Examining the use of worksheets during a biology field trip to the zoo

Jenna Dick

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Abstract

Field trips to museums have been shown to achieve important learning outcomes and promote scientific literacy. However, the success of museum visits relies, in part, in the ability of teachers to effectively mediate the museum experience. A critical analysis of the literature on teacher-led field trips has shown that they are not always conducted in optimal ways and the use of worksheets is a good illustration of this dilemma. Characteristics of effective museum worksheets are described in best-practice literature; however there is a mismatch between researcher recommendations and teacher practices. Clearly there exists a need to improve teacher practice in informal educational settings.

This study sought to provide insight on the ability of a teacher to follow recommendations outlined by the literature and create a best-practice worksheet. It involved two visits to the Johannesburg Zoo, with two different groups of Grade eight learners, where they were observed and audio-recorded whilst completing one of two museum worksheets. The first worksheet was designed before the teacher was aware of best-practice recommendations. The second worksheet attempted to improve on the first using researcher recommendations. The worksheets were analysed, using a worksheet analysing instrument, which showed that both contained more factors that would hinder learning and few factors that would facilitate learning. These findings suggest that, even with knowledge of best-practice recommendations, the teacher was not able to construct a worksheet that completely facilitated free-choice learning – barriers to the process included: the context of the zoo i.e. the plethora of information boards that rendered most observation-dependent questions as text-dependent; the tendency of the teacher to take advantage of the zoo setting and therefore the use of questions with a high site specificity; an increased use of orientation cues needed to reduce the 'novelty factor'; and the use of the worksheet as an assessment tool that, therefore, provided little choice in where and how learners applied tasks asked of them.

The study also investigated insight on whether or not the worksheets promoted curriculum related conversations among a group of learners. Learner conversations were coded, focusing on both nature of discourse as well as type of discourse, and analysis showed that learners cognitively and affectively engaged with worksheet tasks. However, the nature of cognitive engagement tended to be on a superficial level, suggesting learners do not have the necessary

skills - e.g. language, argumentation and critical analysis - to initiate and conduct exploratory discussions.

In view of these findings, it was concluded that it is difficult to translate best-practice recommendations into actual field trip experiences. The agenda of the teacher as well as the ability of his or her learners strongly influence how a worksheet is conducted and the worksheet is used.

Declaration

I declare that this research report is my own unaided work. It is submitted for the degree of Master of Science at the University of the Witwatersrand, Johannesburg. It has not been submitted before any degree or examination in any other university.

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Be strong and courageous! The Lord your God will be with you wherever you go.

Joshua 1:9

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Chapter One

An introduction to the problem

1.1 Introduction

Museums[1] are a valuable and popular resource used in the teaching of science (DeWitt & Osborne, 2007; Tal, Bamberger, & Morag, 2005). Visits to museums enable teachers to supplement the curriculum with resources not found in the classroom such as interactive displays, real-life objects in context, experts to talk to and specimens to handle (Griffin & Symington, 1997; Krombab & Harms, 2008; Mortensen & Smart, 2007).

Research has shown that these out-of-school experiences can achieve important learning outcomes, both cognitive and affective, which are often missing in the classroom (Davidson, Passmore, & Anderson, 2009; Jarvis & Pell, 2002, 2005; Sanders, 2010). Additionally, learning in the non-traditional setting of the museum may promote the development of scientific literacy among visiting learners through improving attitudes towards science, cultivating an interest that leads to lifelong learning and aspirations of future careers in the field (Jarvis & Pell, 2005; Kisiel, 2006; Mortensen & Smart, 2007).

The success of museums in realising the goal of scientifically literate citizens relies, in part, in the ability of the teacher to effectively mediate the museum experience. In addition to influencing how they plan and conduct a field trip (Sanders, 2010), teachers' attitudes can be seen mirrored in the attitudes of their learners (Griffin & Symington, 1997). As the attitude of learners towards science (as a result of museum visits) has been shown to influence achievement in school (Jarvis & Pell, 2005), the museum experience and consequently teacher practices are crucial in shaping the affective and cognitive domains of learners. The focus of this study is on a teacher's practice during biology field trips to a zoo - specifically on the construction and use of worksheets[2].

[1] Museum is used as a generic term to describe science centres, aquaria, art galleries, zoos, botanical gardens and planetaria (Rennie, 2007).

[2] Worksheet is a term used to describe a sheet or sheets of paper containing museum exhibit related problems or tasks for learners to solve (Mortensen & Smart, 2007)

1.2 Background for the study

Given the vast difference between the context of the formal classroom and the informal museum, it is not surprising that teacher's behaviours range from leaving learners to fend for themselves (Griffin, 1994) to marching groups of learners from one exhibit to the next (Sanders, 2010). Teachers may feel intimidated by the informal environment (Griffin & Symington, 1997) and thus find it difficult to adapt their practices to the informal setting (DeWitt & Osborne, 2007; Kisiel, 2003b). Additionally teachers may be concerned with managing the visit, in terms of costs and transport, as well as monitoring the behaviour of their learners, with the result that visits to museums can be largely unstructured recreational events and wasted educational opportunities (Tunnicliffe, Lucas, & Osborne, 1997). One approach to overcoming this problem, and facilitating meaningful learning, is for teachers to employ effective instructional strategies for the museum visit (Nyamupangedengu & Lelliott, 2012).

Research in the field of out-of-school learning has yielded explicit recommendations on how teachers can maximise the effectiveness of field trips as learning experiences (DeWitt & Storksdieck, 2008). Even so teacher-led field trips are not always conducted in ways that optimise cognitive or affective outcomes (Cox-Petersen & Pfaffinger, 1998; Griffin & Symington, 1997; Lelliott, 2009) and the use of worksheets, during field trips, is a good illustration of the mismatch between classroom and out-of-school learning practices.

Although the use of worksheets in free-choice learning environments remains a contentious issue, an argument has been made for their use as tools in structuring field trips to meet the expectations of the teacher without infringing on the free-choice learning environment (DeWitt & Storksdieck, 2008; Schatz, 2004). The characteristics of worksheets which do not infringe on the autonomy of the learner are described in best-practice literature, however as Griffin and Symington (1997) observe, these recommendations are rarely followed. Clearly there exists a need to improve teacher practice in informal educational settings (DeWitt & Osborne, 2007).

One approach to improving teacher practice is for the individual teacher to reflect on and address her own teaching practice. This is the view of Koshy (2005) who contends that "…the quality of educational experiences provided to children will depend on the ability of the teacher to stand back, question and reflect on his or her practice, and continually strive to make the necessary changes" (p. 1). Thus the goal of this study is to determine whether I am

able to follow the recommendations outlined by the literature and create a worksheet that promotes cognitive gains, whilst still promoting affective outcomes.

1.3 Rationale for the study

School trips to museums are becoming increasingly popular in South Africa (Nyamupangedengu & Lelliott, 2012). Despite the fact that the national curriculum document (CAPS) does not specifically prescribe field trips, teachers view museum visits as opportunities to improve learner knowledge, as well as expose learners to the science world. This objective, according to Lelliott (2009), is highly applicable in the South African situation where learners have limited opportunities and resources, particularly in rural and township schools. In an effort to address the lack of resources in South African classrooms, local museums, like their international counterparts, have rebranded themselves as agents for public education and "edutainment" choosing mission statements that reflect goals of improving scarce skills and the quality of science education in the country.

One way museums meet their mission statements is by making curriculum-aligned resources available to teachers and visiting school groups. Although, a survey of the literature (see Chapter Two) shows that the use of worksheets in museums has been criticized as counterproductive to free-choice learning in informal environments, these museum worksheets are valuable for the numerous South African schools with limited resources. Furthermore in a developing country like South Africa, where museum visits are typically characterised by large learner to teacher ratios, worksheets are a preferable instrument for ensuring that all learners experience the museum visit in the same way.

If worksheets are the best strategy South African teachers have for ensuring the educational worth of a museum visit, it becomes essential that worksheets are designed using recommendations for best-practice so that cognitive and affective outcomes can be maximized. However, in a study of South African museum worksheets Nyamupangedengu (2009) found that worksheets analysed from four Gauteng museums were not optimally designed to facilitate learning. Furthermore, in a study investigating practices of South African teachers during museum visits, Lelliott (2009) reported that most teachers indicated that they expected to guide and assist the learners during the visit but 30% had not prepared for the visit. It can therefore be argued that although teachers and museum educators view museum visits as educationally important, especially in cultivating scientifically literate

learners, they are unaware of how best to utilise the informal setting with the result that field trips tend to be "fun days out" rather than valuable educational experiences.

Kisiel (2007), in a study of teacher choices for worksheets in a science museum, hypothesises that there is a mismatch between researcher recommendations and teacher practices. I would agree with his argument as I only became aware of best-practice as a result of postgraduate studies. Thus, as previously mentioned this study focuses on whether I am able to follow the recommendations outlined by the literature and create a best-practice worksheet. In so doing, I hope to bridge the gap between researcher recommendations and my own practice. Furthermore the findings of this study could be used to inform the practice of the teachers in my department as well as teachers in the wider community through practitioner workshops and conferences in South Africa thus furthering the "reach" of recommendations made in the literature.

1.4 A statement of the problem

Worksheets have been shown to effectively facilitate free-choice learning in informal contexts (e.g. Krombab & Harms, 2008; Mortensen & Smart, 2007). However, these studies were conducted in overseas countries where the ratio of learners to teacher are much smaller than during field trips in South Africa and as such the findings of these studies may not correlate with the context of the South African field trip. More recently, however, Nyamupangedengu and Lelliott (2012) reported that worksheets could be used in the context of South African museums to facilitating learning. The authors found that for a worksheet to be successful, it needed to: promote learner-learner and learner-teacher social interaction, focus learners on specific exhibits that related to the purpose of the visit, as well as allow learners time to explore their own interests within the informal context. However, their study was conducted at a small biology exhibit where exhibitors were on hand to help learners if their teachers were not (in the case of large learner to teacher ratios) and learner behaviour could be controlled within the relatively small confines of the exhibit hall. Furthermore, the worksheet used in the study by Nyamupangedengu and Lelliott (2012) could be categorised as a survey-orientated worksheet – that is, one which favours breadth of content over depth, where learners are encouraged to experience all that a museum offers (described in Section 2.4.3) - which is not recommended for free-choice learning (Kisiel, 2003b). Consequently, some questions remain unanswered with regard to worksheet use during South African school field trips for example: "Would there have been significantly different findings, from those

reported by Nyamupangedengu & Lelliott, if the worksheet had been concept-orientated?" and "How would learners use the worksheet in a different context, e.g. a zoo, where there are no exhibitors or readily available teachers to provide appropriate scaffolding during the field trip?". These questions point to a gap in the literature which my study aims to address.

1.5 Aims of the study and Research questions

The aim of the study is to determine whether I am able to follow the recommendations outlined by the literature and create a worksheet that promotes cognitive gains, whilst still promoting affective outcomes. The study will endeavour to answer the following research questions:

1. How can I improve on a worksheet, designed for use by Grade eight learners during a zoo field trip, using best-practice criteria in such a way that promotes free-choice learning?
2. To what extent does the revised worksheet promote curriculum-related conversation?

1.6 Conceptual framework for the study

The Contextual Model of Learning (Falk & Dierking, 2000) is used as a framework in the analysis of my own zoo worksheets. Learning according to the Contextual Model is the product of constant interactions between an individual and his or her physical and social worlds - what the model refers to as contexts. The three contexts are defined as: the personal, socio-cultural (incorporating socio-cultural theory), and physical.

1.7 Research design

The purpose of this study is to determine whether I am able to revise a zoo field trip worksheet, of my own design, using best-practice criteria in such a way as to promote free-choice learning and curriculum-related conversation. The study, therefore, is focused on improving my own professional practice and takes the form of action research. Kemmis and McTaggart (1982) describe action research as a series of 'spirals' (see Section 3.2 of Chapter Three) whereby one develops a plan of critically informed action to improve practice, acts to implement the plan, observes and reflects on the effects of the pan and uses the initial analysis to plan a subsequent critically informed action. I cycled through two spirals of critically informed action research which involved two visits to the research site, the Johannesburg Zoo, with two different groups of Grade eight learners where they were

observed and audio-recorded completing one of two zoo worksheets. The original worksheet was used during the first visit and the revised worksheet was used during the second visit.

1.8 Delineation of the study

Many strategies are can be used to promote out-of-school learning, however, my interest lies in teacher-prepared worksheets and their effectiveness in facilitating cognitive and affective gains. The study was therefore carried out in two parts: the first was an analysis of my own original worksheet, using a worksheet analysing instrument (Nyamupangedengu, 2009), and the consequent revision and construction of a second worksheet to align with best-practice recommendations; the second part was an analysis of on-task learner conversations recorded whilst learners completed the zoo worksheets.

1.9 Organisation of the research report

This report comprises six chapters. Chapter One provides the introduction and background to the study. Chapter Two is a discussion of the relevant literature on out-of-school learning, informal context worksheets, learning conversations and the conceptual framework for the study. Chapter Three is a description of my research methodology and design, the research instrument and coding frameworks I used as well as a description of how I collected my data in a rigorous and ethical manner. Chapter Four is the analysis of the first part of my study: An analysis of my own zoo worksheets. Chapter Five is the analysis of the second part of my study: A qualitative analysis and discussion of learner conversations during two biology field trips to the zoo. Chapter Six comprises a summary of the research findings, limitations of my study and implications in the field of out-of-school learning.

Chapter Two

Literature review

2.1 Introduction

This chapter presents a discussion on the value of field trips, as well as the use of worksheets during school-led visits. It is relevant to my study which focuses on the use of worksheets during a biology field trip to the zoo. The literature review is divided into four sections:

- out-of-school learning,
- the conceptual framework for the study,
- worksheets in out-of-school learning, and
- learning conversations in informal contexts.

The contextual model framing my study, that is socio-cultural theory (Vygotsky, 1978) and the Contextual Model of Learning (Falk & Dierking, 2000), is discussed in the second section. In addition, the increasing use of learner conversations as a tool for describing learning during field trips is discussed in the last section as it has relevance to the second part of my study which investigates the prevalence of curriculum-related conversation as a result of worksheets.

2.2 Out-of-school learning

Out-of-school learning in museums, science centres, zoos and aquaria has been the subject of much educational research over the past four decades. During the 1970s, 1980s, and 1990s the research focused on conceptual outcomes of field trips conducted to museums (Davidson et al., 2009; DeWitt & Storksdieck, 2008). More recently, research in out-of-school learning has tended towards broadening the view of perceived learning outcomes to include positive affective and social experiences. This shift in focus comes as a result of a new understanding of what out-of-school learning is.

2.2.1 Informal learning versus free-choice learning

In reviewing the literature on out-of-school learning, it becomes quite clear that learning that takes place outside of school is known by many different names for example: non-formal learning and learning in out-of-school contexts, settings or environments (Rennie, 2007) however, the most commonly used name is informal learning (Dierking, Falk, Rennie,

Anderson, & Ellenbogen, 2003). It can be argued that these terms are inaccurate and misleading as they imply there is a difference between the learning that takes place in the formal classroom and the learning that takes place when learners leave the classroom (Rennie, 2007). Learning is far more complex than this simple delineation suggests. Rather it is cumulative in nature resulting from a myriad of human experiences ranging from interactions in museums to interactions with the Internet and, as such, much of what people know about the world derives from real-world physical and social experiences (Dierking et al., 2003). This comprehensive, all-encompassing view of learning prompted Rennie (2007) to comment that to try distinguish formal from informal learning is a wasted endeavour as both fall within the range of settings ascribed to the human experience. Rather what is useful is to distinguish between different learning contexts, i.e. formal and informal.

Museum learning is less structured than its formal counterpart for example: attendance and participation is, for the most part, voluntary; the underlying curriculum is open and not didactic; activities tend to be non-competitive and non-evaluative; and social interaction tends to be in heterogeneous groups (Ellenbogen, 2002; Falk, Koran, & Dierking, 1986; Rennie, 2007). Implicit in this reasoning is the recommendation, made by the Informal Science Education ad hoc committee (Dierking et al., 2003), to use out-of-school learning, free-choice learning, life-long science learning or public understanding of science as suitable monikers for this area of research rather than informal learning. Thus for the purposes of this study I will make use of the following three terms: *free-choice learning* - learning that is "self-motivated, voluntary, and guided by the learner's needs and interests" (Dierking et al., 2003, p. 109; Falk, Heimlich, & Foutz, 2009), *informal contexts* – institutional settings outside of the classroom for example museums, science centres, zoos and aquaria (Falk et al., 2009; Koran, Koran, & Ellis, 1989); and *out-of-school learning* – experiences in informal contexts where opportunities arise and can contribute to the cumulative nature of learning. Although free-choice learning and out-of-school learning are used interchangeably in the literature, for the purposes of this study they are used to differentiate between learning in informal settings (out-of-school learning) and learning in informal settings that is under the choice and control of the learner (free-choice learning).

2.2.2 Research on out-of-school learning

Each year millions of learners worldwide take part in science school field trips (Anderson & Lucas, 1997; Balling & Falk, 1980) and they are becoming increasingly popular in South

Africa (Lelliott, 2009) – an indication that they are viewed as an important part of learning science. However, these excursions are both costly and administratively complex to organise (Orion & Hofstein, 1994; Randler, Kummer, & Wilhelm, 2011; Sanders, 2010) and it is therefore not surprising that school principals, teachers and parents want to be assured of their educational effectiveness so as to justify investments of time and money (Balling & Falk, 1980; Orion & Hofstein, 1994). Consequently, early researchers concerned with the critical question of whether people learn in informal contexts, were driven by the impetus to show the educational worth of field trips as being comparable to formal classroom instruction.

These early forays failed to find evidence of cognitive gains (Rennie, 2007), with some even commenting that school-based experiences might provide more learning for the same amount of time as spent in museums (DeWitt & Storksdieck, 2008). Bitgood (1989) argues that it was unrealistic, of early research, to expect to find a profound effect on learning just from spending two to three hours in a museum. Additionally, the paper and pen tests often used to evaluate such learning do not adequately reflect the complexity of the field trip experience. Many of these studies also suffered from too narrowly defined cognitive outcomes, labouring under the assumption that what people learn is predictable and easily measurable when the opposite is true (Rennie, 2007). Learning is a result of personal and diverse experiences and is, therefore, very difficult to measure. For example, Falk and Dierking (2000) showed how two women, who visited a museum together as friends, recounted very different experiences. However, there are many studies that have shown varying degrees of success in quantifying cognitive learning (DeWitt & Storksdieck, 2008).

In their study investigating learning in an informal context, Falk and Storksdieck (2005) found that “a large majority” (p. 758) of the 217 random adult visitors they surveyed left the exhibition with a measurably enhanced understanding of life science. Other studies sought to determine how much information was retained by learners after a museum visit for example, Cox-Petersen, Marsh, Kisiel, and Melber (2003) investigated student learning as a result of guided tours and found that even though learners expressed a high satisfaction with the tour they showed low levels of science learning. The failure of this study, and others like it, to detect appreciable learning may be due to the researchers expecting to be able to measure museum-based learning with the same degree of precision and reliability as classroom studies (Falk et al., 1986) as well as not considering that the visit may have produced a readiness to

learn, but at a later stage (Rennie, 2007). Nevertheless, Falk and Dierking (1997) provide evidence that field trips can lead to long-term episodic memories, even many years later. There are numerous other studies (e.g. Anderson & Lucas, 1997; Balling & Falk, 1980; Beiers & McRobbie, 1992; Falk & Dierking, 2000; Orion & Hofstein, 1994) which have provided evidence that field trips can have a positive impact on the learning of facts and concepts and hence the general consensus among researchers is that, under certain *favourable conditions* field trips may lead to better learning outcomes than traditional formal learning (DeWitt & Storksdieck, 2008).

Given the growing amount of research on the cognitive benefits of informal contexts, Davidson et al. (2009) contend that it would seem prudent to investigate the perspectives of learners, given that they are key beneficiaries of the field trip experience. This shift in focus, from cognitive to affective outcomes, highlights a general consensus that out-of-school learning should encompass more than just cognitive gains (e.g. Dierking et al., 2003). It includes emotions, social interactions, visual and tactile information, increasing curiosity and appreciation for science and developing motivation and interest – these are affective outcomes. Consequently, free-choice learning should be viewed as a self-motivated, voluntary process guided by learners' needs and interests - investigated using multiple, creative methods in a variety of circumstances (Dierking et al., 2003)

2.2.3 Factors affecting out-of-school learning

The result of thirty years of research was an unequivocal yes to the critical question of whether people learn from visits to museums and other similar informal contexts (Bell, Lewenstein, W., & Feder, 2009; Rennie, 2007) but also the identification of a myriad of conditions that have to be met for this learning to take place. For example, the novelty of the field trip setting can impact on the conceptual gains of visiting learners. Research has shown that unfamiliar settings result in learners spending large amounts of time familiarising themselves with the setting – which detracts from cognitive learning (Balling & Falk, 1980). Orion and Hofstein (1994) identified the 'novelty space' as one of two variables (the other being field trip quality) that impact on the educational effectiveness of a field trip. In their study of a one day geologic field trip they show that a learner's 'novelty space' needs to be addressed and reduced so as to enhance learner performance. This finding is confirmed by Anderson and Lucas (1997) and Falk (2004) who showed markedly increased cognitive gains

in learners' who underwent novelty reducing pre-orientation programmes and had prior visitation experience.

Informal contexts enable all visitors to engage with ideas and bring their prior knowledge and experience to bear (Bell et al., 2009). Consequently, a critical factor that can influence learning is prior knowledge (DeWitt & Storksdieck, 2008; Falk et al., 1986) as it determines what exhibits a learner will look at and learn from. Research has shown that learners are more likely to improve their understanding of a concept during a museum visit if they have some understanding of the concept already (Beiers & McRobbie, 1992). Although it should be mentioned that Falk and Storksdieck (2005) showed the less visitors knew the more they learned. Nevertheless, unless visitors have prior knowledge, it is unlikely that learning will result from casual perusal of exhibit content (Falk et al., 1986) and as such exhibits are more likely to enhance learning than teach new and unfamiliar concepts (Tuckey, 1992; cited by Beiers & McRobbie, 1992).

Another factor that impacts on learning in informal contexts is the visitors' personal agenda through which they approach the experience. Visitors come with different motivations but, in general, they enter predisposed to learning and motivated by curiosity (Bell et al., 2009; Falk et al., 1986). However, it should be noted that these visits are typically voluntary (which is the opposite of school-led field trips) and therefore, the agendas of children on a predefined, highly structured class visit are not likely to correlate with the agendas of children visiting with their family or friends. Social interaction is also important in learning in informal contexts. In particular, the nature of interactions and collaborations visitors have within their own groups (Borun, Chambers, Dritsas, & Johnson, 1997) and outside of their groups e.g. with museum guides and demonstrators (Rosenthal & Blankman-Hetrick, 2002) have been shown to strongly influence informal context experiences. In addition, studies have shown that a visitor's cultural affinity also plays a role in how and what they learn in informal contexts (e.g. Fienberg & Leinhardt, 2002).

The factors affecting out-of-school learning, described above, are a small selection of the numerous factors reported in the literature; however the factor relevant to my study, i.e. the impact of structure on a field trip is discussed in Section 2.4 of this chapter.

2.2.4 The teachers' role in out-of-school learning

Teachers play an important role in shaping learners' experiences of museums. They decide what learners will do, influence what learners value and focus on, and what they remember about the trip (Anderson, Kisiel, & Storksdieck, 2006; Davidson et al., 2009; Kisiel, 2006; Sanders, 2010). In short – learners mirror their teacher's attitudes and goals towards field trips.

It has been reported in several studies (Cox-Petersen & Pfaffinger, 1998; Gottfried, 1980; Rennie & MaClafferty, 1995; Tal & Morag, 2007) that teachers' generally view field trips as being important for enriching the curriculum and contributing to their learners' scientific knowledge - conceptual goals; as well as enhancing interest and motivation - affective goals. Sanders (2010) reported that another possible reason for teachers conducting field trips is to compensate for their own lack of knowledge on a particular topic – in this case museum guides and docents would be relied upon. However, there seems to be a mismatch between teachers' attitudes and objectives and the strategies they employ during field trips in order to achieve these objectives. For example, Griffin and Symington (1997) showed that less than 50% of teachers in their study linked their visits to the curriculum. Tal et al. (2005) reported that most of the teachers they surveyed did not plan their visit nor perceive their own crucial influence on the success of the visit. Similarly Lelliott (2009) showed that South African teachers do very little preparation for field trips, and tend not to explicitly link the visit to classroom teaching. The argument can thus be made that a teacher's field trip behaviour is indicative of their true attitudes and objectives with regard to out-of-school learning. Kisiel (2007) deftly illustrates this dilemma when he comments that "… although teachers see the field trips as an important experience, they may not be aware of how best to use these informal learning settings to support learning in their classroom" (p.30). It is, therefore, very important to encourage and assist teachers in planning and conducting field trips that follow best practice recommendations so as to ensure there are both cognitive and affective gains.

Fortunately, researchers have made explicit recommendations to teachers about best practices they can use to ensure the educational effectiveness of the field trips they conduct. These recommendations include becoming familiar with the informal setting before the field trip (Cox-Petersen & Pfaffinger, 1998; Rennie & MaClafferty, 1995); orientating learners to the setting and clarifying the learning objectives (Anderson & Lucas, 1997; Orion & Hofstein, 1994; Rennie & MaClafferty, 1995); designing curriculum aligned pre-visit activities (Cox-

Petersen & Pfaffinger, 1998; Davidson et al., 2009); allowing learners time to explore the environment; designing activities that support the curriculum and take advantage of the uniqueness of an informal learning environment (Cox-Petersen & Pfaffinger, 1998); and planning post-visit activities that reinforce what was learnt during the field trip (Anderson, 1999; Cox-Petersen & Pfaffinger, 1998; Davidson et al., 2009; Rennie & MaClafferty, 1995). However, evidence would suggest that these recommendations are not generally followed (Anderson et al., 2006; Cox-Petersen & Pfaffinger, 1998; Griffin, 1994; Griffin & Symington, 1997).

Teachers have very little idea of how to effectively use informal settings as learning resources, with the result that: formal task-orientated teaching strategies are utilized; pre-visit and follow-up activities, at the very most, consist of organizational preparation and the collection and marking of worksheets respectively; and teacher supervision which ranges from actively working with small groups to leaving them to fend for themselves (Griffin, 1994; Griffin & Symington, 1997; Kisiel, 2006; Lelliott, 2009). It can be argued that these typical behaviours come as a result of teachers, feeling inadequate and intimidated by the field trip experience; relying on strategies they are most confident with - those of their classroom of which the use of worksheets is a common example and the subject of this study.

2.3 A conceptual framework

Human beings are social creatures and given the social context of museum visits, it is not surprising that much research on museum learning is rooted in the epistemological foundation of socio-cultural theory. The socio-cultural view of learning is based on the idea that learners use their own experiences and interact with others, using discourse, to construct knowledge about the world (Cox-Petersen et al., 2003; Tal & Morag, 2007). The importance of these social interactions is emphasized in the Contextual Model of Learning (CML) formulated, by Falk and Dierking (2000), as a device for investigating the complexities of free-choice learning. The study is thus conceptually framed by knowledge related to learning in museums, including socio-cultural theory and the Contextual Model of Learning (Falk & Dierking, 2000).

