreyer).*
>
> Die ding van so ‘n ding is om die ding heeltyd te **laat groei** (Hercules Dreyer).
> *The important thing about this is to **allow the thing to grow** (Hercules Dreyer).*
>
> … moet jy heeltyd **kunsmis ingooi** (Hercules Dreyer).
> *... you have to **add fertilizer** throughout (Hercules Dreyer).*
>
> … en jy moet dit **water gee** (Hercules Dreyer).
> *... and you have to **water** it (Hercules Dreyer).*
>
> … nie net die ding by plekke in te kry nie maar **dit te laat groei** as geheel (Hercules Dreyer).
> *... not only to plant the thing but also to get **the thing to grow** in its totality (Hercules Dreyer).*
>
> Witteberg gebruik Powerpoint in die skoolsaal – ‘n ou moet nooit vergeet dat die **wortels** daarvan was ROLIS nie (Igno van Niekerk).
> *Witteberg uses Powerpoint in the school hall – one should never forget that the **root** of such usage is the CALIS Project (Igno van Niekerk).*

> Jy moes terugkom en die vereiste was dat ‘n ou moes **terugploeg** wat jy geleer het en ek dink selfs ohannes Cronje hulle was daai tyd betrokke by om te se ‘n ou moet **terugploeg** en so, toe land ek by Dr Peet Venter en Hercules en FRETEL en ons het hierdie goed in FRETEL **teruggeploeg** (Igno van Niekerk).
> *One of the prerequisites was that you had to return and **plough back** what you had learnt; even Johannes Cronje emphasised the **ploughing back** of knowledge. Then I was assigned to Peet Venter, Hercules and FRETEL and we **ploughed back** these things into FRETEL (Igno van Niekerk).*

Recovery of further weak implicatures relating to the metaphors quoted below, in the context of the socio-religious situatedness elucidated above, suggest a further relevance of human agency. Not only are humans custodians of the earth, but they also become the sower in the parable of the same name in the Bible. The sower in the parable embodies Christ himself who proclaims the ‘Word’. Some seeds (messages) fall on fertile soil. These grow and prosper. Others fall on rocky ground and are blown away by the wind. Implicated in the parable is a message to the disciples: when Christ has died and been resurrected, they will, in turn, become the sowers. The Project as ‘Word’ is initially propagated by the managers of the Project but, as encompassed in the metaphor relating to ecological or viral growth, further growth and expansion will depend on the ability of ‘converted teachers’ to inspire others to become involved in the Project.

> Jy weet, as jy ‘n **appel sny** dan kan jy sien hoeveel **sade** is daar, maar as jy die **appelsaad** het dan weet jy nie hoeveel **appels** is daar nie. Ek dink hulle het baie **sade geplant** en ek dink daai **appels** weet ons nie eers waar hulle is nie (Igno van Niekerk).
> *You know, when you **cut open an apple**, you can see how many **seeds** there are but when you have the **apple seeds**, you don’t know how many **apples** there are. I think they planted many **seeds** and we don’t even know where all the **apples** are that those seeds gave rise to (Igno van Niekerk).*

> … maar die **vrugte,** soos ek gese het, het voortgegaan (Johan Badenhorst).
> *... but the **fruits** [of the Project], as I said, persisted (Johan Badenhorst).*

In this way the Project as ecological system and the concept of personhood, as integral part of the ecological system, merge and become one.

Both groups of metaphoric patterning examined thus far implicate vertical characteristics of systemic functionality. But systemic functionality is also horizontally diachronic and involves the evolution of the system over time. The diachronic aspects of systemic functionality find expression in metaphoric patterning depicting the progress of the Project as a journey.

4.3.5.3 Patterning of journeying

The metaphor of journey, in our culture, routinely implicates the traversal of physical space from a beginning to an end. Such traversal is not only defined in terms of the physical distance covered but is also defined by the passage of a certain amount of time.

In the first place, the metaphor of journey thus implicates 'motion towards'. This motion may take the form of walking, running, or the use of any number of vehicles. If progression of the Project is a journey, then implicatures recovered from the metaphors used below suggest that the enthusiasm of uptake amongst those involved in the Project determined whether they chose to 'walk' or 'run' towards their goal.

> … wat baie opgewonde was en jy weet, en **geloop** het met dit (Ronel Calitz).
> *... who were very excited and, you know '**walked with**' the Project (Ronel Calitz).*

> Toe was Gibbons en so aan nog daar – dit is baie mooi wat daar **geloop** het (Johan Badenhorst).
> *At that point Gibbons and company were still there and it was very beautiful the way they '**walked with**' it (Johan Badenhorst).*

Odendaalsrus was Odensia en Wessel Maree – daar was ook mooi dinge aan die gang wat **geloop** het (Johan Badenhorst)
*In Odendaalsrus there was Odensia and Wessel Maree where good things were happening and where they '**walked with**' it (Johan Badenhorst).*

By die laerskool was daar definitief ROLIS projekte wat baie mooi **geloop** (Johan Badenhorst).
*At the primary school there were definitely CALIS Projects that were '**walking**' (Johan Badenhorst).*

… wat entoesiasties is wat die dinge laat **loop (Johan Badenhorst)**.
*... who were enthusiasitic amd made things '**walk**' (Johan Badenhorst).*

… so die ROLIS se **voetspore** het aanhou **loop en loop en loop** (Igno van Niekerk).
*... so the CALIS **footprints** carried on '**walking and walking and walking**' (Igno van Niekerk).*

As die besigheid en die skool kan begin saamwerk, kan jy 'n **ongelooflike pad stap** in terme van rekenaarondersteunde leer (Igno van Niekerk).
*If business and the school are able to cooperate, you can **travel together [on foot]** a long way in terms of computer-integrated education (Igno van Niekerk).*

Ou Sarie **loop** vandag nou nog en doen hierdie goed (Igno van Niekerk).
*Old Sarie stills **walks around** doing these today (Igno van Niekerk).*

… en doen programme en **loop** met daai tipe goed (Igno van Niekerk).
and does programmes and 'walks' with those kinds of things (Igno van Niekerk).

Sy het absoluut **gehardloop** met rekenaars goete (Ronel Calitz).
*She absolutely '**ran**' with computers and things (Ronel Calitz).*

Hulle was almal baie oulike mense en entoesiasties en hulle het soort van **gehardloop** met die idees wat ons vir hulle gebring het (Peet Venter).
*They were all very nice, enthusiastic people and they sort of **ran** with the ideas that we brought them (Peet Venter).*

…en **hardloop** sy… (Peet Venter).
*...and she **ran**... (Peet Venter).*

En daar is genoeg ouens wat se koppe reg is wat **hardloop** (Peet Venter).
*And there are enough guys who have the right attitude and who **run** (Peet Venter).*

… is makliker om te **hardloop** met Intel en so aan… (Peet Venter).
*... it is easier to **run** with Intel and the like... (Peet Venter).*

En as jou LF's nie soort van **voor hardloop** nie dan gaan die ander ouens nie kom nie (Peet Venter).
*And if your LF's [Learning Facilitators] don't sort of **run in front**, then the other guys don't follow (Peet Venter).*

Daar is van die LF's wat nou baie goed daarmee **hardloop** van die wat ICDL ook kry en wat nou die Intel **hardloop** (Peet Venter).
*There are a number of LF's who **run very well** with it now – those who get the ICDL [International Computer Driver's Licence] and those who **run** Intel (Peet Venter).*

> Ek glo ons was reg **in die wegspringblokke** om dit te doen (Hercules Dreyer).
> *I am quite sure that we were **in the starting blocks**, ready to do that (Hercules Dreyer).*

> Ek weet Hercules Dreyer en Dr Peet Venter was op daai stadium die twee ouens wat regtig **gehardloop** het (Igno van Niekerk).
> *I know that, at the time, Hercules Dreyer and Dr Peet Venter were the guys who really **ran** with it (Igno van Niekerk).*

> Hulle was die ouens gewees wat ROLIS **gehardloop** het (Igno van Niekerk).
> *They were the guys who really **ran** CALIS (Igno van Niekerk).*

> *And, yes, I was sad it did not continue **running** (Maureen Dale).*

Participants in the Project also made use of an assortment of tools ('vehicles') that they sought to implement in furthering the aims of the Project.

> En daai ouens wat dan **hardloop** begin die ander ouens **saamtrek** (Peet Venter).
> *And the guys who **run** begin to **draw** others after them (Peet Venter).*

> Ek meen, die wiel word nou tien jaar later - 14 jaar later word die ding weer **herontwerp** (Ronel Calitz).
> *I mean, 10 years later – no, 14 years later – the **wheel is being discovered again** (Ronel Calitz).*

> Kan jy dink as ons van daar af **gerol** het want die **wiele** was reeds – die **momentum** was reeds daar (Igno van Niekerk).

*Can you magine if we had **'rolled'** from there, because the **wheels** had been fixed and we had gained **momentum** (Igno van Niekerk).*

Dan is jy so gewoond om onderbreek te word, jy **trek jou venster toe** – jy wil nie goed gratis hê nie (Igno van Niekerk).
*You become so used to being interrupted that you' **roll up' your window** – you don't want any free goods (Igno van Niekerk).*

*It was unbelievable admin work to get that thing **on the road** (Maureen Dale).*

Ek weet nie hoeveel honderde skole moet ons nou **aan boord** kry nie (Sarie du Plessis).
*I don't know how many hundreds of schools we have to **get on board** now (Sarie du Plessis).*

The 'motion towards the goal' figured forth in the metaphors quoted above is more than mere motion. The progress is directed by a clearly defined goal and advocacy of the Project is the banner under which such progression takes place.

Dit het nie opgehou nie – Sarie het maar **met die banier aanhou loop** soos van ouds (Igno van Niekerk).
*It did not end – Sarie continued **carrying the banner**, as she had always done (Igno van Niekerk).*

Ek dink Dr Peet het dit baie **onder dieselfde vaandel** – …(Igno van Niekerk).
*I think Dr Peet did it **under the same banner** - ... (Igno van Niekerk).*

Ons moes maar **stoot** om weer op die ou einde **te kom by 'n plek** - en ek weet ook nie of **is ons al daar nie** (Sarie du Plessis).

