

Master's in Applied Language Studies

LCC 895

Mini-dissertation

Content and Language Integrated Learning:

A study of the linguistic challenges facing English second language Grade 11 learners, and their teachers, in Biology.

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CHAPTER 1 – *Rationale*

It was observed at a high school in Centurion, Gauteng, South Africa¹, where this research was conducted, that second language (L2) learners² of English do not achieve as well as first language (L1) learners, across the curriculum. It was proposed that a study be done of the academic performance of L2 Grade 11 learners (in comparison to achievement levels of L1 learners), in this English medium high school, in Biology, since learners' marks could be distinguished by their language identity. This is a content subject that relies heavily upon the linguistic competence of learners (language is vital for reading content, memorising it and reproducing it in an explanation or description), and the literature shows that L2 learners, while being conversationally competent, may not be academically competent in the language of instruction to reach their potential in acquiring skills in the subject itself (De Bruin 1994: 2). Orr and Schutte, in their work on the language of science, remark:

Biology...has a vocabulary and a language all of its own; it is superimposed on both the language of ordinary literary English, as well as on that of science in general... (Orr & Schutte 1992: 128)

The need to assess the awareness and motivation of high school educators (in this case, Biology teachers) à propos the linguistic demands of their learning area was acknowledged. Furthermore, the researcher recognised the necessity of equipping these teachers in turn to develop the linguistic skills, relevant to their subject, of their L2

¹ In order to protect the identity of the subjects involved in this research I have chosen not to mention the name of the school concerned.

² Throughout this dissertation, where I refer to **L2 learners**, I am referring to second language speakers or users of English, who are high school learners for whom English is the medium of instruction and learning.

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learners, in order that the L2 learners might reach not only their social and affective potential, but also their cognitive potential.

It is perhaps necessary at the outset of this dissertation to define clearly what is meant by “first”, “second”, and “third language” speakers, within the context of this research. First language (L1) speakers are those who acquire a language – in this case English – spontaneously as a young child (i.e. it is their primary language). Second language (L2) speakers are those who acquire a language through formal study at school, and this learning process is supported by extended exposure to the language in daily life (i.e. it is an additional language). It is not their home language, but it is the language of instruction at school and it is also heard and used by learners in the wider community. Thus, it can also be acquired outside of the classroom environment. A third language (L3) refers to a foreign language that is learned purely within the educational milieu, and for which there is little scope for practice and development outside of the school.

This study, therefore, deals with those learners who fall into the category of being second language speakers of English, and who take Biology (Grade 11) as a subject in an English medium high school.

An argument in favour of conducting this research was that, in South Africa at least, studies of this nature have focused on L2 learners from previously disadvantaged backgrounds. The focus has often been on socio-economic and cultural realities. At this school, however, there is a broad spectrum of L2 learners from diverse socio-economic and cultural backgrounds. Mother tongues of L2 learners might be Afrikaans, Sotho, Mandarin or Hindi. The environment is also such that learners are in the privileged position of being in relatively small classes (maximum 27 learners in a class), and pedagogic resources are readily available. These factors may well be utilised to influence cognitive and linguistic development.

Cummins (1996) states:

There is compelling evidence that factors related to power and status relations between groups in the wider society play a significant role in determining patterns of minority pupil academic performance. (1996:8)

This view of academic proficiency was a further motivation to conduct research at this school. In October 2003, this particular institution received significant press coverage in connection with its language policy. Tension between a group of Sotho learners and a group of Afrikaans learners had erupted, owing to the fact that the two groups could understand neither each other, nor the insults that were being tossed between them. The statement was made that, since the school is an English school, only English should be used to deal with problems arising, or to diffuse the tension. L2 learners in the school were angered by this statement, and were more determined than ever to exercise their right to use their mother tongues within the school environment. The school has subsequently had to address the serious issues surrounding racial, cultural and linguistic integration in the school, and the effects that these have on the academic performance of learners. With this context in mind, the researcher sought to discover what affective factors L2 learners faced in the Biology class.

Having considered the afore-mentioned linguistic situation, and having done a thorough investigation of the related literature (see **Chapter 2** of this dissertation), the following primary research questions were identified:

- What linguistic obstacles to reaching academic potential lie in the pathway of L2 learners in Biology?
- What recommendations can be made to Biology teachers to equip L2 learners to overcome these obstacles?

From these core questions, many others arose. For example, it was imperative to ascertain whether or not the Biology educators concerned would be willing to

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incorporate any language-focused didactic changes within their teaching methods in order to assist their L2 learners, and indeed whether or not these teachers even saw a need for linguistic amelioration amongst the L2 learners.

To answer these research questions, I chose to consult the relevant literature and to conduct empirical, field research at the school. In terms of the literature review of existing research, I considered:

- The relation between language and cognition
- What linguistic skills L2 learners need in order to succeed academically in content subjects, and
- How L2 language skills can be developed in content subjects.

The empirical research consisted of interviews with Biology teachers and English second language learners. Furthermore, statistical analysis of data pertaining to these learners' academic performance was carried out, and learners were required to write an English language proficiency test, relating specifically to their use of English in Biology. This field research was conducted from October 2003 to April 2004.

Chapter 3 of this dissertation offers a full explanation and justification of the research design and methodology.

Chapter 4 details my data collection process, as well as the analysis and interpretation of the results obtained.

In **Chapter 5** conclusions are drawn and recommendations for solving the research problem are offered, based on the findings. Suggestions for further research on this problem are presented.

CHAPTER 2 – *Theoretical and conceptual framework*

This study falls into the theoretical frameworks of cognitive development in learners, bilingualism and second language acquisition (SLA). With this in mind, I have set out to address three related issues, namely:

- What is the relationship between language and cognition?
- What skills in the L2 are needed for success in content subjects?
- How can relevant L2 skills be developed within content subjects?

Over thirty different sources related to this field of research were accessed. The subjects covered were cognition, bilingualism, SLA, communicative language teaching (CLT), language policy, assessment, affective issues in language learning and the performance of L2 learners in content subjects.

Relationship between language and cognition

Since language is the medium in which we encode reality – our means of thinking, judging, shaping our beliefs and distilling our feelings (Clark 1996: 4) – it stands to reason that it should play an indispensable role in educational development. Learning cannot take place unless one can name, categorise and assimilate the learning material – and this is done through language.

Matlin states that “cognition, or mental activity, involves the acquisition, storage, retrieval, and use of knowledge”, and that “language is not only our most remarkable cognitive achievement, but it is also the most social of our cognitive processes” (1992: 2, 261). Acquiring a language is therefore a cognitive (and psychological, social and cultural) event, and that language then becomes the medium through which we interact,

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cognitively and socially, with others and the world around us. It follows, therefore, that learners having to make sense of knowledge presented in a language that they do not know well are at a cognitive disadvantage. Bialystok comments, “We can access children’s language [skills] only through the filter of their cognition, and the two may not be equally developed” (2001: 22).

Matlin (1992: 263-327) highlights the cognitive processes that take place as an individual acquires a language. She distinguishes between the cognition associated with listening to spoken language, reading, speaking and writing (e.g. learning to recognise individual words from a succession of sounds, or learning to group letters into semantic or lexical units of sense). A full exposition of her theories is beyond the scope of this dissertation, but they are entirely relevant to adolescents acquiring a second language (a stringent cognitive process) in which they must perform further cognitive tasks. This is especially significant since both Matlin (1992: 323) and Bialystok (2001: 19, 22) assert that language is most effectively acquired at an early age. The age at which L2 learners were exposed to English influences their academic performance therein (i.e. whether they were exposed between the ages of one and three years, at nursery school, or at primary school).

A learner cannot hope to succeed in a content subject – or in any academic study, for that matter – without the necessary language skills needed to facilitate the cognitive processes of that subject. In their study of L2 learning, Hurley and Tinajero (2001) effectively express the vital link between language and cognition:

Content reading gets its name from the first priority of subject matter teachers: to teach content. Every subject... has its own content or defining set of facts, concepts, and principles that are neither static nor solid (Conley, 1995).

Literacy, once associated almost exclusively with written text is now thought of in broader terms. Literacy relates to the ability to construe meaning in any of the forms used in culture to create and convey meaning (Alverman & Phelps, 1988).