2.3.1. Socio-cultural theory

The policy statement of the Informal Science Education ad hoc committee (Dierking et al., 2003) highlights the need to use socio-cultural theory as a framework for studying the process

of out-of-school learning. Central to this theory is the view that out-of-school learning is a process, not a product, of an individual's personal experiences and interactions (Cox-Petersen et al., 2003; Tal & Morag, 2007). This view of learning builds on Vygotsky's (1978) socio-cultural theory which states that higher mental functioning in an individual develops from the individual's social life, where scientific ideas are talked through on the social plane first, before they are internalised by the individual (Leach, 2003). Conversations and other types of interactions among visitors to museums and similar facilities are therefore assumed to be chief mechanisms of knowledge construction (Tal & Morag, 2007). Thus this study uses a socio-cultural lens to determine the nature of conversations among learners on a field trip structured by worksheet.

2.3.2 The Contextual Model of Learning

The CML (Falk & Dierking, 2000), is a robust model that enables researchers to explore learning in museums beyond the limited scope of traditional views and ideas. It is based on the authors' view that learning is not something that happens as an isolated incident but rather as an organic, integrated experience that happens in the real world. Within the model, learning is conceptualised as a contextually-driven never-ending effort to make meaning of and survive in the world, and as such is the product of constant interactions between an individual and his or her physical and social worlds – or more specifically, the product of an individual's personal, socio-cultural and physical contexts (Falk & Storksdieck, 2005). Thus, the socio-cultural context as well as the context of the individual's personal experience and physical space all interact to contribute to his or her experience of a museum (Cox-Petersen et al., 2003) and consequently, what and how they learn. The three contexts of the CML are described below:

Personal context: Falk and Dierking (2000) drew on numerous studies grounded in constructivist theories to 'flesh out' their view, that the personal context was an individual's entire personal and genetic history, to include an individual's: background, previous experiences, interests, social skills, prior knowledge (Rennie & Johnston, 2004), motivations or agendas as well as the desire for choice and control over a learning experience (Falk & Storksdieck, 2005). Thus, we should expect informal context learning to be highly personal and strongly influenced by an individual's motivations, expectations and desire to control his or her own learning (Falk & Storksdieck, 2005; Tal & Morag, 2007). In the case of informal contexts, this usually translates into leisure-orientated, culturally defined experiences.

Socio-cultural context: Humans are social creatures and given the free-choice setting inherent in informal contexts and the fact that most visit with a companion or in groups, we can expect learning that takes place therein to be socio-culturally situated (Tal & Morag, 2007). The socio-cultural context thus describes the interactions of an individual with other people as well as with the social and cultural features of displays and exhibits (Rennie & Johnston, 2004) and museum educators or guides (Falk & Storksdieck, 2005) – hence the importance of addressing the novelty factor (discussed in Section 2.2.3).

Physical context: Informal contexts are generally voluntary and conducted in a non-sequential manner, and as such we can expect visitors to be highly reactive to what the setting affords (Falk & Dierking, 2000) which includes both large-scale properties such as space, lighting, climate, architectural design and layout of the facility; as well as smaller-scale properties such as exhibits and exhibit labels (Falk & Storksdieck, 2005; Rennie & Johnston, 2004). As such learning has been shown to be highly correlated by how successfully an individual can navigate a complex three-dimensional environment (e.g. Anderson & Lucas, 1997).

Although they are described separately the contexts are never static. Instead they overlap and interact to significantly influence learning in informal contexts. Falk and Dierking (2000) suggest that the best way to think of the constant interaction is to view "the personal context as moving through time; as it travels it is constantly shaped and reshaped as it experiences events within the physical context, all of which are mediated by and through the socio-cultural context" (p.11). In this way, the CML is not a model – it does not claim to make predictions about learning - but rather a framework used for organising the complexities of learning within informal contexts (Falk & Storksdieck, 2005).

There are hundreds of factors that influence, either directly or indirectly, learning in informal contexts (Falk & Storksdieck, 2005). Falk and Dierking (2000) identified eleven of the most influential factors and included them within their model. Furthermore, the authors contend that when any of these factors are missing, learning in an out-of-school setting becomes more difficult. The eleven factors and three contexts are illustrated in Figure 2.1 overleaf.

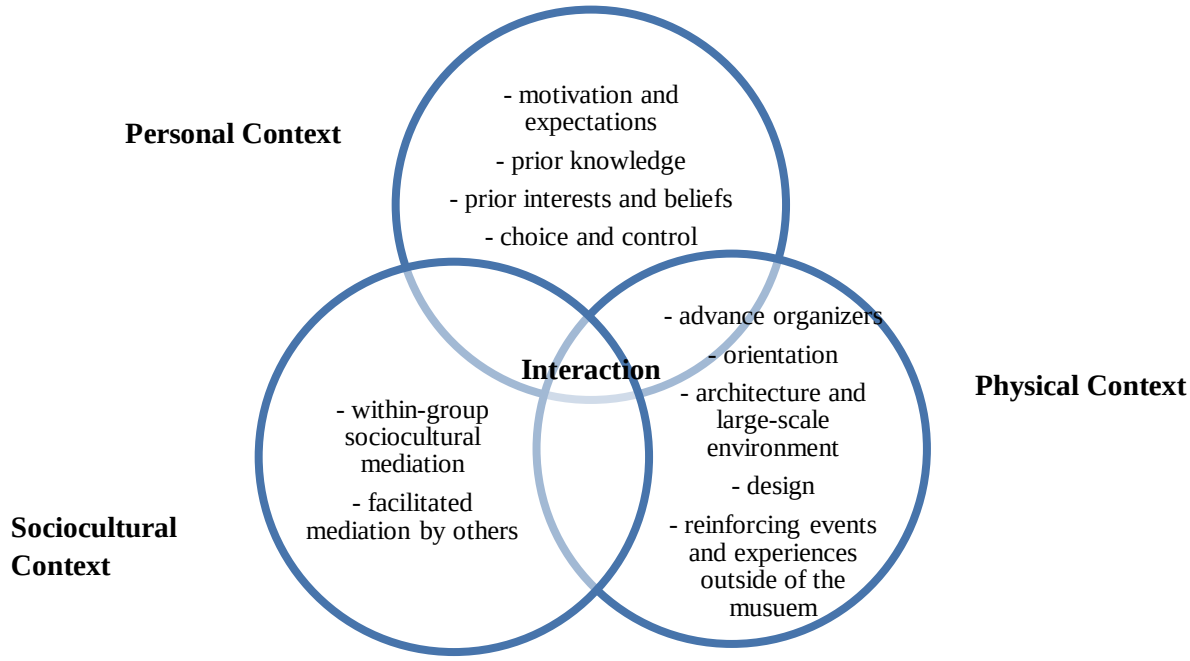


Figure 2.1: The Contextual Model of Learning (Falk & Dierking, 2000)

Falk and Dierking (2000) contend that the power of the CML lies in its ability to embrace and organize the complexity of learning in an informal context into a manageable whole and, as such, successfully accommodate much of what is known about learning. Mortensen and Smart (2007) affirmed this view with their appraisal of the CML: "it manages the complexity of an informal learning situation without reducing its inherent richness" (p. 1391). The CML has thus been widely used as a framework for investigating free-choice learning (e.g. Cox-Petersen et al., 2003; Falk & Storksdieck, 2005; Kisiel, 2003b) and as such is used in my own study as a framework to improve a worksheet of my own design to fit best-practice recommendations.

2.4 Worksheets in out-of-school learning

Teachers have been observed using a variety of strategies to facilitate learning during field trips. These strategies vary in terms of the structure they impose ranging from very little structure – rowdy groups of learners running unsupervised through museum halls, to the opposite extreme – subdued groups led from one exhibit to the next (personal observation; Sanders, 2010). Kisiel (2003a) reported that 40% of teachers he surveyed indicated a preference for some sort of structured engagement during field trips. Worksheets are a common strategy for implementing this structure as evidenced by the frequent observation of learners completing some sort of written task in informal settings (Kisiel, 2007). Teachers are thus comfortable with worksheets (DeWitt & Storksdieck, 2008; Kisiel, 2003b) and some

learners have commented that even though completing a worksheet kept them from freely exploring other exhibits during a museum visit, they felt that they would not learn anything if they did not have one (Griffin, 1994). Therefore "… if [learners] feel that worksheets are necessary for real learning, and if [teachers] believe that worksheet materials are necessary for what they consider a successful field trip, … it seems that building a tool that emphasizes the qualities inherent in an informal setting may be one way to help [teachers] better exploit the museum setting" (Kisiel, 2007, p. 32). As such, it is important that educators are aware of the best-practice recommendations made in the literature on worksheet design and implementation. Nevertheless, personal observation and several studies (e.g. Griffin & Symington, 1997; Kisiel, 2003b) suggests that these important recommendations are not reaching the central stakeholders – teachers continue to impose formal classroom, task orientated worksheets during their field trips. School-led field trips are thus, not being conducted in the most effective way and recommendations made by researchers remain on dusty library shelves.

2.4.1 Research on worksheets in museums

Worksheets, by their very nature, impose structure in any learning experience. It is therefore not surprising that worksheets are viewed by some as counterproductive to free-choice learning characteristic of informal contexts (e.g. Griffin, 1994; Griffin & Symington, 1997). Some criticisms of museum worksheets are that they: impose classroom-like constraints on free-choice learning (Mortensen & Smart, 2007); emphasise label reading rather than object or specimen observation (Griffin, 1994); stress the filling in of answers to the exclusion of free exploration of the surroundings (Nyamupangedengu & Lelliott, 2012); and limit the autonomy of the learner (Griffin & Symington, 1997).

Several studies, however, have shown that if worksheets are well thought-out and constructed they can facilitate free-choice learning (Griffin & Symington, 1997; Kisiel, 2003b; Krombab & Harms, 2008). Mortensen and Smart (2007) show that a museum worksheet, designed in accordance with best practice recommendations, significantly increases the number and diversity of curriculum-related conversations among grade three to five learners. McManus (1985) found that comprehensive worksheets promoted learning by introducing the concept to be studied and helped learners locate exhibits. Krombab and Harms (2008) report that, when completed in pairs, a museum worksheet can strengthen learner motivations as well as

their conceptual understanding. The evidence indicates, therefore, that the usefulness of the worksheet cannot be dismissed.

2.4.2 Kisiel's characteristics of a worksheet that impact on learning

Several recommendations have been made for effective museum worksheets. McManus (1985) suggests that worksheets can be used as effective learning tools in informal contexts if they encourage and allow enough time for observation, refer to objects and not exhibit labels, are clear about where to find task-related information, and encourage collaboration among group members. More recently, Kisiel (2003b) proposed eight worksheet characteristics which have implications for museum learning. He elucidated these characteristics from an analysis of teacher-prepared worksheets, intended for self-guided school field trips, which he then compared with the factors identified by Falk and Dierking (2000) in the CML (see Section 2.4). Kisiel's eight characteristics include: task density, orientation cues, site specificity, information source, level of choice, cognitive level, response length, and response format. A detailed description of each of these characteristics as well as a summary of each characteristic is included in Table 2.1 below.

Table 2.1: Characteristics of a worksheet which have implications in out-of-school learning (Kisiel, 2003b)

Characteristic	Explanation
Task density	Amount of work learners are asked to complete
Orientation cues	Extent to which the worksheet guides learners through the museum
Site specificity	Extent to which tasks are based on a specific exhibition
Information source	Extent to which answers are text-dependent (reading labels) or object-dependent
Level of choice	Learner-centred or museum-centred
Cognitive level	Level of questioning based on Bloom's taxonomy
Response length	Length of the expected answer
Response format	How the learner is directed to respond

Task density refers to the amount of work learners are asked to complete. It is described as either the total number of questions on the worksheet; the time per museum hall (for the purposes of this study the time per animal display) or the time per question learners are allocated to complete the worksheet (Mortensen & Smart, 2007). For example, in his analysis of twelve museum worksheets Kisiel (2003b) found task density ranged from three questions answered over 45 minutes to 53 questions answered over 90 minutes. This translates into a

time per question ratio (T/Q) of 45 minutes/3 questions or 15 minutes per question, and 90 minutes/53 questions or approximately 1 minute 42 seconds per question respectively. The T/Q ratio provides researchers with an approximate standard by which to compare the experience of learners completing a worksheet during a field trip. A low T/Q, e.g. 1 minute 42 seconds per question, indicates a worksheet that provides little time for learners to complete each question. A high T/Q, therefore, indicates a worksheet that provides longer periods of time for learners to complete each question for example 15 minutes per question. Similarly, task density can also be described by the time per museum hall/display (T/H) ratio where a low T/D and high T/H indicate short and long periods of time spent in each museum hall or area respectively. For example, if learners need to visit two areas of a museum in order to complete a worksheet in 45 minutes the T/H ratio is 45 minutes/2 halls or approximately 22 minutes and 30 seconds in each hall. Therefore a worksheet that has a high task density, that is many questions requiring many exhibits in a short period of time (low T/Q and T/H), would only allow for brief visits in each museum hall and short periods of time to complete each task. Kisiel (2003b) describes these worksheets as survey-orientated worksheets (see Section 2.4.3) as they emphasise the "breadth of a topic over its depth" (p.9). What he does not give an indication of, however, is what the optimal task density of a museum worksheet should be. As Nyamupangedengu (2009) points out "how high is high" and "how low is low"? Also, in the case of my research, how does the size of the informal setting (a zoo) affect T/H and T/Q ratios? The T/Q might be perceived as high but the time allocated to each question is spent walking around the zoo looking for the animal exhibit.

Orientation cues describe the extent to which a worksheet directs learners through an informal environment so that they can find relevant information to answer related worksheet questions. Informal settings can be overwhelming (Mortensen & Smart, 2007), with the result that learners will often spend large amounts of time familiarising themselves with their unfamiliar environment (Balling & Falk, 1980). Research suggests that, to help learners avoid unnecessary distractions, the novelty effect of informal settings needs to be reduced (Anderson & Lucas, 1997; Falk, 2004; Orion & Hofstein, 1994). A worksheet with orientation cues is one method that can be employed to address this issue. However, it is important to note that orientation cues may be viewed as counter to free-choice learning as overly structured worksheets limit learners' choice and control over what they look at and learn (Falk et al., 2009). However, as Kisiel (2003b) describes, orientations cues can vary in their degree of specificity, for example: general directions such as the name of an exhibit or

museum hall that learners need to look at or visit can be used to gently guide learners. A more structured field trip would employ detailed step-by-step orientation cues, such as where to turn and where to look, often using maps or the particular way-finding system of the facility. Furthermore, Kisiel (2003b) contends that a teacher's objectives and concerns will influence the degree of orientation she provides in a worksheet i.e. worksheets with a large degree of specific orientation cues might be used to help learners find all the answers, focus learners on a particular concept, or as a tool to keep learners on task. Teachers who want to take advantage of free-choice learning but focus learners on specific content will need to establish a delicate balance between detailed orientation cues so as to facilitate cognitive learning without infringing on the choice and control of the learners.

Site specificity indicates the extent to which worksheet questions are based on specific museum exhibits. A worksheet with a high site specificity is made up of tasks that are specific to a particular display and a worksheet with a low site specificity is not limited to a particular display – rather it can be answered in the greater area of the informal setting or at another setting (Mortensen & Smart, 2007). The two sample questions that follow illustrate the difference between a high and low site specificity task: "Find the Spectacled Bear, so named for the markings around its eyes. What status does this bear have on the Endangered Species List?"[3] – this question has a high site specificity as, unless another zoo had the same species of bear, the relevant information to answer the question can only be found at the zoo's bear enclosure; "Find an animal that is protected by the zoo but endangered in the wild. What is this animal's status on the Endangered Species List?"[4] – this question has a low site specificity as many animals within the zoo could be visited to answer the task. The latter question could also be answered at any other zoo facility that protects endangered species.

Information source refers to whether the information needed to answer worksheet questions is text-dependent - found on exhibit labels and information boards, or object-dependent - by looking at and thinking about objects, animals or specimens on display. An example of an object-dependent question is: "Give two physical characteristics that you can observe that show these [Polar] Bears are not adapted to the African environment."[5] Learners have to look at the Polar Bears and think about their appearance so as to answer the question. Text-dependent questions can only be answered by reading information boards and labels, for

[3] Activity 2, Question 1, Appendix A1
[4] Activity 2, Question 1, Appendix A2
[5] Activity 1, Question 7, Appendix A2

example: "The Gibbons swing from branch to branch, sometimes over 10 metres, with long arms. What name do we use to describe this kind of movement?"[6] Learners can look at the Gibbons and watch them swing around their enclosure, but only by reading the information board will they discover the correct term – brachiation – needed to answer the question. It should be noted that text-dependent questions tend to also have high site specificity. By contrast, object-dependent questions tend to have low site specificity and are therefore good questions to use in worksheets that aim to promote free-choice learning.

Level of choice categorizes the amount of choice and control that each question affords learners. This choice varies from no choice at all (questions that have one correct answer only), to some choice (questions with several correct answers to choose from), to subject choice (learners can choose the subject for which the question is asked). The following examples illustrate these distinctions: "Explain how the zoo raises the Wattle Crane chicks without imprinting on them"[7] – no choice; "Discuss with your group one other way in which the zoo can be water-wise. Write your group's suggestion down"[8] – some choice; and "Describe one physical and one behavioural adaptation for this animal [that you chose]"[9] – subject choice. As the core of the field trip experience is free-choice learning (Falk & Dierking, 2000) and learners value being given choice and control during their field trip (Griffin, 2004; Griffin & Symington, 1997), worksheets should make use of questions that allow for learner autonomy.

Cognitive level refers to the level of questioning as described by Bloom's taxonomy of processing in the cognitive domain. The taxonomy is a multi-tiered model used to classify thinking into six hierarchical levels of complexity: knowledge, comprehension, application, synthesis and evaluation (D. Allen & Tanner, 2002; Forehand, 2005; Green & Rollnick, 2007). Knowledge requires a learner to recall or recognize previously learnt facts such as definitions, criteria, classifications and generalizations. Comprehension assesses the learner's ability to understand the literal meaning of a communication (oral, written or graphic) demonstrated by the ability to paraphrase, predict consequences or translate one form of communication into another. Application describes the ability of a learner to use information in new and concrete contexts for example problem solving tasks. Analysis assesses a learner's ability to break information down into its constituent parts and then describe the

[6] Activity 1, Question 6, Appendix A1
[7] Activity 2, Question 6, Appendix A1
[8] Activity 5, Question 4, Appendix A2
[9] Activity 2, Question 1, Appendix A1

relationship between those parts, for example analysis of experimental data. Synthesis and evaluation describe the ability of a learner to integrate ideas to form a coherent whole and make judgements on the value of material for a given purpose respectively. These categories are arranged from simple to complex and from concrete to abstract so that they represent a cumulative hierarchy (Krathwohl, 2002) where each level includes, builds on, and is more difficult than that of the levels below it. In other words, a higher cognitive thinking level is assumed to include the lower thinking levels (Green & Rollnick, 2007). This is summarised, with an example, in Table 2.2 below:

Table 2.2: Bloom's cumulative hierarchical cognitive levels of thinking

Cognitive Level	Abilities Involved	Example (D. Allen & Tanner, 2002)
Knowledge (K)	K	Name the six kingdoms of living things
Comprehension (C)	K and C	Describe how living things are classified into kingdoms.
Application (Ap)	K, C and Ap	If a new life form were discovered, what process would you use to assign it to a kingdom?
Analysis (As)	K, C, Ap and As	How are fungi and plants similar to and different from each other?
Synthesis (S)	K, C, Ap, As and S	Develop a classification system for objects commonly found in your kitchen. State the rules of your classification system
Evaluation (E)	K, C, Ap, As, S and E	Should the classification of living things be based on their genetic similarities or their morphology/physiology? What are the reasons for your choice?

The hierarchical thinking process is evident in the examples described in Table 2.2: Knowledge requires learners to recall facts of the six kingdoms of classification; comprehension asks learners to show more in-depth understanding of these kingdoms so as to explain the process of classification; application asks learners to use what they know (knowledge and comprehension) and apply it in classifying a new life form; analysis assesses the ability of learners to compare and contrast fungi and plants – which again builds on the previous three cognitive levels as only with knowledge of classification, understanding of the classification process and practice in applying this process will learners be able to answer the question; synthesis assesses whether learners can combine ideas (incorporating the previous four levels) to produce a plan of action; and finally evaluation asks learners to demonstrate

their ability to reason and judge the value of the classification system – learners will need to employ all five previous levels of thinking to answer this question.

Although Bloom's Taxonomy is widely accepted, it is not beyond the reach of criticism. Seddon (1978) argues that the hierarchical view of Bloom's Taxonomy is flawed as the evaluation does not necessarily incorporate the abilities of synthesis, rather they can be viewed as two divergent processes that operate within the same cognitive level. Green and Rollnick (2007) echo this view and suggest that a higher thinking level does not necessarily imply that all lower thinking levels are included (with the exception of knowledge which is crucial to perform at all thinking levels) – their view prompted the authors to propose an alternative conceptualization of Bloom's hierarchical taxonomies (described in Section 3.3 of Chapter Three), which was adopted in this study.

Response format describes how the learner is directed to respond i.e. write, draw, touch, discuss or do a physical activity. Questions that require a verbal answer encourage learning through social interaction (Kisiel, 2003b). Written responses enable teachers to account for completion of a worksheet (Griffin, 1994; Nyamupangedengu, 2009). Physical activities allow learners to experience real life objects and therefore facilitate learning (Nyamupangedengu, 2009). Kisiel (2003b) conceptualises response format along two dimensions: verbal-nonverbal and written-nonwritten. Figure 2.2 illustrates these dimensions.

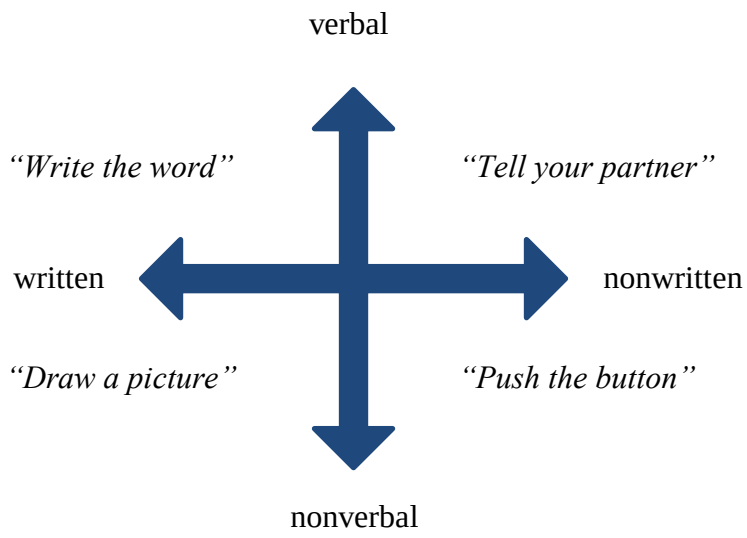


Figure 2.2: Dimensions of response format (Kisiel, 2003b)

Thus according to Kisiel's conceptualisation, a worksheet should make use of a variety of combinations of response formats for example: discuss with your group and then write and touch and then discuss or draw a picture.

Classroom connection refers to the degree with which the field trip experience and worksheet relate to the classroom curriculum. Worksheets that connect to the classroom curriculum are more likely to facilitate learning through a learner's prior knowledge (Mortensen & Smart, 2007). Research has shown, however, that field trips are often seen as unrelated events that happen outside the classroom (Kisiel, 2003b) and although teachers generally report a link to topics already covered in the classroom, on closer inspection, these seem incidental (e.g. Griffin & Symington, 1997; Kisiel, 2007; Lelliott, 2009).

Further analysis of informal context worksheets led Kisiel (2003b) to identify two broad types: the survey-orientated and concept-orientated worksheet and, consequently, what a more effective worksheet might look like. Kisiel also showed that a teacher's agenda, subconsciously, influences their preference for a particular type of worksheets

2.4.3 Teacher agendas and the informal context worksheet

As previously mentioned, teacher agendas affect how they plan and conduct a field trip experience and as many teachers view the worksheet as a tool for keeping learners on task and learning (Kisiel, 2003b), the worksheet remains a regular feature of school field trips. Furthermore, as there seems to be a mismatch between researcher recommendations and teacher practices (Kisiel, 2007), worksheets that fit the formal classroom and not out-of-school learning tend to predominate teacher practice. Consequently, the nature of the field trip experience depends on the teacher's agenda and interpretation of what an effective worksheet might be.

Kisiel (2003b) identifies two broad teacher agendas: the survey agenda describes a teacher that encourages his or her learners to see and experience everything on display; the concept agenda teacher is more interested in using the informal context as a specific teaching resource and thus focuses his or her learners on specific displays. Analysis of teacher-prepared worksheets enabled Kisiel (2003b) to extend these two categories to include the type of worksheet characteristics each agenda type would employ. The result of this analysis was the elucidation of the survey-orientated and concept-orientated worksheets. Table 2.3, overleaf, provides a comparison of the two worksheet types.

Table 2.3: A comparison of survey-orientated and concept-orientated worksheets (Kisiel, 2003b; Nyamupangedengu, 2009)

Distinguishing characteristics	Survey-orientated worksheets	Concept-orientated worksheets
Task density	High – low T/Q and T/D ratios, more questions	Low – high T/Q and T/D ratios, less questions
Orientation cues	Yes	Not always
Site specificity	High - questions label-dependent and exhibit specific	Low - questions can be answered using many different exhibits
Information source	Text – responses based on exhibit labels	Object – more object-dependent questions
Level of choice	Few, if any choices	Some choice incorporated in question
Cognitive level	Less likely to use higher order questions	More likely to use higher order questions

Survey-orientated worksheets have many questions which require the learner to visit many exhibits. The overall experience is one where there is little time to answer each question. These worksheets tend to focus learners towards object-labels with lower order questions and little time for free exploration. At the opposite extreme, concept-orientated worksheets have fewer questions, allowing more time to be spent on each. Questions focus learners at the objects themselves, not their labels and are broad enough that they could be answered in many settings. The concept-orientated worksheet uses higher order questions and allows for exploration of the environment. It should be noted, however, that Kisiel (2003b) is careful to acknowledge that the two agendas and worksheet types cannot classify teacher agendas for a field trip into a clear cut dichotomy, rather he suggests a continuum to illustrate the relationship between these agendas and the phenomenon that aspects of both, in varying degrees, are reflected in many teacher-led field trips. Table 2.4, overleaf, illustrates this continuum. It should be noted, however, that 80% of the teachers surveyed by Kisiel (2003b) could be classified closer to the survey agenda end of the scale.