*We had to **press on** to arrive eventually at our **destination** – and I don't know **whether we are even there yet** (Sarie du Plessis).*

In the process of directing the Project in their own particular contexts, participants attempted to control the direction and speed of the journey'. Once again, human agency directs the course of events or the evolution of the Project, and, once again, systemic functionality and development are such that the journey is not without obstacles and hindrances.

Ek was nie **aan die stuur** daarvan nie (Ronel Calitz).
*I was not **at the helm** (Ronel Calitz).*

Onderwysers van regoor die Vrystaat het gekom en bygewoon en gesien 'maggies maar hier is 'n **hele nuwe wêreld** vir die ouens oopgegaan (Peet Venter).
*Teachers from all over the Free State attended and realized that a **whole new world** had opened up for them (Peet Venter).*

As ek daaraan dink, dink ek Dr Venter het nogals vir 'n mens **horisonne** gegee wat jy nie geweet het bestaan nie (Sarie du Plessis.
*Now that I think about it, I thnk Dr Venter made one aware of **horisons** that one had never even envisaged (Sarie du Plessis).*

Mens moet hou van nuwe goed – met ander woorde jy moet hou – jy moet kan **explore;** nuwe goed moet nie vir jou angs bring nie (Sarie du Plessis).
*One has to enjoy **discovering** new things – in other words, you must be able to **explore**; new things must not cause you anxiety (Sarie du Plessis).*

Sy't weer vir my 'n hele **nuwe wêreld** oor baanbrekerswerk gedoen – 'n nuwe wêreld oopgemaak oor lees (Sarie du Plessis).

*She was a pioneer and **opened up a whole new world** for me (Sarie du Plessis).*

In daardie proses het ons die skoolhoofde probeer om hulle dan nou daai **bruggie oor te steek** (Johan Badenhorst).
*In the process, we attempted to get the principals to **cross that bridge** (Johan Badenhorst).*

Mens kan duidelik sien waar beland – waar word – wat noem ek dit – **pitfalls** (Ronel Calitz).
*One can see quite clearly where the **pitfalls** are (Ronel Calitz).*

Ja , die **slaggate**, ja – en mens kan niks daaraan doen nie (Ronel Calitz).
*Yes, the **potholes** – and one can do nothing about it (Ronel Calitz).*

In wese het hulle ‘n **teerpad afgebreek (Peet Venter).**
*In actual fact, they **destroyed a tar road** (Peet Venter).*

The implicated hindrances on the journey to reaching the Project’s destination result in unplanned and largely unchartered detours that seem to divert participants from continuing the journey towards the destination, namely the full implementation and sustainability of the Project.

… en **deur die bosse geloop** en nou wil hulle die teerpad weer bou net daar waar hy was (Peet Venter).
*…and **blunder through the bushes**, and now they want to rebuild the tar road where it originally was (Peet Venter).*

Hulle wil nog **in die bos rondfoeter** jy weet (Peet Venter).
*You know, they still want to **blunder about in the bush** (PeetVenter).*

… waar hierdie ouens nog, wil ek amper sê, **met die mikstok en die brief rondhardloop (Peet Venter).**

> *... where these guys, in a manner of speaking, still want* ***run around with letters in cleft sticks*** *(Peet Venter).*

The obstacles and hindrances thus identified lead on to that which lies at the heart of the metaphoric patterning relating to journeying, namely absence.

In participants' narratives, frequent references are made to the fact that the Project 'het doodgeloop'. This Afrikaans expression is used with almost metronomic regularity by almost all participants when referring to the demise of the Project. The compound word contains both 'dood' (dead) and 'loop' (walk). Both terms resonate particularly loudly in the context of the metaphoric patterning discussed thus far in this particular study. Metaphoric patterning relating to concepts of personhood evokes weak implicatures conceptualising the Project as human, and the demise of the Project involving not only death, but murder.

But, when the two concepts are combined in the expression 'doodgeloop', it takes on one or more of the following meanings: "tire oneself out by walking; come to a dead end (street); peter out; fizzle out" (Kritzinger et al, 1986, p.125). In the use of this expression there is thus a confluence and intermingling of implicatures that characterise metaphoric patterning relating to personhood and that relating to journeying. Just as the absence that constitutes 'death' characterises personhood patterning, so also the absence that constitutes a 'dead end', in the face of an attempt to reach the journey's destination, characterises the patterning related to journeying.

> A: En nadat Ronel nou weg is en die ding het **doodgeloop** jy kan sien die kinders sukkel, hoor, veral met lees (Ronel Calitz).
> *A: And once Ronel had left, and the thing had* ***'fizzled out'****, you could see that the children were battling – particularly with reading (Anna: Ronel Calitz)*

> A: Glad nie. Dit het **doodgeloop, doodgeloop , soos in doodgeloop** (Anna: Ronel Calitz).
> *Not at all – it* ***'fizzled out, fizzled out, fizzled out'*** *(Anna: Ronel Calitz).*

> …ook op 'n stadium daar gehad maar dit het ook **doodgeloop**. (Ronel Calitz).

*… at one point they also had that there but it also '**fizzled out'** (Ronel Calitz).*

Ek myself - die rukkie wat ek nog daar was nadat dit **doodgeloop** het - jy kan sien die kinders sukkel (Ronel Calitz).
*I myself, during the short time that I was there, could see how the children battled after it had '**fizzled out'** (Ronel Calitz).*

Hy het later 'n Future Kids sentrum begin, weet ek, op 'n stadium, maar ek dink dit het toe maar op die einde ook maar **doodgeloop** (Johan Badenhorst).
*I know that he later began a Future Kids Centre but I think it eventually also '**fizzled out'** (Johan Badenhorst).*

Daar was baie mooi goed aan die gang, maar ek dink daar het dit redelik **doodgeloop (Johan Badenhorst).**
*They did good things there but I think it has '**fizzled out'** (Johan Badenhorst).*

Ek het nie werklik die geleentheid gehad om nou te gaan sien hoe dit aangaan en of dit **doodgeloop** het nie (Peet Venter).
*I haven't really had the opportunity to to see whether it {CALIS Project] continued or whether it '**fizzled out'** (Peet Venter).*

As dit nie vir daai tipe mense was nie, het die goed bloot eenvoudig **doodgeloop (Igno van Niekerk).**
*If it hadn't been for those kinds of people, things would simply have **'walked into a dead-end' /'fizzled out'** (Igno van Niekerk).*

The nature of light patterning in the universe alerts astronomers and cosmologist to the existence of mysterious dark matter that appears to be powerful enough to shape the structure of the universe. In the same way, the metaphoric patterning relating to journeying in participant narratives alerts one and draws one's attention to the absence that lies at the centre

of such patterning. Implicatures recovered in the context of metaphoric patterning discussed thus far suggest that this absence not only ties in with patterning related to personhood, but that the crux of the journey is the fact that it is not completed. This suggestion finds further support in the next section.

4.3.5.4 Patterning of energy

If a journey is to be completed and the traversal of physical space achieved, sustained propulsion is required. Such propulsion may rely on various sources of energy. The Project as journey finds implicated sources of energy in metaphoric patterning related to the concept of energy.

The first, and possibly most primitive, of energy sources relates to metaphors conceptualising teacher and learner enthusiasm as the igniting of a fire.

> Die eerste ekspo wat ons gehou het was 'n fantastiese sukses gewees, in die sin dat dit het **vuur en vlam aan die brand gesteek** (Peet Venter).
> *The first expo we presented was a fantastic success, in the sense that it **ignited the fire** (Peet Venter).*
>
> … en dit het die **vlam aan die brand** gesteek (Peet Venter).
> *... and that **ignited the fire** (Peet Venter).*
>
> Nou is hulle **vuur en vlam** vir dit (Peet Venter).
> *Now they are **consumed by** enthusiasm (Peet Venter).*
>
> Weet jy hoe het die kinders **gebrand** om hulle boeke uit te haal om te kyk wat het die digter gedoen (Hercules Dreyer).
> *Do you know how the children **'burnt'** with / were **consumed** by the desire to see what the poet had done? (Hercules Dreyer).*

The second source of energy required for propulsion, conceptualised in the narratives via metaphor, is that of electricity. Traditionally, electricity is considered a 'clean' source of

energy, but , like fire, it is difficult to produce enough electricity to satisfy the ever-escalating need for energy in this way.

> Sy kan ‘n ding baie goed organize – sy is **livewire** wat dit aanbetref (Peet Venter).
> *She can organise things very well – in that sense she is a* ***livewire*** *(Peet Venter).*

> Jy kan gerus met haar ook praat want sy was ‘n unbelievable **livewire** gewees (Peet Venter).
> *You should speak to her because she was also an unbelievable* ***livewire*** *(Peet Venter).*

> Jy identifiseer baie vinnig **die bright spark** in die klas (Hercules Dreyer).
> *You soon identify the* ***bright spark*** *in the class (Hercules Dreyer).*

In this way, weak implicatures recovered from the interference pattern of different metaphoric patterning in the narratives, conceptualise the sources of energy discussed thus far as propulsion agents in the journey towards sustainability of the Project. But, just as both fire and electricity are inadequate in addressing spiralling energy needs, so also these propulsion agents become ineffective in the face of hindrances and obstacles placed in the path of ensuring the sustainability of the Project. In fact, the withdrawal of government support brings the journey to a dead end, and the perceived hindrances turn into an absence, almost like a black hole in the fabric of space-time. Further propulsion is virtually impossible – unless the energy source is completely unlike its predecessors; unless an energy source can be found that functions according to totally different rules. Enter quantum physics and the concept of nuclear fusion.

What makes energy release during nuclear fusion different from energy release during ignition or electrification (besides the magnitude of energy release), is the fact that the nuclear fusion reaction (at least in theory) becomes self-sustaining. Implicated in the metaphor quoted below, is the conception of government withdrawal from the Project as the withdrawal of energy sources (support) and thus also propulsion. The absence of propulsion leads to the journey being interrupted. In fact, the journey has ‘come to a dead end’ or ‘fizzled out’ (Kritzinger, 1986, p.125). What is needed is an energy source beyond those contemplated

before. The energy source, in fact, cannot be sought outside of the Project. The energy source is the enthusiasm and determination which lies dormant in those already involved in the Project. What is needed to release this dormant energy is a chemical reaction – but not just any chemical reaction; this reaction has to take place at the sub-atomic level, governed as it is by quantum laws. Such a reaction will not only release many magnitudes of energy more than traditional sources, but will also self-sustain.