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Most researchers agree that the traditional notion of literacy and its association with text has been replaced by the concept of multiple literacies: cultural, civic, computer, scientific, and technological literacies. Content literacy is the ability to use reading and writing to learn subject matter in a given discipline and how a student uses literacy to learn... Language plays a vital role in understanding technical terms and greatly influences the success of students in the content-related fields. Language helps a learner make sense of the world, to understand and be understood. As a result, language and meaning cannot be severed from one another (Vacca & Vacca, 1995)... Instead of seeing language merely as means of communication, teachers need to see language as a medium of learning. (2001: 86-87)

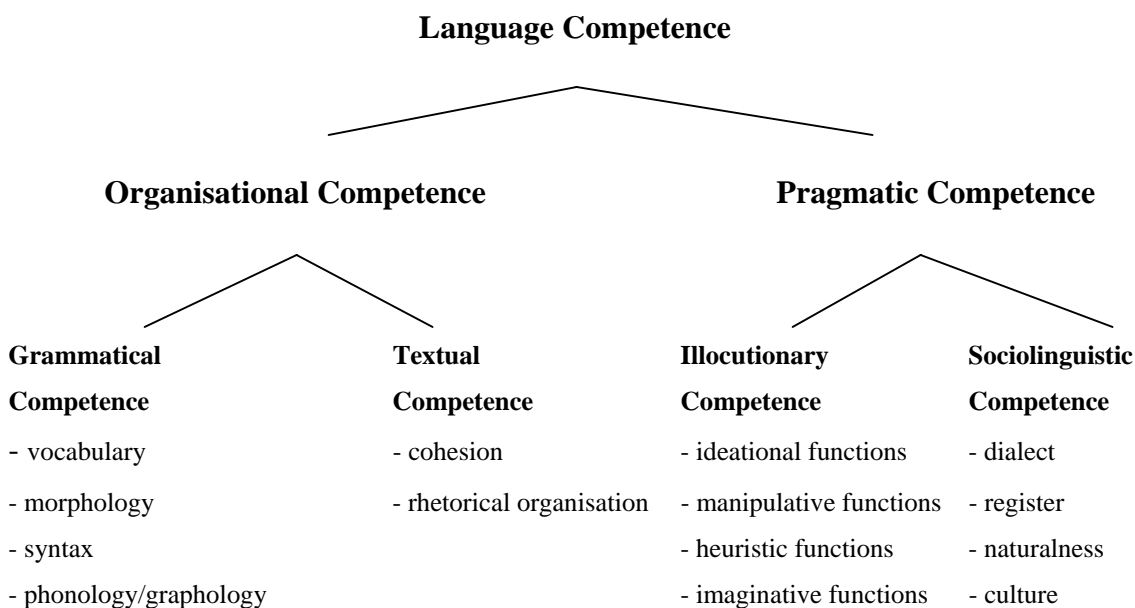
The authors go on to emphasize the importance of teaching learners how to construct and interpret various kinds of text (in this case, those prevalent in the study of Biology), as well as how to focus on the specialized meanings (within a content subject) of commonly used words.

Ellis (1985: 5) defines second language acquisition (SLA) as “the study of how learners learn an additional language after they have acquired their mother tongue.” He goes on to state that educators need to examine learners’ utterances or productions of language as “windows through which the internalized system can be viewed”, and that these learners’ performance gives us an indication of their competence, described as the “mental representation of linguistic rules and units which constitute the speaker-hearer’s internalized grammar” (1985: 5-6). Ellis explains how some scholars distinguish between second language acquisition (a natural, “picking up” of a language) and second language learning (a conscious, deliberate study of a language). I have observed that in content subjects L2 learners are for the most part expected naturally to acquire the language skills needed in that subject. Again, these skills are considered later in this chapter and in the dissertation as a whole.

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Ellis seems to focus primarily on the grammatical aspects of language competence and language learning. However, language as a whole is far more than grammar. It is imperative in a study of this nature to highlight the textual, functional and sociolinguistic elements of language competence as well, since the ability to construct academic texts hinges on factors such as coherence and cohesion (textual competence), and ensuring that a text performs the required function within a specific context (functional competence). Bachman (1990:87) illustrates the components of language competence as follows:



In Biology then, textual competence would include writing cohesively and coherently, identifying main and subordinate points in a text, and knowledge of the genres of typical Biological texts.

Le Roux states that “language proficiency is crucial to the achievement of success in the classroom, as all education is based on communication” (le Roux, 1990). To succeed in the classroom, children have to understand the content that is presented to them (Westby and Rouse, 1985). A problem in language could therefore be manifested as a problem in learning (Post 1993: 1). This observation is certainly relevant to the South

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African context, where more than half of the South African learners are completing their schooling in their second or third language.

Related to the concept of language and cognition is that of language competence and educational development. It is imperative in language education that all aspects of language competence receive the necessary focus and emphasis. It is common, for example, for grammatical competence to receive much exposure in the classroom, but for textual competence, functional competence and socio-linguistic competence to take a back seat. In other words, learners are not necessarily equipped to structure a paragraph that has a topic sentence (textual competence), that performs a function such as to persuade or inform (functional competence), and that is written in the correct register for the given context (socio-linguistic competence). In order for learners to competently give expression to their cognitive processes, all of these language skills need to be developed. Adequate communicative competence and academic language proficiency facilitate the cognitive manifestation of the learner.

Linguistic skills needed for content subjects

John Clark, in his discussion of task-based learning, claims:

Schools need to concentrate on helping students through purposeful activity to construct the essential knowledge they need for today and tomorrow, and at the same time to learn how to search for, interpret, share and use the new knowledge that is constantly emerging... [Language] is our master for finding things out, for interpreting and evaluating what we discover, for constructing knowledge in our heads, and for expressing and exchanging our thoughts with others in the search for ever-better knowledge. Language is the key which unlocks the door to knowledge, and English in particular has become the international key to advanced knowledge-exchange. Teachers must therefore provide students with an effective apprenticeship in learning how to use language... for a range of

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purposes associated with the search, development, sharing and use of knowledge. **All** teachers are responsible for supporting students in their learning of knowledge and language and of how to go about constructing further knowledge and language for themselves.

This sheds some light on the matter of what language skills learners need in order to succeed academically. I list below some of the general academic skills that Clark records, all of which naturally need to be developed through the medium of language.

- To inquire and find things out for themselves
- To interpret and judge the value of what they hear and read
- To solve a wide range of real problems through goal-directed talk
- To construct, think and express thoughts and feelings in a wide range of knowledge areas
- To communicate effectively and work harmoniously with others who have different value systems
- To have an effective apprenticeship in using a contextually appropriate range of languages for personal, social, academic, economic, cultural and political purposes (1996:5)

From these *academic* skills we might say that the following *language* skills are necessary to perform them:

- To read independently (i.e. without assistance or explanation from another)
- To comprehend or access a text (understand its meaning)
- To highlight the main point of a text, or the topic sentence of a paragraph
- To reformulate, in one's own words, the meaning gained from a text
- To be able to compare and contrast different texts
- To structure a text with coherence and cohesion

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- To present an argument, orally or in writing
- To be able to negotiate meaning cross-culturally
- To be able to perform tasks such as *describe, contrast, list, explain, differentiate* or *indicate*.

One can note at this point that the Learning Outcomes as defined in the Revised National Curriculum Statement (2002: 91-92) for English (Home Language) for the Senior Phase (Grades 7-9) are as follows (thus, up to this point in the L2 learners’ education, the goal in the *English* class of an English medium high school has been to equip the learners with these skills):

- The learner will be able to listen for information and enjoyment, and respond appropriately and critically in a wide range of situations.
- The learner will be able to communicate confidently and effectively in spoken language in a wide range of situations.
- The learner will be able to read and view for information and enjoyment, and respond critically to the aesthetic, cultural and emotional values in texts.
- The learner will be able to write different kinds of factual and imaginative texts for a wide range of purposes.
- The learner will be able to use language to think and reason, as well as to access, process and use information for learning.
- The learner will know and be able to use the sounds, words and grammar of the language to create and interpret texts.

In a formal educational environment it is necessary to look at conversational proficiency *as well as* academic language proficiency. The former does not assume the latter (Dreyer 1994: 12-13), and this fact often explains the crux of L2 learners’ academic difficulties. Because they can “get by just fine” in their social interactions, similar expectations of coping are placed upon them in the academic sphere. It is thus vital to

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establish what language skills learners need in order to succeed in a learning area like Biology (i.e. subject specific language skills).

Furthermore, it is necessary to discover what aspects of linguistic competency – or lack thereof – in fact act as a *facilitator* or a *barrier* to success in a content subject such as Biology. For example, one might well argue that spelling and punctuation do not really interfere with the negotiation of meaning if a learner has understood a particular concept. However, since an expected skill in Biology is reasoning and text construction, lack of coherence in a written explanation could certainly be disadvantageous in communicating a point. This aspect will be dealt with in more detail in Chapters 3-5.