Table 2.4: A representation of survey-orientated and concept-orientated worksheets as a continuum (Nyamupangedengu, 2009)

Concept-orientated worksheet		Survey-orientated worksheet
Low	Task density	High
Low	Orientation cues	High
More	Information source (object-dependent)	Less
Low	Information source (text-dependent)	High
High	Level of choice	Low
High number of higher order questions	Cognitive level	Low number of higher order questions
Low	Site specificity	High

continuum

It is also worth noting that worksheets produced by informal contexts, like museums, are also influenced by the agendas of those who constructed them. For example, Mortensen and Smart (2007) found that a museum worksheet, designed to help chaperones guide groups around a natural history museum, complied with concept-orientated worksheet criteria. Nyamupangedengu (2009) however found that the majority of worksheets she analysed, from four museums in the Gauteng Province of South Africa, tended to be very structured and showed elements that would both hinder and facilitate learning. Given the importance of out-of-school learning experiences in promoting scientific literacy in resource poor South African schools, it would seem prudent for worksheets prepared by museums and educators alike to comply with the recommendations made by Kisiel (2003b) – these are discussed in the next section.

2.4.4 Characteristics of a worksheet that is likely to promote learning

As previously discussed, this study is framed by the CML (Falk & Dierking, 2000) which described learning as the interaction of an individual's personal, physical and socio-cultural contexts. The work of James Kisiel uses the factors inherent in the CML to describe a hypothetical worksheet that is likely to promote learning in informal contexts. That is, he

hypothesized the components of a worksheet that account for the different contexts described by Falk and Dierking (2000). Table 2.5 illustrates the characteristics suggested by the CML with the characteristics of Kisiel's hypothesised worksheet.

Table 2.5: A comparison of Kisiel's hypothesised worksheet characteristics based on the CML (Kisiel, 2003b; Nyamupangedengu, 2009)

Distinguishing characteristics	Suggested worksheet characteristic based on the CML	Kisiel's hypothesised worksheet
Task density	*Personal context (motivation, expectations and prior interests):* task density should be low enough to allow time to explore, orient within the environment and for novelty effects	Low – fewer questions, fewer displays examined, high T/Q and T/H
Orientation cues	*Physical context (orientation):* worksheet needs to help learners orient	Orientation cues used without providing too much structure e.g. maps, locations of displays
Information source	*Physical context (exhibit design):*worksheet must focus learners on that which is unique and unavailable in the classroom	Object-dependent – worksheet emphasises that which would be difficult to experience in the classroom
Level of choice	*Personal context (choice and control, prior knowledge and interests):*	Some choice given to learner in what information is sought
Cognitive level	*Personal context (prior knowledge):* A combination of higher and lower order questions accommodates differences in learner experiences and abilities	Both low and higher levels of questions
Response format	*Socio-cultural context (within group social mediation):* a variety of response modes addresses different learning styles and promotes social interaction	All response formats included – verbal, nonverbal, written and unwritten
Classroom connection	*Physical context (reinforcing experiences):* making connections to prior knowledge makes the field trip experience more meaningful	Worksheet referred to after visit to promote discussion and introduce additional activities

The worksheet hypothesised in Table 2.5 is more closely related to the concept-orientated worksheet end of the continuum, which led Kisiel (2003b) to contend that the concept-orientated worksheet was more likely to contribute to a meaningful learning experience when viewed using the framework of the CML. Nevertheless, Kisiel (2007) found that almost 70% of teachers he surveyed (n=106), in a follow-up investigation, preferred the survey-orientated worksheet. The most common reason (50%) for this preference was the worksheet's task density and the teacher's concern for keeping learners on task (1/3 of teachers reported this concern). The study also showed that no respondents cited a link to classroom learning as a

reason for worksheet preference. This finding supports the findings of others (e.g. Griffin & Symington, 1997; Lelliott, 2009; Tal et al., 2005) who reported that, in general, teachers do not adequately prepare for a field trip nor link it to the classroom curriculum.

However, the most significant finding reported by Kisiel (2007) was the observation that teachers "may not be aware of research-based, pedagogical practices that support learning in [informal contexts] and that a model for a 'best' [field trip] may not be universally accepted by all teachers" (p. 40). As my own exposure to the relevant literature only came about as a result of postgraduate studies, it is a personal belief that teachers, that have not undergone further studying, will not be aware of the recommendations made for effective field trip worksheets. These teachers will favour, as I have, worksheets that manage behaviour. These views are echoed in the claims of Kisiel (2007) who contends that best-practice for field trips, recommended by researchers, may not coincide with teacher practices and intentions; and that keeping learners on task and under control are important considerations shaping teachers beliefs, worksheet preparation and use.

2.5 Learning conversations in informal contexts

It has already been established that learning can occur from a field trip to a museum, zoo, science centre or aquarium (Falk et al., 2009) and given the fundamentally social nature of informal contexts (Leinhardt, Crowley, & Knutson, 2002), this learning is characterised more as a process, and not as a product, of the informal context. Thus the expectation is that researchers in the field will not be able to measure out-of-school learning with the same precision and degree of reliability as classroom learning (Falk et al., 1986). How then do we approach the question: "what do people learn from visiting [informal contexts] and how do they learn it?" posed by Leinhardt et al. (2002, p. ix).

A large body of research points to the strong influence visitor interactions and collaborations have on a field trip experience and the profound difference quality interactions have on learning (Falk, 2004). People do not come to informal contexts to talk, but they do – deftly moving from discussions of how to navigate and manage the visit to details of the exhibits themselves (Leinhardt et al., 2002). These conversations are a rich source of information on what and how people learn and therefore, are increasingly used (e.g. S. Allen, 2002; DeWitt & Hohenstein, 2010) as a tool to uncover the complexities of out-of-school learning. However, many of these studies have focused on adult-child conversations (e.g. Ash, 2002; Tare, French, Frazier, Diamond, & Evans, 2011) and those studies that have investigated

conversations among learners, for example Tunnicliffe et al. (1997), have only focused on the content of the conversations. More recently, however, DeWitt and Hohenstein (2010) investigated both the nature and type of learner talk which allowed the authors to unravel the nature of interactions between learners as well as determine the level of cognitive and affective engagement, crucial in supporting learning in any setting, learners had with the task at hand. Thus for the purposes of this study, two coding frameworks (described in Chapter Three) are used to determine the extent to which a teacher-prepared worksheet promoted curriculum-related conversation during a biology field trip to the zoo. This approach in determining the kinds of learning that take place during a field trip is consistent with socio-cultural perspective that frames the study.

2.6 Conclusion

In this chapter, I have discussed out-of-school learning and the use of worksheets therein. I have also discussed learner discourse and the socio-cultural perspective inherent in informal context field trips. The discussion on worksheets in informal contexts shows that they are preferred by teachers as a behaviour controlling tool, but when prepared using best-practice recommendations, they have the potential to promote cognitive gains in such a way that does not impede on the affective gains of the learners guided by them. Furthermore, the CML and Kisiel's (2003b) hypothetical worksheet provide a benchmark for what an effective worksheet might look like. However, there is a need to make these recommendations known to teachers and museum educators such that the mismatch between teacher practices and the relevant literature are addressed. The next chapter discusses the methods I used to investigate my own ability to follow best-practice recommendations to improve on a worksheet of my own design for use by grade eight learners during a biology field trip to the zoo.

Chapter Three

Research design and Methodology

3.1 Introduction

This chapter comprises a discussion of my research design and the methods that I used to select the study site, participants and how to collect my data. I also discuss the instruments, pilot study, ethics and reliability and validity issues. The chapter is divided into six sections:

- the methodology,
- worksheet analysing instrument,
- analysis of on-task learner conversations,
- data collection,
- research rigour, and
- ethics.

The discussion is accompanied by a review of the literature pertinent to the research aspects of my methodology.

3.2 Methodology

The aim of the study is to determine whether I am able to follow the recommendations outlined by the literature and create a worksheet that promotes cognitive gains, whilst still promoting affective outcomes.

The study endeavoured to answer the following research questions:

1. How can I improve on a worksheet, designed for use by grade 8 learners during a zoo field trip, using best-practice criteria in such a way that promotes free-choice learning?
2. To what extent does the revised worksheet promote curriculum related conversation?

It is important to note that even though the wording of my first research question assumes that I will be able to improve my worksheet I acknowledge that this may have not be the case in all aspects of the worksheet. Acknowledging my failures enabled me, the teacher-researcher, to continue cycling in the process of action research (discussed in Section 3.2.3)

to improve my professional practice beyond this study. Consequently, failure to improve on aspects of the worksheet is included with the discussion of this study.

3.2.1 Research design

The purpose of this study was to determine whether I was able to improve my own zoo field trip worksheet, using researcher recommendations, so it promoted free-choice learning. Furthermore, the study aimed to determine if the modified worksheet promoted curriculum related conversations more effectively than the original worksheet. The study therefore was focused on improving my own professional practice and took the form of action research.

Action research has been described as trying out ideas in practice for their improvement and to increase knowledge (Kemmis & McTaggart, 1982). This description of action research emphasises the importance of the "action" in the research process and thus serves as a bridge between theory recommended in the literature and the practice of participants - an approach to research that Kemmis and McTaggart (1982) describe as "ideas-in-action". Furthermore, action research leads to an increase in knowledge which is relevant to the institution in which the study is conducted as well as the research community. Thus action researchers describe and interpret events at the same time as trying to change them for the better (Bassey, 1995, cited in McNiff, Lomax, & Whitehead, 1996). The action researcher is thus differentiated from the reflective teacher who is described as being concerned with the technical matters of the classroom (McNiff et al., 1996) as she reflects on and changes her practice daily but does not approach this reflectivity from a systematic empirical standpoint.

Purists argue that action research is exclusively collaborative, where investigations are conducted by groups of practitioners with a shared concern e.g. teachers and principals (Kemmis & McTaggart, 1982). However, more recently definitions like that of Sagor (2005, cited in Abrams, 2010) make provision for the individual researcher: "an investigation conducted by the person or the people empowered to action concerning their own actions, for the purpose of improving their actions" (p. 4). This view is echoed by McNiff et al. (1996) who describe individual action research as "insider research" where teachers ask questions like "How do I improve what I am doing?" so as to engage in their own professional development. The terms teacher-researcher, research practitioner, and teacher-as-researcher have therefore been used to denote the action research of a single teacher (Abrams, 2010) who works alone to improve her own practice. For the purposes of this study the term

teacher-researcher will be used to identify my role as both researcher and teacher in the research process.

Another approach to investigating one's own practice is self-study research (Pinnegar & Hamilton, 2009). It should be noted that action research and self-studies are very similar. Like action research, self-studies are characterised by being self-initiated and focused with the aim of improving practice (LaBoskey, 2004). Self-study methodologies also involve cycles of critical reflection on practice and interactions between others in that practice (LaBoskey, 2004). However, unlike action research, self-studies aim to improve practice as a result of knowledge derived from research *findings* (LaBoskey, 2004) not as part of the research *process*. In other words, self-study research investigates who the teacher is where action research investigates what the teacher does. Consequently, the "action" is of a lower priority in self-studies when in action research it is the motivating force (McNiff et al., 1996).

3.2.2 Constructivist paradigm

This research falls under the constructivist paradigm which maintains that reality is socially constructed from multiple perspectives (Mertens, 2005; Reeves & Hedburg, 2003). It differs from the positivist paradigm which postulates a single context-free reality where educational research and social observations can be treated in much the same way as the physical phenomena of pure science (Johnson & Onwuegbuzie, 2004; McMillan & Schumacher, 2010). It is evident from my research questions and method of action research that interpretation of my data could not be achieved through a positivist approach which calls for emotionally detached and uninvolved observers (Johnson & Onwuegbuzie, 2004). Rather I needed to be immersed in the context of my study (Reeves & Hedburg, 2003) so as to report on and interpret complex social phenomena from the unique standpoint of a teacher-researcher. Schwandt (2000) (cited in Mertens, 2005) describes this position of the constructivist paradigm succinctly when he said researchers should strive to understand the complex world of lived experiences from the point of view of those who live it. I therefore chose the constructivist paradigm as it allows for an approach to educational research where my own teacher-researcher's values and perspectives are considered in the interpretation of my data (McMillan & Schumacher, 2010; Mertens, 2005).

3.2.3 The action research plan

The study took the form of two "spirals", as described by Kemmis and McTaggart (1982), where I developed a plan of critically informed action to improve my teacher practice for a field trip to the zoo, acted to implement the plan, observed and reflected on the effects of the plan in the context of the zoo in which it occurred and used my initial analysis as a basis for planning a subsequent critically informed action. To achieve this, each spiral involved an analysis of a zoo field trip worksheet, analysis of learners' worksheet answers and recordings of learner conversations whilst they walked around the zoo answering questions posed by a worksheet. Data collection, therefore, took place during two separate zoo visits each on a separate day. The two spirals were then followed by an analysis of learner conversations. My action research plan is illustrated in Figure 3.1 below.

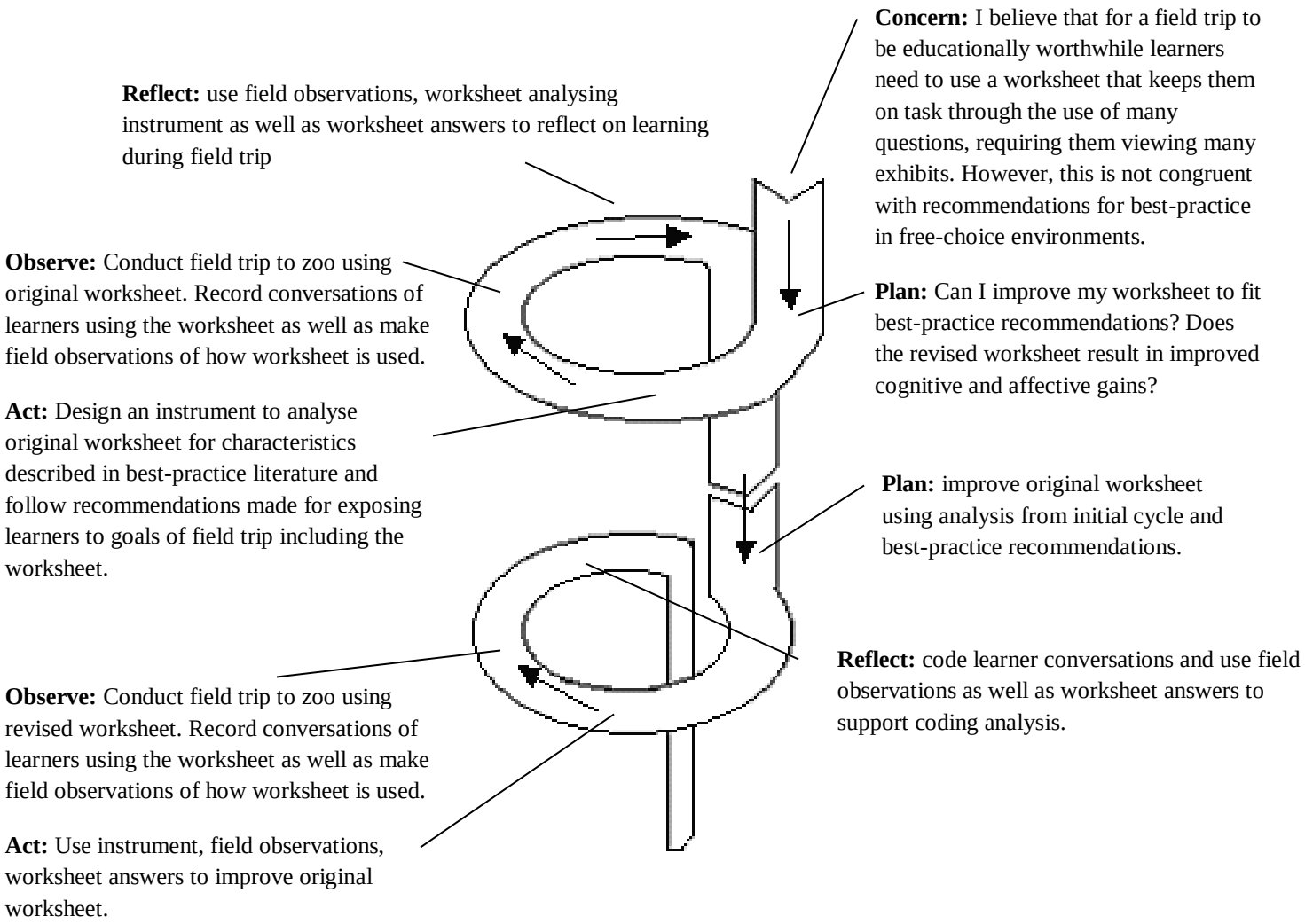


Figure 3.1: The Action Research Spiral (adapted from Kemmis & McTaggart, 1982)

3.3 Analysing the zoo worksheets – the worksheet analysis instrument

The original zoo worksheet, Worksheet A[10], was of my own design to be used by grade eight learners during a biology field trip to the zoo. The worksheet was designed three years ago before I was made aware of best-practice recommendations and as such the construction of the worksheet was not informed by relevant literature. Consequently it was important to analyse Worksheet A to determine the extent to which it complied with best-practice recommendations.

Analysis of Worksheet A was achieved by using a worksheet analysing instrument (Table 3.1) developed by Nyamupangedengu (2009). The instrument was used in her study of worksheets and learning in South African Museums in which she analysed 19 worksheets from four museums. Nyamupangedengu (2009) was able to idenitfy features of each worksheet that were likley to facilitate learning and some that were likely to restrict it.

Table 3.1: The worksheet analysing instrument (Nyamupangedengu, 2009)

Characteristic of worksheet (categories)	Sub-categories		Frequency		Comments
1. Task density	*(a) Number of tasks in the worksheet*	*Time/question (T/Q)*			
	(b) Number of displays to be visited to complete the worksheet	*Time/Display (T/H)*			
2. Orientation Cues	*(a) Pre-visit orientation tasks*				
	(b) During visit orientation tasks				
	(c) Is there a map or directions in the worksheet				
3. Information Source	*(a) Tasks requiring information from text/labels*				
	(b) Tasks requiring information from objects				
	(c) Tasks requiring information from audio-visual presentations				
	(d) Tasks requiring information from the teacher/ museum educator/ tour guide				
	(e) Tasks requiring prior knowledge				
	(f) Tasks requiring information from practical activities				

[10] Appendix A1

Characteristic of worksheet (categories)	Sub-categories	Frequency	Comments
4. Level of Choice	*(a) Tasks with 1 correct answer only (no choice*		
	(b) Tasks with 2 or more correct answers (some choice)		
5. Cognitive Level	*(a) Lower order tasks (knowledge)*		
	(b) Medium order tasks (comprehension and application)		
	(c) Higher order tasks (analysis, synthesis and evaluation)		
6. Response Format	*(a) Tasks requiring oral answers only*		
	(b) Tasks requiring oral and written answers		
	(c) Tasks requiring pictorial presentation for answers		
	(d) Tasks requiring action only, no verbal answers		
	(e) Tasks requiring written text answers		
7. Question Format	*(a) Open-ended tasks*		
	(b) Closed-ended tasks		
8. Classroom Connection	*(a) Tasks connecting to classroom topics*		
	(b) Tasks with no connection to classroom		
9. Social Interaction	*(a) Tasks requiring learners to work in groups or pairs*		
	(b) Tasks requiring teachers/ tour guides to work with learners		
	(c) Tasks requiring learners to work individually		
10. Site specificity	*(a) High*		
	(b) Low		

The instrument makes use of the Kisiel (2003b) characteristics of a museum worksheet (described in Chapter Two) as coded categories: task density, orientation cues, information source, level of choice, cognitive level, response format, site specificity and classroom connection; as well as two categories identified by Nyamupangedengu (2009): question format and social interaction, which describe the degree to which the worksheet promotes social interaction through group work and questions that encourage learner responses that extend beyond simple facts. Nyamupangedengu (2009) expanded on these ten worksheet characteristics, using the literature as well as her museum experiences, to include several sub-categorises. For example, in Category three (information source) Nyamupangedengu

identified two forms of information sources described by the literature: object and label text, these she coded as 3(a) and 3(b) respectively. She also identified, from her own museum experiences, 3(c) audio-visual presentations, 3(d) teacher, museum educators or tour guides, 3(e) prior knowledge and 3(f) practical activities as additional sources of information available to learners during a museum visit. The instrument thus has ten coded categories, representing ten worksheet characteristics, in the first column of the instrument and each category has sub-categories coded in the second column. It should also be noted that Nyamupangedengu made use of three cognitive levels in category 5: 5(a) lower order tasks (knowledge), 5(b) medium order tasks (comprehension and application) and 5(c) higher order tasks (analysis, synthesis and evaluation). This simplification of Bloom's taxonomy, discussed in Chapter Two, was suggested by Green and Rollnick (2007) who argued that comprehension and application were comparable in terms of cognitive demand and could thus be grouped together. The same reasoning is directed at analysis, synthesis and evaluation which are also grouped together.

It is important to note that the analysis of Worksheet A allowed me to determine areas of weakness that needed to be revised. Hence, the instrument allowed me to revise and improve on my original worksheet in an effort to align with best-practice recommendations. The result of this process, together with the use of detailed field notes from the first visit to the zoo, was the construction of Worksheet B[11] which was analysed in the same manner as Worksheet A. How I used the instrument is described in Section 3.6.7 of this chapter.

3.4 Analysis of on-task learner conversations

It is has been established, in Chapter Two, that museum learning is highly social and as such the use of visitor conversations in describing learning has become more frequent among researchers (S. Allen, 2002; Griffin, 2004). Leinhardt et al. (2002) highlight the importance of meaning-making through museum conversations in their approach of "focusing on conversations as both the process and the outcome of museum learning" (p. ix) in determining how people learn from museums. I have used the same approach, that of investigating museum conversations, described by these authors.

[11] Appendix A2

3.4.1 Audio recording learner conversations

A range of methodologies have been used to investigate meaning-making in museums, from a socio-cultural perspective, including: diaries, interviews and observations; however with recent improvements in technology an effective approach to investigating moment-by-moment learning is through the recording of museum conversations (S. Allen, 2002). For this reason, the second part of my study involved audio-recording conversations of eight groups of learners (four per zoo visit) as they walked around the zoo answering a worksheet. High quality cordless and portable digital audio recorders were used to collect the data.

Although audio-recordings give the distinct advantage of collecting data in-situ, it does present a few methodological challenges. For example, the ambient noises and poor acoustics of a research site might affect the audibility of conversations (S. Allen, 2002). In her research, Nyamupangedengu (2009) found that the quality of her recordings was improved if the audio recorders were used in conjunction with small lapel microphones. Similar microphones were not used in this study as I had difficulty sourcing them. Also results of the pilot study, discussed in Section 3.5, showed that the out-doors setting of the zoo allowed for conversations to be recorded successfully without excessive ambient noise and without lapel microphones.

A further concern was the authenticity of learner conversations. S. Allen (2002), in her study, cautions that microphones may affect the nature and behaviour of learner talk in unpredictable ways. To address this challenge, the audio-recorders were placed in small bank bags with a ribbon "handle" and learners were asked to hang them around their necks under their t-shirts. I thought that if the recorders were out of the learners' sight they would 'forget' that they were being recorded and thus their conversations would be uninhibited. This view was confirmed when I played the recordings back and found that some of the learners had discussed a teacher accompanying them on the field trip.

3.4.2 Analysis of on-task learner-talk

The audio-recorded conversations were played back and, in following DeWitt and Hohenstein's reasoning that "off-task talk is unlikely to lead to conceptual learning" (DeWitt & Hohenstein, 2010, p. 50), I decided to transcribe and code only on-task conversations. On task-talk was defined as learner conversations that were related to the activity of completing the worksheet. The coding framework was constructed from several approaches which

combined cognitive, affective and strategic perspectives (see S. Allen, 2002; DeWitt & Hohenstein, 2010; Rosenthal & Blankman-Hetrick, 2002) from a socio-cultural standpoint. As discussed in Chapter Two, socio-cultural perspectives focus on learning as a joint activity (S. Allen, 2002) and therefore the conversations of groups, not individuals, were coded for evidence of learning. It is important to note that the scope of analysis for on-task talk was narrowed further so that only on-task talk for selected questions was coded. The reasoning and selection for these questions is discussed in Section 3.6.8.

3.4.3 Typological coding of on-task learner talk

Hatch (2002) conceptualises data analysis as a process of asking questions of data and argues that this approach is suited to studies rooted in the constructivist paradigm and thus qualitative analysis frameworks. Qualitative data analysis is primarily an inductive process which involves organising the data into categories or groups and then identifying and explaining relationships that emerge between these groups (Cohen, Morrison, & Manion, 2011; McMillan & Schumacher, 2010). In short, researchers start with the specifics of the data and end with general themes and relationships rather than impose these themes prior to data collection. This process can be quite eclectic and as such there is no single correct approach to qualitative analysis (Cohen et al., 2011; McMillan & Schumacher, 2010).

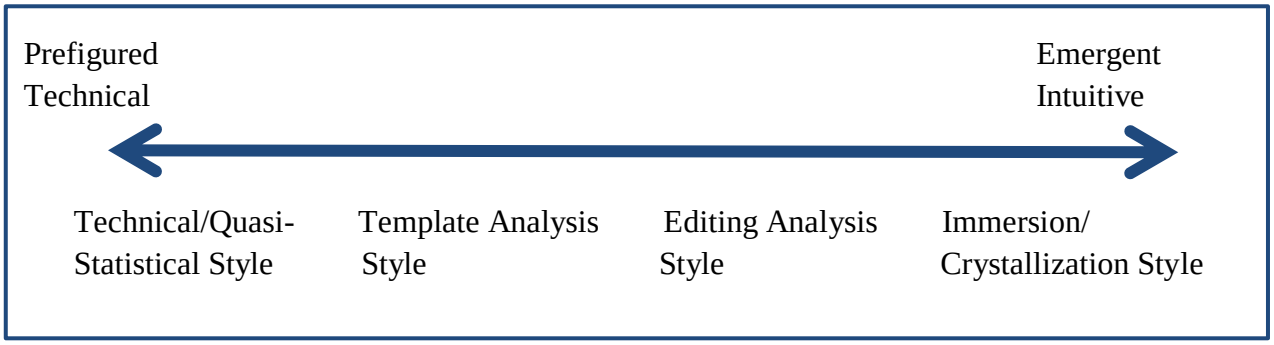


Figure 3.2: Continuum of Analytic Styles (McMillan & Schumacher, 2010)

I decided to approach the coding of on-task talk from a typological perspective which allowed me to categorise learner-talk based on predetermined typologies. McMillan and Schumacher (2010) describe this analytic perspective as 'pre-figured technical' and tending towards the objectivist end of the Continuum of Analytic Styles (see Figure 3.2) - the opposite end tends towards emergent intuitive perspectives. This, at first, appears to be the opposite of inductive analysis characteristic of qualitative perspectives however, as

Hatch (2002) explains, the typological model still depends on inductive thinking within several of its steps. For example, the predetermined typologies were derived inductively from my field observations as well as from other research in the field. The use of existing frameworks simply aided me in refining and focusing my initial observations into defined and described codes. The manner by which typologies were determined thus illustrates the efficiency of the model in reducing the time it takes to discover categories (Hatch, 2002) – a potential weakness of the purely inductive approach. Although some may argue that predetermined categories blind the researcher to other dimensions of the data (Hatch, 2002), it is important to note that my research questions were focused on the success or failure of the worksheet and consequently the use of narrowed typologies allowed me to put the worksheet experience in a stronger position to make claims about its efficacy in facilitating meaningful learning. Any other dimensions of the data that may have emerged were not the subject of this study and therefore not considered in the selection of typologies.