> Dit werk amper soos in die Fisika met uraan wanneer jy die **regte bestanddele** bymekaar bring. (Peet Venter).
> *It is similar to what happens in physics when you combine the **right ingredients** (Peet Venter).*

> En ons het toe die volgende jaar die ekspo weer herhaal en Hercules was die organiseerder van die ekspo – dit was werklik ‘n ongelooflike **katalisator wat die energie losgemaak het** (Peet Venter).
> *We repeated the expo the following year – Hercules was the oganisor. It was an unbelievable **catalyst that released so much energy** (Peet Venter).*

> Dan kry jy **fusion en ‘n helse omtploffing** – ek het dit rêrig daai tyd gesien met die ROLIS projek (Peet Venter).
> *Then you get **fusion and one hell of an explosion** – I really experienced that with the CALIS Project (Peet Venter).*

In this way, sustainable propulsion is assured and so also is ‘motion towards’ the destination. As is the case in any complex system, sustainability is ensured by the adaptability of evolutionary (often indeterminate) change, rather than the predictability of linear progression.

> Dit is maar **dryfkrag** van onderwysers – … (Johan Badenhorst).
> *It is simply the **drive** that teachers have - ... (Johan Badenhorst).*

> Hulle hoef jou nie te **dryf** nie. Jy moet jouself kan dryf (Sarie du Plessis).

*They don't have to **drive** you – you have to be able to **drive** yourself (Sarie du Plessis).*

4.4 Summary

Implicatures recovered in the previous paragraphs, provide the multiple and complex links that elucidate and animate the seemingly discrete influences on the successful implementation and sustainability of the Project, discussed in the first half of this chapter, namely personal, programmatic, physical and systemic influences. Such influences are subject to multiple, mutual, and complex, cause-and-effect relationships that cannot be accounted for in any linear fashion. A Relevance Theoretic consideration of wide ranges of weak implicatures associated with the use of metaphor provides the language of complexity with which complexity it is to be addressed.

In Chapter 5 I bring the findings presented in this chapter into dialogue with the existing literature in the field, and the conceptual framework proposed in Chapter 2.

Chapter 5

Conclusions and recommendations

5.1 Overview of chapter

This Chapter opens with a brief summary of the research presented in this study. This is followed by an integration of the findings presented in Chapter 4 with views presented in the literature and the conceptual framework, presented in Chapter 2. The dialogue arising from this integration is followed by a brief summary and pointed evaluation of such dialogue. Subsequently, anomalies and differences between the findings and the literature are elucidated. These differences inform the adapted design of the conceptual framework presented in Section 5.3.3.

Having addressed the similarities and differences between the findings and the literature, the discussion moves to a reflection on methodological, substantive, scientific and exploratory aspects of this study. Finally, recommendations for policy, practice and further research precede the conclusion to the study.

5.2 Summary of this research

The motivation for this research was derived from my own experiences as a secondary school teacher, and Head of Department tasked with the development of information technology in the institution. I became aware of the fact that some teachers seemed to integrate computers effortlessly into the taught curriculum, whilst others found it impossibly difficult – all within the same institution. This led to questions surrounding not only the initial uptake of such integration amongst teachers, but also questions surrounding the sustainability of such integration. On being made aware of the CALIS Project that had taken place in the Free State Province in the early 1990's I realised that the Project presented an excellent opportunity of exploring possibilities with regard to my concerns.

From this exploration, the following research question was derived:

> *How did influences on the implementation of the CALIS Project affect the sustainability thereof?*

This research question was later expanded and formulated as five, related sub-questions:

> *1. How did personal qualities, possessed by people directly or tangentially involved in implementing the Project, influences the implementation and sustainability of the Project?*
> *2. How did elements of programmatic design (those elements of programmatic design specifically embodied in the goals of the Project) influence the implementation and sustainability of the Project?*
>
> *3. How did the availability of physical resources during implementation influence the sustainability of the Project?*
>
> *4. How did the larger systemic environment in which the Project was implemented, influence the sustainability thereof?*
>
> *5. How was the further development of the Project affected by the animated, interactional interrelatedness of the complex system infused by all of the influences mentioned above?*

What follows is a dialogue between the literature and conceptual framework, presented in Chapter 2, on the one hand, and, the findings of this research study, presented in Chapter 4, on the other. The issues addressed are those raised in each of these sub-questions.

5.2.1 Research Question 1

> *1. How did personal qualities, possessed by people directly or tangentially involved in implementing the Project, influences the implementation and sustainability of the Project?*

On the national structural level (4.3.1.2), personal qualities possessed by the lecturers and students involved in the M.Ed. C.I.E. at the University of Pretoria are perceived by participants to have had a very positive influence on the Project. Mooij and Smeets (2001) refer to the importance of active participants at all structural levels of the educational system, and Ely (1999a) refers to the importance of knowledge and skills amongst teachers. Yet, there is no specification in the literature of specific skills at various structural levels of the education system that are likely to influence the successful integration of computers into classroom practice.

With reference to this differentiation, participants in the study noted that the qualities possessed by the then Director-General of Education in the Free State (Mr Heyns), namely his enthusiasm for computers in education, visionary leadership and financial management expertise, similarly had a positive influence on the sustainability of the Project on regional level (4.3.1.3). Some of these qualities were also identified in Dr Venter, the Project co-ordinator and manager, but, in addition, he is deemed to have been: innovative; a strategic

planner; an inspiring manager who was not afraid to adopt an unorthodox managerial style; an energizer; and someone who fostered communities of practice. Such qualities seem to have been well-suited to his role as strategist, planner and energizer of the Project. Similarly, Hercules Dreyer's capacity for hard work and his determination accord very well with his role as implementer of the Project - so also, Johan Badenhorst's pure intentions, passion for the Project, empathy, and willingness to help accord very well with his role in the Project - namely that of teacher support. Ely (1999a) refers to the importance of leadership in determining the successful implementation and sustainability of such educational projects, but this suggestion applies to leadership at institutional level and does not envisage the finely-nuanced, layered matching of personal qualities with specific roles identified by the participants in this study.

The fact that institutions were approached to take part in the Project (4.3.1.6) but were not coerced into doing so, meant that principals who became involved did so because, like Maureen Dale, they foresaw ways in which their institutions could be enriched. What is also clear is that such principals, and members of school management teams, envisaged the Project contributing positively to the system as a whole, and not merely to their individual institutions. In support of these findings in participant narratives, the literature is replete with references to the importance of the existence of knowledge and skills at school leadership level (Ely, 1999a); the importance of staff development (Becker, 19994, 2000a, 2000b; Shuldman, 2004; Mooij and Smeets, 2001); and the importance of principal and school management leadership (Baylor and Ritchie, 2002; Shuldman, 2004).
In contrast, some of the major concerns expressed in the literature, such as the scheduling of computer time (Pelgrum, 2001) and the importance of a full-time technology coordinator (Becker 1994, 2000a, 2000b) are not supported by participants, essentially because the classroom-based implementation of computers precluded the possibility of computer laboratory congestion (at least, initially) and the perception of limited resources on the part of educators in most schools precluded any thought of school-based technical support.

But some form of support across institutions is reported to have come from a source not anticipated in the literature, in the case of two of the participants interviewed. In the case of Ronel Calitz, her husband was the principal at a nearby school, and, in the case of Sarie du Plessis, her husband taught at the secondary school attached to the primary school at which she taught. Furthermore, both were technology coordinators for their respective schools. The influence of close personal relationships across contiguous institutions is not contemplated in the literature as a contributory influence to the successful integration and sustainability of computers in classroom practice.

Just as schools were not coerced into taking part in the Project, so also educators could choose whether they wanted to be involved or not. Voluntary participation of educators in the Project (4.3.1.7) meant that those who did choose to become involved were, by definition, educators who were, at best, passionate, or, at worst, interested in the integration of computers into classroom practice. But, besides such interest, participant narratives identify very specific qualities associated with educators who became involved: they were naturally curious and embraced innovation and change; they were generally subject matter experts who sought solutions to educational challenges; they generally viewed teaching as a calling, and were committed to the improvement of their craft; and, perhaps most importantly, they were possessed of above-average drive and determination.

No mention is made in the literature of teacher drive or determination as an important influence on the implementation and sustainability of computer-integrated education. Veen (1994, 1995) argues that teacher factors outweigh all other factors influencing the successful implementation and use of computers in classroom practice. In this regard, Ten Brummelhuis (1995) and Ten Brummelhuis and Tuijnman (1992) argue that teachers' perceptions regarding the relevance of the innovation is by far the most important factor. This view is supported by Baylor and Ritchie (2002), who feel that teachers' openness to change is the crucial factor. If this is the case, then the decision to involve only teachers who were convinced of the efficacy of computer-integrated classroom practice would have contributed significantly to the success of the CALIS Project.

Ely (1999a) postulates dissatisfaction with the existing state of affairs, the existence of teacher knowledge and skills, and the availability of time as key conditions for the implementation of computer-integrated education. The first two pre-conditions are met in participant narratives, but very little mention is made of lack of time – possibly because teachers who took part in the Project were internally motivated and did not experience the extra work that they took on as a burden. One of the most widely-reported obstacles to the integration of computers in classroom practice is the lack of teacher skill regarding integratory practices, and the concomitant negative impact on teacher confidence (Pelgrum, 2001; Mooij and Smeets, 2001; McMullan, 2002). Participant narratives are generally devoid of references to this perceived problem. The answer might well lie in the fact that volunteer-teachers decided to take part in the Project exactly because they were looking for a way in which technology could help them to solve educational problems. In contrast, as mentioned above, the hardware infrastructure in many developed countries preceded related pedagogical practices and thus provided a technological imperative for computer-integrated education,

rather than an educational one. McMullan (2002) argues that one of the major problems associated with the integration of computers into classroom practice is the fact that teachers have not been able to adapt their practice to embrace new technologies. The question that arises is the following: is such adaptation sought for the sake of enriching learning and teaching or is such adaptation sought for the sake of accommodating innovative technology?