Developing linguistic skills in content subjects

Clark asserts that learning is “a form of apprenticeship” (1996:2) and he goes on to state:

[A]ny form of learning, including language learning, is a result of learners participating in purposeful activity with experts, observing and picking things up, talking through things with them to see how they think, plan and adjust what they do, checking and confirming their understanding as they go along, doing authentic tasks themselves, and reflecting on it all. When knowledge has been socially constructed through the experience of doing things with others in this way, it is then possible for individuals to internalise the new knowledge, expand or reorganise their existing knowledge to accommodate it, make it part of their inner thinking and use it again in novel situations. (1996:2)

This perspective is akin to the notion of content and language integrated learning, which this research aims to investigate. It suggests that L2 learners learning a content subject through the medium of English in fact benefit more linguistically than if they were simply learning English as a subject in itself. This is because the language gains

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purpose and significance as it is used in conjunction with purposeful, significant skills development. “Language learning occurs best alongside other learning” (Clark 1996: 10-12).

Within this content learning environment, however, these L2 learners may still need language assistance. Clark addresses this issue by stating that teachers need to be supported in terms of professional development – so that they can, in turn, assist their learners in educational development. He stresses that “improvement to learning in the classroom must start with improving teachers’ and teacher educators’ understanding and practices” (Clark 1996: 5). In content learning areas, it is often the case that the teacher is an L2 speaker of English herself. Therefore, she might more easily slip into the learners’ L1 (and her own) in the teaching of her subject (Clark 1996: 12). Thus, the language training and experience of the teacher is a vital aspect to consider in terms of equipping L2 learners to cope better, linguistically and academically, in content subjects.

On this question of whether or not, and how, formal language instruction of sorts should be realistically incorporated into content learning areas, Ellis is in agreement with Clark. He points out that “some of the utterances produced by [L2] learners are not well formed according to the adult grammar” (1985: 9). He also reiterates how important input is in SLA, and that L2 learners should be given opportunities to reproduce that input meaningfully (1985: 12). Different from the principles of natural acquisition, Ellis suggests that formal language instruction for L2 learners can be extremely beneficial, with a powerful delayed effect that allows learners to recall, produce and effectively implement language structures in context (1985: 16).

The literature has much to say regarding teaching methods and classroom organization in SLA. Ehrman and Dörnyei “address the classroom environment from a... process-oriented, dynamic point of view” (1998: 2), and assert that the psychological element of L2 learning and teaching is as crucial as the actual teaching of the language. L2 learners

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face the double challenge of (1) a restricted subject knowledge understanding (because of their language backlog) and (2) uncertainty in terms of their L2 competency. The following extract from Ehrman and Dörnyei exemplifies the importance of aspects such as student-centred teaching, language anxiety, motivation and perception in SLA:

[The] learning process is often considerably hindered by a lack of understanding of how dysfunctional³ classroom interactions between teachers and students and among the students can divert energy and attention away from the learning task. On the other hand, any cognitive and affective learning can be substantially enhanced by adroit use of interpersonal and group dynamics. (1998:2)

The authors stress that a sense of safety must be created so that learners are willing to take risks, and that group cohesiveness contributes to this safety (1998: 4). It is often claimed that teachers perform the role of leaders, parents and healers in the classroom. L2 learners have a need for specific guidance and may need the teacher to fill in linguistic gaps left by their real parents, and to “heal” the emotional anxiety and cognitive difficulties associated with performing in the L2 (1998:212). Again, space does not allow for a full explanation of the implementation of these ideas.

Various studies (Post 1993, de Bruin 1994, Pillay 1988, Bialystok 2001) have been conducted in which the performance of L1 and L2 learners, in diverse aspects of language comprehension or production, has been compared. Post, in her study of auditory comprehension proficiency in L1 and L2 learners, found that the greatest problem area of L2 learners was vocabulary, and then verb tenses and subordinate sentences. L2 learners thus did not understand all the terminology used, could not distinguish between events predicted or reported, and could not recognise a main point from a point of detail or added description. She recommends that teachers take into

³ I believe what is meant by a “dysfunctional” classroom situation is a situation where what is being discussed or focused upon is irrelevant to the learning objectives, or where learners are not given a voice (i.e. one-way interaction).

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account these differences in auditory comprehension between L1 and L2 learners, and make provision for dealing with these in the lessons.

Post’s research was of further interest to me, because although she is conducting language research from the point of view of a speech therapist, she encapsulates in the following statement largely what I would like to achieve through my proposed research. (It must be stated here that there is a clear distinction between a speech therapist and a language teacher. L2 learners should not be viewed as being “ill” – in need of healing or therapy. Furthermore, I do not claim that speech therapists are qualified second language educators. I merely include Post’s findings as educationists can also benefit from this discipline, and her findings can be meaningfully applied to L2 learner support practices.)

This involvement does not imply that the speech-language therapist should do the work of a language teacher (Alant, 1989). Rather, she should act as a consultant to the teachers, advising them on strategies and methods that would facilitate language performance and thus in turn, academic performance (Damico, 1987). The speech-language therapist should also act as a consultant to the teachers in developing curricular activities that would be aimed at preventing deficiencies (Gerber, 1987). (1993: 4)

De Bruin, in her comparison of requests for information (about subject matter being presented in a given class) and clarification (of terminology, for example) of English second language and English first language learners, highlights the fact that “early communicative success may reduce motivation to learn more complex linguistic forms required in academic English and cause the English acquisition to plateau. Therefore, it is not merely social interaction that is necessary, but a quality of exposure that encourages learning must be maintained” (1994: 2). Thus L2 learners in the high school setting, for example, should be made aware that functioning competently in the L2 on the rugby field or in the tuckshop line is not a measure or a guarantee of academic

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success. They need to be motivated to attain a higher level of language proficiency in order to reach their cognitive potential in Biology in the L2. This supports the notion of formal language instruction for academic purposes, including in content subjects.

Furthermore, de Bruin found that CLT ideally supports L2 learners’ need for clarification of information. In a traditional classroom situation, “interactions are dominated by questions and instructions from the teacher, and students’ utterances are almost exclusively for answering the teacher’s questions (Klein and Harris, 1986). This relationship often does not allow the necessary clarification, requests, comprehension and confirmation checks that facilitate SLA (Pica, 1987), and so limits the language level that the child is engaged in” (1994: 3). L2 learners were not as confident as L1 learners in requesting information, suggesting that their affective needs⁴ had not been met in the classroom environment, thus affecting their language proficiency. This aspect of the classroom environment was addressed in the interviews with teachers and learners of the school where the research was undertaken, and recommendations made.

It should be noted, however, that the ideal atmosphere of a CLT classroom is very different from the test and examination conditions that L2 learners face. It is these situations that often pose the greatest challenge to the L2 learner, as he cannot request clarification or express himself orally. He has to reproduce independently the input that he has assimilated. See Chapter 4 for a discussion of language challenges facing L2 learners in the domain of their written work.

Pillay (1988) discovered similar L2 language difficulties as Hurley and Tinajero (2001), mentioned earlier. In a study focusing on reading problems encountered by Ciskeian Grade 8 L2 learners of English in Geography, he found that L2 learners were incompetent in terms of accessing expository (content) texts (1988: 98). He suggested that learners be exposed to this type of text structure in primary school, so as to reduce

⁴ Affective needs refer to a learner’s emotional and psychological needs within the learning environment. An educator should ensure that a learner feels safe, confident and relaxed in the classroom, in his interactions with peers and educator alike.

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“register shock” in Grade 8 when the demands of content subjects increase (1988: 98-99). Pillay also established that learners’ “ability to make inferences and predictions is determined to a large extent by the prior knowledge and background experience that a pupil brings with him to the text and by his ability to achieve that background knowledge” (1988: iii). From this observation he asserts that learners should be “lured away from their obsession with words and encouraged to exploit their powers of inference and prediction” (1988: 99). Relevant to this study, Pillay also suggests pre-service and in-service training of content teachers, to get them to be more learner-centred and less teacher-centred (1998: 102).

CHAPTER 3 – *Research design and methodology*

The world of research offers a vast selection of methods when one is considering research within a specific context. It is necessary first to ascertain whether one’s proposed study would be regarded as empirical or non-empirical research, the former offering a greater degree of control within the research environment than the latter. Also, one should question whether one would be creating primary or secondary data, the latter arising from existent studies and literature.

Researchers also necessarily differentiate between quantitative and qualitative research. Locke (1998: 123) describes quantitative research as descriptive, correlational and predictive, experimental and quasi-experimental and single subject. Qualitative research is described as being interpretative and critical.

It is then essential to determine the instrumentation of the study, that is, what methods of gathering research are available – and suitable – to the proposed study. Examples of different types of instrumentation include statistical analysis and comparison, conducting experiments on a control group and an experiment group, “interviews, systematic observation of the setting or events under investigation, ...analysis of documentary materials” (Locke 1998:140), questionnaires and action research.