3.4.4 Coding frameworks for on-task learner conversations

The coding framework for identifying the nature of learner-talk by DeWitt and Hohenstein (2010) was used to describe the overall tone of learner conversations. The authors describe learner talk as a "window into the nature of the interactions among individuals and the extent to which they may be engaged… with an activity in which they are participating" (p.59). I therefore chose to use the Nature of Discourse (NoD) framework as it enabled me to determine how the worksheet content was discussed by the groups and identify the kind of learner talk that might lead to meaningful learning. The framework captures the level of cooperation in learner interactions as they work together to answer worksheet questions: parallel talk and disputational talk describe non-cooperative discourse which is less likely to build and extend understanding, cumulative talk is more reflective of learners working together and exploratory talk describes cooperative learning with visible reasoning which has the potential to build and extend learners' understanding (DeWitt & Hohenstein, 2010). Also, after initial analysis of one transcript, it was decided that two more categories should be included in the NoD instrument. These are simple dialogue and monologue which show short responses between groups (an intermediary between parallel talk and cumulative talk) and 'thinking out loud' by an individual learner respectively. The NoD instrument is illustrated in Table 3.2 overleaf.

Table 3.2: The Nature of Discourse coding framework

Nature of talk	Explanation	Example
Cumulative[a]	Learners build positively but critically on what the other has said, use talk to construct a 'common knowledge' by accumulation, characterised by repetitions, confirmations and elaborations.	L 1: Type of feeding behaviour? L 3: It eats whatever's on the floor! L 1: Ja! L 3: Or it eats whatever's in the pot.
Exploratory[a]	Learners engage critically but constructively with each other's ideas. Ideas may be challenged and counter challenged, but challenges are justified and alternative hypotheses are offered, characterised by visible reasoning.	L1: They're cute. L2: They're not cute! They look disgusting! L1: They're cute! No man, I love animals, I just like... If I, I wouldn't mind becoming a vet, to be honest.
Disputational[a]	Characterised by disagreement and individual decision making, few attempts to pool resources or to offer constructive criticisms or suggestions.	L1: Don't have to write full sentences, hey. L4: Ja, you do. L2: You say you originate because it's two questions we're answering and we're not doing it in the same way and L1: No, you don't have to write in full sentence but unless if they ask for two things.
Parallel[a]	Learners take turns but they are not actually responding to each other's comments.	L3: *[reads worksheet]* Find the Cape vulture. What kind of feeding... L1: I'm so glad we're finished.
Simple dialogue	Learners take turns responding to each other's questions, the construction of a common knowledge is absent, usually in the context of procedural talk.	L 3: Hang on, where's the gibbons? L 4: It's this here.
Monologue	Individual learner responds to his or her own musings.	L 1: *[reading worksheet]* When and where did this animal originate? … China.

[a](DeWitt & Hohenstein, 2010)

The coding framework for identifying the type of learner-talk adapted from Bloom's taxonomy (Clarke, 1999) and S. Allen (2002) was used to describe the cognitive and affective level of learner conversations. Learner conversations were analysed for three cognitive levels

of engagement: knowledge, medium order thinking (Bloom's II and III) and higher order thinking (Bloom's IV, V, and VI). Nyamupangedengu (2009) makes use of the same categories in her instrument, codes 5 (a) – 5 (c), and therefore analysing worksheets and conversations using the same criteria provided an opportunity to correlate cognitive demand of the worksheet with cognitive engagement by the learners. Learner conversations were also analysed for affective engagement (both positive and negative). The Type of Discourse (ToD) instrument is illustrated in Table 3.3.

Table 3.3: The Type of Discourse coding framework

Type of talk	Explanation	Example
Lower order	Remembers facts or identifies simple facts from exhibit labels	L 3: *[reads worksheet]* What kind of feeding behaviour does this bird display? L 1: It um eats off dead animals. **(knowledge)**
Medium order	Processing information and using knowledge in new situations	L 2: But this is the bear brown? L 1: It looks more like a black bear, to be quite honest. **(medium order)**
Higher order	Using prior knowledge to solve problems in new contexts and make choices based on reasoned arguments	L 3: Parasite. The one's an advantage, the other one's a disadvantage. L 1: Well no, it's actually kind of not an advantage because it takes the skin off. **(higher order)**
Affective	Expressions of positive or negative feelings, or feelings of intrigue	L 2: Oh, that's one helluva bear!
Procedural	Procedural talk relating to the task of answering a worksheet as a group	L 1: Bradley can hold onto it if… because you haven't done much, no offence.

I decided to add a fifth category, after analysis of one transcript, to this framework. Procedural talk was used to code any learner conversations related to the procedure of answering a worksheet as a group. How I used the coding instruments is described in a later Section 3.6.8 of this chapter.

3.5 Pilot study

The aim of the pilot study was to test the audio-recorders and determine whether learner conversations were audible. I decided not to test the efficacy of Worksheet A as the pilot was conducted on Grade 10 learners who had completed the same worksheet in their grade eight year. The pilot study involved six learners, three boys and three girls, from the College where

I am employed. Prior arrangements had been made with their parents and consent forms were signed. It is recommended that a pilot should be done with participants similar to those in the study (McMillan & Schumacher, 2010) however I made the decision to use these learners for two reasons: convenience - I teach them Life Sciences, and logistics – I did not want to use Grade eight learners and then exclude them from their class field trip later. The learners were divided into two groups, one group of boys and one group of girls so as to mimic the grade 8 learners who are taught in separate boys and girls classes and as such would form all boy and all girl groups. The recorders were placed in small bank bags and secured around the neck of one learner in each group. The learner was then asked to place the recorder underneath their t-shirt. Hiding the recorders was done to determine whether conversations would still be audible underneath layers of clothing – a necessary step in helping learners to 'forget' about the recording. Each group was given one copy of the original zoo worksheet and asked to complete selected questions. These questions were selected for two reasons: to keep the learners moving around the zoo as well as to keep the learners in a small area of the zoo so that the recording was only done for approximately one hour. These conversations were not transcribed, but were listened to so that I was able to make some notes.

The pilot study showed that the recorder was of a high enough quality to record audible conversations of the group through layers of clothing. The recorders were of such a high quality that conversations were audible even when the recorder was worn under a thick winter scarf, as was the case for the girls group. The pilot study also showed that learner conversations were most clearly audible when the group members were standing in close proximity to each other. S. Allen (2002) noted that a challenge of recording museum conversations is that groups move around continuously. This poses a problem when there is distance between individual group members and the learner with the recorder. However, the pilot study showed that when learners needed to answer a question, posed by the worksheet, group members came together and could be heard when the recordings were listened to.

3.6 Data collection

3.6.1 The research site

The site where the research took place was the Johannesburg Zoo. It is a popular local attraction and many schools in the surrounding areas, including the College where I am employed, make use of the facility. The zoo covers 81 hectares of land and houses over 320 species of animals, totalling about 2000 animals. The Johannesburg Zoo was chosen for two

reasons: it is conveniently located to both my home and the College where I am employed, and I conduct an annual field trip to this zoo with grade eight learners. The close location allowed me to make short regular trips to the zoo to familiarise myself with changes to the animal exhibits as well as and to carry out the pilot study.

The visit to the zoo took place during the school day. Learners spent approximately three hours at the zoo which included a half hour lunch break.

3.6.2 The research sample

The group of learners that participated in the research represent a convenience sample – selected on the basis of being accessible (McMillan & Schumacher, 2010). That is, the participating learners visit the zoo as part of their grade eight Natural Sciences curriculum. I am a Life Sciences teacher at the College and conduct this field trip annually using a worksheet of my own design. Table 3.4 below shows a summary of the participants of my study. Convenience samples thus make conducting research far easier and practical, however there is no way of generalising from the sample to any type of population which is a disadvantage of this approach to sampling (McMillan & Schumacher, 2010).

Table 3.4: Learner composition for each field trip to the zoo

Zoo visit	Number of girls	Number of boys	Number of groups	Number of groups audio-recorded
First visit	19	23	11	4
Second visit	17	21	11	4

It should be noted that grade eight learners at the college are taught in all boy or all girl classes with the result that learners may have been distracted by the presence of the opposite sex during the field trip. To pre-empt this possibility, I initially thought to conduct the first field trip with the two girl classes only and then the second field trip with the two boy classes only. However, it was decided that I would take one girl and one boy class each time so that if there were any distractions they would present during both field trips and therefore the context of each visit would be comparable.

It is important to note that sampling participants from the College where I am employed may be viewed as unethical, however the participants were not whom I currently teach and ethical considerations were strictly adhered to as described in Section 3.8 of this chapter.

3.6.3 Recording of conversations and observations of learner groups

For each visit, the following procedure was followed. The two classes going on the field trip were addressed, the day before the visit, by their Natural Sciences teacher during their Natural Sciences lesson. During this lesson the teacher allowed the learners to choose their own groups of approximately four and gave each group a copy of the worksheet. She then instructed the learners to write their names on the front cover and then, after explaining the logistics of the worksheet and field trip, the teacher collected the worksheets back from each group. The teacher then cross-referenced the group members with their consent forms and identified the groups who had consented to being audio-recorded, observed and to analysis of their worksheets. From this narrowed list, the teacher then selected four groups, two girl and two boy, which consisted of learners that received an average symbol (60%) for Natural Science. On arrival at the zoo the teacher then identified a learner from each of these groups who had a clear voice and directed them to me. I then turned on the recorder, locked it in record mode, placed it in the bank bag and asked the learner to wear the device under their t-shirt.

Due to the expansive setting of the zoo, continuous observation of each recorded group was not possible. However, I did make general observations of all groups in an unobtrusive manner.

3.6.4 Worksheet use

The worksheets were returned to the groups by their teacher on arrival at the zoo. The learners were aware from their pre-visit lesson that the worksheet would contribute to their assessment mark and were therefore compelled to answer it. Also learners were given the freedom to explore the zoo and therefore answer the worksheet questions in any order.

3.6.5 Transcription of conversations

At the conclusion of data collection I had recorded eight learner groups from which I selected four recordings (one boy and one girl group from each visit). These recordings were selected based on three criteria: sound quality of the audio-recording, whether the group remained

together as they traversed the zoo and the gender of the group (I wanted equal representation of boy and girl groups). I played these recordings back one at a time and identified, in the form of timestamps, on-task learner conversations. These timestamps were then sent, along with the recordings, to a transcriber who produced transcripts of on-task learner conversations. I decided not to do my own transcriptions, even though S. Allen (2002) recommends that researchers should do their own, as it is a very time consuming exercise (nearly nine hours to transcribe one hour of recordings). I did, however, check the transcripts with the recordings so as to include the details the transcriber had missed or had difficulty hearing.

3.6.7 Data analysis: Analysing Worksheet A

I used the worksheet analysing instrument in the following way: I focused on one worksheet activity at a time and coded one category at a time, working through the entire activity until all 10 categories were coded. Table 3.5 shows my thinking and approach to the coding of Question one of Activity One of Worksheet A.

Table 3.5: An example of my approach to the coding of worksheet questions

Category	Code	Explanation
1 - Task density	(a)	***Number of tasks in the worksheet:*** Question 1 consists of one task/ part
2 – Orientation cues	-	I coded the entire group (question one to three) as 2(c) as the questions direct the learners to the farmyard as well as provide a picture of the animal to help learners identify it.
3 – Information source	(a)	***Tasks requiring information from text/labels:*** The answer to the question was found on the exhibit label/ text
4 – Level of choice	(a)	***Tasks with 1 correct answer only:*** This question had one correct answer only i.e. Vietnamese Pot-Bellied Pig
5 – Cognitive level	(b)	***Middle order thinking (knowledge and application):*** Learners needed to apply their understanding of the term 'common name' to the task of finding this name on the exhibit label
6 – Response format	(e)	***Tasks requiring answers in the form of written text only:*** Learners were required to write the answer in the space provided on the worksheet

Category	Code	Explanation
7 – Question format	(b)	***Closed-ended tasks:*** the required answer is a short response, the learners are not required to elaborate or extend their response
8 – Classroom connection	(b)	***Tasks with no connection to classroom topics:*** The question was not linked to topics taught in the classroom
9 – Social interaction	(a)	***Tasks requiring learners to work in pairs or groups:*** Learners were required to work in groups to answer the question
10 – Site specificity	(a)	***High:*** The question has a high site specificity as the animal exhibit and label needed to complete the question

Each grouping of questions centred on a specific animal enclosure was coded 1 (b) – the number of animal exhibits needed to complete the worksheet. Also where questions were made up of multiple parts I coded them as separate questions, for example: Question Three (Figure 3.3) was coded as two separate questions. Part one required learners to identify the type of feeding behaviour of the pig and part two required learners to list the types of food found in the pig's diet. The result of this process is illustrated in Figure 3.3 overleaf, where each number and lower case letter represents a worksheet characteristic and sub-category as indicated in column one and two of Table 3.1 respectively. I continued to code each grouping until the entire worksheet was coded and the results were then summarised on worksheet analysing instrument A (see Chapter Four). These results allowed me to identify where my worksheet did not align with best-practice recommendations made in the literature, resulting in the design of Worksheet B. Worksheet B was analysed, using the worksheet analysing instrument, in the same way as described for Worksheet A.

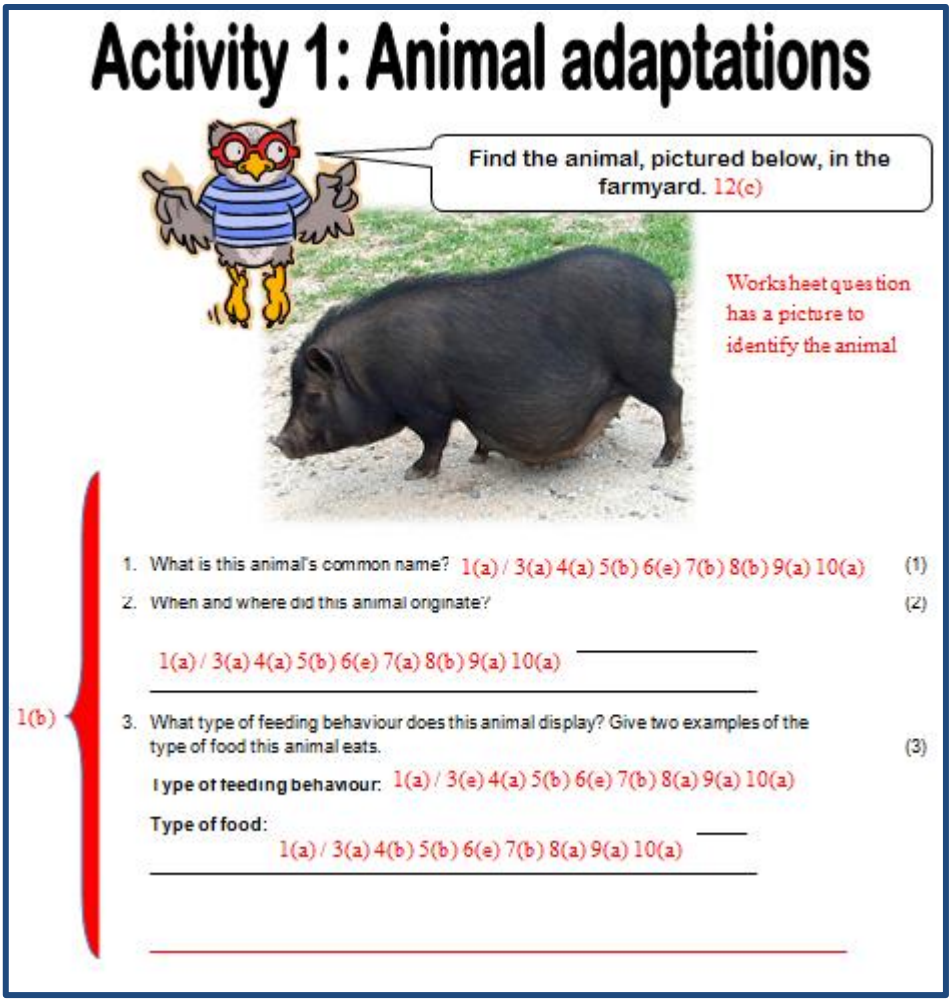
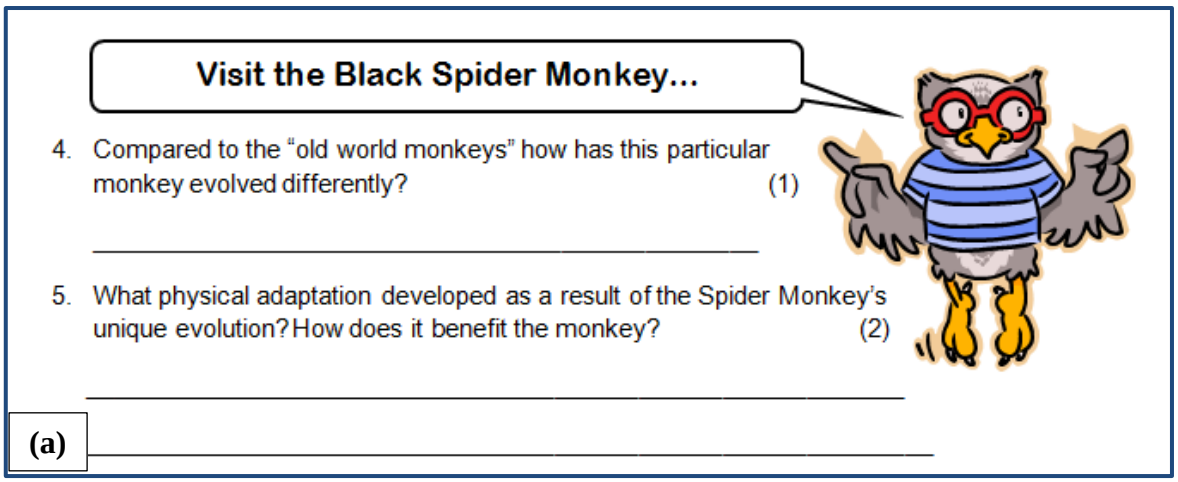


Figure 3.3: Coded Activity One of Worksheet A

3.6.8 Data analysis: Coding of on-task learner-talk

The fundamental goal of my study was to determine whether I was able to follow recommendations made in the literature and produce an improved field trip worksheet. Furthermore, I wanted to determine if my revised worksheet engendered curriculum-related conversation among learners to a larger extent than the original worksheet did. Consequently, my analysis of on-task learner conversations needed to take the approach of a comparative and descriptive analysis i.e. conversations ensuing from Worksheet A needed to be compared to conversations ensuing from Worksheet B. I therefore decided to select specific questions from each worksheet and compare the conversations that resulted as the groups completed their tasks. The questions were selected as they illustrated the changes I made in trying to improve Worksheet A to align with best-practice recommendations. An example of two such questions is shown in Figure 3.4 overleaf.



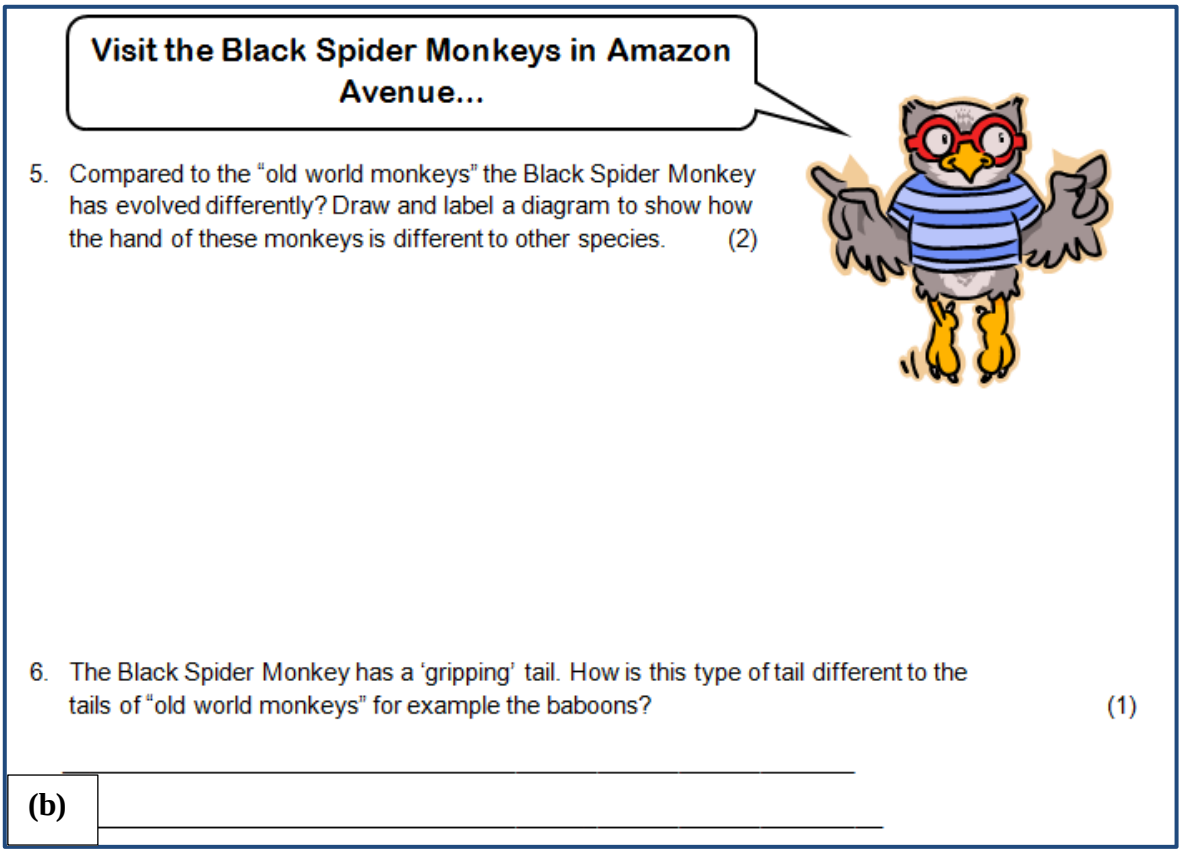


Figure 3.4: (a) Original question from Worksheet A; (b) Revised question from Worksheet B

I also chose to include two questions which did not change from Worksheet A to Worksheet B to show that any differences that presented in the on-task talk were as a result of the revised questions and not as a result of the context of the visit. In other words, were all other factors that could have influenced learner conversations sufficiently similar during the field trips so that any observed conversational differences were as a result of the revised worksheet

questions. Thus it was important that I narrowed the scope of my analysis to selected questions only, and not the entire worksheet, so as to better answer my research questions. The selected questions are summarised in Table 3.6:

Table 3.6: Overview of questions selected for coding of on-task learner talk

Activity	Worksheet A	Worksheet B	Comparison code
1	1 – 3	1 – 4	1(a)
	6	7	1(b)
2	1 – 3	1 – 4	2(a)
3	1	1	3
6	1	1	6

Once I had identified the key questions of interest, I broke each transcript into segments of conversation that centred on each of these questions, for example: sections where learners discussed Activity One Question One to Three for Worksheet A and Activity One Question One to Four for Worksheet B were blocked on each of the transcripts respectively. I continued this process until all segments were identified and blocked on all four transcripts. Once each segment of talk was identified, I then broke the conversation into units of analysis of decreasing size - *sequences, turns* and *utterances* – adapted from DeWitt and Hohenstein (2010). A sequence of talk is defined as a segment of talk that is at least two turns in length, a turn is defined as an alternating conversational turn where one person is speaking and an utterance may be a single turn or a single word that is a statement about a narrower topic. A new sequence was marked when there was a pause in the conversation longer than three seconds or the topic changed. Figure 3.5 shows an interaction made up of two sequences; the first is comprised of three turns, or five utterances. Once each segment of talk had been delineated into units of analysis I highlighted and marked all utterances that showed indicators of each of the categories described by the Type of Discourse (ToD) framework and marked all turns that showed indicators of the Nature of Discourse (NoD) framework – Figure 3.5 overleaf shows an example this process.

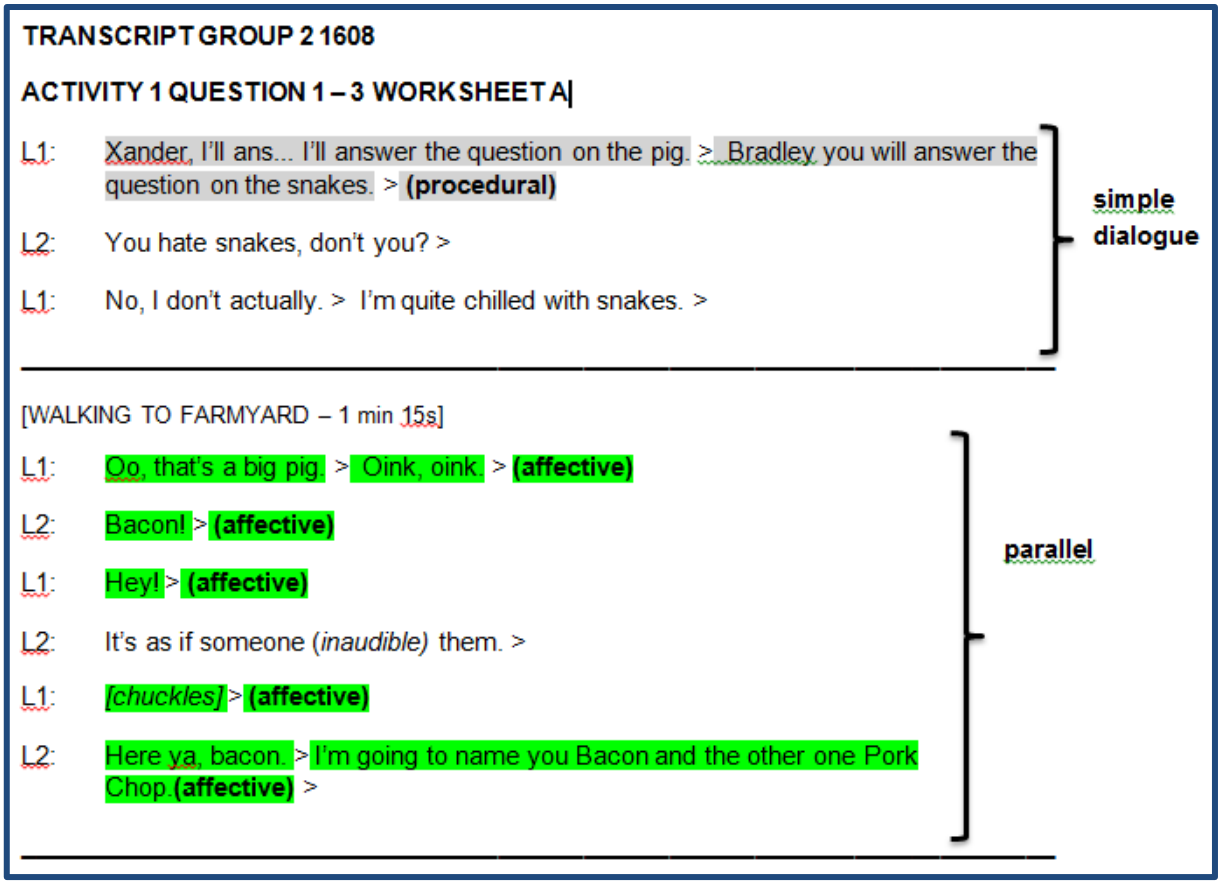


Figure 3.5: An example of a transcript coded using the NoD and ToD frameworks

My analysis of learner talk was supported by field observations made of the entire student group as well as from an analysis of worksheet answers. Learner answers to the selected questions were analysed for their resulting mark. I decided on this additional approach to analysis as it enabled me to triangulate my data and find regularities in the patterns I identified (McMillan & Schumacher, 2010).