5.2.2 Research Question 2:

> *2. How did elements of programmatic design (those elements of programmatic design specifically embodied in the goals of the Project) influence the implementation and sustainability of the Project?*

The planning of the CALIS Project included an initial research and information-gathering phase (4.3.2.1) which involved, amongst other things, a tour to institutions in the United Kingdom and the United States of America and attendance of the National Computing Conference in the U.S.A. Although Mooij and Smeets (2001) envisage the influence of active contributors to the success of a computer-integrated education project at all structural levels of the educational system (also the international level), the nature of such active contributions is never explored any further. Also, no indication is given of what exactly constitutes 'active' involvement. Presumably the host institutions, possessed of the necessary knowledge and skills (Ely, 1999a) sought by the Project initiators, were quite willing to receive their guests from South Africa, but it can hardly be argued that their role in the CALIS Project was anything other than passive, and yet, the knowledge and skills gained by the visitors were invaluable in planning and implementing the Project on their return to South Africa.

The same cannot be said of the partnership entered into by the CALIS Project team and the University of Pretoria's Computer Integrated Education (C.I.E.) contingency on national level (4.3.2.2). After having conducted research into the relative level of expertise resident at South African higher education institutions in terms of computer-integrated education, the Project managers approached the C.I.E. group with a view to entering into a partnership. The role played by the C.I.E. representatives in the ensuing partnership was not only active but positively inspiring, as mentioned above. Proof of such inspiration is the fact that many teachers involved in the Project enrolled in the M.Ed. (C.I.E.) at the University of Pretoria after having been exposed to the contribution to the Project made by this programme. The participation and commitment of teachers envisaged by Ely (1999a) as an important influence on the success of similar projects is thus also true of active participants at other structural levels of the education system. The same can be said of the importance of school leadership, identified by Ely (1999a).

On regional level (4.3.2.3), the interrelatedness of programmatic and systemic influences is clearly visible. The implementation of a regional computer literacy programme amongst teachers does not fall within the gambit of programmatic influences, as defined in the sub-question, since it is not part of the CALIS Project as such. Yet, the vision for the integration of computers into schools was systemically approached as a three-phase process: a computer literacy drive; the introduction of computers in schools as administrative tools; and the integration of computers into the taught curriculum. Such interrelated horizontal influences that cut across vertical structural levels are not explicitly addressed in the literature. The computer literacy drive that preceded the CALIS Project led to the establishment of five computer centres, one in each of the districts of the region. These centres were later used for teaching of Computer Science as subject since there was a dearth of expertise at schools. When CALIS was implemented, these centres served as district-based support centres for the Project. Besides references to a 'phased approach' (Mooij and Smeets, 2001; Armstrong et al., 2004), the literature tends to approach the integration of computers into the classroom as a stable process that is not dynamically co-determined by system-wide influences. For this reason, the concept of ecological or viral change in educational systems and the concept of sustainability in complex educational systems, introduced in the conceptual framework, address such dynamism in two ways. Firstly, Cavallo (2004, p.97) argues that participants in such systems "design and introduce new variants along certain principles and see how well they grow". This process, he argues amounts to appropriation and experimentation. So, the process is anything but stable and predictable. Secondly, Fullan (2005) emphasises the systemic interrelatedness of influences by postulating contextual change at all levels as an essential element of sustainability in complex educational systems. The integration of computers into classroom practice as complex educational process is thus neither stable nor predictable. As such, we should expect complex interrelated influencing of the system, both vertically and horizontally.

The same point is made by participants with reference to the project structural level (4.3.2.4). The CALIS Project was never intended to be a stand-alone project, but was meant to be one of a triad. CALIS and the other projects, namely FRENET (Internet connectivity) and FRETEL (television-based instruction and administration), were intended to be seen as addressing educational needs in the region in an integrated manner. Pelgrum and Plomp (1993) claim that one of the most worrying obstacles to the integration of computers into classroom practice in the 1990's was the fact that school principals were not able to formulate clear goals relating to such integration. In the case of the CALIS / FRENET/FRETEL triad, these goals were formulated at project level and principals did not have to do so. So also,

envisaged obstacles to successful implementation for sustainability such as the lack of time on the part of teachers (Ely, 1999a) and the difficulty of integrating computers into classroom practice (Pelgrum 2001) were not felt at the level of the institution since much of the work had been done at the level of the project. Once again, the literature wishes to address these obstacles discretely at the level of the institution, and does not contemplate the "intelligent accountability and vertical relationships" identified by Fullan (2005, p.14) in the conceptual framework as one of the essential elements of sustainability in complex educational systems. A cogent example of such intelligent accountability is Dr Venter's establishment of the CALIS infrastructure based, partly, on the realisation that such an infrastructure held the promise of enabling sustainability of computer-integrated education under the new political dispensation.

The CALIS /FRENET / FRETEL triad had another very important goal, namely the establishment of horizontal networks of teachers who shared resources and expertise, rather than reinforce the existing culture of competition and isolation. The literature does not contemplate the convergence of institutional and regional culture with the objectives of complex educational projects in co-influencing successful implementation and sustainability. In this regard, the conceptual framework offers theoretical grounding in the form of Fullan's (2005) insistence on the importance of lateral capacity building through networks. Such networks are energised by systemic thinkers and actors at all levels of the system and result in contextual change (thus also institutional and regional change in culture) in the system as a whole.

As far as the educational objectives of the Project are concerned, participant narratives are unanimous in the view that the primary objective of the Project was the full integration of computers into teaching practice at regional level. A secondary objective was full regional diffusion of computer literacy amongst all teachers in the region. The philosophy underlying implementation was that the Project would initially serve white schools only but that infrastructure would be put in place with a view to serving all schools in the region under the new dispensation.

Furthermore, the Project was to contribute to bringing about changes in educational practices. In this regard, Hawkins (2002) endorses the importance of linking computer-integrated education to broader educational reforms in developing countries. Whereas existing practices at the time favoured the development of cognitive skills, the Project would set out to enable the acquisition of a wide range of cognitive, connative and sensori-motor skills. This would go hand-in-hand with a move away from the solely instructivist pedagogical practices to a

more varied approach, including cooperative, social constructivist practices. This view is endorsed by Kozma (2003) who argues that the adoption of computer-based education goes hand-in-hand with widespread adoption of constructivist learning and teaching practices. Pelgrum (2001) and Pelgrum and Plomp (2005) specifically refer to the centrality of active student involvement to the success of computer-integrated education.

Practically, this view found expression in the installation of 8-10 computers in a class of 30 pupils. Such a configuration would enable the use of computers by a third of the class at any given time – the idea being that the rest of the class could be divided into two groups, such that one would work independently and the other would be engaged in work with the teacher. The idea was, further, that expert teachers would develop course modules which could be accessed via the FRENET or FRETEL systems. Furthermore, the presentation of annual expos and concurrent competitions for outstanding computer-integrated course modules would provide the 'cyclical energising' envisaged by Fullan (2004, p.14) as one of the essential elements of sustainability in complex educational systems.

One of the challenges facing the successful integration of computers into classroom practice identified by Shuldman, namely the ability of teachers to adopt innovation and cope with change, is only alluded in passing in the narratives. Far from being a challenge, the ability is mentioned as a characteristic of the teachers who chose to become involved in the Project. Yet another perceived challenge, namely the fact that many teachers use computers to teach the standard curriculum (Law et al., 2000; Scofield and Davidson, 2002), did not find expression in the narratives because teachers who chose to become involved in the Project, did so in the belief that computers could provide novel ways of approaching educational problems resident in the accepted, standard curriculum as it then existed.

Implementation of the Project at the institutional structural level (4.3.2.6) took place with due consideration being given to local contexts and the kind of support that was elicited from school governing bodies, and wider parent and community bodies. The role played by these contextually-defined bodies related particularly to issues surrounding financial sustainability. Such financial sustainability enabled the appointment of a full-time technology coordinator (Becker, 1994, 2000a, 2000b) in some schools; staff development programmes (Becker, 2000a, 2000b; Shuldman, 2004; Mooij and Smeets, 2001) in some schools; and the development of principal and school management leadership in the field of computer-integrated education (Baylor and Ritchie 2002; Shuldman, 2004) in some schools.

Educators (4.3.2.7) who implemented the project in their classrooms did so, similarly, with due consideration of the district and institutional context within which such implementation took place. But, additionally, such educators viewed computer-integration as a way of addressing educational problems. In this way, both Ronel Calitz and Sarie du Plessis were primarily concerned about the teaching and assessment of reading at the Foundation Phase. The Project offered them a way of addressing the issue via the use of custom-made software. The literature (Ely, 1999a; Baylor and Ritchie, 2002; Shuldman, 2004) envisages leadership at institutional level as an important influence on the implementation and sustainability of computer-integrated educational projects. But there is a real sense in which teachers such as Ronel Calitz and Sarie du Plessis embody the new kind of leadership envisaged by Fullan (2005), where such leadership is defined as systems thinking in action, and is to be found at all levels of the system.

Such system-wide leadership, argues Fullan (2005), brings about contextual change at all levels. This certainly seems to have been the case on the structural level of the learners involved in the Project (4.3.2.8). The narratives bear witness to a change in learner perceptions and of and attitudes towards pedagogical practices. The Project seems to have inspired curiosity, excitement and, eventually, the perceived need for computer-integrated education. There were even instances where learners became involved in innovative projects to ensure the financial sustainability of the CALIS Project at their institutions. Such evidence provides further support for Ely's (1999a) insistence on the importance of active student participation.

5.2.3 Research question 3:

> *3. How did the availability of physical resources during implementation influence the sustainability of the Project?*

<u>How did the availability of physical resources during implementation influence the sustainability of the Project?</u>

Just as the interrelatedness of personal, programmatic and systemic influences on the Project cannot be overlooked, so also, physical influences cannot be seen in isolation. In this regard, physical influences on the international structural level (4.3.3.1) are not easily distinguished from systemic influences on the same level. On the one hand, narratives indicate ways in which standard *Windows* applications such as *MS Word* and *MS Excel* were integrated innovatively into classroom practice. In this way, specific physical resources were utilised, in a programmatic manner, in the implementation of the Project. On the other hand, the

implementation of the Project, fortuitously, coincided with the advent of *Windows* 3.1 and the first intuitive, widely available graphical user interface. Had such systemic coinciding not taken place, it is not clear what the influence on the Project would have been. It does not end here. Igno van Niekerk relates his own euphoria at installing his multimedia personal computer. The advent of multimedia computing made richer, more engaging learning environments a reality. With the arrival of the Internet and e-mail, such potential enrichment of the learning environment was accompanied by the possibility of communicating horizontally and vertically across the system in order to share resources and expedite administrative functionality.