Action research is research that aims to change a social practice or environment and cannot be conducted by the research alone. It has to involve the participation of other people within the research context. A study of this nature lends itself to action research, as one wants to “take action” and change the unsatisfactory situation (L2 learners not reaching their potential) into a better one, rather than simply studying the given situation. However, since the researcher is not the educator who could physically implement those proposed changes (i.e. I am not a Biology teacher, and since I teach in

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two other learning areas, I would not be free to be present in the classroom to observe a Biology teacher implementing my proposed changes), action research in its purest form cannot be used. Furthermore, action research should necessarily be implemented over a substantial period of time, since revised methods (in this case of teaching Biology to English L2 learners) are being put into operation, further revised, and then re-executed. The time frame of this dissertation does not allow for this. I will propose, however, that the Grade 11 Biology teacher involved employ the recommendations I make based on the information that comes to light through my chosen research methods.

The advantage of using a questionnaire to ascertain respondents' views or perceptions is that the results can in a sense be quantified through percentages, and graphically presented by pie charts or graphs. The researcher has less control in the case of interviewing. However, interviewing allows for a deeper awareness and understanding of the learners' affective position, as L2 learners in an English mother tongue environment.

Considering the scope of a mini-dissertation, it is accepted that questionnaires or other forms of field research will be unnecessary, since the essential information can be gleaned from observing and analysing learners' work (test and exam responses), or from personal interviews conducted with students and teachers.

With regard to research design and methodology, therefore, this study will fall into the quadrant of empirical research, whereby primary data will be created (since a study of this nature has not previously been undertaken at the school concerned). The research done will be predominantly qualitative, and yet aspects of quantitative research are touched upon, for example descriptive and single-subject research is undertaken. The study is single-subject in that the school concerned is the only field of research under analysis.

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The instrumentation will take the shape of observation and interviews (open-ended, group, respondent and informant) (Powney & Watts, 1987) with learners and educators. By this I mean that open questions will be asked (the respondents – Grade 11 L2 Biology learners and their Biology teacher – can elaborate freely upon the issues raised); the learners will be questioned in a group and can respond to one another's comments as well as to the researcher's questions. Some closed (informant) questions will also be asked, whereby the respondents will be guided towards giving specific descriptions of a relevant situation. The research questions will be dealt with in the interviews (e.g. expectations placed on L2 learners by their parents or peers or teachers, educators' experiences with L2 learners, learners' own perceptions of the situation).

Another form of instrumentation will be the gathering of statistical data. The research question dealing with the performance of L2 learners in Biology compared to L1 learners in Biology necessitates the collecting of data such as: ratio of L1 to L2 learners taking Biology (descriptive research), % average of L1 learners versus L2 learners in Biology (simple correlational research), and average age at which L2 learners began instruction in the medium of English. For this information I will consult the school's electronic cumulative academic archives.

Examples of L2 learners' language performance (e.g. Biology essays) will be analysed, learners will be asked to complete a language proficiency assessment instrument, and conclusions will then be drawn regarding English language proficiency levels of these students.

Specific tools that will be needed for the proposed research are the electronic archives mentioned above, learners' personal record files (detailing past scholastic history and cumulative result sheets), access to L2 learners and Biology teachers, time to arrange and conduct interviews and to analyse existing data, a language proficiency assessment instrument (designed to reveal L2 learners' language barriers in this content subject),

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and access to examples of L2 learners’ work produced in Biology, as well as access to Biology textbooks.

Locke describes this process of qualitative, interpretive research as follows:

In this kind of study, the investigator builds an extensive collection of “thick description” (detailed records concerning context, people, actions, and the perceptions of participants) as the basis for inductive generation of explanatory theory. The purpose often is to understand the setting for social action from the perspective of the participants. (p 140)

Limitations of this method of research relate to reliability and validity. The researcher will have to be aware that factors such as fatigue or emotion could affect interview results. Furthermore, the researcher’s status as researcher, colleague, teacher, friend, subordinate and superior in the various different interviewing situations will have to be, as far as possible, neutralized in order to secure unbiased results. It is noted as well that more reserved L2 learners might not respond as readily to questions asked in a group. Their more vocal peers may dominate the discussion and hence these quieter learners may not express their opinions as easily. The researcher determines to arrange additional personal interviews with L2 learners should a situation like this arise.

The literature describes what factors influence the development of the cognitive competence of L2 learners, and what demands are placed on them by the current education dispensation. From this, the core research questions and objectives of this dissertation were formulated. As mentioned in Chapter 1, they can be summed up as follows:

- What linguistic barriers to reaching academic potential lie in the pathway of L2 learners in Biology?

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- What recommendations can be made to Biology teachers to equip L2 learners to overcome these obstacles, and do Biology teachers have the willingness, the language knowledge and the didactic knowledge to do this?

In order to answer these questions, other questions will be posed to the Grade 11 Biology educator as well as to the Grade 11 Biology learners.

The educator concerned will be asked:

- Do you experience learners' language proficiency as a problem in your learning area?
- What linguistic training do you have? Do you have any language didactic training?
- Do you value language accuracy? (i.e. Is it important to you that learners express themselves in correct English?)
- Do you have access (in your teaching/prep) to any language resources?
- Are you conscious of learners on different linguistic competence levels? Are you aware of a responsibility towards L2 learners, or to second language acquisition in general?
- What linguistic skills are needed in Biology, as the medium of learning? What specific linguistic tasks are learners expected to perform?
- What kinds of English input (spoken or written) occur in the Biology classroom? What opportunities do you give the L2 learners to reproduce this input? (i.e. What opportunities are they given to use the English vocabulary and language that they hear or read in the classroom?)
- Are textbooks designed with any consideration for L2 learners (in terms of, for example, explanation of terms)?
- What is your attitude towards language use in your subject? (i.e. do you view academic linguistic competence as vital to the success of the learners in your field?)

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- Have you recognised the need to equip L2 learners with language skills relevant to Biology, and if so, are you willing to implement such a programme?

The Grade 11’s will be asked:

- How long have you been in an L1 English environment? When did your exposure to English begin?
- How and where else are you exposed to English (at home, in the community)?
- What aspect of Biology do you find the most challenging?
- Do you find the classroom atmosphere “safe”? (i.e. Do you “take risks” by asking and answering questions?)
- How often do you participate in class discussions?
- What expectations are placed on you – by your parents, teachers or peers – to perform in Biology?
- Do you see language as an important part of success in Biology?

Details of the conducting of these interviews, and their results, are featured in Chapter 4.

As mentioned previously in this chapter, a further research method that will be used is that of a language proficiency assessment instrument (see Table 1). This tool was drawn up to gain further insight into the L2 Grade 11 Biology learners’ discrete and academic language skills, and thus to discern what aspects of language knowledge pose obstacles to their success in this content subject. I decided to focus on L2 learners’ written work (as opposed to their oral competence), since in Biology they are assessed through written comprehension and written expression, and it was in these two areas that language obstacles were detected. Before drawing up the proficiency assessment instrument below, I analysed L2 learners’ written tests and examinations, as well as the

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questions in the examination papers, and from these I identified various language inadequacies that need to be addressed.

I will furthermore consider the Grade 11 Biology textbooks that are in use at the school, in order to establish the nature of the language that they employ, and that the learners are therefore expected to cope with.

The Language Proficiency Assessment Instrument is detailed below:

LANGUAGE PROFICIENCY ASSESSMENT INSTRUMENT:

Conducted in March 2004 on Grade 11 Biology learners with English as a second language.

Please answer the following questions in full sentences.

1. Identify your key responsibilities as a learner at [your school].
2. Describe your idea of an ideal learning environment.
3. List the aspects of school life that cause you the greatest dissatisfaction.

Now study the diagram and explanations of the human digestive system and answer the questions that follow.

4. Reflect the data presented in the diagram by means of a simple flowchart. Label clearly.
5. Explain the function of insulin in the digestive process.
6. Tabulate the different functions of hunger hormones, according to their roles in both triggering and suppressing appetite.
7. Discuss the primary function of PYY₃₋₃₆.
8. Name the elements that form part of the body's digestive system.
9. Indicate how cholecystokinin signals to the brain that an individual should stop eating.

10. Differentiate between PYY₃₋₃₆ and ghrelin.
11. Quote a statement that suggests that hunger hormones have a dual function.
12. "Like runners in a relay, hunger hormones work in tandem to regulate eating, as they trigger appetite and suppress feasting." Rewrite this compound sentence as two simple sentences.
13. Put the following statements into the correct sequential order:
 - Calories are quickly burned up.
 - The body's fat cells secrete leptin.
 - Appetite decreases owing to an excess of leptin in the blood.
 - The amount of fat is kept stable.
14. One word in each of the following lists is **not** a Biological term. Underline it.
 - i. sucrose / glucose / glycogen / glucerine*
 - ii. ribose / aderine / thymide / deoxyribose*
 - iii. cytocine / pseudopodia / amigo / monomer*

Table 1: Language Proficiency Assessment Instrument

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Questions 1 – 3 of the test are open questions, unrelated to Biology. However, they require that the learner knows how to perform the language tasks *identify*, *describe* and *list*. Thus no matter what the learner's aptitude for Biology is, academic language skills are being assessed.