3.7 Research rigour

All research is concerned with producing valid and reliable knowledge, however being able to trust research results is particularly important in fields, like education, where research practitioners intervene in people's lives (Merriam, 1998). Many authors address the issue of trustworthiness by referring to the terms 'validity' and 'reliability'. However, 'validity' and 'reliability' have different meanings in qualitative and quantitative data collection. Validity in quantitative approaches refers to the extent to which inferences made on the basis of numerical indices are appropriate, meaningful, and useful (McMillan & Schumacher, 2010). In other words, are numerical findings statistically significant in the degree of relationship

between the conclusions drawn and the data on which they rest? Validity in qualitative approaches, by comparison, refers to the congruency between explanations of phenomena and the realities of the world (McMillan & Schumacher, 2010). In other words, do researchers actually observe what they think they see and does an instrument measure what it purports to measure?

Validity has long played a role in debates over the legitimacy of qualitative research with proponents of quantitative approaches criticizing the absence of 'standard' means of assuring validity (Maxwell, 1992). However, as Merriam (1998) contends, where "understanding is the primary rationale for the investigation, the criteria for trusting the study are going to be different than if discovery of a law or testing of a hypothesis is the study's objective" (p.200). Trustworthiness, therefore, in qualitative research means that the research is credible, dependable and confirmable. I used a number of strategies to improve the trustworthiness of my study.

3.7.1 Rigour in action research

Melrose (2001) describes five guidelines that were be used to guide my study so as to ensure the research was carried out rigorously. Firstly, once through the cycle is not enough to reassure audiences that claims are well grounded. Consequently my study, given the limitation of time, cycled twice through the action research planner described in Section 3.2.3. Secondly, the credibility of the research group increases the perceived rigour of the research and thus I consulted with experts to validate both my worksheet analysis and coding. Thirdly, action researchers should use appropriate methods of data analysis that are suitable to the underlying research paradigm. As my study is orientated in the qualitative interpretative research paradigm the use of field observations and audio-recordings enabled me to interpret the phenomenon of worksheet use in a museum setting. Additionally, audio-recordings, observations and worksheet analysis provided an opportunity to cross-check my analysis by collecting different types of data that described the same phenomenon. Fourthly, confirmation of findings must be collaborative to counter any researcher bias. For this reason, the Natural Science teachers accompanying the learners to the zoo were asked to validate field observations. Finally, there must be practical 'workability' where the findings promote a change in the 'real-world' context valuable to the broader teacher community, that is the findings of the study will be communicated to my colleagues and other teachers so that they might address their own field trip practice.

3.7.2 Trustworthiness of the worksheet analysing instrument

The worksheet analysing instrument was designed by Nyamupangedengu (2009) and as such, validation was carried out by the author during her own study. Nyamupangedengu (2009) validated the instrument through face validation which involved using experts in specific fields of study to check if the instrument measured what it was designed to measure. The experts (an expert in informal education, an academic who is an experienced life sciences lecturer at Wits School of Animal Plant and Environmental Sciences, a museum educator, and a group of ten Life Sciences teachers) were asked to comment on whether the worksheet categories were relevant, if they catered to all the features of a worksheet; and if the wording of the sub-categories were unambiguous. These experts suggested a number of changes, some of which Nyamupangedengu (2009) incorporated into the instrument described in Table 3.1.

3.7.3 Reliability of the worksheet analysing instrument

"Reliability refers to the extent to which research findings can be replicated" (Merriam, 1998, p. 205) and therefore, the reliability of an instrument points to whether it produces similar results in similar conditions (Scaife, 2004). The test re-test procedure was used to judge the reliability of my use of the instrument. This was achieved by analysing my zoo worksheets, recording the results and sending the same two worksheets to an expert in the field[12] who analysed them with the same instrument. I then compared her results with mine, which differed for all categories except category two, eight and nine. This result, at first, threw doubt on the reliability of my results as the traditional perspective of reliability and validity rests on the assumption that a study is more valid if repeated observations produce the same results (Merriam, 1998). However, research in education is highly contextual and a familiarity with the zoo setting and learner's prior knowledge was needed to fully analyse the worksheet. It is therefore not surprising that my and the expert's results differed – especially when you consider the subjectivity of assigning cognitive levels. The fact that replication of worksheet analysis did not yield the same results does not discredit the findings of my study. Dey (1993, p. 251, cited in Merriam, 1998) states: "If we cannot expect others to replicate our account, the best we can do is explain how we arrived at our results". In other words, instead of needing outsiders to get the same results as mine I would rather, given the data collected, outsiders agreed that the results made sense i.e. they are consistent and dependable. I used

[12] The expert was the same author who designed the instrument

three techniques (Merriam, 1998) to show that my results were consistent with the data I collected:

- *The investigator's position* – I have included detailed descriptions of the assumptions and theory behind the study; the group being studied; reasons for selecting specific groups for analysis; and the social context from which the data was collected.
- *Triangulation* – I used multiple methods of data collection i.e. instrument, field notes, audio-recordings and completed worksheet analysis, strengthening reliability as well as internal validity.
- *Audit trail* – I described in detail how data was collected, how categories were derived, and how decisions were made throughout my study so that an independent judge could authenticate my findings.

3.7.4 Trustworthiness of coding framework

Another type of reliability is a coefficient of agreement which indicates the extent to which two or more people agree with what they have coded (McMillan & Schumacher, 2010). That is, when coders work independently with a transcript, will they agree about what has been coded? If they do, there is some consistency in the measurements (McMillan & Schumacher, 2010). There are two commonly used procedures that result in a reliability coefficient: Kendall's coefficient of concordance and Cohen's kappa (McMillan & Schumacher, 2010). I selected Cohen's kappa, in determining interrater agreement, as it is used with categorical data (McMillan & Schumacher, 2010).

Transcripts were analysed and only on-task learner conversations, which centred on answering the selected questions indicated in Table 3.6, were coded. The coding process, completed by myself and an expert in the field of science informal learning, consisted of two steps: conversations were first coded using the ToD framework; and then using the NoD framework. As these steps are independent of one another, I assessed interrater reliability for both steps separately. Interrater agreement was calculated for both steps, based on one transcript selected from a pool of four transcripts (i.e. 25% of all transcripts), by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100, as well as using Cohen's (1930, cited in, Veenman, Denessen, Anneriet van den, & van der Rijt, 2005) kappa value. The interrater agreement across the five categories of the ToD framework was 72.97% and Cohen's kappa value was 0.619. The

interrater agreement across the six categories of the NoD framework was 61.90% and Cohen's kappa value was 0.398. A kappa value of between 0.40 and 0.75 is considered to be within the intermediate to good range and a value above 0.75 is considered to be excellent (Veenman et al., 2005) – therefore, the interrater agreement is considered to be within the intermediate to good range for ToD coding and the fair range for NoD coding.

3.8 Ethics

Consent was granted by the Principal[13] and the Natural Sciences teacher[14] of the college and consent letters were issued to the participants[15] and their parents[16]. Permission was also sought and granted from the research site – the Johannesburg Zoo[17]. Learners who did not consent to the study were not audio-recorded, observed or their worksheets collected for analysis. They were, however, still allowed to participate in the zoo visit so that they were not disadvantaged. I copied the completed worksheets of the participating learners and gave them the duplicated copy so that they were not disadvantaged by submitting their worksheets for analysis.

Confidentiality and anonymity were ensured by including a cover sheet on the worksheet for each group of learners to write their names on. This sheet was removed after the worksheet was submitted and the worksheet was assigned a code. Audio recordings were assigned a matching code so that worksheets could be paired with correct learner conversations. Additionally, transcripts made use of learner and educator pseudonyms.

Furthermore, my research proposal was presented to The Ethics Committee in Education of the Faculty of Humanities who, acting on behalf of the Senate, granted permission for my study assigning it the protocol number 2013ECE021M.

3.9 Conclusion

In this chapter I have described my research design and how I collected the data, highlighting the issues of trustworthiness and the dependability and consistency of my findings. The descriptions were detailed to provide the reader with a full account of how I carried out my study so that, even though repeating the study would not yield the same results, there is

[13] Appendix B1
[14] Appendix B6 and B7
[15] Appendix B2 and B3
[16] Appendix B4 and B5
[17] Appendix B8

enough evidence to explain how I arrived at my results. The next chapter details the findings of my analysis of the zoo worksheets, which is followed by Chapter Five – analysis of curriculum-related learner conversations.

Chapter Four

Analysis of zoo worksheets

4.1 Introduction

This chapter presents the results and the discussion of the two 'spirals' of my action research project which was the analysis and revision of Worksheet A[18], resulting in the construction and subsequent analysis of Worksheet B[19]. The aim of this phase of my study was to analyse my original worksheet, constructed three years ago without knowledge of best practice recommendations, for its effectiveness as an informal context worksheet and then try and improve this worksheet to align with recommendations made in the literature. The research question that I was trying to answer was:

How can I improve on a worksheet, designed for use by grade eight learners during a zoo field trip, using best-practice criteria in such a way that promotes free-choice learning?

My analysis of each worksheet characteristic for Worksheet A followed by an analysis of how Worksheet B was revised in an attempt to align with best practice recommendations is described in Section 4.2.

4.2 Analysis of Worksheet A and B

My analysis of Worksheet A formed part of the first spiral of my action research plan, described in Section 3.2.3. Using a worksheet analysing instrument[20] developed by Nyamupangedengu (2009), I identified four areas that needed revising to improve the efficacy with which the worksheet promoted free-choice learning – the worksheet needed: more object-dependent tasks; tasks that required drawing as a response format; tasks that gave learners some choice in their responses; and more specific orientation cues. Field observations as well as my analysis of completed worksheets confirmed the weaknesses of Worksheet A, identified by the instrument, and showed that I needed to address the social context of the field trip experience as well. Revision of the worksheet marked the start of the next spiral, of my action research plan, which resulted in the production of Worksheet B and its analysis using the instrument[21], field observations and completed worksheets. Once audio-

[18] Appendix A1
[19] Appendix A2
[20] Appendix A3
[21] Appendix A4

recordings were selected and transcribed, learner conversations were used in support of my findings. I present these findings using the ten worksheet characteristics described in Chapter Two and three as sub-sections of this chapter, that is:

- task density – the amount of work learners were asked to complete,
- orientation cues – aspects of the worksheets that learners could use to navigate the zoo experience,
- information source – whether information needed to answer the question could be found by reading information boards or looking at animals,
- level of choice – whether questions promoted choice in how learners responded,
- cognitive level – the level of questioning as described by Bloom's taxonomy,
- response format – how learners complete a question, i.e. draw and write,
- question format – whether a question is close or open-ended,
- classroom connection – whether a question linked to the classroom curriculum,
- social interaction – the degree to which the worksheet promotes learner-learner interactions, and
- site specificity – the extent to which worksheet tasks were based on specific animal enclosures

Each sub-section, therefore, comprises of a short description of each worksheet characteristic, the analysis of Worksheet A for that specific worksheet characteristic and how Worksheet B was then constructed to address weaknesses identified in Worksheet A, as well as supporting evidence in the form of completed worksheet answers and excerpts from learner conversations from both zoo field trips.

4.2.1 Task density

Task density refers to the amount of work, i.e. the number of tasks, learners are asked to complete during the field trip (Kisiel, 2003b). Task density was indicated by the number of questions on the worksheet and the number of animal enclosures learners were expected to visit in order to answer the questions. Task density was expressed as Time/Question (T/Q) and Time/Hall (T/H) – where 'hall' indicates an animal enclosure – (described in Section 2.3.2).

A worksheet comprised of many questions, visiting many animal enclosures would have a:

- low T/Q - very little time available for learners to answer each question
- low T/H – very little time given for visiting each animal enclosure.

Low T/H and T/Q values are indicative of a worksheet with a high task density. Although Kisiel (2003b) does not suggest a standard unit of comparison for task density, Mortensen and Smart (2007) classified a worksheet with a T/Q of 8.5 minutes within the middle to high range i.e. learners would have little time available to answer the many questions posed by the worksheet. Extending this classification I decided to categorise worksheets with T/Q values greater than 8.5 minutes as middle to low task density and worksheets with T/Q values less than 8.5 minutes as higher task density worksheets. This scale is illustrated graphically in Figure 4.1:

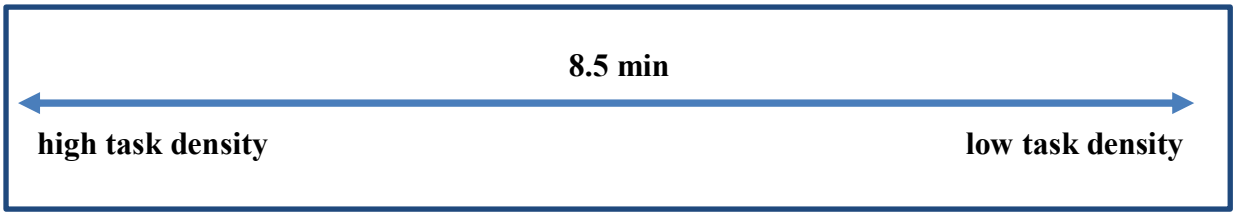


Figure 4.1: Scale used to categorise T/Q ratios

Table 4.1 shows that Worksheet A can be categorised as a high task density worksheet as it has a T/Q value of 5.14 minutes. Learners had approximately five minutes to answer each question and could spend up to nine minutes at each animal enclosure. Furthermore, when you consider that learners were expected to navigate 81 hectares of land, read information boards to answer questions and eat their lunch – five minutes per question and nine minutes per display would not have been enough time for the in depth discussions and development of deep understanding described by Kisiel (2003b).

Table 4.1: Task density for zoo worksheets

Worksheet	Time allocated (min)	Number of questions	Number of displays	Time/ Question (min)	Time/ Display (min)
A	180	35	20	5.14	9.00
B	180	34	16	5.29	11.25

Evidence to support this view comes from my analysis of the completed worksheets (Worksheet A), in particular the number of questions that were not attempted by each group during the first visit to the zoo. Table 4.2 below shows the number of questions omitted by each group for both zoo visits. It should be noted that the worksheets consisted of 35 and 34 questions respectively.

Table 4.2: Number of questions omitted by each group for Worksheet A and B[22]

Group number		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
No. of omitted questions	**W/S A**	3	5	9	1	0	1	0	4	15[23]	0	1
	W/S B	1	9	0	5	2	0	2	8	0	0	1

As illustrated by Table 4.2, the number of Worksheet A questions omitted by each group during the first visit to the zoo ranged from zero - three groups completed their worksheets - to one group which did not attempt to answer 15 questions. Group nine, which omitted 15 questions, merged with another group (Group three) and after analysing their worksheets I noted that Group nine stopped recording their responses on their own worksheet and combined their responses on Group three's worksheet. I therefore decided to exclude Group nine's completed worksheet from my analysis, which then showed the number of omitted questions ranged from zero to nine with a modal value of one.

Although Table 4.2 shows a high frequency of incomplete worksheets, all groups from the first visit were waiting at the rendezvous point 30 minutes before they were required to. It would seem then that the time allocated to answering Worksheet A was sufficient, and other factors were at play with regard to the omitted questions. I observed and noted these factors during my field observations:

- learners battled to find some of the animal enclosures (to be discussed in Section 4.2.2);

[22] W/S – worksheet
[23] Group nine's worksheet was omitted from analysis

- learners were distracted by various snack huts and kiosks along the way;
- learners were distracted by animal enclosures not specific to the tasks; and
- some groups attempted to answer the worksheet in order of the questions, even though their teacher advised them (during a pre-visit lesson) to plan their visit, which resulted in these learners walking unnecessarily long distances around the zoo thus wasting time.

The informal environment of the zoo provided ample opportunity for distraction (e.g. food kiosks etc.) and learners were often observed succumbing to these distractions. This observation coupled with the analysis of incomplete worksheets suggested that learners did not feel constrained by or obliged to complete the worksheet. I found this behaviour surprising given that learners were aware that the task would contribute to their term's assessment.

The Contextual Model of Learning (CML) described by Falk and Dierking (2000) recommends that the field trip experience cater for the learners' personal context by allowing time for free-exploration of the informal context. To satisfy this recommendation of the CML, my next worksheet needed to have high T/Q and T/H ratios and therefore fewer questions requiring fewer animal exhibits. However, given the early completion of Worksheet A, as well as and field observations of learners engaging in unintentional free-exploration, it could be argued that the T/H of the worksheet was not that high that learners were totally engrossed with answering questions during the entire visit. I therefore chose to leave the task density relatively unchanged and include designated free-exploration instead. In other words, the number of questions decreased from 35 to 34 in Worksheet B and the number of animal enclosures changed from 20 to 16 (purely as a result of the revision of some questions). This choice also met my and the Natural Science teacher's objective for the field trip in that the accompanying worksheet served as an assessment task and therefore both worksheets needed to be as closely standardised as possible – that is, similar in duration and in the amount of work learners needed to complete.

The task density of Worksheet B is included in Table 4.1 and shows a small increase in T/Q and T/H ratios. Learners had approximately 5.29 minutes to complete each question and 11.25 minutes to spend at each enclosure. However, I did not feel the small change in task density had any impact on the learners' field trip experience as the number of questions omitted during the second zoo visit was comparable to the first ranging from zero – four

groups completed the worksheet – to nine questions (see Table 4.2) with a modal value of zero. Even though the second visit groups had more time to spend at each enclosure, they omitted questions with a comparable frequency to the first visit groups who had less time at each enclosure. Furthermore, most second visit groups were waiting at the rendezvous point forty minutes before they were expected to – this was ten minutes earlier than the first visit. I attest this to my increased use of orientation cues in Worksheet B - enabling learners to navigate faster and not waste time looking for specific enclosures. It would therefore appear that the task density of the zoo worksheets was suitable for the length of time learners had to complete them and incomplete worksheets were as a result of other factors which are described later in this section.

4.2.2 Orientation cues

Orientation cues refer to those aspects of a worksheet which learners use to navigate the informal setting they are visiting. Orientation cues include maps, facility-specific way finding systems, directions and advance organisers such as pictures of the exhibits, displays or animals. Table 4.3 below shows the extent to which Worksheet A made use of orientation cues.

Table 4.3: Orientation cues present in Worksheet A

Activity no.	Question no.	Type of orientation cue	Comments
Introduction and instructions		Map and Introductory text	A map of the zoo is included with the worksheet. An introductory paragraph provides information about what was expected from learners
1	1 – 3	Picture and caption	Question 1 – 3 focus on one animal – Vietnamese pot-bellied pig. A picture of this animal is included with a caption instructing learners to find it in the farmyard.
	4 – 5	None	An instruction speech bubble instructs learners to find the next animal – Black Spider Monkey – but does not include any directions to the location of the enclosure.
	6	Directions	An instruction speech bubble instructs learners to find the gibbons in Madagascar.
	7	None	An instruction speech bubble instructs learners to find caracal and hyena, but does not include any directions to the location of the enclosures.

	8 – 10	None	Questions only – tasks are not marked in any way to indicate where the enclosures are located.
2	1 – 5	None	Questions only – tasks are not marked in any way to indicate where the enclosures are located. A cartoon picture of one of the animals – rhino – is included with the question.
	6		Learners are instructed to 'look out' for bat boxes around the zoo – but no further details are given regarding their location.
	7	None	An instruction speech bubble instructs learners to find the Wattled Cranes, but does not include any directions to the location of the enclosure.
3	1	None	Question only – task is not marked in any way to indicate where the enclosures are located. A cartoon picture of the animal – hippos – is included with the question.
4	1 – 7	None	Questions only – task is not marked in any way to indicate where the enclosures are located. A cartoon picture of one of the animals – elephant – is included with the question.
5	1 – 4	None	Questions only – task is not marked in any way to indicate where the display is located.
6	1	None	Question does not require learners to visit an animal enclosure.

It is suggested that, in order to reduce the novelty effect of an informal setting, a worksheet should include a map. This form of orientation cue helps learners navigate a very large novel environment in order to find the displays or exhibits needed to answer the worksheet. A map also enables learners to identify and visit interesting displays of their own choice – promoting free-choice learning. During the construction of Worksheet A, I decided to include a map of the zoo so that learners would be free to move at their own pace, without constant supervision. I made use of the Johannesburg Zoo map leaflet which is made available for visitors to purchase. As the map was printed in the month of May and the visits to the zoo took place in the months of August and September, it provided learners with an up to date layout of the zoo. Use of the map was encouraged by the Natural Science teacher during a pre-visit lesson. The teacher suggested that the learners devise a 'plan of action', with their group members, by plotting their planned journey through the zoo on the map. In this way the teacher prepared her learners for the zoo field trip and the learning that would take place, a

suggestion made by many researchers in the field (e.g. Anderson & Lucas, 1997; Orion & Hofstein, 1994). An example[24] of a plan is illustrated in Figure 4.2 below.

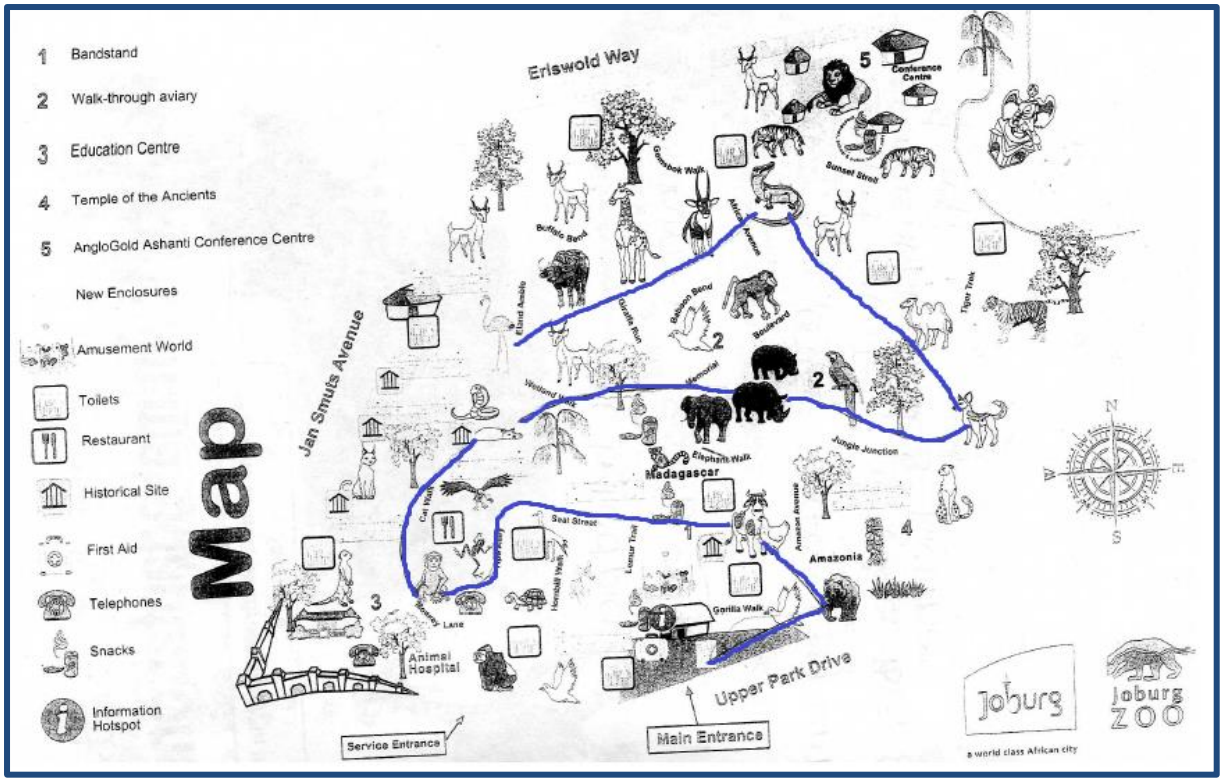


Figure 4.2: Evidence of planning by learners

I analysed each group's map and noted that three types of planning were evident:

- **no plan** – maps showed no annotations;
- **identification of important enclosures to visit** – some groups highlighted (with a highlighter pen) areas of interest on the map, including the location of toilets and snack kiosks; and
- **identification of a walked route**– learners numbered the map or drew in routes (illustrated in Figure 4.2 above) to show the order in which the group planned to visit each animal enclosure.

Four groups did not make any additions to their maps, although it should be noted that one of these four groups did opt to purchase a colour copy of the map rather than use the black and white copy included in their worksheet. Fortunately two of the four groups which had not indicated a plan on their map had been chosen to wear an audio-recorder. Transcriptions of

[24]Additions made to the map by learners are emphasised in blue.

their conversations showed that these groups did in fact refer to the map to help them navigate the zoo. Examples of these instances are shown below.

Group A

Girl 2: *Look at the map of this… where's that road we came on?*

Girl 1: *Oh, this one?*

Girl 2: *That same one? Then it means Madagascar's down there. Yes! Madagascar's down there.*

In the excerpt above, it is clear that the group used the map of the zoo to help them navigate from their location (the farmyard) to Madagascar. The success of this example is due to the combination of map and worksheet instruction – discussed later in this section. The next excerpt, taken from the same group, shows a potential weakness of this particular map as an orientation cue and highlights the need for teachers to critically evaluate the quality and effectiveness of informal setting maps before a field trip. This is a consideration I overlooked in both worksheets as my own familiarity of the zoo layout blinded me to the weaknesses of the map.

Girl 1: *Go and look on your map Rashika, look on the map.*

Girl 2: *It's somewhere around here. It doesn't tell you exactly where…*

Girl 1: *Ok let me see.*

Here the exchange between the two learners shows that sometimes the exact location of an animal enclosure was only indicated in a general area or was not included on the map at all, for example, the Black Spider Monkey was not shown on the map. This made navigating the extensive environment of the zoo very difficult and may have contributed to the high number of omitted questions by some groups (described in Section 4.2.1).

The next excerpt is taken from another group. Here the exchange shows how these three learners used the map as well as the zoo's road signs to correct their course.