The literature envisages two obstacles to the integration of computers in the classroom on the international level, namely the fact that the provision of computer hardware tends to outpace the diffusion of effective teaching practices (Moursund and Bieleveldt, 1999), and the fact that the 1990's were characterised by a dearth of educationally specific software packages (Pelgrum, 2001). The narratives suggest that the Project was, from the outset, an educational enterprise and, as such, was clearly informed by sound pedagogic practices. The implementation of the physical infrastructure was thus predicated on pedagogical principles, and not vice versa, as the literature suggests. Secondly, the Project-initiated use of *Windows*-based applications and shareware offerings obtained from the Internet meant that the dearth of education-specific software packages at international level was counteracted, to some extent. Also, the kind of appropriation and experimentation envisaged by Cavallo (2004) as a characteristic of evolutionary, ecological education systems was encouraged by the absence of numerous targeted educational software packages.

On national level (4.3.3.2), the availability of software that aided administrative tasks associated with teaching played a significant role in positively influencing the integration of computers into classroom practice. In this way, the availability of packages such as *As Easy As* and *Framework* bear witness to Ely's (1999a) insistence on the availability of resources as an important determinant of success. In terms of computer-integrated education in developing countries, Hawkins (2002) identifies an important influence on national level, namely the existence of telecom monopolies that impede connectivity and financial sustainability. Because South Africa was a divided society at the time, and because the Project was implemented in many relatively affluent white schools, the effect of this influence was not as severe as it might have been had implementation in all schools taken place at the same time?

Participant narratives indicate that one of the most important physical influences on the Project at regional (4.3.3.3) and project (4.3.3.4) levels was the way in which Mr Heyns

(Director-General, Education) enabled the availability of funds for the Project, thereby lending support to Ely's (1999a) insistence on the existence of knowledge and skills, and the availability of resources, as important influences on the implementation of computer-integrated education. But, once again, the literature deals with such influences in a discreet, static fashion. Dr Heyn's contribution to the sustainability of the Project must be seen against the backdrop of his own vision for computer-integrated education, which preceded the CALIS Project and which held implications for the anticipated new educational system brought about by political change in the country. Such service is better grounded in Fullan's (2005) conception of "public service with a moral purpose" as one of the essential elements of sustainability in complex educational systems. Such was the impact of financial management and infrastructure creation, that by the time government support for the Project was withdrawn, the physical infrastructure was virtually in place. This fact was, partly, made possible by the financial support of local businesses. On the one hand, many local businesses sponsored the generous prizes offered to winners of the competitions run in tandem with the annual expos. On the other hand, Absa Bank offered the OFSED satellite bandwidth at a greatly reduced rate so that the FRETEL Project could be realized. This involvement on the part of local and national business organizations embodies the kind of private-public partnerships envisaged by Armstrong et al. (2004) and McMullan (2002) as crucial elements of sustainability with reference to future projects involving computer-integrated education. Additionally, with specific reference to the district level (4.3.3.5), narratives document the fact that schools situated in larger urban areas could command much higher school fees and thus financial sustainability of the Project was far more likely to be the case in such institutions.

On the institutional (4.3.3.6) and educator (4.3.3.7) levels, managers of the Project entered into agreements with schools whereby the purchase of computers would be jointly funded by the OFSED and individual institutions. This meant that even relatively poorer rural schools could implement the Project in a more sustainable manner. Also, the importance of the student-computer ratio emphasised by McMullan (2002) was taken cognisance of. In this way scarce resources were pooled most effectively (Ely, 1999a; Cawthera, 2002) and the community was encouraged to take ownership of the Project. Such community involvement is seen by Hawkins (2002) as one of the ten principles that underlie the sustainability of computer-integrated practices in developing countries.

5.2.4 Research question 4:

4. How did the larger systemic environment in which the Project was implemented, influence the sustainability thereof?

How did the larger systemic environment in which the Project was implemented, influence the sustainability thereof?

The interrelatedness of categories of influences on the implementation and sustainability of computer-integrated educational projects has already been mentioned. Admittedly, the categories identified in participant narratives are, to some extent, abstractions of a far more complex reality. Yet, the literature on the sustainability of such projects offers numerous suggestions in terms of important influences. As pointed out above, however, such suggestions are presented as individual influences, and the interrelatedness of such influences is never pursued in more than a cursory fashion. The prevailing approach in the literature is at an even greater loss to account for influences related to synchronous systemic functionality. Consequently, it is the conceptual framework postulated for this study that provides much of the theoretical grounding for these influences, rather than the existing literature on the topic. As a result, the study suggests a conceptual framework within which such theoretical grounding may be achieved. Essentially, concepts from complexity theory, systems theory, autopoetic theory, theory relating to the sustainability of complex educational systems, and relevance theory are combined to present a theoretical foundation that is able to account for the sustainability of a dynamic, complex computer-integrated education project, namely the CALIS Project.

As elucidated above, the availability of physical resources during the implementation of the Project fortuitously coincided with the advent of *Windows* 3.1 and a concomitant freely-available graphical user interface. Such 'fortuitous coincidence' is not accounted for in the literature on sustainability, but it is a defining characteristic of dynamic complex educational systems as envisaged by Senge (1990, 2000), Stacey (1992, 1996) and Fullan (1993, 2001, 2005). Furthermore, complex systems are characterised by unpredictability brought about by non-linear mutual feedback loops and unanticipated lines of development. One of the reasons for this unpredictability, according to Cavallo (2004) is the fact that host environments in which such projects are implemented is unique. Multiple, interrelated influences on the sustainability of the Project thus stem from the system as a whole, explaining not only

'fortuitous coincidence, but also the context-sensitive way in which the Project was implemented in individual institutions and individual classrooms.

Similarly, on the national (4.3.4.2) structural level, participant narratives report systemic influences on the Project that influenced the implementation and sustainability of the Project positively. One of the systemic influences that might well have contributed to positive attitudes towards the Internet and e-mail is the vast distances that separate communities on the South African landscape. Another is the fact that the implementation of the CALIS Project 'fortuitously coincided' with focuses on the problem-based approach in Mathematics and the communicative approach in English. But some systemic influences are even more subtle than this. Igno van Niekerk recounts how, prior to the implementation of the CALIS Project, male teachers who could type were stereotypically labelled as 'gay'. And yet the ability to type was a valuable skill relating to routine administrative functionality surrounding the typing of class notes, tests and examination papers. The Project offered male teachers the opportunity of honing their typing skills in a socially acceptable fashion. Today the stereotype no longer exists. Fullan (2005) addresses exactly this kind of influence when he claims that national, regional and institutional culture is an important influence on sustainability. Such culture is part and parcel of context. It is the goal of systems thinkers at all levels of the system to change the context in which the system functions. In this sense, the male teachers who took part in the Project were systems thinkers and actors.

Cavallo (2004) suggests that participants in dynamically complex ecological educational environments design and introduce new variants into the system in order to see how well they grow. Support for this view is provided in participant narratives with relation to systemic influences on the institutional structural level. Managers of the CALIS Project insisted that computers had to be installed in classrooms. With the passage of time, however, many institutions removed these computers from classrooms and installed them in computer laboratories. The decision was motivated by considerations of cost-effectiveness and partnerships with private companies providing computer training. So, host specific environmental or contextual factors motivated individual institutions to 'introduce a new variant into the system'. Another institutional-level systemic influence on the sustainability of the Project was the fact that remedial teaching typically took place in a remedial classroom on a one-to-one basis - the ideal environment in which to implement computer-integrated learning, particularly in the light of the 'fortuitous concurrent' development of the Rose Reading programme by Ronel Calitz. Once again, the system in which the Project was implemented followed the behaviour of dynamic complex educational systems, as envisaged by Cavallo (2004) and Fullan (2005).

A further systemic influence on the Project, reported on the learner (4.3.4.7) structural level, is the fact that the teaching of Computer Science at the district computer centres, before the implementation of the CALIS Project, was so successful, that the subject became popular amongst learners. It was thus not the case that computers were completely foreign to learners when the CALIS Project was introduced – even in the context of computer-integrated course work.

5.2.5 Research question 5:

> *5. How was the further development of the Project affected by the animated, interact ional interrelatedness of the complex system infused by all of the influences mentioned above?*

How was the further development of the Project affected by the animated, interactional interrelatedness of the complex system infused by all of the influences mentioned above?

Categorically defined influences on the implementation and sustainability of the CALIS Project are presented above. Furthermore, numerous instances are highlighted where two or more influences, from different categories, are so entwined that it is difficult to separate out the effect of each on sustainability. In addition, mention has been made of the fact that the existing literature on the sustainability of computer-integrated education projects does not attempt to account for such 'entwining' in a cogent, theoretically-driven manner. As mentioned above, the study suggests a conceptual framework within which such theoretical grounding may be achieved. Essentially, concepts from complexity theory, systems theory, autopoetic theory, theory relating to the sustainability of complex educational systems, and relevance theory are combined to present a theoretical foundation that is able to account for the sustainability of a dynamic, complex computer-integrated education project, namely the CALIS Project.

The fifth research question, framed above, was by far the most challenging question. Answers to the preceding four research questions were, to a large extent, provided by the content of participant responses, and could have been elicited in other ways, such as the use of questionnaires. The dynamism of interrelated influences in a living, complex system was more difficult to capture. For this reason, I decided to elicit narratives from the participants. I was convinced that elements of narrative structure and narrative style would provide me with data that would address this research question. Such data, on analysis of the narratives, did

not reside in narrative structuration, as I had thought it would, but in the metaphoric patterning that emerged across narratives. Such patterning is not contrary to that which is to be expected in dynamic, rhizomatic structures associated with complex, living systems. But analysis of such metaphoric patterning had to proceed according to a theoretical approach consonant with the theories relating dynamic complex systems.