Questions 4 – 11 are comprehension-type questions, based on a passage about the human digestive system. The passage is from TIME magazine, and so while the language is of a sophisticated standard, the information given is explained in layman's terms. Therefore, the learners are not being assessed on their knowledge of Biology (they do not need any previous knowledge to access the text), but rather on their ability to respond, linguistically, to the content of the text. Once again the learners' proficiency in terms of learning words is assessed. They are required to *reflect*, *explain*, *tabulate*, *discuss*, *name*, *indicate*, and *differentiate*. All of these terms are extracted from previous Biology tests and exams that have been set for the learners, thus it is imperative to determine whether or not they know how to perform these different functions.

Questions 12 – 13 also relate to the given passage. Question 12 assesses the learner's ability to manipulate a text and effect cohesion and coherence. Question 13 assesses the learner's ability to access a text, to recognise structure, and to reproduce it coherently.

The final question is related to Biology terminology that the learners would have been exposed to in their syllabus. They are required to recognise one word out of four that was *not* a Biological term. I believe that this question will be useful because from my research up to this point there is an indication that L2 learners have difficulty understanding, learning, assimilating and using the jargon of the subject. L1 learners have the advantage of unconsciously understanding the words surrounding the Biological terms – they have little or no difficulty in establishing the context in which the terms are used – whereas L2 learners are not as adept at this, and so distinguishing between different terminology is more challenging for them. L1 learners also simply

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have a wider English vocabulary, and so find it easier to differentiate between technical and non-technical terms.

Once all the aforementioned data is collected, the process of data analysis will begin. From the literature review and the field research I will be able to draw up recommendations designed to heighten teachers’ awareness of, and equip them to deal effectively with, linguistic problems experienced by L2 learners (implementing a “language development” of sorts). These recommendations can be implemented over a reasonable time period. The teachers will be asked to give feedback relating to the feasibility and effectiveness of the proposed changes, which might then lead to possibilities of further research beyond the compass of this dissertation.

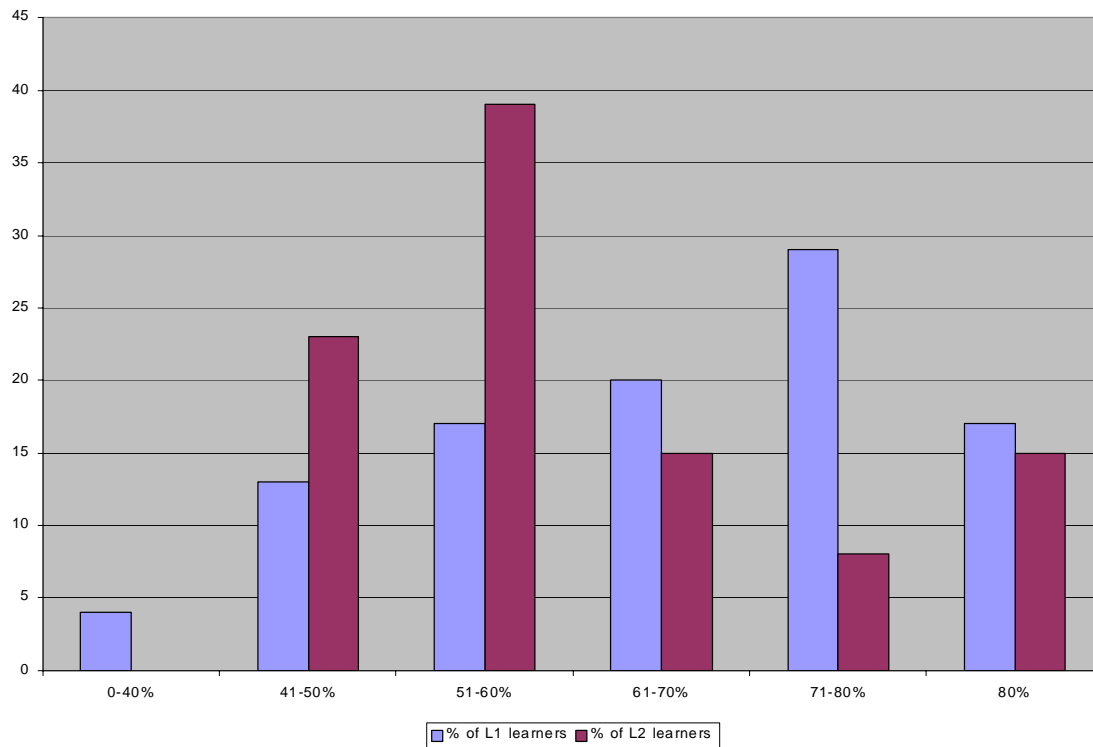
CHAPTER 4 – *Data collection, analysis and interpretation*

Statistical analysis

I commenced the collection of data by accessing the electronic data archive files of the school, in order to ascertain how many Grade 11 learners would be taking Biology as a subject in 2004, as well as to obtain records of the current Grade 11's promotion marks at the end of Grade 10.

The above records revealed that the ratio of L1 to L2 learners in the Biology class is 2:1 (33 L1 learners to 16 L2 learners). Thus, one third of the Biology learners are L2 students. While still in the minority, they represent a significant portion of the school's population.

The following graph represents the achievements (based on the Grade 10 promotion marks in Biology) of both L1 and L2 learners.



Graph 1: Promotion schedule of Grade 10 L1 and L2 Biology learners

It is interesting to note that the majority of L2 learners are achieving between 50% and 60%, while the greatest percentage of L1 achievement lies between 70% and 80%. These statistics are an indication that L2 learners are in general not achieving as well, academically, as their L1 classmates. At this point one cannot categorically state that the discrepancy in achievement levels is due only to language barriers on the part of the L2 learners. It is possible that these learners do not achieve as well academically because of cultural factors. For the L1 learner, the school environment is merely an extension of the home. He comes from an academic culture – a culture of learning – and thus feels comfortable with the style of learning he is exposed to, and the expectations that are placed on him. The L2 learner, however, is positioned in this western school culture of learning, and yet the style and expectations of learning at home, within his own culture, might be radically different.

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Textbook analysis

The Biology teacher of the Grade 11 learners made available to me textbooks that are used for Grades 10-12. For the purposes of this study I will give attention to the one that is used by the Grade 11 learners.

The textbook in question makes use of not only complex Biological terminology (as could, of course, be expected) but also of advanced English vocabulary, such as “comparable”, “replicate”, “catapulting”, “indispensable”, “fluctuations”, “transverse” and “mosaic” (Smit et al 1999). These are words that an L1 learner has in all probability previously encountered. An L2 learner, however, may well struggle to negotiate the meaning of such words within the context of Biological jargon. From the above it is evident that lexical competence is important for mastering this subject, and yet once again textual and functional competence are also vital (e.g. recognizing the logical relationship within or between sentences).

For the most part the sentences are kept short and are easily negotiable, for example:

Seen from the front the head is more or less square, but a lateral view shows it to be almost oval. (Smit et al 1999:239)

However, interspersed in the text are longer, more complex sentences, such as:

The **prothorax** (first segment) is enlarged, especially dorsally, but also to a lesser extent laterally, to form the **pronotum** (collar) which covers the other two segments dorsally. (Smit et al 1999:239)

There are potentially four distinct sentences that one could make from the above. Once again, this type of compound sentence would pose little problem to the L1 learner, but may be especially challenging to the L2 learner, since the latter’s knowledge of

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syntactic rules in the L1 is not as well developed. There may be a tendency to miss the relation between phrases and clauses.

A helpful feature of the textbook is that Biology terms used for the first time in the text are printed in bold face, and often a layman’s meaning is indicated in brackets (e.g. “...to form the **pronotum** (collar)...”). This is beneficial to the learner who may be struggling to navigate through the murky waters of incomprehensible Biological jargon! However, a characteristic of this textbook that might pose further problems to the L2 learner is that the information is presented in large bodies of text. Information presented in point form would be far more accessible to the L2 learner, as he could “digest” one individual concept at a time – analyse and internalise one sentence at a time – rather than trying to differentiate and assimilate the various points of information from a passage of continuous prose. (Improved textual competence would, however, allow learners to better differentiate main from subordinate points within a paragraph.) I quote here an example of a typical body of text:

Female organs (**archegonia**) are borne on short stalks in the midst of a cluster of green leaves at the tip of another shoot of the same plant. Paraphyses occur in this case also. The mature archegonium is shaped like a flask and consists of a relatively long stalk, which attaches the archegonium to the gametophyte, an expanded portion, the venter, and a long thin neck. The venter is hollow and opens to the exterior by means of a narrow canal through the neck. The venter contains a single ovum or egg cell. (Smit et al 1999:78)

The above passage contains five Biology terms, nine distinct ideas or points of information and two compound sentences.