Group B

Boy 3: *African Avenue….. we walked the wrong way, look. We're here, were need to go there. So we're here.*

Boy 1: *African Avenue being the fact that we are, we are here on Boulevard.*

Boy 3: *No, no, wait, wait, wait, we're not on Boulevard, we're on Sunset Stroll so by mistake, instead of going that way, we went down here. So we need to go back up there .*

Boy 1: *No, it's fine… actually, to be quite honest…*

Boy 3: *Okay, so then do you want to do the … okay then, if we're gonna do that… and then let's now weave.*

Boy 2: *Simple. There's the War Museum*

Boy 1: *Oh, actually he does have a point.*

Boy 2: *Ja*

Boy 3: *Look, we're here.*

Boy 1: *Look, African Avenue.*

Boy 3: *We're either here or here.*

Boy 3: *Mmm, because remember that was the crocodile thing we walked past. So obviously we went down past the crocodile.*

Boy 3: *Ja, so we're here because this is African Avenue. Ja.*

Boy 1: *So I don't suppose you guys want to go down that way?*

Boy 3: *Look, look, if we go down here then we can do the inside here*

Boy 1: *And then that will make it faster?*

Boy 3: *Then that must go to tiger last…*

Boy 2: *There's Memorial Boulevard*

Boy 1: *See, told you. I told you guys we were on Memorial, those were the bat boxes, I'm sure of it. Anglo Gold Ashanti Conference Centre – isn't there a Conference Centre somewhere on there?*

Boy 3: *There's a Conference Centre*

Boy 1: *So basically we are on, ja, we are on this road?*

Boy 3: *Ja*

It is interesting to note that the group also used landmarks visible in the zoo and included on the map, such as the war memorial monument, to orientate them within the map. This is an important observation as it highlights the suitability of maps as orientation cues. In this instance, grade eight learners were experienced enough to use the simple map. This may not be the case for lower grades.

Another orientation cue that can be useful in directing learners is an advance organiser. By including a picture, with an appropriate descriptive caption, of a particular exhibit or display learners can easily identify specific question-related sources of information. Worksheet A made very little use of advance organisers, only including a picture of a Vietnamese Pot-Bellied Pig and a caption of where to find it[25]. This approach to orientation appeared to be very successful as all ten groups found the animal in question.

Finally, one other orientation cue is the inclusion of introductory text in some questions. Although several questions instructed learners as to which animal they were to find next, only one[26] gave the general location of the animal. This question pointed learners to the Madagascar area of the zoo – an area that is included in bold print on the map. The result of this combination, i.e. clear directions and support from the map, proved to be efficient (as shown previously in the transcript excerpt) as only one group did not answer the question.

The use of an overly structured worksheet during informal experiences seems counter to the attitude of free-exploration and learning however, recommendations made in the literature are that teachers should address site novelty and reduce the time spent by learners familiarising themselves with the space. Consequently, only when learners are familiar with the animal enclosures and the environment of the zoo is learning likely to take place. The orientation cues of Worksheet A addressed this recommendation by introducing the worksheet to the learners before the visit, and providing a map so learners were able to plan and navigate during their visit. Other orientation cues were incorporated into the worksheet without providing too much structure – a recommendation made by Kisiel (2003b) to align with the physical context of the CML. Even so, the lack of orientation cues dampened learner enthusiasm and hindered the learning process when they battled to find animal enclosures that they needed.

McManus (1985) makes several recommendations for ways to improve the efficacy of worksheets in informal contexts, one of these recommendations is that the worksheet should be unambiguous about where information is found - a shortcoming of Worksheet A which, perhaps, contributed to the high frequency of omitted questions. Figure 4.3 included below shows the frequency with which certain questions were omitted. It is evident from the graph that the most frequently omitted questions were those of Activity Four, in particular:

[25] Activity 1, Question 1-3, Appendix A1
[26] Activity 1, Question 6, Appendix A1

- Question 4.5 was not answered by seven groups;
- Question 4.2 was not answered by four groups; and
- Question 4.3 was not answered by three groups.

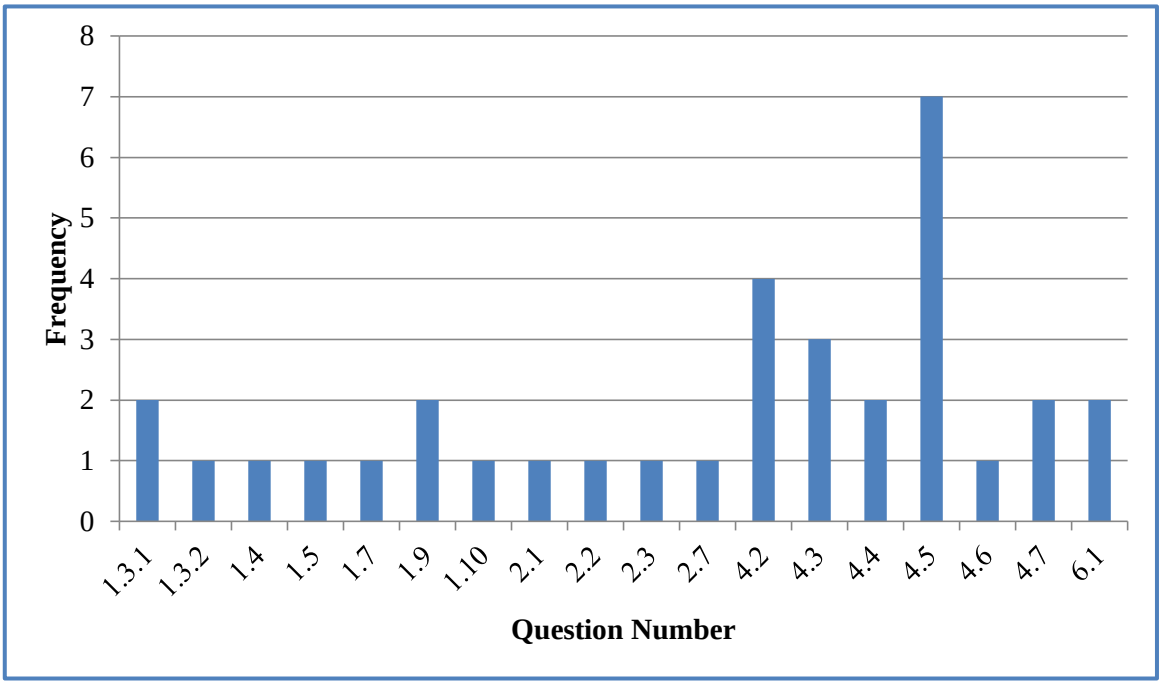


Figure 4.3: Frequency with which learners omitted questions on Worksheet A

Each of these questions required learners to find information from locations that were vague and not obviously sign boarded. For example, Question 4.5 asked learners to give the highest recorded mass of the biggest animal in the cat family. If learners did not know that the tiger is the largest cat, they would not know where to find the information needed to answer the question. The same argument can be applied to Question 4.2 and 4.3 – information for both these questions could only be found on obscure information boards found at the elephant and hippo enclosures respectively. Evidence to support this shortcoming of Worksheet A was observed during the visit when learners asked their teachers and zoo staff for the location of animals. I planned to address this weakness by utilizing the effectiveness of the map and site location combination of orientation cues e.g. *Find the Cape vulture at the corner of Cat Walk and Seal Street.* Figure 4.4 illustrates the difference between the orientation cues of the two worksheets.

I made use of the zoo's specific way-finding system by including the names of the roads and zoo sections, shown on the map, as orientation cues for Worksheet B. The only questions that did not have orientation cues were: those of Activity Four – this allowed me to compare the

two visits, Activity Three – the hippos can easily be found using the map; activities that required learners to find their own animal; Activity Five – which could be found using the map; and Activity Six – which was not site specific. The number of orientation cues thus increased from Worksheet A to Worksheet B.

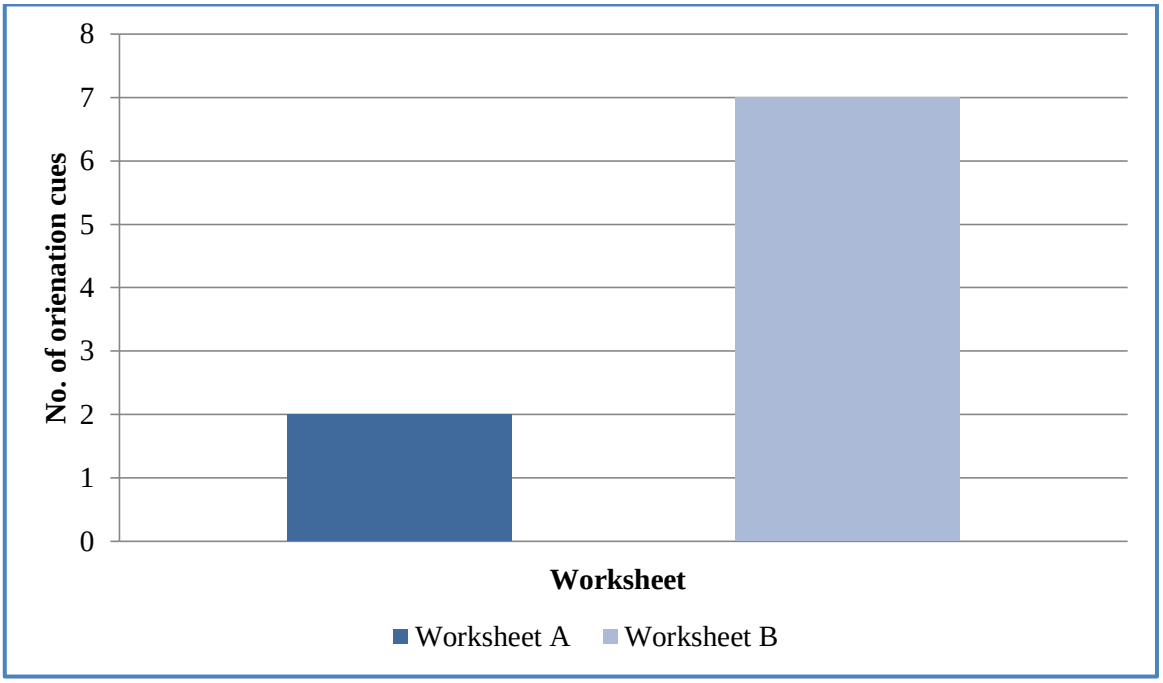


Figure 4.4: Number of orientation cues included in zoo worksheets

Analysis of completed worksheets (Worksheet B) showed that far fewer groups had evidence of a planned route - seven groups out of eleven showed no planning at all – which is surprising as the inclusion of specific orientation cues would make planning a route much easier than it was for the first groups.

The groups, who answered Worksheet B, also omitted questions from Activity Four (see Figure 4.5), although to a lesser extent that the groups who answered Worksheet A. The first visit omitted Question 4.5 most frequently (seven groups) however all second visit groups answered this question. This is surprising as I did not include any orientation cues for Activity Four of Worksheet B, however analysis of the worksheets showed that only three groups responded correctly. This is an indication that, even though all Worksheet B groups answered the question, not all the groups actually found the correct animal enclosure i.e. the Siberian tiger.

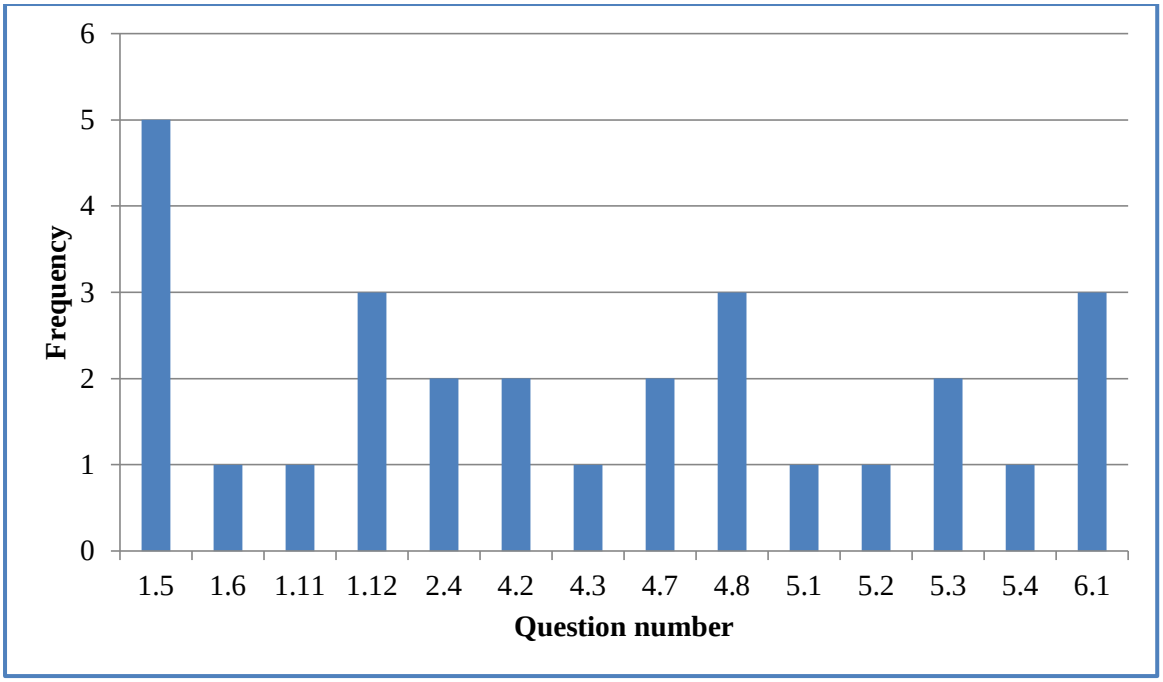


Figure 4.5: Frequency with which learners omitted questions on Worksheet B

Similarly, only one Worksheet B group omitted Question 4.3 compared with three Worksheet A groups which seemed to show that the Worksheet B groups found the information board that the first groups did not. However none of the groups that responded to the question answered correctly i.e. hippo. The responses that were given indicated that some groups drew on prior knowledge to answer the question, for example: four groups responded with 'baby Howler Monkey' (an animal not housed at the zoo); and three groups answered with 'Aussie Dog' (also not housed at the zoo). Given the propensity of learners to copy answers, it is very likely that the above two answers were shared among Worksheet B groups – an indication that these groups tackled the difficulty of Activity Four, in the absence of orientation cues, by guessing and sharing answers as they felt compelled to complete the worksheet.

4.2.3 Information source

Information source describes where learners find the information needed to complete worksheet tasks. There are many sources of information to be found in informal learning settings: information can be found by reading labels or information boards (text-dependent); by observing objects (object-dependent); from accompanying teachers or museum educators; by listening to and watching audio-visual presentations; by doing practical activities or from prior or general knowledge (PK).

An example of a text-dependent question was:

Bust the myth that snakes are deaf.[27]

The answer to this question could be found on a zoo information board that was situated at the entrance of the reptile enclosure. Only by reading the board were learners able to find the answer.

An example of an object-dependent question was:

Describe one physical adaptation of the caracal.[28]

Again the enclosure included an information board however; the information included did not describe any physical adaptations. Learners had to study the animal in order to derive an answer to the question.

An example of a prior knowledge question was:

Find the Cape vulture. What kind of feeding behaviour does this bird display?[29]

Learners would not find reading the information board or observation of the vulture helpful in answering this question. They had to draw on their prior knowledge, in this case – the term scavenger was discussed in the Natural Science classroom during a section on ecology – to answer the question.

An example of a practically based question was:

How much taller is the Polar Bear than you? Give your answer in centimetres.[30]

In order to answer this question, learners needed to visit the Polar Bear enclosure which included, as part of an information display, a life size 'cut-out' Polar Bear standing up on his hind legs. The bear board was positioned next to an appropriately scaled ruler. Learners had to determine the bear's height using the ruler and then their own and calculate the difference.

I did not include any questions that specifically required information from a teacher or museum educator or from an audio-visual display as: firstly, the zoo is an extensive environment and therefore learners would find it difficult to find a teacher who is walking

[27] Activity 4, Question 7, Appendix A1
[28] Activity 1, Question 7, Appendix A1
[29] Activity 1, Question 9, Appendix A1
[30] Activity 4, Question 6, Appendix A1

around supervising other groups; and secondly, the zoo did not make use of audio-visual displays.

Figure 4.6 below shows that Worksheet A:

- favoured text-dependent questions (28 questions) over object-dependent questions (two questions);
- did not include any questions based on audio-visual displays or information from teachers and museum educators;
- made use of few questions that drew on learners' prior knowledge; and
- had only one practical activity question.

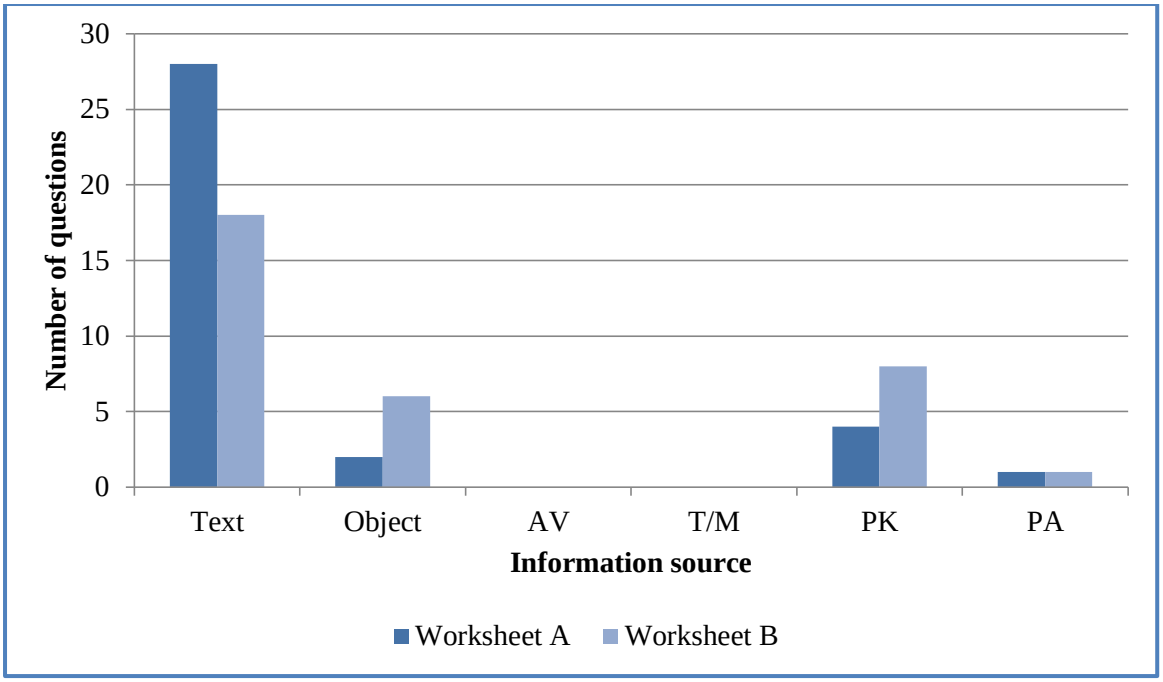


Figure 4.6: Sources of information for tasks in Worksheet A and B[31]

Learning in an informal context is supported by direct experiences with objects and exhibits unique to the informal context (Kisiel, 2003b). A museum worksheet should, therefore, take advantage of these and focus learner attention on objects which are not found in the classroom (Kisiel, 2003b; McManus, 1985). Figure 4.6 shows that this was not the case for Worksheet A, as 80% of the questions were text-dependent. The zoo field trip experience was reduced to a textbook activity, characteristic of the classroom, and one which learners quickly

[31] AV – audio-visual, T/M – teacher and museum educator, PK – prior knowledge, PA – practical activity

lost enthusiasm for. It should be noted that the loss of enthusiasm observed towards the end of the field trip is also evident in the high frequency of omitted questions.

Furthermore, Worksheet A incorporated only one practical activity and made little use of prior knowledge questions. Therefore little use of the learner's personal and social context of the CML was utilized, limiting the opportunities learners had to share their own experiences and prior knowledge about an animal. Therefore, in terms of the recommendations made in the literature regarding effective museum worksheets, Worksheet A was unlikely to support learning due to the use of many text-dependent questions.

In addressing this weakness of Worksheet A, I attempted to revise some text-dependent tasks so that they became object-dependent. Studies have shown that worksheets need to provide learners with opportunities to observe and think deeply about concrete objects, and make generalisations from them. These recommendations conform with the constructivist view of personal knowledge construction and thus may improve the learning potential of a field trip (Mortensen & Smart, 2007). Even so, I found it extremely difficult to revise some text-dependent questions purely because the zoo had done a very thorough job of providing every animal enclosure with an information board (zoo exhibit label). I therefore tried to design questions that could not be answered by reading the accompanying information – this was not always possible. The other limitation I encountered was designing questions for animals that were very likely to be visible in their enclosures on the day of the visit. I tried to use animals that were easily visible and easy to observe. An example of one such question, where learners were explicitly directed to observe a specific animal and not its information board, is shown below.

Find the Polar Bears at the top of Memorial Boulevard. Give two characteristics that you can observe that show these bears are not adapted to the African environment.[32]

I included this question as I knew there was no information that could be found on the zoo exhibit labels that learners could use to answer the question. Learners were forced to answer the question by studying the Polar Bears and applying their knowledge of how animals are suited to their environment. The Polar Bear question was thus cognitively demanding (medium order questioning) and learners, therefore, needed to spend a little more time thinking about and answering the question – this approach is only evident in three out of

[32] Activity 1, Question 7, Appendix A2

eleven Worksheet B groups. Despite the fact that all eleven Worksheet B groups answered the question, although only two provided a correct response. Some responses are included below:

- *"they need to be kept in cool places"*
- *"they have a lot of shade and have a river running though"*
- *"they have white fur, so no camouflage and their thick fur gets too hot"*

The first response included above was given by four Worksheet B groups. This provided evidence of groups copying their answers from other groups. The second answer shows that the group did study the Polar Bear enclosure and observe how the zoo had tried to mimic their natural habitat. However, they failed to link their observations to the physical characteristics of the Polar Bear. The third answer shows the correct response given by two groups. It would seem, therefore, that learners were not comfortable with the object-dependent nature of the Polar Bear question where they were not assured of the 'correctness' of their answer by an information board. Further evidence to support this observation could be found in a transcript of one of the groups which showed that learners spent time searching the Polar Bear enclosure for information boards and when they couldn't find any they left the question out only to write a response later when they had left the enclosure and weren't able to observe the bears. This observation is in direct contrast with school groups that were observed by Mortensen and Smart (2007) which showed a preference for solving cognitively higher object-dependent tasks, rather than text-dependent knowledge level tasks, even though the former took longer to complete with conceivably more effort. A similar observation was made for a second object-dependent question I included on the Black Spider Monkey – this observation is discussed in more detail in Section 4.2.6. Furthermore, the need to identify and copy down the correct information from information boards by learners is discussed in Section 5.3.1.1

I also attempted to include more prior knowledge questions which would encourage learners to apply their knowledge in the novel setting of the zoo. An example of such question is included overleaf:

Choose three animals you have seen today and draw a food chain to show the relationship between these animals as it would be observed in the wild.[33]

I expected that all learners would be able to complete this task as the concept of food chains, feeding levels and flow of energy in an ecosystem had been taught in the classroom. Also, I felt the question offered a degree of choice (discussed in Section 4.2.4) that Worksheet A questions did not, and thus a degree of free-choice learning. Even so, four Worksheet B groups omitted this question and those that did answer the question failed to receive the full mark allocation as their food chains were incomplete, for example:

- *sun → grass → elephant → compost*
- *fruit tree ← mouse ← snake ← owl*
- *fish → seal → Polar Bear*

Although the first response is correct, elephants could be observed eating 'grass' in their enclosure, the learners did not meet the question's requirements to include three animals they observed at the zoo. The second question shows a common misunderstanding learners have with regard to food chains where they invert the arrow to show 'what is eating what' – this is an advantage of using worksheets in that they can be used to identify learner misconceptions (Nyamupangedengu, 2009). The last question shows a group who did not meet the requirement of the question to include animals that had been seen at the zoo – there are no seals or fish at the zoo they visited.

Figure 4.6 shows that:

- object-dependent questions increased from two to six questions,
- text-dependent questions decreased from 28 to 18, and
- prior knowledge questions doubled in number from four to eight.

Thus my revision of Worksheet B to include a greater variety of information sources does not fully meet with the recommendations made in the literature. The context of the visit, i.e. the zoo setting does not allow for practical activities in the way that a science centre would and the abundance of information boards reduced the possibility of true object-dependent questions. Nevertheless, if I were to cycle through a third spiral of action research (discussed

[33] Activity 4, Question 8, Appendix A2

in Section 3.2.1) I will need to revise Worksheet B to incorporate still more object-dependent and prior knowledge questions so as to promote free-choice learning.

4.2.4 Level of choice

Level of choice indicates the number of correct answers each question has available for learners to choose from. A question may have only one correct answer which gives the learner **no choice** or several correct answers which gives the learner **some choice** when completing a task. An example of a no choice question was:

What is the Rock Hyrax's closest relative?[34]

This question had only one correct answer – elephant – therefore the question did not provide learners with any choice.

An example of a question with some choice was:

How did the river in the zoo become polluted?[35]

This question offered some choice as there are many ways in which a river can become polluted. Learners could choose from litter, animal waste, human waste, faecal contamination etc. Table 4.4 below shows the levels of choice that was offered by Worksheet A and B.

Table 4.4: Level of choice that is offered by Worksheet A and B

Level of choice	No. of questions	
	W/S A	W/S B
No choice	25	21
Some choice	10	13

It is recommended that informal context worksheets accommodate learners' prior interests as well as provide a sense of autonomy by allowing learners to exercise a degree of choice and control over their field trip (Kisiel, 2003b; Mortensen & Smart, 2007). Research has shown that learners prefer tasks that offer some choice, often solving them in a variety of ways and at a variety of sites (Mortensen & Smart, 2007). Offering learners some choice therefore cultivates a positive attitude towards the field trip and promotes free-choice learning.

[34] Activity 4, Question 2, Appendix A1
[35] Activity 5, Question 1, Appendix A1

Table 4.4 shows that this is not true for Worksheet A, which has considerably more 'no choice' answers than 'some choice' answers.

In a study by Griffin (2004, p. 63) learners stated that "…because you have to go around looking for the information, you haven't got time to study the things we want to see." This sentiment was evident during the zoo visit, learners felt obliged to complete the worksheet but succumbed to distractions such as interesting animals. The need for one 'correct answer' was also evident as groups resorted to copying answers from one another. The transcript overleaf illustrates one of the many instances of copying that took place:

Group A

Girl 3: *Can't we ask them for the answers and then I trade them for an answer too?*

[Learner 3 moves out of audio-recorder range presumably to trade answers with another group]

Girl 4: *Do you know how many answers you actually get?*

Girl 2: *Yes, they gave us two pages of answers. This whole… she gave us this whole thing.*

Girl 4: *Hmm*

Girl 2: *Then she gave us, she gave us this, this, this and this.*

Girl 1: *(Yawns)*

Girl 4: *Great*

The excerpt was taken two hours into the field trip and shows that learners had grown tired of finding answers.

The low level of choice, provided by the worksheet, meant that learners' prior knowledge, interests and sense of autonomy (the personal context of the CML) were not taken into consideration. Therefore, as far as level of choice was concerned Worksheet A was less likely to support learning and was revised to try and incorporate more questions that promoted learners' choice and control. Table 4.4 shows that I was only able to reduce the number of 'no choice questions' by four and increase the number of 'some choice' questions by three.