The traditional view of metaphor (Lakoff and Johnson, 1980) as figurative construct postulates the mapping of a literal meaning to a figurative meaning within the gambit of a culturally –defined process. Such a view is mechanistic and simplistic. In contrast, Relevance Theory (Sperber and Wilson, 1986, 1995; Pilkington, 2000) views metaphor interpretation as an inferential process which gives rise to the recovery of multiple implicatures. In the case of highly standardised metaphors, interpreters will recover a fairly narrow range of strong implicatures, whereas, in the case of very creative metaphors, interpreters will recover a wide array of weak implicatures, some of which will have originated with the interpreter, rather than the producer of the metaphorical expression. Such an approach accords well with theory relating to dynamic complex systems since it recognises plurality, complexity and is predicated on an acceptance of the indeterministic nature of metaphorical interpretation. In short, Relevance Theory presents a view of metaphor as the 'language' of complexity.

Patterning relating to personhood (4.3.5.1) elicited implicatures relating to the CALIS Project itself as living entity and human being. Senge (1990, p.13) argues that there is a crucial shift of mind that lies at the heart of the learning organisation: from seeing ourselves as separate from the world to seeing ourselves as connected to the world. In this sense, such patterning 'embodies' Senge's (1990, p.7) claim that human endeavours are also systems and that participants in such systems are 'part of the lacework' themselves. Complex implicatures may be recovered. These relate to the participants in the Project as human, but, at the same time, part of a larger humanity, constituted by the Project as a whole. Just as human beings are subject to violence and suffering, so also the Project is subjected to violence and suffering. Just as human endeavour ends in death, the Project is perceived to have died. An aspect relevant to later metaphoric patterning is the use of metaphor associated with Christian endeavour. Participants are drawn from a society that openly proclaims Christianity. It is thus not strange to encounter in the narratives metaphors relating to teaching as a calling, conducted in missionary surroundings where the 'unconverted' (those opposed to the Project) have to Christened.

But participants in the project also take on the role assigned to Adam and Eve in the Christian Bible, namely custodians of the ecological system that is the Project. Metaphorical patterning

relating to ecology (4.3.5.2) stresses connectedness, situatedness, nested ecological systems and the rhizomatic, plant-like growth and spread of the Project. As such, this patterning embodies views expressed in the conceptual framework (Blikstein and Cavallo, 2003; Cavallo, 2004) on the ecological growth of educational systems. Linked to, and flowing from the Christian view of human custodianship of nature, is metaphoric patterning relating to the Project participants as pioneer farmers. Such patterning is entwined with the image of participants as the farmer in the Parable of the Sower in the Bible. Just as the sower in the Bible becomes a metaphor for Christian disciples who convert and save the heathen, so also, the sower becomes a metaphor for the participants in the study who are tasked with converting 'unbelievers' and thus saving the educational system.

This endeavour takes on the form of a journey. The journey is undertaken under a banner – that of 'converting' those opposed or neutral towards the Project. Metaphoric patterning related to journeying (4.3.5.3) suggests that the course of the Project is a journey. Although participants in the Project set the course and seek to steer the implementation and further development of the Project in the planned direction, unanticipated obstacles slow down the progress of the journey and eventually bring the Project to a cul-de-sac or 'dead end' in the road. At the heart of such patterning lies an absence. Metaphors of journeying, highly standardised metaphors with a fairly narrow range of strong implicatures (Sperber and Wilson, 1995), routinely implicate the traversal of physical space from a specific place of origin to a specific destination. The patterning relating to journeying in the case of the Project is characterised by the absence of arrival at a destination. The alternate translation of the Afrikaans term "doodgeloop", as indicated in Chapter 4, is the English expression "fizzled out". It is this meaning of the term that is taken up in the metaphoric patterning surrounding energy.

Such patterning (4.3.5.4) embodies the growing sophistication in terms of the implementation and sustainability of the Project. It is captured in imagery which progresses from fire to electricity. The imagery thus figured forth relates specifically to the energising of the system by individual participants. But energy figured forth in this way is incapable of driving the project forward, and it seems as if the Project is doomed to 'fizzle out'. Enter nuclear fusion. Imagery relating to this energy source emphasises the fact that nuclear fusion is a process that is internal to (potentially all) atoms and that it makes use of the massive potential for energy that lies dormant within all atoms. Such imagery provides implicatures relating to the massive energy which lies dormant within each of the participant teachers in the Project. If such energy can be released in sufficiently large numbers of participants, then the Project as a whole will be re-energised and driven towards the originally determined destination of the

journey. This metaphoric patterning presents a visualisation which corresponds well with Fullan's (2005) views on the pivotal role played by systems thinkers and actors in ensuring the sustainability of complex educational systems. Such systems thinkers-in-action transform the system as a whole by subjecting it to cyclical energising. In essence, such patterning encapsulates Heifetz's (2004) characterisation of an adaptive challenge as an enterprise in which the people with the problem are the problem – and also the solution (Fullan, 2005, p.45).

Taken together metaphoric patterning in participant narratives, represent a religiously, socially and culturally defined 'meta-narrative' that takes the form of a 'meta-parable'. Such a 'meta-parable' captures study participants' integration of all influences on the implementation and sustainability of the CALIS Project, within the context of a religiously, socially and culturally mediated reality. Frick (1996) errs when he suggests that teachers should select the best of culture, and make it available to students as they guide their learning. Culture will not be 'selected' – it is woven into the very fabric of everything we know and believe.

In an attempt at capturing the 'inclusiveness' of learning environments, Blikstein and Cavallo (2003, online) argue that learning atmospheres surround learning environments and encompass 'entities' such as generative spaces, multiple expressive media and relationship building. The problem here is that the metaphor underlying this argument reverts to imagery associated with the discrete entities of Newtonian physics. The inclusion of an 'entity' entitled 'relationship building' attempts to include affective functionality in the 'learning atmosphere', but conceptions such as 'entities' and 'atmospheres' serve to alienate us from a world and reality which is shaped, in large part, by out own religious, social and cultural construction.

5.3 Synthesis

5.3.1 Summary of findings

The narratives produced by participants in this study provide evidence which suggests that influences on the implementation for sustainability on the CALIS Project can, in fact, be identified on various structural levels of the educational system, as suggested by Mooij and Smeets (2001). Furthermore, there is enough evidence in the literature on this topic to support such suggestions. The problem with much of the existing literature on the topic, however, is that, in the final analysis, it proceeds from the implicit assumption that individual influences

are discreet entities. As such, the literature proposes a taxonomic approach to investigating the sustainability of computer-integrated education. Paradoxically, the complex systemic nature of educational systems, so well documented and debated in the wider literature involving educational practice generally, is virtually ignored in literature relating to computer-integrated education.

The findings of this study thus endorse a number of propositions expressed in the conceptual framework concerning the implementation of computer-integrated education projects with a view to ensuring sustainability.

1. It is not only the generic personal characteristics possessed by teachers involved in the project that are important; rather there are very specific characteristics associated with participants at all structural levels of the system that need to be taken cognisance of. This is to be expected in complex systems where functional specialisation in integral smaller components of the system enables system-wide functionality.

2. Programmatic planning and implementation of such projects needs to be informed by a systems approach. Such an approach is informed by the recognition that computer-integrated education projects are implemented in a dynamic, complex educational system characterised by unique local host environments and ecological growth patterns. This implies that implementation will be context-specific and that unique, complex feedback systems will stimulate ecological growth of the project along unanticipated trajectories. Far from implying chaos, the implementation of the project needs to guarantee the maintenance of the resulting system on the boundary between over-regulation and implosion. In the case of dynamic, complex educational systems, this can be achieved by growing large numbers of leaders who are systems- thinkers-in- action. Such leaders must actively pursue Fullan's eight essential elements of sustainability at all levels of the system. Only then, can context at all levels of the system be changed. Such context includes institutional and system-wide cultures, defined by Fullan (2005) as that which we (as participants, institutions, systems) agree on as being true.

3. The availability of physical resources, most notably funding, remains a crucial aspect of implementation and sustainability, but it cannot be seen in isolation. The availability of resources is inextricably tied up with: the personal characteristics possessed by participants in the project; the programmatic involvement of

communities in which such projects are implemented; the establishment of public-private partnerships; and the vagaries of historical, economic, technological and political processes that characterise the larger systems within which the educational system functions.

4. It is also evident from participant narratives that computer-integrated education projects are implemented in an educational system which is, in turn, embedded in larger systems. The dynamism of these larger systems thus also influences the educational system, and, by extension, the projects implemented in that system. Such influences, drawn from nested systems cannot be viewed as discreet, individual forces, but rather as interrelated, co-determinants of sustainability.

Thus, the findings of this study suggest that the implementation and sustainability of computer-integrated education projects needs to be informed by a systems approach. Such an approach includes conceptions of unique host environments, ecological growth patterns and a systems definition of sustainability. This approach is adequately captured in the conceptual framework of the study.

But participant narratives produce evidence of further influences on the implementation and sustainability of computer-integrated projects not fully accounted for in the conceptual framework, as indicated below.

5.3.2 Anomalies and differences between findings and the literature

The conceptual framework presented in Chapter 2 incorporates concepts drawn from theories relating to complexity, systems, autopoetic and autonomous systems, and complex educational systems. As indicated above, findings produced from participant narratives provide support for these concepts. But findings also provide evidence for a number of metaphoric patterning across narratives. As indicated above, the traditional approach to metaphor interpretation (Lakoff and Johnson, 1980) is precluded in favour of the interpretation of metaphor proposed by Relevance Theory (Sperber and Wilson, 1995; Pilkington, 2000). The reason for this decision is simply the fact that the latter theory proposes an interpretation of metaphor consonant with the plurality and complexity of educational systems, as encapsulated in the existing conceptual framework. Relevance Theory provides a tool with which metaphoric patterning in the narratives can be unlocked, in order to provide access to a socially, religiously and culturally defined ‘meta-narrative’ that situates

systems influences, previously identified, within a wider anthropomorphic context. Given this insight, the conceptual framework may be updated, as indicated below.