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Analysis of written work produced by L2 learners

I proceeded to evaluate the written test and exam responses of the L2 Grade 11 Biology learners. Several language barriers to academic success were identified in these written texts.

The learners made many common language errors (e.g. concord errors such as “they is” instead of “they are”; spelling errors such as “alot” instead of “a lot”, and other common spelling errors). This kind of inaccuracy does not interfere with the meaning being conveyed. The errors still allow for an effective expression of information.

However, barriers to the effective negotiation of meaning occurred when learners used incorrect vocabulary (through confusion or poor spelling), for example, using “found” instead of “formed”. This type of language error could certainly result in loss of credit in a test or exam (because a learner might be explaining how an embryo is *found* rather than *formed*), and thus in a learner not reaching his academic potential. This trend of confusing lexical items was picked up with regard to the Biological terminology as well. Learners made errors such as writing down “endophytes” instead of “erythrocytes”. I noted that the phrasing of the questions in a multiple choice section of an exam paper unwittingly “set a trap” for learners to make this same kind of lexical confusion mistake. A question read:

Which one of the following is not an organic molecule?

- A amino acid
- B glycerol
- C glucose
- D water

The similar roots of “glycerol” and “glucose” might perhaps confuse an L2 learner in an exam situation – when he is grappling with not only Biological terminology but also the

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language in which it is embedded. However, an L1 learner who has not studied sufficiently for the exam could quite easily make the same mistake!

I noted that learners were also penalised for not writing in full sentences. In other words, a learner would lose marks if he could not express himself completely in clear sentences. A preparatory school English teacher at the school where the research was conducted stated that teaching learners to write in full sentences is vital. If a child cannot formulate a complete sentence it is an indication that in fact he cannot formulate a complete thought. This may not be entirely true, since a learner may choose not to express himself in a complete sentence out of laziness or time constraints. However, the stipulation is relevant to L2 learners who may be struggling to express themselves clearly in the L2, since their L1 is dominant.

In assessing essay and paragraph answers, the Biology teacher had made comments on the scripts such as “Too vague!” and “Please write in full sentences.” One learner wrote about “the biggest amount in the blood system”, but failed to mention what it was in the blood system that amounted to so much. Other examples of poor sentence structure – resulting in nonsensical, vague or inexplicable statements – are as follows:

In plant and animal life needs to be supported in order to lead a normal life.

[This sentence begs the question: Who or what needs to be supported in order to lead a normal life?]

Plants have an epidermis around it.

[Incorrect pronoun]

The plant also has roots that helps in to stay upright and the older the plant the beter.

[It is unclear as to why increased age in plants is beneficial.]

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The above examples reveal that for the most part the learners have a fairly good understanding of the concepts at hand, and yet they lack the ability to express those ideas concisely, succinctly and accurately. This may not be the case for every L2 learner, for it can be argued that with a full understanding of a concept comes the ability to express that concept clearly.

A further language problem that was detected in the written work of the L2 learners was that they were not skilled in academic writing, and lacked knowledge of an appropriate academic style. Socio-linguistic competence demands that the correct register is employed for a given context. For the most part, in their essay and paragraph writing, the L2 learners adopted a conversational tone, writing as they would speak. For example, one learner wrote that the “skeleton keeps the body up straight”. While this statement shows that the learner has understood the concept, a measure of appropriate scientific expression is expected from the learners, and when a global mark is being allocated for a piece of writing, such informal language use may disadvantage the learner. One learner, in an essay describing the body’s cardiac system, wrote the following statements:

I’m now going to tell you the proces of how a red blood cell moves from Superior Vena Carva untill it is released through the Aorta.

...

The blood cell enters through the Superior Vena Carva, it comes from lets say the head.

...

So now you know the basic Cardiact System.

The chatty style of this learner does not interfere with the accuracy of what she is expressing. It is, however, inappropriate in that it disobeys the norms for scientific behaviour. Since an academic style of writing is a criterion of assessment in Biology, it

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is reasonable to expect the Biology teacher to pay attention to this aspect of the learners' educational development.

Record of interviews with Biology teacher and L2 learners

The Biology teacher was interviewed after school one afternoon, in her office. She was asked the following questions and responded completely to each question posed.

- Do you experience learners' language proficiency as a problem in your learning area?

The teacher responded that she did indeed see language proficiency as an important part of her learning area, and that learners' language proficiency – or lack thereof – creates problems in the subject, because the required content is not adequately expressed.

- What linguistic training do you have? Do you have any language didactic training?

This educator replied that she studied Afrikaans at university and did Afrikaans didactic training as part of her teaching diploma. Thus, she has a sound knowledge of language teaching.

- Do you value language accuracy? (i.e. Is it important to you that learners express themselves in correct English?)

The teacher responded that she does value language accuracy, and particularly spelling, sentence structure and paragraph construction. She remarked that the learners' paragraphs must have a topic sentence.

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- Do you have access (in your teaching/prep) to any language resources (e.g. language textbooks)?

The teacher does not have access to *language* resources, only to subject specific resources.

- Are you conscious that the learners are on different linguistic competence levels? Are you aware of a responsibility towards L2 learners, or to second language acquisition in general?

The teacher replied that she is indeed aware of the L2 learners in her classes and of her responsibility toward them. She makes an effort to use alternative words when explaining work, and also to explain concepts in more than one way, giving learners added opportunity to understand the work.

- What linguistic skills are needed in Biology, as the medium of learning? What specific linguistic tasks are learners expected to perform?

Skills needed, according to the teacher, are essay writing, paragraph writing and the learning of Biological terminology – and the correct use of this subject vocabulary. She remarked that learners tend to “create their own words”!

- What kinds of English input (spoken or written) occur in the Biology classroom? What opportunities do you give the L2 learners to reproduce this input? (i.e. What opportunities are they given to express the English vocabulary and language that they hear or read in the classroom?)

Learners use photocopied notes and the textbook in class, and the teacher conducts lessons in English. During practical lessons the learners work in groups and as the teacher goes around assessing each group, they have to explain their practical work (a

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dissection, for example) to her, using the correct vocabulary associated with that section of work.

- Are textbooks selected with any consideration for L2 learners (in terms of, for example, explanation of terms)?

The teacher responded that no consideration was given to L2 learners in this regard.

- What is your attitude towards language use in your subject? (i.e. do you view academic linguistic competence as vital to the success of the learners in your field?)

The teacher responded very definitely that she considered language use to be a vital part of success in her subject. She commented that L2 learners’ ability to recall information is not as accurate as that of the L1 learners, and that this creates problems for the L2 learners in tests and exams. She also said that the L2 learners’ lack of proficiency in English impacts upon their time management in tests and exams⁵. (In content subjects like Biology a vast amount of information needs to be conveyed by the learner in a limited time.) For example, they do not know – or cannot remember – a particular term, and so they have to use two sentences in order to explain that one word. This heightens their stress levels in an exam situation, which is detrimental to their academic performance.

She continued by saying that L2 learners often misinterpret the nuances of a question, and thus misunderstand what is being asked. For example, a learner might misinterpret the instruction to “tabulate” and merely “list” the required information. She also stressed the importance of learners knowing “instruction” words like *discuss*, *contrast* and *compare*. These words appear a lot in the learners’ practical procedures – which contribute a large percentage to their final mark – and she has known L2 learners to fail

⁵ This could also be attributed to cultural factors, as discussed earlier in this chapter.

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these practicals on account of being nervous when confronted with these question words. She mentioned learners by name who are adept at conversational English but struggle severely to express themselves in academic writing.

- Have you recognised the need to equip L2 learners with language skills relevant to Biology, and if so, are you willing to implement such a programme?

The teacher replied that she has recognised this need and is willing to implement a programme of amelioration. She stated that already, at times, she gives the learners (both L1 and L2) alternative words for difficult terminology. She will also explain, for example, that “photo” means “light”, so that when a learner comes across the term “photosynthesis” he can place it within a framework of sense, rather than learning it in isolation.

The Grade 11’s were questioned in two groups with approximately ten learners in each group. The two group interviews took place with the permission of the Biology teacher during one of their Biology periods. They were not interviewed in front of their teacher or any of their L1 peers. They were asked the following questions and gave the following responses:

- How long have you been in an L1 English environment? When did your exposure to English begin?

40% of the learners were exposed to English from primary school, and 60% were only exposed to it from the beginning of high school.

- How and where else are you exposed to English (at home, in the community)?

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The learners responded that they are exposed to English television and radio broadcasts. Some of them stated that their parents are bilingual and so at times English is spoken in their homes.

- What aspect of Biology do you find the most challenging?