An example of one of these questions is included below:

Now find an animal that you think is interesting or unusual. Describe one physical adaptation and one behavioural adaptation for this animal.[36]

I included this question to increase the level of choice learners had and in so doing, promote free-choice learning through designated free-exploration. Analysis of completed worksheets showed that learners had reported on animals they found interesting e.g. tiger, camel and gorilla. However, copying of answers was evident between four groups showing that even when given the opportunity to find animals they wanted to see, learners were more likely to choose the easiest way out and copy answers. It should be noted that free-choice learning is defined by purists (Falk et al., 2009) as learning designed and controlled by learners and I acknowledge that this question is not free-choice learning in the strictest sense of the word. However, the nature of the field trip required completion of the worksheet – meeting the teacher's and my agenda for the visit. This question attempted to bridge the gap between this agenda and the agenda of the learners and yet two groups chose to copy and two groups chose to write about the animal closest to them at the time of reading the question.

Another observation I made and will consider in the future is the impact of 'some choice' questions on the accuracy of the worksheet memorandum. If teachers use a field trip worksheet as an assessment task, 'some choice' questions complicate the compilation of an accurate memo. All eventualities needed to be considered and marked fairly – asking learners to choose from the many species housed at the zoo resulted in some responses I had not prepared for in the memo. This problem was not too difficult to overcome, as quick references could be made and added to the existing memo, however in the contexts of other informal settings the same might not apply. This observation suggests that a teacher's choice of an informal context worksheet may, in addition to those reported by Kisiel (2007), include the perceived ease of marking of said worksheet.

With regard to level of choice, Worksheet B did not meet the recommendations for accommodating the autonomy of the learner as 61% of the worksheet fell in the 'no choice' category. However, it should be noted that true autonomy cannot be achieved with the style of worksheet reported here.

[36] Activity 1, Question 8, Appendix A2

4.2.5 Cognitive level

Cognitive level uses the six levels of questioning as described by Bloom's taxonomy: knowledge, comprehension, application, analysis, synthesis and evaluation (Kisiel, 2003b). For the purposes of this study, the cognitive levels were grouped into three subcategories. These three subcategories are described in Section 2.3.2 and are shown in Table 4.5 overleaf.

Table 4.5: Subcategories of Bloom's six cognitive levels

Subcategory[a]	Cognitive level	Description[b]
Lower order	Knowledge (K)	Recall of simple facts or information
Medium order	Comprehension (C)	Understanding of facts that will enable an individual to process information
	Application (Ap)	Use acquired knowledge in novel situations
Higher order	Analysis (As)	Recognise hidden meanings in given information
	Synthesis (S)	Integrate knowledge from several areas
	Evaluation (E)	Examine, compare and judge based on reasoned arguments

[a](Green & Rollnick, 2007) [b](Nyamupangedengu, 2009)

Recommendations made in the literature suggest that informal context worksheets should incorporate both low and high levels of questions (Kisiel, 2003b; Mortensen & Smart, 2007). In this way, the worksheet will account for differences in learners' abilities as well as encourage group participation and, in so doing, accommodate both the social and physical contexts of the CML.

I designed the worksheet to correspond with classroom topics - ecology and biodiversity as well as animal adaptations and their behaviours. The zoo visit was scheduled for after these sections had been completed by the Natural Science teacher and therefore learners had a fair amount of prior knowledge on the topics before they visited the zoo. I therefore decided to code any question that required the recall of simple facts, learners encountered in the classroom, as lower order questions. An example of this type of question was:

Find the Cape vulture. What kind of feeding behaviour does this bird display?[37]

Learners encountered the term 'scavenger' as well as examples of these animals (including vultures) in the classroom and answering this question simply required the recall of a fact.

[37] Activity 1, Question 9, Appendix A1

Where learners had to read information boards and zoo exhibit labels to find relevant information - I coded medium order level questions; and where learners had to read beyond the simple facts included on information boards and labels, combine knowledge from several sources or exercise their own judgement – I coded higher order level questions. Examples of a medium order and higher order question are included below:

Give five interesting physical adaptations of the crocodile.[38] (medium order)

Write a paragraph in which you describe what conservation is, why it is important to educate people about conservation and how the zoo is working to protect species from extinction. You must include in your answer whether you think the zoo is doing a good job at promoting conservation and whether you think zoos are an important part of society.[39](higher order)

The crocodile enclosure is accompanied by ten information boards with various interesting facts. Learners needed to read these information boards, apply their understanding of a physical adaptation, and sift out only those facts that were related to the physical make-up of a crocodile. This thought process involved: learners' prior knowledge – remembering what a physical adaptation is **(K)**; understanding that a physical adaptation of a crocodile would refer to the body of a crocodile and would need to help the crocodile successfully function within its habitat **(C)**; and then use this understanding to select only those facts that met the criteria of a physical adaptation **(Ap)**. Hence the allocation of this question to medium order levels of questioning.

The last question of the worksheet is an open-ended long response question designed to help learners consolidate their experiences at the zoo. It is coded as a higher order level of questioning as learners needed to: draw on and integrate many sources of their knowledge (prior knowledge and knowledge acquired during the visit) **(S);** as well evaluate the efforts of the zoo **(E).**

It should be noted that deciding on the cognitive level of each question was not an easy task and called for familiarity with the teaching situation (Green & Rollnick, 2007). For example, if I had not known that the learners encountered vultures as an example of scavengers I might have coded the same question as medium order. My thinking would have been that learners would have to have linked the term carrion (included under 'diet' on the zoo exhibit label) to

[38] Activity 1, Question 8, Appendix A1
[39] Activity 4, Question 6, Appendix A1

their understanding of scavengers in order to identify the feeding behaviour of the Cape Vulture as scavenger. Thus to reiterate what Green and Rollnick (2007) stated, assigning questions to cognitive levels requires an understanding of what learners already know. Coding of cognitive levels is subjective in that it is related to the goals and intentions of the individual teacher.

Figure 4.7 below shows that Worksheet A did not offer a variety of cognitive levels. Only one question was at a lower level, five questions were of a higher level and the rest (29 questions) were of a medium level.

In their study of the effectiveness of worksheets for learning in a natural history museum Krombab and Harms (2008) showed that prior knowledge contributed to the success of the learning experience. My revised zoo worksheet needed to capitalise on prior knowledge, by incorporating lower level questions. Lower level questions promote knowledge acquisition by helping learners link what they have encountered in the classroom to real-world objects and experiences. Lower level questions also allow weaker learners to participate and encourage learners to work cooperatively.

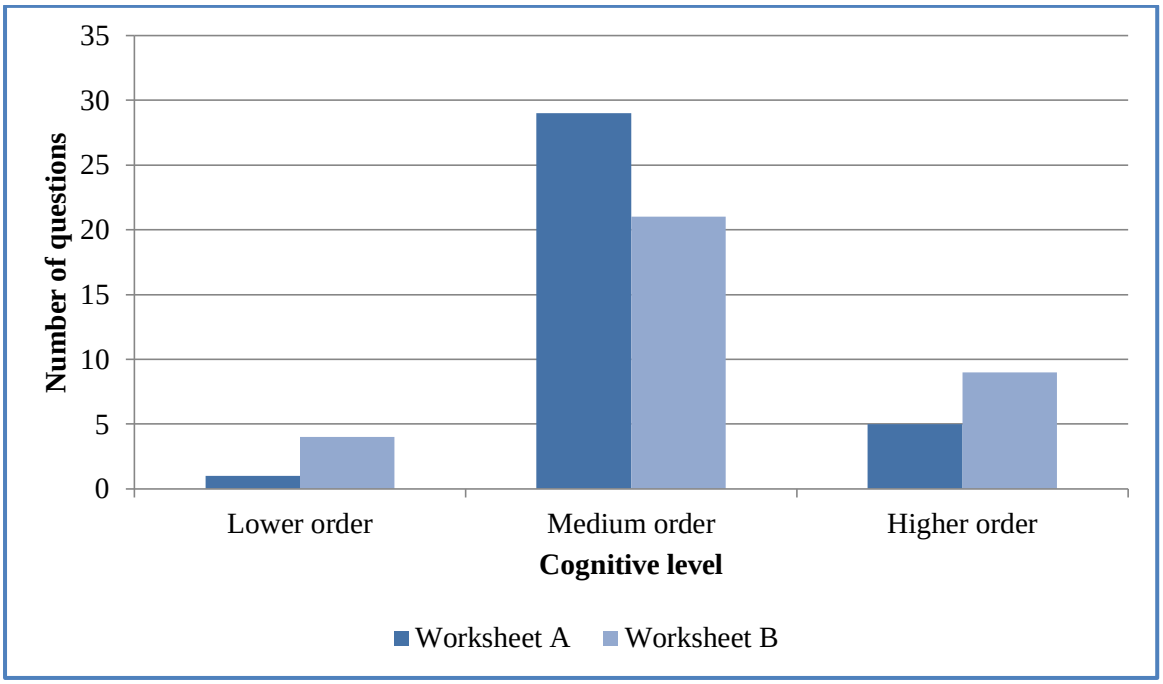


Figure 4.7: Cognitive level of tasks in Worksheet A and B

Mortensen and Smart (2007) reported learners in their study preferred answering higher order questions that took more time and effort rather than lower order questions. This observation made me think that my limited use of higher order questions was a weakness of the worksheet. However, Green and Rollnick (2007) contend that higher order questioning is not appropriate for time-limited situations e.g. examinations and in this case – the field trip. These tasks take a lot of time to answer and encroach on the time available for free-exploration. Question one of Activity Six illustrates this problem very effectively, for both Worksheet A and B – it was the last question of a long worksheet, learners were tired and consequently quality of the responses was poor:

- the average mark attained was one and two out of five for Worksheet A and B respectively; and
- two out of ten Worksheet A groups and three out of eleven Worksheet B groups did not attempt to answer the question (see Figure 4.2 and 4.4).

The nature of Activity Six played a role in the frequency with which it was answered – long paragraphs are not conducive to field trip experiences or group work. However, I found it difficult to revise questions to incorporate choice, variety of response formats and information sources without the questions becoming medium and higher order cognitive levels. Figure 4.7 shows that the resulting cognitive demand of Worksheet B changed from A to include more lower level questions, less medium order questions and more higher order questions. Higher order questions, like the one included below, were carefully constructed to encourage group discussion and collaboration and be quicker to respond to.

In your group come up with a catchy slogan that the zoo could use on their information boards to educate the public about the plight of this animal.[40]

The use of both lower and higher levels of questioning aligns with recommendations made in the literature (e.g. Kisiel, 2003b; Mortensen & Smart, 2007) and therefore Worksheet B, with regard to cognitive demand, is more likely to promote free-choice learning than Worksheet A.

[40] Activity 2, Question 4, Appendix A2

4.2.6 Response format

Response format indicates how learners are instructed to complete worksheet questions and include writing down the answers, drawing, verbalising and discussing answers, and doing practical activities. Kisiel (2003b) recommends that a worksheet use a variety of these response formats to promote social interaction (social context of the CML) and accommodate all styles of learning (personal context of the CML). Oral answers are easier and faster to give than written ones, drawings also introduce variety and encourage closer observation of animals and their surroundings (Nyamupangedengu, 2009). However, Worksheet A took the form of the written variety which reduced the informal context of the zoo to the formal context of the classroom.

As previously mentioned, teacher-designed worksheets meet the objectives of the teacher – this applies to my design of Worksheet A. When I designed the worksheet, three years ago, I knew that teacher supervision would be low as I wanted learners to work independently. I also had to show the educational worth of the experience when I sought permission for the excursion. I therefore felt that a written response worksheet would work well in helping to keep learners on task. I also planned to mark completed worksheets and use them as an assessment task. Consequently, Worksheet A was almost exclusively dominated by written response questions: 34 out of 35 questions required learners write down answers; and one question asked learners to show their answer in the form of a table.

However, the task density of the worksheet coupled with the extensive amount of writing resulted in worksheets that were incomplete, responses that were illegible (despite the use of clipboards) and the observation of frequent 'sharing' of answers between groups. Simply put, the worksheet failed to engender learners to answer questions in such a way that reflected their *own* group's thinking – a key component of an assessment tool – and therefore the Natural Sciences teacher could not fairly assign marks for the field trip. Although it must be noted that it did work very well as a behaviour controlling tool and promoter of cooperation among groups. I found many groups wanted to share the responsibility of writing down answers. An example of this cooperation is illustrated in the excerpt below:

Group B

Boy 2: *You know we each have to write something.*

Boy 3: *I know.*

Boy 1: *And Jander's doing this part. I'll be doing on the hippo.*

Nevertheless, in terms of response format, Worksheet A was unlikely to support free-choice learning. To address this weakness I revised some questions so that they called for drawing as a response format. I also wanted to include some questions which used verbal and 'doing' responses but, without a teacher present to listen to and observe these responses, there was no way to control and assess these types of question. Table 4.6 shows the response format of Worksheet A and how it was revised in Worksheet B.

Table 4.6: Response format offered by Worksheet A and B

Response format	No. of questions	
	W/S A	W/S B
Written	34	32
Pictorial	1	2

In terms of response format, I was unsuccessful in fully revising Worksheet A to comply with best practice recommendations as I only was able to revise two 'written' tasks. However, these two revised questions produced very different results from typical written response tasks. I have included a detailed description of one of these questions below to illustrate this finding.

The most frequently omitted question of Worksheet B was Question 1.5 (see Figure 4.5)[41]. This question was one of my revised questions from Worksheet A which originally asked learners to explain how the evolution of the Black Spider Monkey compared with the evolution of 'old world' monkeys[42]. I revised this question to try and incorporate more object-dependent tasks (encouraging observation, rather label reading) that called for learners to respond by drawing. The revised question told learners that Black Spider Monkeys had evolved differently to 'old world' monkeys and then asked learners to show how the hands of these monkeys differed from each other by means of a labelled diagram. A surprising five out of eleven Worksheet B groups did not attempt to answer this question, and of those that had answered it only two answered it correctly. At first I thought this result was due to learners being unable to find the Black Spider Monkey enclosure – even though I had included its

[41] Activity 1, Question 5, Appendix A2
[42] Activity 1, Question 4, Appendix A1

general location within the zoo – however when you consider that only one group omitted Question 1.6 (the follow-up Question to 1.5), it is more likely that learners found the enclosure but omitted the question simply because they did not know the answer. An example of an incorrect response is show in Figure 4.8 below.

Figure 4.8: Learner response to Question 1.5 of Worksheet B

Figure 4.8 shows that learners failed to observe the fundamental difference between the hands of the Black Spider Monkey and the 'old world' monkeys is that they do not have a thumb. I found this result very interesting as all Worksheet A groups, except one, from the first visit completed the original question which required label reading. Also, Worksheet B groups from the second visit had access to the same information board used by the Worksheet A groups of learners but failed to recognise it as a source of helpful information. It would seem, therefore, that the nature of the question i.e. observation and drawing as opposed to reading and writing, blinded learners to zoo exhibit labels. Also, the nature of learners' drawings suggests that biological drawing, as a necessary skill, was not sufficiently taught in the formal classroom.

A similar observation was made for Question 1.12[43] which asked learners to draw and annotate a diagram of a vulture beak to show how it is physically adapted for its function. This question was omitted by three Worksheet B groups (see Figure 4.5) and of those that did answer the question only one group answered correctly. The predominant error in learner responses was an incorrect beak shape as shown in Figure 4.9 overleaf.

[43] Activity 1, Question 12, Appendix A2

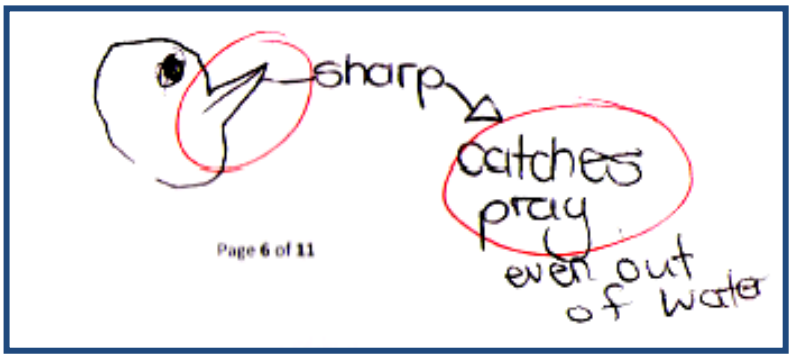


Figure 4.9: Learner response to Question 1.12 of Worksheet B

It is clear that the group who produced the drawing in Figure 4.9 did not observe the vulture. Similar beak drawings confirm this finding and suggest that drawing response questions are hastily answered. Perhaps learners think that drawings are marked with less accuracy than written fact based answers and thus view them as less important. Evidence to support this speculation could not be found in the transcripts, however, there was evidence to support copying of answers which may be an indication of the value learners place on drawing responses.

4.2.7 Question format

Question format describes whether questions are open-ended or close-ended. Close-ended questions usually require short simple answers whereas open-ended questions encourage learners to answer freely and share more than just facts.

An example of an open-ended question is:

Write a paragraph in which you describe what conservation is, why it is important to educate people about conservation and how the zoo is working to protect species from extinction. You must include in your answer whether you think the zoo is doing a good job at promoting conservation and whether you think zoos are important parts of society.[44]

As discussed in Section 4.2.5, the question above will result in a myriad of learner responses, requiring the skill of synthesis and evaluation as well as a longer period of time than the close-ended questions would need.

[44] Activity 6, Question 1, Appendix A1

An example of a close-ended question is:

What are the names and ages of the zoo's two elephants?[45]

Each learner will be expected to answer with the same answer. Close-ended questions can be answered quickly and can, therefore, be used to ensure learners have more free time to explore the informal context. Table 4.7 shows that Worksheet A was almost completely dominated by close-ended questions – this characteristic may have counteracted the high task density of the worksheet (discussed in Section 4.2.1) resulting in learners completing the worksheet faster than I expected and thus meeting at the rendezvous point 30 minutes earlier than expected.

Table 4.7: The number of open-ended and close-ended questions offered by Worksheet A

Question format	No. of questions	
	W/S A	W/S B
Open-ended	1	6
Close-ended	34	28

Also, Krombab and Harms (2008) showed that close-ended tasks resulted in greater advances in knowledge acquisition than open-ended tasks. Therefore, it would seem that in terms of question format, Worksheet A was likely to promote learning - although it should be noted that studies by Herman, Morris and Taylor (1987, cited in Nyamupangedengu, 2009) found that open-ended questions helped to developed creative thinking, problem solving and cognitive growth in children. Krombab and Harms (2008) share this view but caution that teachers cannot use open-ended tasks if their objective of the field trip is that learners will become familiar with the specifics of a certain display. I therefore chose to include only five questions that were open-ended, an example of which is included below:

Why are scavengers important in an ecosystem? Discuss with your group and then write down two of the group's suggestions.[46]

[45] Activity 4, Question 1, Appendix A1
[46] Activity 1, Question 13, Appendix A2

With regard to question format, a good worksheet should have a mix of open-ended and close-ended questions (Nyamupangedengu, 2009). Worksheet B offered enough open-ended questions to encourage cognitive development without infringing on time available for free-exploration once the worksheet was completed (as evidenced by groups meeting at the rendezvous point early). Also, the open-ended questions were attempted by all Worksheet B groups (except 1.6, 2.4, 5.4 and 6.1 which were omitted by one, two, one and three groups respectively) which show the propensity of learners to answer open-ended questions. Therefore, Worksheet B aligned with best practice recommendations for informal context worksheets.

4.2.8 Classroom connection

Classroom connection refers to the degree with which a worksheet is related to topics covered in the formal classroom. Kisiel (2003b) contends that a field trip is more likely to be educationally effective if connections are made to learners' prior knowledge and therefore the classroom experience. However, several studies have shown that field trips are often viewed by teachers as separate entities, not related to the classroom experience (e.g. Griffin & Symington, 1997; Kisiel, 2003b; Lelliott, 2009; Orion & Hofstein, 1994). Table 4.8 shows the degree with which the worksheets were connected to the classroom.

Table 4.8: The number of questions, offered by Worksheet A and B, connected to classroom topics

Classroom connection	No. of questions	
	W/S A	W/S B
Connection to classroom topics	20	19
No connection	15	15

As previously mentioned, I designed the original worksheet for use after two topics had been covered in the classroom, therefore, more than half the questions posed by Worksheet A linked the field trip experience to the classroom. This allowed learners to use prior knowledge (classroom knowledge) in navigating the zoo visit. An example of a curriculum-related conversation that illustrated this point is included below.

Group A

Girl 4: *[reads worksheet] Describe 3 of the relationships and categorise...*

Girl 2: *I think the board has the relationships. Did you check the board? There's like a board. See there's...*

Girl 4: *It doesn't say anything about relationships.*

Girl 2: *Then I've no idea.*

Girl 1: ***Oh!!! No!***

Girl 2: *It's the food chains probably.*

Girl 1: ***No, no, no, no Symbiosis I know this! Remember the parasitism? Remember parasitism?***

Girl 4: *Commensalism is?*

Girl 1: *Is when both of them benefit.*

Girl 4: *Mutualism is when both of them benefit?*

Girl 1: *No, commensalism is when... No, no, no, no, one... When one don't care and the other one is.*

The excerpt included above is only part of the conversation that took place whereby learners answered the symbiosis task set on hippos[47]. The beginning of the exchange between the three learners is when girl four (a girl from another group) asks girls three from group one what she had to write for the task in question. While learner two directs girl four to the information board, girl one remembers (indicated as bold text) what she had learnt about symbiosis in a natural science lesson. The rest of the conversation involves the girls building on their understanding of the phenomenon of symbiosis – clearly drawing on prior knowledge to complete the task. Mortensen and Smart (2007), in their study of worksheet use, observed similar curriculum-related conversations when learners worked to answer questions with a classroom connection. It is therefore important for an informal setting worksheet to connect with the school curriculum (Bamberger & Tal, 2007). However, it should be noted that activities that relate to the classroom curriculum must be chosen with care as they tend to be focused on fact learning and thus do not promote free-choice learning (Mortensen & Smart, 2007). For this reason, I tried to retain the degree of classroom specificity in Worksheet B but revise some of the questions to accommodate free-choice learning. For example Question One to Four of Activity Two asked learners to find

[47] Activity 3, Question 1, Appendix A1

information on an endangered animal protected by the zoo. The original question asked learners to find the same information but for a specific animal – the Spectacled Bear – and was therefore not an example of free-choice learning. The result of this process was 19 questions with classroom connectivity of which 13 promoted free-choice learning by increasing the degree of choice afforded by Worksheet B. Thus, with regard to classroom connectivity, I feel Worksheet B aligns with best practice recommendations.

4.2.9 Social interaction

Social interaction indicates the degree with which a worksheet promotes social learning. Falk and Dierking (2000) contend that informal contexts like museums and, in this study, zoos are good venues for social learning as groups of visitors interact with each other whilst they interact with exhibits. It therefore follows that a good informal context worksheet should include tasks that promote social interaction. Worksheet A was designed to be completed by groups of learners and this was achieved by providing one worksheet per group of three or four learners. However, my field observations as well as audio-recordings of learner conversations during the first zoo visit, showed that worksheets tended to be completed by individuals – learners took turns writing down the answers or worksheets were answered by one learner while the rest trailed behind. I therefore decided to include tasks in Worksheet B that required discussion among group members, for example:

This animal was domesticated in China in 8000 BC. Discuss with your group what you think the word 'domesticated' means and then write a definition for this word below.[48]

Discuss with your group one other way in which the zoo can be water-wise. Write your group's suggestion down.[49]

These questions encouraged learners to work within their groups, drawing on and sharing their prior knowledge. The transcript excerpt overleaf illustrates how one Worksheet B group worked cooperatively to complete a worksheet task.

[48] Activity 1, Question 1.2, Appendix A2
[49] Activity 5, Question 1.4, Appendix A2

Group C

Girl 2: *[reads worksheet] This animal was domesticated in China in 800 BC because… Discuss with your group what you think the word domesticated means and then write…*

Girl 3: *Domesticated is when you keep it at home.*

Girl 1: *When you keep it as a pet.*

Girl 2: *Keep it*

Girl 1: *As a pet, ja*

Girl 2: *Out of the wild.*

Girl 1: *Keep it as a pet.*

It was evident from the conversation that all three group members were actively involved in formulating a response for the task. Similar conversations were recorded for other Worksheet B questions that asked learners to 'discuss' their answers as a groups. Recordings of groups answering the original Worksheet A question (i.e. when and where was this animal domesticated) during the first zoo visit showed learners simply pointed out or read the answer from the zoo exhibit label for the scribe to write down. Accordingly, my inclusion of discussion type questions seemed to increase the efficacy with which Worksheet B promoted social interaction and thus curriculum-related conversations among learners. It should also be noted that the nature of these revised questions allowed for more than one correct answer, thus increasing the level of choice offered by the worksheet – an important characteristic of free-choice learning.

4.2.10 Site specificity

Site specificity describes the extent to which worksheet tasks are based on specific informal context exhibits. High site specificity means that a worksheet question is specific to a particular animal enclosure - learners have no choice as to where they can complete the task. Worksheet A was heavily dependent on learners finding specific animal enclosures – 34 out of 35 questions, and although recommendations in the literature are inconsistent in terms of an acceptable degree of site specificity (Mortensen & Smart, 2007), free-choice learning would favour a low specificity. However, worksheets need to facilitate orientation and focus learners on the task needed to be completed (Kisiel, 2003b) and therefore a worksheet with a low site specificity may result in learners spending inordinate amounts of time trying to

familiarise themselves with the novel environment. Mortensen and Smart (2007) found that learners preferred tasks of medium site specificity with some choice and some orientation – an indication that an intermediate approach to site specificity may be ideal. This was achieved in Worksheet B which had 24 questions with high site specificity and 10 questions with low site specificity.

4.3 Conclusion

In reading my analysis of Worksheet A it is clear where my shortcomings were: I depended heavily on written response questions; I tended to construct questions that used zoo exhibit labels and information boards and were site specific; I neglected to use specific orientation cues instead relying on the zoo map; and I limited the autonomy of my learners by providing very little choice and control. The result of these short comings was a zoo worksheet that strongly aligned with a survey-orientated worksheet (discussed in Section 2.4.3) and therefore one that was unlikely to promote free-choice learning. What followed was an attempt to revise Worksheet B, with an understanding of best practice recommendations, to produce a worksheet that aligned more with a concept-orientated worksheet (discussed in 2.4.3). However, from my analysis of Worksheet B, it is clear that this objective did not come to fruition for all the worksheet characteristics. In particular, task density, information source, level of choice, question format, response format and site specificity were characteristics that I did not fully improve on, despite knowing recommendations made in the literature and therefore Worksheet B can be viewed as an intermediary worksheet, part survey-orientated and part concept-orientated.

The findings of this part of the study also show that a worksheet can be designed to harness the uniqueness of out-of-school learning: both worksheets were designed for group use and thus promoted social interactions among learners – addressing the socio-cultural context of the CML; Worksheet B made use of orientation cues that combined a map and animal enclosure locations, such that learners were able to navigate more successfully than those using Worksheet A – acknowledging the physical context of the CML; questions linked to the classroom curriculum, encouraging the use of prior knowledge – acknowledging the personal context of the CML. Nevertheless, analysis highlighted the difficulties I experienced in constructing a best-practice worksheet even with a working understanding of recommendations made in the literature. Furthermore, it can be argued that before a

worksheet can effectively mediate free-choice learning, learners need to be equipped with the skills needed to complete the tasks i.e. biological drawings, observation, navigation etc.