5.3.3 Updated conceptual framework

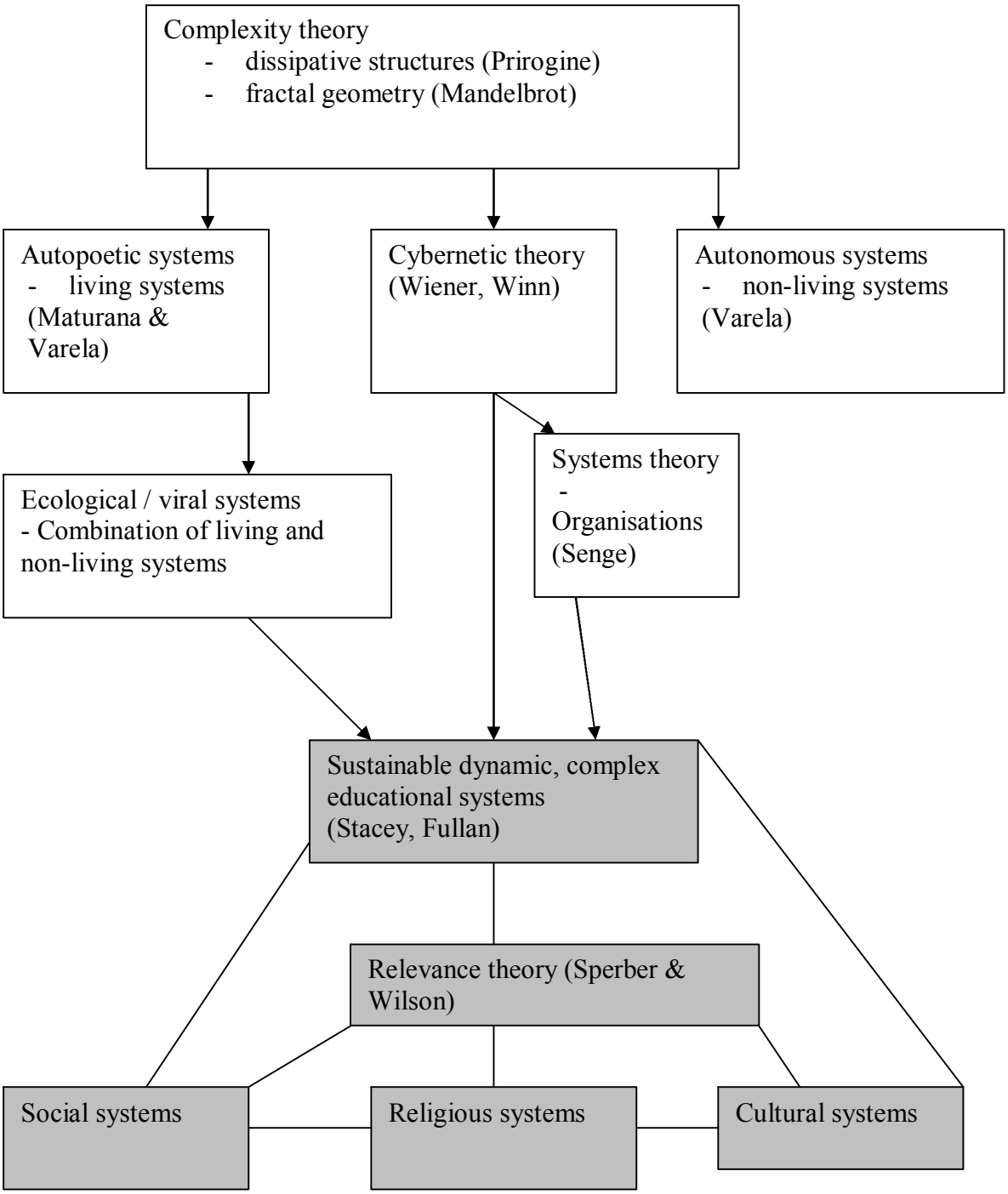

Figure 2: Updated Conceptual Framework

5.4 Reflection

5.4.1 Methodological reflection

From the outset it was clear to me that the methodological approach to the study would have to be philosophically consonant with a broadly postmodernist philosophy. In this regard, a qualitative research approach was adopted. Initially, having conducted exploratory reading on the topic of research design, it appeared to me that a case study design would provide me with the opportunity of utilising instruments which would provide the necessary data relating to the research questions that I had formulated.

On conducting and analysing the first interview, however, it became apparent to me that I would have to adapt my approach in a number of ways. Firstly, I realised that the passage of time (virtually ten years since the Project had been officially terminated) had meant that all of the documentation regarding the Project had been lost. Also, processes of erosion and accrual relating to physical infrastructure had been subjected to a myriad of influences from many quarters over a period of ten years. It would thus be impossible to separate out physical site-based influences brought about by the Project specifically.

Secondly, on conducting and analysing the first interview, it became apparent to me that the semi-structured (English medium) interview (Appendix B) that I had envisaged would have to be discarded in favour of an eliciting of narratives from participants in the language of their choice. In this way, participants would not be prompted to respond to specific questions, thereby precluding mention of influences on the Project not foreseen by myself. An examination of the literature on narrative analysis and life history research provided support for this perception. Such narratives would be supplemented by the keeping of a research journal which would provide an insight into the way in which I, constructed as I am by my own experiences and views, conducted the research process.

Thirdly, further analysis of participant narratives revealed metaphoric patterning across narratives. It became apparent to me that such patterning would have to be subjected to further analysis within an acceptable theoretical framework. I was aware of the fact that Relevance Theory (Sperber and Wilson, 1995) provided an account of metaphor interpretation within the broader framework of a pragmatic inferential account of utterance interpretation. This particular approach to metaphor interpretation is consonant with the larger aims of this study. On the one hand, analysis takes place on the level of utterances rather than

the written sentence. On the other hand, the Theory proposes metaphor usage as an integral part of everyday communication, and not as a special kind of language usage, as is suggested by the 'literal-figurative' dichotomy. Relevance Theory would thus provide a key to analysing the integral nature of metaphoric patterning to the narrative communication produced by participants. The analysis thus conducted proved to be justified by providing insight into the existence of a socially, religiously and culturally defined 'meta-narrative' that integrates all other influences on the Project.

As envisaged in Chapter 3, the findings in this study can be generalised to the theoretical position adopted in the conceptual framework. Although all host environments are unique in terms of context, all educational systems and the projects implemented in them are dynamic, complex systems and, as such, are governed by the same functional characteristics. For this reason, an examination of the local context within which an individual project is implemented will have very limited value, unless such an examination is situated within an examination of the larger systemic context.

5.4.2 Substantive reflection

Although numerous studies document the implementation of computer-integrated education projects, many of these are informed by a quantitative methodology, which leads to a taxonomic approach to the elucidation of relevant influences on the project. As a result, influences are, more often than not presented as discreet, individual forces, rather than interrelated, cross-structural co-determinants of successful implementation and sustainability.

Even in studies underpinned by qualitative methodology, failure to acknowledge the dynamic, complex nature of the educational system in which these projects are implemented leads to simplistic conceptions of sustainability as being determined by the ability of the project to persist over time, as a result of the availability of physical resources. Sustainability, in the case of computer-integrated education projects needs to be seen as a quality relating to these projects within the educational system as a whole, rather than a quality relating to individual projects, specifically.

Furthermore, as Selwyn (2000) cautions, we ignore the social, religious and cultural situatedness of such projects to our peril. This study provides some evidence in support of his claim that such situatedness will, in the final analysis, be a far more powerful influence on the implementation and sustainability of such projects than any number of 'nay saying' politicians.

5.4.3 Scientific reflection

This study has contributed to the scientific body of knowledge in the following ways.

1. A conceptual framework is suggested, within which postmodernist research relating to computer-integrated education can be conducted.
2. The study suggests further that influences on the implementation and sustainability of computer-integrated education projects have to be contemplated from a systems perspective, where such projects are recognised as being implemented in a dynamic, complex educational system. Failure to do so will result in taxonomies of influences that do not reflect the interrelatedness of influences across all structural levels of the system.
3. Social, religious and cultural 'meta-narratives' encompass and integrate all other influences on implementation and sustainability. Failure to take cognisance of 'meta-narratives' will lead to a simplified and incomplete understanding of the sustainability of such projects.

Given the insights mentioned above, recommendations regarding policy and practice (5.5.1), and recommendations regarding further research (5.5.2), are made in the relevant sections below.

5.4.4 Reflection on exploratory journey

Just as the metaphorical journey presented in participant narratives reflects the absence of arrival at, or perpetual distance from, the destination, so also this study is the beginning of a journey, the course and destination of which are unknown. What is known are the processes and characteristics of the system within which further research is to be conducted?

This study has elucidated the processes and characteristics of dynamic, complex educational systems, involving unique host environments, ecological growth, indeterminate lines of development and unknown end-states. An awareness of such characteristics and processes has sensitised me to the importance of educational research approaches that include plurality, complexity, flexibility and dynamism. Such 'openness', however, needs to be balanced by attention to rigour, and constant reflection on what it means for knowledge to be accepted as 'truthful' or 'believable'.

5.5 Recommendations

5.5.1 Recommendations for policy and practice

Based on the findings presented above, the following recommendations for policy and practice are made regarding the implementation and sustainability of computer-integrated education projects.

1. It is not only the generic personal characteristics possessed by teachers involved in the project that are important; rather there are very specific characteristics associated with participants at all structural levels of the system that need to be taken cognisance of. This study indicates that participants at national, regional and project management levels need, critically, to possess the following characteristics. Firstly, they need the ability to envision the project within its complex systemic situatedness, and the ability to communicate this vision. Secondly, they need to have extensive managerial experience. Thirdly, and perhaps most importantly, they need to be able to create and energise leaders at all levels of the system, which are also systems-thinkers-in-action. Implementers of the project, at the structural level of the project, need to possess a passion for the goals of the project. This passion has to be supplemented by the necessary drive and capacity for hard work. School principals and school managers need to possess similar qualities, as well as managerial capabilities. Teachers who implement the project in their classrooms should, ideally be people who: are naturally inquisitive; have a high tolerance for change and uncertainty; are driven to succeed; are passionate about the enterprise; and who seek answers to educational challenges.