The learners stated unanimously that the learning of Biological terminology is the most difficult aspect of the subject.

- Do you find the classroom atmosphere “safe”? (i.e. Are you willing to “take risks” by asking and answering questions?)

The learners responded that they feel comfortable in the classroom. They like their teacher and are not scared to ask questions if they do not understand something.

- How often do you participate in class discussions?

The learners feel comfortable socially in the classroom, but do not participate as much in class discussions as their L1 peers. If asked a question, however, they will answer.

- What expectations are placed on you – by your parents, teachers or peers – to perform in Biology?

The learners all expressed the fact that their parents place the most amount of pressure on them to achieve well in this subject, and across the curriculum. The parents of the learners are paying significantly high school fees, and so expect the children to make the investment worthwhile. There is a measure of academic pressure or expectation from the teacher, and none from their peers.

- Do you see language as an important part of success in Biology?

The learners responded that they did see language proficiency as important to their success in the subject. A discussion ensued, in which the learners admitted that they feel insecure about their spelling in English, and some admitted that they also feel unsure of themselves when speaking in front of their classmates.

The interviews conducted with the L2 Biology learners confirmed that they are far more adept at understanding concepts presented orally than in writing, and that they are also more capable and confident in expressing themselves orally than in writing. This is perhaps because, as far as their language competence is concerned, they are far more conversationally competent than they are academically competent. Few of the language errors identified in their written texts were evident in their spoken language.

Understanding oral expression, therefore, does not seem to pose as great a problem to the L2 learner as reproducing or formulating language himself.

Results of language proficiency assessment

Having interviewed the L2 Grade 11 Biology learners, I requested them to complete the Language Proficiency Assessment Instrument detailed in chapter 3. This they did willingly.

The learners answered the questions confidently, and yet it was detected that in many cases these learners could not negotiate the meanings of the various question words in the assessment instrument, and so did not follow the instructions of the questions. They also confused some of the vocabulary, and struggled with the questions testing their ability to recognise coherence and cohesion (Question 13). These various aspects of language difficulty are discussed below.

As far as their actual written expression was concerned, what the learners were trying to communicate was for the most part comprehensible, and yet several of them made the

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error of leaving out the subject of a sentence, making their statements unclear. Also, some learners employed similar sounding yet incorrect words. For example, one learner wrote about too much “homeword” instead of “homework”; and a “nursing environment” instead of a “nurturing environment”.

Many of the learners did not “list” when required to do so; they explained their points in a paragraph. In fact some learners did not even give more than one element when required to list. They merely explained their opinion on one issue. Similarly, the flow diagram that the learners were requested to draw lacked the conciseness of a diagrammatic representation. Learners seemed to feel the need to write a few sentences at each point in the cycle.

Question 11 read:

Quote a statement that suggests that hunger hormones have a dual function.

The correct answer was:

“Like runners in a relay, hunger hormones work in tandem...”

Few of the learners made the semantic link between *dual* and *tandem*. This indicates the backlog of their regular English vocabulary, since an L1 learner would probably not have struggled to make this connection.

Other areas of lexical confusion arose. One learner, when requested to name the elements of the body’s digestive system listed the various hunger hormones, despite the fact that the large diagram detailing the stomach, gallbladder, pancreas and intestines was labelled “THE DIGESTIVE SYSTEM”. Diagrams, graphs and tables are also *texts* in Biology, and learners must be equipped to read them effectively.

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The instruction to tabulate was misinterpreted by many of the learners, and thus the information required was misrepresented. The question read:

Tabulate the different functions of hunger hormones, according to their roles in both triggering and suppressing appetite.

Thus, what was requested was a table showing a list of the hunger hormones and how each one (1) triggers and (2) suppresses appetite. The learners all knew that they had to draw a table, but most of them dedicated columns to where the hormone is found and its composition, or merely gave one function of each of the hunger hormones.

The majority of the learners struggled to place the four sentences given in Question 13 into the correct sequential order. The information in these sentences was taken directly from the final paragraph of the passage, and was merely rewritten in slightly different words (thus the question did not rely on their knowledge of Biology and was aimed at testing coherence). The learners should have been able to connect each sentence in the question with a sentence of identical meaning in the passage, and from that construe the correct order in which the sentences in the question should be placed. The fact that they battled to do this highlighted that assimilating and then reproducing information in a coherent way posed a problem for these learners. Furthermore, several of the learners struggled to divide the compound sentence given in Question 12 into two simple sentences that made sense and kept the meaning of the compound sentence. In Grade 10 and Grade 11 this aspect of sentence construction and division is covered in detail, and yet these learners have clearly not mastered the skill adequately. The sentences should have read:

Like runners in a relay, hunger hormones work in tandem to regulate eating.
They trigger appetite and suppress feasting.

Versions that some of the learners wrote read as follows:

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Hunger hormones work in tandem to regulate eating. Like runners in a relay, they trigger appetite and suppress feasting.

Like runners in a relay. They trigger appetite and suppress feasting.

The majority of the learners were able to answer Question 14 without much difficulty, identifying the word that was not a Biological term, and so no definitive conclusions could be drawn from this method of assessment.

CHAPTER 5 – *Research findings, conclusions and recommendations*

In this dissertation I set out to discover the language barriers facing English second language Grade 11 learners in Biology, and which prevent the learners from reaching their academic potential in this content subject. The research questions were summed up as follows:

- What linguistic obstacles to reaching academic potential lie in the pathway of L2 learners in Biology?
- What recommendations can be made to Biology teachers to equip L2 learners to overcome these obstacles?

I commenced the necessary research by consulting the past academic records of these learners and comparing their performance in Biology with the performance of their L1 peers. Subsequently I analysed the nature of the language employed in the Grade 11 Biology textbook, and how this may impact upon the learning process of the L2 learners. I assessed the learners' language use in Biology by studying test and examination papers that they had written, and also gave them a language proficiency assessment instrument whereby I could gauge their language difficulties. The learners themselves and the Biology teacher were interviewed with regard to language usage in Biology.

Having carried out the proposed research, I would like to detail in this chapter the implications of my findings. Hence, I can make certain recommendations regarding language development in L2 learners that content subject teachers can apply in their learning areas. With a shift in didactic or educational practice on the part of the teacher,

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many of the L2 learner's language barriers can be overcome. I have subdivided the chapter according to my recommendations.

Group work and classroom management

Peer tutoring

Teaching coherence

Teaching reading skills

Subject specific vocabulary

Teacher training

As shown by the statistics given in Chapter 4, there can be no doubt that the L2 Grade 11 learners in the Biology class do not perform as well academically as their L1 classmates do. The fact that these L2 learners make up one third of the class makes their academic plight well worth considering. Should one be able to improve their success rate, it would have a significant effect on the results of that grade group as a whole. The school aims to produce excellent Matriculants with fine results. Thus, finding methods to help the L2 learners to reach their academic potential would be in the interests not only of these learners but of the school as well.

Considering the Biology textbook made it clear that lexical, textual and functional linguistic competence are exceedingly important for accessing the textbook and for

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success in the subject. The Biological terminology and extensive bodies of text created a barrier for learners less adept at English.

I would recommend that teachers provide opportunities for learners to summarise – whether orally or in writing – sections of the information presented in the textbook, and then to explain or “teach” this content to other learners in a small group. In this way the L2 learners are encouraged to “own” the content being dealt with, in an environment where help (the teacher and peers) is at hand. Thus they do not have to cope with the subject knowledge, presented in a high level of English, on their own at home. Such an exercise would also create the opportunity for learners to find synonyms or layman’s explanations for Biological terms, and so give them something to “hook” their thoughts onto when attempting to memorise terminology. Where time is limited, each group could be given a different section of the content to summarise, and then each group could present their understanding of the information to the rest of the class.

The teacher should furthermore encourage the formation of study groups outside of the classroom, and even promote the sharing of summarised notes between study groups.

Where sequences of Biological processes are being discussed in the textbook, the teacher might offer alternative notes in point form to simplify the information; or set a task whereby learners have to reformulate the information given in prose form into a diagram. This might aid them in acquiring textual and functional competence, as they develop the skill of recognizing the logical relationship between statements (textual competence), and the purpose of certain written explanations in relation to the broader Biological theme being studied (functional competence). Biology study guides are available, and L2 learners should perhaps be encouraged to make use of these resources as commentaries on the more complex textbook.

L2 learners would cope better with reading the textbook if their reading skills in general were refined. The Biology teacher could hand out, from time to time, articles on

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Biological topics, for “interest’s sake”, from scientific journals or magazines like Time. Learners could be encouraged to prepare for a class discussion on the relevant topic by reading the article. Because the learners find the article of some interest, they may not even realise that in reading it they are picking up subject related vocabulary, improving their linguistic competence in general, and equipping themselves to better access the textbook from which they have to study.

Orr and Schutte (1992: 131) recommend the Chambers’s Twentieth Century Dictionary (W & R Chambers Ltd) and the Concise Oxford Dictionary of Current English (Oxford University Press) for Biology learners and educators. These provide significant help in discovering the meaning and origin of Biological terms.

With regard to the learners’ written work that was analysed, I would like to propose that teachers do not focus unnecessarily or exclusively on grammatical aspects such as spelling and punctuation, *if* the learner has succeeded in conveying his meaning sufficiently. Similarly, a learner should not necessarily be penalised for not writing in a full sentence, *if* the subject and complement are adequately implied.

Teachers can certainly point out learners’ errors and offer corrections, in a manner that does not threaten their confidence in the subject (heightening learners’ awareness of their errors without penalising them may well stimulate in them a desire to improve in those areas). However, to harp on common spelling errors that do not detract from the content being communicated is of no help in terms of building a learner’s confidence to express himself linguistically in the subject. Over-critical behaviour on the part of the teacher will discourage the learner from using the L2. Grammatical competence is expected in the professional world, and high school is certainly the forum of preparation of learners for their adult life. Yet one should not lose sight of the fact that *Biology*, not grammar, is what is being learned and assessed in Biology.

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Teachers should also be made aware that L2 learners *will* make grammatical errors. They will never be as competent linguistically as L1 learners, and so this is to be expected. The Biology teacher is also not the language teacher, and so one should be careful of expecting the former to perform the job of the latter. There are, however, aspects of language development that the Biology teacher can address.

Once again, analysing the L2 learners’ written work made it clear that textual and functional competence is an area requiring the greatest attention. A Biology teacher would do well to make use of Orr and Schutte’s work on the language of science (1992), since the authors dedicate chapters of the book to defining and explaining the structure of sentences and different types of sentences; types of reading (e.g. scanning, skimming, comprehensive reading and thoughtful reading) and how these should be used in studying a science; constructing paragraphs and identifying the main points of a paragraph; and identifying signpost words in texts (e.g. *as well as, besides, furthermore, for example, such as, even though, however, whereas, consequently, unless, in brief*).

So often a teacher can “see” that there is something “wrong” with a learner’s piece of writing, but she cannot actually pinpoint the specific error or offer a solution. The above resource could be most beneficial. Through her greater knowledge of the structure of a text, the teacher could for example ask a learner the question, “What is the main point of your paragraph? Which sentence is your topic sentence?”, and so guide the learner to greater linguistic competence and consequently greater success in Biology.

Orr and Schutte furthermore discuss points relating to logical thinking (1992: 106), something that they term “information management”. A linguistic barrier to success detected in the L2 learners’ writing was a difficulty in organising given information into a logical, sequential explanation or description. Orr and Schutte suggest that learners follow this process in studying Biology:

- (1) Always work with a pencil and paper.

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- (2) Establish what is known, what is given, what the facts are. List them.
- (3) Reduce ambiguity. If something is confusingly phrased, re-state it in ways that make sense.
- (4) Eliminate extraneous factors. If there are facts or variables which are irrelevant to the central problem, cross them out. Focus only on key variables and relationships.
- (5) Visualise the problem. Draw diagrams, graphs, charts p whatever will help you to get a more concrete concrete grasp of the situation.
- (6) Establish what the point of all the information is. What are you supposed to do with the data; what are you required to solve? (1992: 106)

These are points of departure for studying that the Biology teacher could quite easily share with her learners. She is not explicitly teaching them language skills, and yet their textual and functional competence in managing, manipulating and reproducing the language of the subject will certainly improve.

From the Biology tests and exams that were considered for this research, as well as from the language proficiency assessment instrument carried out amongst the L2 learners, it was clear that L2 learners did not always understand what was meant by question words such as *describe*, *list*, *identify* or *explain*. This was identified as a language barrier in the language proficiency assessment instrument as well. I suggest that the Biology teacher dedicates a certain amount of time to ensuring that learners are familiar with these words and what the words expect of them. Vocabulary lists of question words could be supplied to the learners, with examples of test questions employing these words and model answers.

As discovered in the analysis of the textbook and in the interviews with the learners and teacher, the actual Biological terminology poses a significant problem to L2 learners as well. This vocabulary could be practised and reinforced through 10 mark tests every second or third Biology period. Learners could be asked to differentiate between similar

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sounding words, or they could answer questions such as “Give one word for (a description of a Biological phenomenon)”. This will assist them in formal tests and exams to recall the subject vocabulary. Small class tests could also be given that require the learners to place randomly presented pieces of information into the correct sequential order, representative of a specific Biological process. The language proficiency assessment instrument indicated that the L2 learners had difficulty with this aspect of language manipulation.

All of the above discussion of the L2 learners’ written work amounts to the basic language difficulty of academic writing. The recommendations I have made will all help towards improving this aspect of the learners’ language competence. A final recommendation in this regard is to make use of the school’s system of peer tutoring. Peer tutors – senior L1 learners who are strong academically – are available on certain afternoons after school to assist other learners who are struggling in a particular subject. In the case of Biology, a competent peer tutor could set tasks for an L2 learner, such as using certain terms in full, clear sentences, or practising writing paragraphs – with clear topic sentences – on a particular subject. This would further support the learners in their endeavour to attain to greater cohesion and coherence in their writing, to identify the function of a particular piece of writing, as well as to express their subject knowledge in the appropriate register.

The interviews with the Biology teacher and the L2 learners respectively confirmed many of the suspected language barriers to success in Biology. It was noted, for example, that while the teacher’s attitude towards language development was extremely positive, she focused primarily on vocabulary and grammatical competence amongst her L2 learners and did not specifically recognise their need for greater textual, functional or socio-linguistic language competence. This aspect has been dealt with extensively earlier in the chapter. I have also recommended helpful educator resources that will assist the teacher in recognising and addressing various language errors.

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The learners commented that at times they felt insecure in the classroom environment (in front of their L1 peers), because of their limited knowledge of English. The solution is not necessarily to get the L2 learners to participate more by asking them more questions in front of the class. This might only increase their sense of anxiety and they might feel even less inclined to “take risks” linguistically in the subject. The teacher could handle the situation by moving amongst the learners in the classroom while they are busy with written work or practicals, and in so doing ask the L2 learners questions about the content being covered. In this way the learners are given more opportunity to reproduce the content of the subject in the L1 – to practise the L1 – in a less slightly threatening forum than a whole-class discussion. Their confidence will grow with every opportunity to apply their L1 knowledge, and so more and more they will be prepared for using English at any time in the Biology class.

The teacher also verified that the L2 learners lose valuable marks in their practical tests and exams because of their lack of assurance in orally expressing the content of the subject under pressure. To minimise nervousness and boost confidence, “practice” practical sessions could be arranged with L1 peer tutors, whereby L2 learners could prepare themselves better for their Biology assessments. Group work and mutual teaching amongst the learners (discussed earlier in the chapter) will provide further opportunity for the L2 learners to reproduce the linguistic input they are receiving from the textbook, the notes and the educator.

The teacher of course has the role of simply encouraging the L2 learners in all their endeavours to use the L1 as the medium of learning. She should commend them for answering questions or giving their opinions in class discussions – not necessarily in front of the whole class, but perhaps when the lesson is over. Furthermore, even if an L2 learner’s response does not exactly make the mark, she should undertake to praise the learner for his efforts. Comments such as, “Yes, you’re on the right track... What other causes might there be?”, can do wonders for a child’s self-esteem.

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The teacher expressed a sincere desire to see language being developed in L2 learners in the content subjects across the curriculum. Once a month the staff of the school has a Staff Development meeting. Sometimes issues pertaining to the workings of the school in general are dealt with, and sometimes in-service training is done. I would like to propose to the management team of the school that a language awareness and development course be run during one or more of these meetings, particularly for content subject teachers, to make them more aware of the language needs and barriers of the L2 learners of the school. A simple explanation of the function and importance of cohesion and coherence in academic writing, for example, might assist teachers in recognising the language weaknesses of their learners. They will then be more equipped to guide these learners to greater language proficiency.

Moreover, and perhaps more importantly, such an exercise might go a long way in adjusting people's language attitudes, in that I believe many do not recognise how vital language proficiency is for academic – and life – success. Clark expresses this concept as follows:

Language is the means by which we think and judge, construct our value-systems, and express and refine our views and feelings. Language is the means by which we take part in the ongoing social debate on how best to shape our world. And it is the means by which we learn to disagree and provide alternative visions and judgements, where we judge others to be wrong. Thus language is at the heart of the construction of democracy and equity. Education systems need to encourage critical thinking among all students, so that they learn how to judge the truth-value of what they read and hear for themselves, shunning prejudice and propaganda from wherever it comes, in favour of exploration of the truthful and valuable. (1996:4)

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