2. Programmatic planning and implementation of such projects needs to be informed by a systems approach. Such an approach is informed by the recognition that computer-integrated education projects are implemented in a dynamic, complex educational system characterised by unique local host environments and ecological growth patterns. This implies that implementation will be context-specific and that unique, complex feedback systems will stimulate ecological growth of the project along unanticipated trajectories. Far from implying chaos, the implementation of the project needs to guarantee the maintenance of the resulting system on the boundary between over-regulation and implosion. In the case of dynamic, complex educational systems, this can be achieved by growing large numbers of leaders who are systems- thinkers-in- action. Such leaders must actively pursue Fullan's eight essential elements of

sustainability at all levels of the system. Only then, can context at all levels of the system be changed. Such context includes institutional and system-wide cultures, defined by Fullan (2005) as that which we (as participants, institutions, systems) agree on as being true.

3. The availability of physical resources, most notably funding, remains a crucial aspect of implementation and sustainability, but it cannot be seen in isolation. The availability of resources is inextricably tied up with: the personal characteristics possessed by participants in the project; the programmatic involvement of communities in which such projects are implemented; the establishment of public-private partnerships; and the vagaries of historical, economic, technological and political processes that characterise the larger systems within which the educational system functions.

4. It is also evident from participant narratives that computer-integrated education projects are implemented in an educational system which is, in turn, embedded in larger systems. The dynamism of these larger systems thus also influences the educational system, and, by extension, the projects implemented in that system. Such influences, drawn from nested systems cannot be viewed as discreet, individual forces, but rather as interrelated, co-determinants of sustainability. Implementation of computer-integrated education projects must ensure that cognisance is taken of the social, religious and cultural context that characterises not only individual institutions, but also the system as a whole. Such contexts powerfully influence the sustainability of such projects by providing 'meta-narratives' that integrate all other influences in mutually intelligible, and mutually accepted systems of belief as to what constitutes truth.

5.5.2 Recommendations for further research

The influence of close personal relationships across contiguous institutions is not contemplated in the literature as a contributory influence to the successful integration and sustainability of computers in classroom practice. Yet, the findings of this study suggest that the influence of such relationships should be examined more closely.

Another suggestion related to further research springs directly from the last recommendation made in the previous section. More research is required into the ways in which social, religious and cultural 'meta-narratives' integrate influences on the implementation and

sustainability of such projects. Concomitantly, research needs to be conducted into the methodological processes by which evidence of such meta-narratives' is obtained. In this study metaphorical patterning provides some evidence of such 'meta-narratives' but a more inclusive study of social, religious and cultural artefacts need to be undertaken (in specific contexts) in order to provide richer evidence of the kind of integration of influences envisaged in this study. Such evidence could be accessed by conducting research into influences on the sustainability of the CALIS Project in individual institutions where the Project is recognised as having been sustained.

A further suggestion related to further research involves the view that the educational system within which a project is implemented should be characterised by leaders at all levels of the system who are also systems-thinkers-in-action. A detailed evaluation of what constitutes such systems 'thinking' and such systems 'action' in specific institutional settings will provide tangible models which can be adapted to inform programme planning, staff development and best practice in a far more concrete fashion.

Perhaps the most promising avenue of research opened up by this study is an investigation of institution-specific influences on the sustainability of a computer-integrated education project. In this respect, data could be gathered relating to specific institutions involved in the CALIS Project, with a view to identifying influences on sustainability that arise in particular contexts.

5.6 Conclusion

This investigation into a computer-integrated education project took place in a unique host environment, characterised by the abrupt withdrawal of government support at the exact moment when it seemed as if the project was set to grow very quickly. According to accepted accounts of sustainability, the project should have come to an abrupt end at that point. But such an account of sustainability views influences as discreet, individual forces. In contrast, a view of the education system as dynamic, complex and integrally connected to larger systems, predicts that ecological growth takes place in environments where sustainability is a function of such dynamism and complexity. For this reason, many schools continued using computers in curriculum-integrated ways. Such usage evolved, over time, into practices, some of which the original instigators of the project could not have foreseen. At the heart of the complex systems approach to technology in education lies a radically new mindset: the ability to be surrounded by indeterminacy whilst being content with this state of affairs. This contentment does not spring from a cynical acceptance of the perception that planning and action are futile – rather it informs a belief in the efficacy of planning and action in the face of incomplete

knowledge. This is what systems-thinkers-in-action believe and do. The rest of us are capable of similar beliefs and actions.

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Appendix A

Johan Badenhorst: schools in the Free State that still offer computer-integrated courses

School	City / town
Sand du Plessis Primary	Bloemfontein
Eunice Primary	Bloemfontein
Eunice High	Bloemfontein
Technical High Louis Botha	Bloemfontein
Volkskool	Welkom
Rooidak Combined	Boshoff
Jacobsdal Primary	Jacobsdal
Dagbreek Primary	Welkom
Unitas Primary	Welkom
Gymnasium High	Welkom
Goudveld High	Welkom
St Helena High	Welkom
Welkom Preparatory	Welkom
Odensia Primary	Odendaalsrus
Wessel Maree Primary	Odendaalsrus
Riebeeckstad Primary	Riebeeckstad
Sandveld High	Wesselsbron
Harrismith High	Harrismith
Harrismith Primary	Harrismith
Kestell High	Kestell
Technical Combined	Ficksburg
Jordania Primary	Bethlehem
Hoogland Primary	Bethlehem
Voortrekker High	Bethlehem
Zastron High	Zastron
Ladybrand Primary	Ladybrand
Ladybrand High	Ladybrand

Appendix B

Original Interview Schedule

This investigation involves the CALIS Project conducted in the Free State from 1991 to 1996. The results will be reported in the form of a Ph.D. dissertation to be supervised by Professor Johannes Cronje from the University of Pretoria.

1. How did you initially become involved in the CALIS Project?

2. Why did you decide to become involved in the CALIS Project?

3. Who were the people initially identified to manage the project?

4. Did others later become involved in the management of the Project?

5. Which schools were initially selected to take part in the Project?

6. Were other schools added at a later date?

7. What were the initial goals / aims of the Project?

8. Did these goals change during the course of the Project?

9. To what extent was the then Department of Education of the Orange Free State involved in the Project?

10. What were the important achievements / successes in the implementation of the Project?

11. What were the important shortcomings or failures in the implementation of the Project?

12. At which point of the implementation of the Project was government support withdrawn?

13. What was the nature of this withdrawal?

14. How did you feel at the time?

15. How did other members of the management team react to this withdrawal?

16. How did teachers involved in the Project react to this withdrawal?

17. What effect did this withdrawal have on the Project as a whole?

18. Were there schools / teachers who continued to use computers after the support of the OFS DE had been withdrawn?

19. Why did these schools / teachers continue using computers even after official departmental support had been withdrawn?

20. Are you aware of any of the originally selected schools / teachers who still use computers effectively today?

21. Are there any of these schools that have managed to do this in the absence of extensive material resources?

22. What has enabled these schools to do this?

23. What, in your opinion, would have been the impact of the Project on the sustained use of computers in schools if the support of the OFS DE had not been withdrawn?

24. Is there any other information relating to the Project or the people involved in the Project that you feel should be documented?

Appendix C

Ethics documentation

Computers in schools: implementing for sustainability

12 November 2005

Dear Participant

You are invited to participate in a research project aimed at identifying influences on the implementation of the CALIS Project (1991-1996) with a view to ensuring the sustainability thereof.

Your participation in this research project is voluntary and confidential. You will not be asked to reveal any information that will allow your identity to be established, unless you are willing to be contacted for individual follow up interviews. Should you declare yourself willing to participate in an individual interview, confidentiality will be guaranteed and you may decide to withdraw at any stage should you wish not to continue with an interview.

You role in the research process will involve viewing a schedule of interview questions, whereafter you will be asked to respond to these questions. The ensuing narrative will be taped on an audio recorder and will be transcribed by the researcher.

The results from this study will be used to inform the findings presented in a Ph.D. dissertation to be submitted in the Faculty of Education at the University of Pretoria.

If you are willing to participate in this study, please sign this letter as a declaration of your consent, i.e. that you participate in this project willingly and that you understand that you may withdraw from the research project at any time. Participation in this phase of the project does not obligate you to

participate in follow up individual interviews, however, should you decide to participate in follow-up interviews your participation is still voluntary and you may withdraw at any time. Under no circumstances will the identity of interview participants be made known to the Orange Free State Education Department.

Participant's signature..... : Date: .....

Researcher's signature ..... : Date: .....

Yours Sincerely

H.E. Thomas

Appendix D

Consent

Thank you for agreeing to participate in this study which will take place from 2003 to 2006. This form outlines the purposes of the study and provides a description of your involvement and rights as a participant.

The purposes of this project are:

1) to fulfill a course requirement for a Ph.D. study in Computer-integrated Education in the Faculty of Education at the University of Pretoria; and

2) to gain insight into and experience on the topic of influences on the implementation of a computer-integrated project, with a view to the sustainability thereof.

Your role in the research process will involve viewing a schedule of interview questions, whereafter you will be asked to respond to these questions. The ensuing narrative will be taped on an audio recorder and will be transcribed by the researcher.

I will use the information from this study to write a case report about you (the respondent). This report (Chapter 4: Findings) will be read by you and the supervisor of this study, in order to check on the accuracy of the report. The case report will not be available to any other person to be read without your permission.

I guarantee that the following conditions will be met:

1) If you grant permission for audio taping, no audio tapes will be used for any purpose other than to do this study, and will not be played for any reason

other than to do this study. At your discretion, these tapes will either be destroyed or returned to you.

2) Your participation in this research is voluntary; you have the right to withdraw at any point of the study, for any reason, and without any prejudice, and the information collected and records and reports written will be turned over to you.

3) You will receive a copy of the final report (Chapter 4: Findings) before it is handed in, so that you have the opportunity to suggest changes to the researcher, if necessary.

Do you grant permission for your name to be used in the research report?

Yes _____ No _____

Do you grant permission to be quoted directly?

Yes _____ No _____

Do you grant permission to be audiotaped?

Yes _____ No _____

I agree to the terms:

Respondent _____ Date _____

I agree to the terms:

Researcher _____ Date _____