The next chapter serves to illustrate how both worksheets were discussed, by learners, through the analysis of on-task learner talk.

Chapter Five

Qualitative Analysis and Discussion of Learner Conversations

5.1 Introduction

This chapter presents the results and the discussion of the second phase of my study which was the coding of on-task learner conversations. The aim of this phase was to determine the extent to which Worksheet B promoted curriculum-related conversation during the field trip to the zoo, as compared to Worksheet A, using two coding frameworks. The research question that I was trying to answer was:

To what extent does the revised worksheet promote curriculum-related conversation?

My analysis of learner talk was centred on specific worksheet questions (see Table 3.6) and my findings are set out in the following way:

- overview of each group and how they were selected,
- qualitative description of each of the selected questions followed by a discussion of the Type of Discourse (ToD) and the Nature of Discourse (NoD) coded in the resultant learner conversations,
- discussion of analysis, and
- concluding comments.

It should be noted that ToD and NoD are discussed, for each question, in the same section but delineated into different sub-sections as this eliminated repetition of results as well as allowed for a more holistic description of on-task talk. Also, the significance of my findings, reported for each question, is discussed later in the chapter in Section 5.4.

5.2 An overview of the process by which groups were selected

As described in Chapter Three, the study consisted of two grade eight field trips to the zoo (each on a separate day) where learners worked together in groups to answer a worksheet. The first group of learners, on the first field trip, completed Worksheet A[50] and the second group of learners, on the second field trip, completed Worksheet B[51]. There were 11 groups, four of which were audio-recorded, per field trip. The audio-recordings of each group were

[50] Appendix A1
[51] Appendix A2

played back and two selected from each field trip i.e. two from the four groups recorded during the first field trip and two from the four groups recorded during the second field trip. The groups were selected for the quality of the audio-recording as well as if the group remained an intact unit throughout the field trip. Table 5.1 provides a brief description of each group.

Table 5.1: Demographics of the four audio-recorded and transcribed groups

Group	Number of learners	Gender	Worksheet
A	4	Female	A
B	3	Male	A
C	3	Female	B
D	4	Male	B

Four audio-recordings were analysed, on-task learner talk identified and transcribed. Once transcriptions were completed and checked against the audio-recordings, I identified and grouped all on-task talk that centred on specific questions, as indicated by Table 3.6 in Chapter Three, into excerpts. These were further delineated into sequences, turns and utterances (DeWitt & Hohenstein, 2010), which represent units of analysis of decreasing size. The ToD framework was applied to utterances and the NoD was applied to sequences and reported as the total number of turns within the sequence. A detailed description of this process can be found in Section 3.6.8 of Chapter Three.

5.3 Analysis of conversations: Type of Discourse (ToD) and Nature of Discourse (NoD)

In examining the type of discourse between learners, talk was first coded as: lower order, medium order, higher order, affective, or procedural; and analysis examined the number of utterances in each of these categories. This framework is described in Chapter Three Section 3.4.4, however Table 5.2 overleaf summaries each code. This allowed me to identify the focus of learner talk and determine whether there was cognitive and affective engagement between learners.

Table 5.2: The ToD Coding Framework

Type of talk	Explanation
Lower order	Remembers facts or identifies simple facts from exhibit labels
Medium order	Processing information and using knowledge in new situations
Higher order	Using prior knowledge to solve problems in new contexts and make choices based on reasoned arguments
Affective	Expressions of positive or negative feelings, or feelings of intrigue
Procedural	Procedural talk relating to the task of answering a worksheet as a group

It should be noted that some utterances were left un-coded in each sequence as, even though they were part of on-task talk, they did not fit any of the ToD codes. For example: "hold on", "sorry" and calling each other by name. Un-coded utterances are reported for each question along with the ToD coding.

In examining the nature of discourse between learners, talk was coded as: cumulative, exploratory, disputational, parallel, simple dialogue and monologic. This framework is also detailed in Chapter Three Section 3.4.4 and summarised in Table 5.3 below.

Table 5.3: The NoD Coding Framework

Nature of talk	Explanation
Cumulative[a]	Learners build positively but critically on what the other has said, use talk to construct a 'common knowledge' by accumulation, characterised by repetitions, confirmations and elaborations.
Exploratory[a]	Learners engage critically but constructively with each other's ideas. Ideas may be challenged and counter challenged, but challenges are justified and alternative hypotheses are offered, characterised by visible reasoning.

Nature of talk	Explanation
Disputational[a]	Characterised by disagreement and individual decision making, few attempts to pool resources or to offer constructive criticisms or suggestions.
Parallel[a]	Learners take turns but they are not actually responding to each other's comments.
Simple dialogue	Learners take turns responding to each other's questions, the construction of a common knowledge is absent, usually in the context of procedural talk.
Monologic	Individual learner responds to his or her own musings.

[a](DeWitt & Hohenstein, 2010)

NoD analysis allowed me to characterise learner talk generally and determine the quality of the learners' engagement by capturing the extent to which learners worked cooperatively with each other and their interactions helped in building their understanding (DeWitt & Hohenstein, 2010). Therefore, a high frequency of 'cumulative' and 'exploratory' talk coded in the learner interactions would indicate a large degree of cooperative work with visible reasoning and therefore interactions that are of a higher quality and more likely to build understanding. A high frequency of simple dialogue and parallel talk would indicate a lesser degree of cooperative talk. Monologic talk and disputational talk represent no cooperation among groups, with disputational tending towards opposition within groups. Consequently, simple dialogue, parallel, monologic and disputational talk is less likely to build understanding in out-of-school learning.

5.3.1 Analysis of on-task learner talk: Question 1(a)

Question 1(a) [52] was selected for analysis as two sub-questions were revised to incorporate best-practice recommendations. The first of the revised questions, as well as the original, is as follows:

This animal was domesticated in China in 8000 BC. Discuss with your group what you think the word 'domesticated' means and then write a definition for this word below. **[revised]**

When and where did this animal originate? **[original]**

[52] Group A and B = 1.1 – 1.3 of Worksheet A; Group C and D = 1.1 – 1.4 of Worksheet B

The revised question shows the following changes:

- information source: text-dependent to prior knowledge; and
- cognitive level of questioning: medium order to higher order.

The second revised question, as well as the original, is as follows:

What type of feeding behaviour does this animal display? Circle the correct answer below. Herbivore Carnivore Omnivore **[revised]**

What type of feeding behaviour does this animal display? **[original]**

The revised question shows the following change:

- cognitive level of questioning: medium order to lower order.

Group A and B completed the original questions and Group C and D completed the revised questions, their ToD and NoD are illustrated in Table 5.4 and Table 5.5 respectively.

5.3.1.1 ToD: Question 1(a)

In general, Question 1 (a) of Worksheet A promoted, in almost equal measure, both lower and medium levels of cognitive engagement i.e. 19% lower order and 18% medium order in Group A, and 10% lower order and 18% medium order in Group B.

Table 5.4: ToD talk during the answering of Question 1 (a) (Percentage of on-task utterances to the nearest percentage)

Group	Lower order	Medium order	Higher order	Affective	Procedural	Un-coded	Total no. of utterances
A	19	18	0	6	38	18	78
B	10	18	0	23	18	30	60
C	18	15	0	10	42	16	89
D	7	39	0	0	37	17	41

The high frequency of lower order utterances is not surprising as the questions of 1(a) in Worksheet A were predominately text-dependent and, therefore, learners had to simply read the animal's information board to find facts to complete the task. The turn below illustrates

this point - Girl 1 (from Group A) read the question[53], identified the relevant information on the exhibit label and instructed the scribe of her group to copy directly from where she had indicated.

Group A

Girl 1: *When and where did it originate? Copy here… The, 8 000 BC.* ***[lower order]***

The turn also provided an interesting illustration of typical learner behaviour that I observed during the field trips. That is, their reliance on the information boards accompanying the animal enclosures. Figure 5.1 overleaf shows part of the information board found at the Vietnamese Pot-Bellied Pig's enclosure.

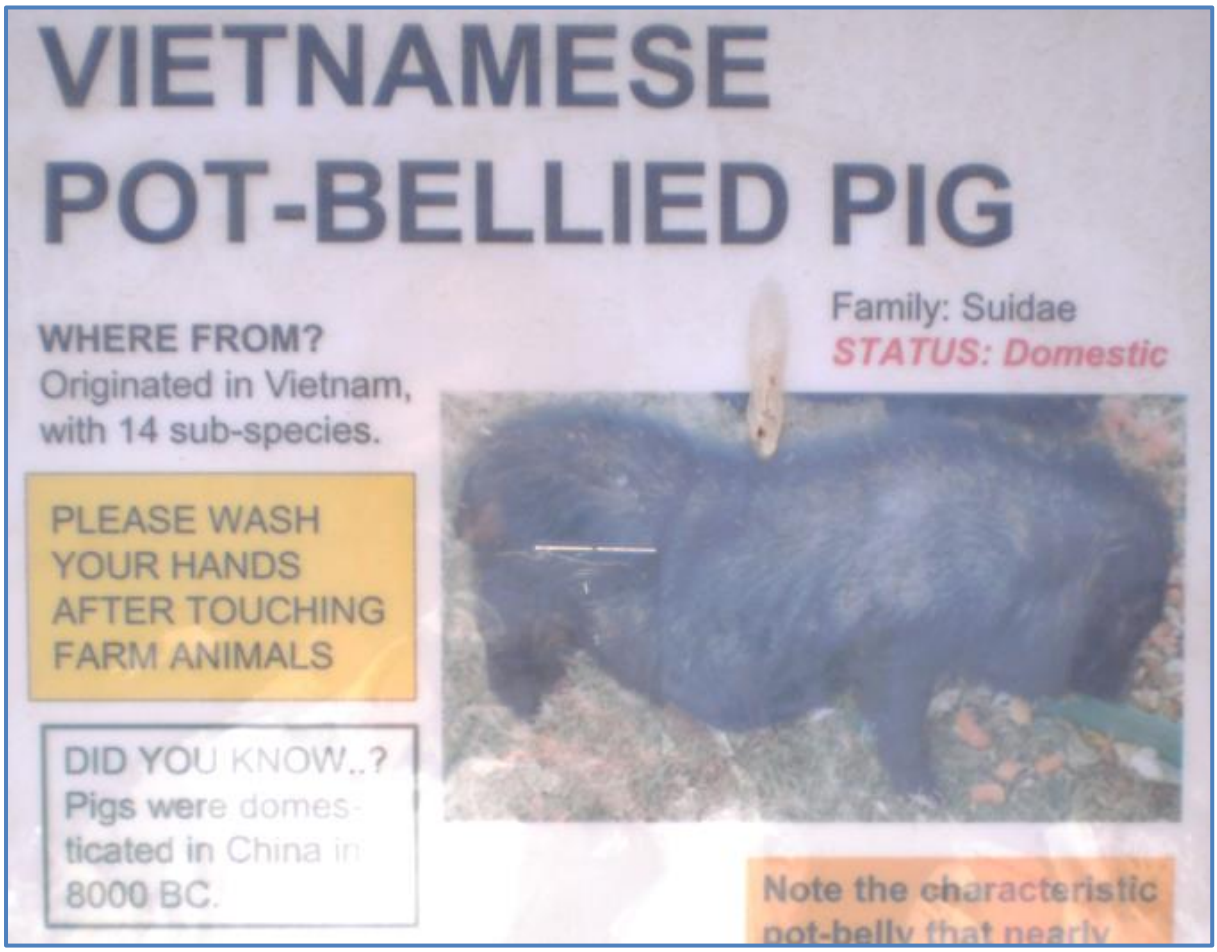


Figure 5.1: Partial zoo exhibit label for the Vietnamese Pot-Bellied Pig

The information board included information on the origins of the pig (above the yellow block) as well as information on when the animal was domesticated (white block) i.e. the pig

[53] Activity 1, Question 2, Worksheet A

originated in Vietnam but was domesticated in China in 8 000 BC. However, the question asked learners to record when and where the pig originated from – a design flaw, as the only relevant information was the pig's country of origin. Nevertheless, eight out of ten groups answered "8 000 BC in Vietnam" – this may be an indication that learners selected the information without any critical cognitive engagement. Although, it should be noted (see turn and sequence included overleaf) that one learner in both Group A and Group B did recognise the problem and show evidence of medium order thinking with regard to this question and yet answered with the same response as the six other groups – "8 000 BC in Vietnam".

Group B

Boy 1: *Oh. Hey, it's... [reading zoo exhibit label] Pigs were domesticated in China in 18 000.* ***[lower order]*** *So it says when... I can't really answer that.* ***[medium]*** *No, wait, 8 000 BC?* ***[medium]*** *Maybe I should just say 8 000 BC because that's..* ***[medium]*** *Okay, I'll just say that.... BC* ***[medium]***

and,

Group A

Girl 1: *Ja in 18 000, 8 000 BC.* ***[lower order]***

Girl 2: *No, this is when it was domesticated.* ***[medium]***

Girl 1: *Which was domesticated in China and …****[lower order]***

Girl 2: *It originate. Where did it originate from?*

Girl 1: *It originated in Vietnam.* ***[lower order]***

Girl 2: *It originated in Vietnam.* ***[lower order]***

Girl 1: *Ja, so that Vietnam part you write about the 8 000 BC because they don't mention anything about it.* ***[medium]***

This observation suggests that the learners were driven by the need to write down an answer, even if it was not completely correct. Medium order cognitive engagement was also evident (see the sequence overleaf) when learners discussed the feeding behaviour of the pig[54].

[54] Activity 1, Question 3, Worksheet A

Group A

Girl 2: *What's a type of feeding behaviour?*

Girl 1: *Diet. The feeding behaviour's the diet.* ***[medium]***

Girl 3: *Fruit and vegetables is the type of food.* ***[lower order]***

Girl 2: *Oh, type of feeding behaviour. Oh! Oh, I think they mean are they herbivores, carnivores, omnivores.* ***[medium]***

Girl 3: *Ja, omnivores.* ***[medium]*** *Ja*

It was my intention that learners would draw on their prior knowledge of feeding behaviour and apply it to the novel situation of the Vietnamese Pot-Bellied Pig. This is evident in the second turn of Girl 2 who realised what the question was asking i.e. is the pig an omnivore, carnivore or herbivore. This reasoning is not visible in the conversation of Group B, although there is evidence of medium order cognitive engagement with regard to the diet of the pig e.g.:

Group B

Boy 1: Type of feeding behaviour?

Boy 3: It eats whatever's on the floor! ***[medium order]***

Boy 1: Ja!

Boy 3: Or it eats whatever's in the pot. ***[medium order]***

Boy 2: It eats everything. ***[medium order]***

Furthermore, both Group A and B showed evidence of correctly identifying (from the information board) the type of food that makes up the pig's diet e.g. ***Group A*** *"Girl 2*: *[reads zoo exhibit label] Diet. A varied diet of fruit, vegetables* ***[lower order].****"* However, they failed to use this observation to help them correctly identifying the type of feeding behaviour of the pig - Group A identified the pig as an omnivore and Group B omitted that part of the question.

By comparison, Question 1(a) of Worksheet B elicited different results, in terms of cognitive engagement between Group C and D. Much of Group D's cognitive engagement was coded as medium order (39%) and only 7% was coded as lower order. Revision of Question 1(a)

was not that extensive to account for such a large difference in cognitive engagement between the first two groups and Group D, the difference can be ascribed to the fact that Group D did not answer the question at the pig's enclosure, using the information boards, but rather using prior knowledge. The sequence below illustrates this observation.

Group D

Boy 1: *A pig is an omnivore, do you know that?**[knowledge]** It eats anything. **[knowledge]***

Boy 2: *Pigs eat?*

Boy 3: *What do pigs eat?*

Boy 2: *Steak?**[medium]***

Boy 1: *No, like common foods they eat.*

Boy 2: *Like cabbage and stuff **[medium]***

Boy 4: *What's that?*

Boy 1: *Let's say vegetables and stuff. **[medium]** Vegetables. **[medium]***

Conversely, Group C answered the question at the animal's enclosure and made use of the information boards, resulting in more frequent lower order utterances than Group D and cognitive engagement that closely mirrors those of Group A and Group B, i.e. 18% lower order and 15% medium order. For example:

Group C

Girl 2: *[reads worksheet] What type of feeding behaviour does this animal display?*

Girl 1: *[reads exhibit label] Diet: A variety of fruit **[knowledge]***

Girl 3: *Fruit, vegetables **[knowledge]***

Girl 1: *Fruit, vegies, pellets **[knowledge]***

Thus, when responding to the question of the pig's food, conversations among the members of Group C were comparable to the exchanges between the members of Group A and B – an expected result as this question was the same in both worksheets. Conversation stemming from the revised question of 1(a), however, which asked learners to provide a definition for the term 'domesticated' was coded as medium order.

Group C

Girl 2: *[reads worksheet] This animal was domesticated in China in 1800 BC because… Discuss with your group what you think the word domesticated means and then write…*

Girl 3: *Domesticated is when you keep it at home.* ***[medium]***

Girl 1: *When you keep it as a pet.* ***[medium]***

Girl 2: *Keep it*

Girl 1: *As a pet, ja* ***[medium]***

Girl 2: *Out of the wild.* ***[medium]***

Girl 1: *Keep it as a pet.* ***[medium]***

The exchange between the girls shows a degree of medium order cognitive engagement, however the frequency of medium order on-task talk for Group C was less than that for Groups A and B. This result may be an indication that the revised question did not elicit any deeper cognitive engagement than the unrevised question of Worksheet A. Although it should be noted that the medium order cognitive engagement reported for Group A and Group B was unintentional as it resulted from the faulty question in Worksheet A and not as a result of the type of question. However, if these codes were excluded from the overall frequency Group A and Group B would then show 15% and 12% medium order utterances respectively. As such it can be argued that there is no difference in cognitive engagement between Worksheet A and Worksheet B. This finding could not be corroborated using Group D's transcript as there was no evidence to suggest they discussed this question.

Question 1(a) did not elicit higher order cognitive engagement in any of the groups, which is not a surprising result as there were no higher order thinking questions. Also, the question promoted some affective talk, e.g. ***Group B*** *Boy 1: Ooo, that's a big pig. Oink, oink.,* in Groups A (6%), B (23%) and C (10%) but not in Group D. This is mostly likely due to the fact that Group D, unlike the other three groups, did not answer the question whilst observing the pig.

Question 1(a) did promote a high frequency of procedural talk among all four groups; i.e. 38%, 18%, 42% and 37% respectively. These utterances illustrate cooperation among members of each group as they read out the questions, worked together to find the animal enclosures and information.

5.3.1.2 NoD: Question 1(a)

Data from the transcripts of Group C and Group D, illustrated in Table 5.5, showed a higher percentage of cumulative talk than simple dialogue talk – which was not the case for Group B which favoured simple dialogue talk. This observation is indicative of an improvement in the quality of the learners' conversations as a result of the revised questions. Although, it should be noted that Group A had very similar frequencies of cumulative and simple dialogue talk. However, it can be argued that the increase in cumulative talk for Group D was not a result of the revised question but rather the approach used to answer the question – that is by using prior knowledge and not an information board. Nevertheless, it is likely that the inclusion of a question that encouraged group discussion would encourage learners to build constructively on each other's responses and thereby improve the quality of their on-task conversations.

Table 5.5: NoD during the answering of Question 1(a) (Percentage of on-task turns to the nearest percentage)

Group	Cumulative	Exploratory	Disputational	Parallel	Simple dialogue	Monologic	Total no. of turns
A	46	0	8	0	40	6	**50**
B	15	0	0	44	41	0	**34**
C	45	0	0	31	24	0	**58**
D	70	0	0	0	26	4	**27**

It is also interesting to note that parallel talk tended to occur when learners in Group B and Group C showed affective engagement. For example, 46% and 33% of the total parallel talk reported for Group B and Group C were also coded as affective engagement using the ToD framework. However, parallel talk did not feature exclusively in affective engagement. The majority of Group C's parallel talk (67%) constituted procedural talk whereas the majority of Group B's parallel talk (54%) was coded when learners were completing the task but not working together as a group.

Disputational talk reported for Group A was not indicative of group members cognitively engaging with and debating worksheet questions but rather the amount of detail that was needed in their response based on the mark allocation. Monologic talk evident in Group A and D provided evidence of learners working on their own and not in a group. This finding is

supported by my field observations whereby the job of completing the worksheet was shared among group members who then tackled some questions individually. There was no evidence of any exploratory talk in any of the groups - a consequence of the low cognitive level of questioning

5.3.2 Analysis of on-task learner talk: Question 1(b)

Question 1(b)[55] was selected for analysis as the question was completely revised to incorporate best-practice recommendations. The revised question, as well as the original, is as follows:

Give two physical characteristics that you can observe that show these bears [Polar Bears] are not adapted to the African environment. **[revised]**

The Gibbons swing from branch to branch, sometimes over 10 metres, with the help of their specially adapted long arms. What name do we use to describe this kind of movement? **[original]**

The revised question shows the following changes:

- information source: text-dependent to object-dependent; and
- level of choice: 'no choice' to 'some choice'
- cognitive level of questioning: medium order to higher order
- classroom connection: no connection to connected to classroom curriculum

Group A and B completed the original questions and Group C and D completed the revised questions, their ToD and NoD are illustrated in Table 5.6 and Table 5.7 respectively.

5.3.2.1 ToD: Question 1(b)

Both Group A and Group B's on-task talk for Question 1(b) showed a comparable number (5% and 6% respectively) of lower order utterances and no utterances coded as medium order or higher order. This was an expected result as the question was text-dependent with very little cognitive demand.

[55] Group A and B = 6 of Worksheet A; Group C and D = 7 of Worksheet B

Table 5.6: ToD during the answering of Question 1(b) (Percentage of on-task utterances to the nearest percentage)

Group	Lower order	Medium order	Higher order	Affective	Procedural	Un-coded	Total no. of utterances
A	5	0	0	5	64	27	22
B	6	0	0	22	28	44	50
C	4	8	0	36	26	26	50
D	0	58	0	4	15	23	26

Learners approached this task in much the same way as they did for the text-dependent tasks of Question 1(a) i.e. by identifying the correct information and copying it down. For example:

Group B

Boy 2: *What's this? Raising the… [reading worksheet question] What do we use to describe this type of move... movement? Wait. [reading zoo exhibit label] 106. species of Crested Gibbons... what what.*

Boy 1: *They swing. Called?*

Boy 2: *Brachiation* ***[knowledge]***

Boy 1: *Brachiation?*

Boy 2: *[reading zoo exhibit label] And they swing around by their arms called brachiation.* ***[knowledge]***

Question 1(b) for Worksheet B, by comparison, elicited no lower order exchanges between learners of Group D. Although it did elicit 4% lower order utterances in Group C. However, the question did promote medium order cognitive engagement, with 8% and 58% coded for Group C and D respectively. This result can be ascribed to the nature of the revised question, i.e. observation based, open-ended and medium level of questioning, which encouraged learners to engage with each other and with the question. The two sequences overleaf illustrate this finding:

Group C

Girl 3: *[reads worksheet] Give two physical characteristics that you can observe that show these bears are not adapted to the African environment. They're white.* ***[medium]*** *[chuckles] No, they, um…*

Girl 2: *Mmm*

Girl 3: *Their original habitat is in the snow, they're not built for warm weather.* ***[medium]***

Girl 2: *But they're very furry.* ***[medium]***

and,

Group D

Boy 2: *The one is adapted to the… Wait, they say give two physical characteristics that show you ?*

Boy 4: *These are nice.*

Boy 2: *African environment.*

Boy 1: *Because it's really warm here.* ***[medium]***

Boy 3: *Because look at their coat.* ***[medium]***

Boy 2: *Mmm*

Boy 3: *They have thick coats.* ***[medium]***

Boy 1: *Ja, they have thick coats.* ***[medium]***

Boy 4: *And they have big faces for hunting.* ***[medium]***

Boy 2: *Hmm?*

Boy 4: *And they have a bodily shape for hunting, or something like that.* ***[medium]***

Boy 2: *They are built for hunting. They're built for hunting. Okay, they're built for hunting!*

Boy 1: *And they're white.* ***[medium]*** *Their coat is white* ***[medium]****, that's for being… you know like…*

Ja, I mean… And their fur, I mean their coat is white ***[medium]****, just trust me.*

Boy 2: *Their coat is white so they reflect it.* ***[medium]***

The two sequences show that the level of cognitive engagement increased from Worksheet A to Worksheet B, for Group C and D, due to the revision of the original question to align with best practice recommendations made in the literature.

Affective engagement was recorded, in varying amounts for all four groups and, interestingly, both the Gibbons and Polar Bears seemed to promote similar amounts of affective comments in Group A and D, and Group B and C respectively – an indication that affective engagement may not be dependent on the animal subject. Also, procedural talk was evident in all four groups – an indication of cooperation in completing the question.

5.3.2.2 NoD: Question 1(b)

Simple dialogue talk dominated both Group A (100%) and Group B's (60%) on-task conversations for Question 1(b), as illustrated in Table 5.7. This is not a surprising observation as the text-dependent, close-ended nature of the original question only encouraged 'read and copy' approaches by the group members.

Table 5.7: NoD during the answering of Question 1(b) (Percentage of on-task turns to the nearest percentage)

Group	Cumulative	Exploratory	Disputational	Parallel	Simple dialogue	Monologic	Total no. of turns
A	0	0	0	0	100	0	**17**
B	0	0	0	37	60	3	**30**
C	29	0	0	64	7	0	**28**
D	59	0	0	41	0	0	**17**

An example of a typical simple dialogue interaction is illustrated in the following sequence:

Group A

Girl 1: *Okay, then that's it there. Okay, description..*

Girls 2: *[reads zoo exhibit label] Did you know… Yes Okay. Spell it out. B-r-a- b-r Bra, write 'bra' c-h-i-a-tion t-i-o-n*

The revised question, by comparison, encouraged observation and collaboration among Group C and Group D - evidence to support this view can be found in the increase of cumulative talk in Group C (29%) and Group D (59%) compared with Group A and B (0%).

Affective engagement, reported in Section 5.3.2.1, took the form of parallel talk in three of the four groups – in particular 100% of Group B, 83% of Group C and 14% of Group D's reported parallel talk were affective utterances. However, the majority of Group D's parallel talk was coded when the group was not working together to answer the question but rather were calling out random facts to their scribe. Also, there was no evidence of exploratory or disputational talk in any of the groups. Group B had a small instance of monologic talk (3%) which was not characterised as a learner working individually, but rather a learner giving instructions as to move onto the next enclosure i.e. procedural talk.

5.3.3 Analysis of on-task learner talk: Question 2(a)

Question 2(a)[56] was selected for analysis as the focus of the question was revised to incorporate best-practice recommendations. The original question directed learners to the Spectacled Bear enclosure to answer questions on the status of the bear on the endangered species list. The revised question incorporated the recommendation that a worksheet should accommodate the autonomy of the learner, i.e. provide some choice and control in the field trip experience, and therefore asked learners to answer the same questions as Worksheet A but for an animal of their own choosing. I also included an additional question shown below:

In your group come up with a catchy slogan that the zoo could use on their information boards to educate the public about the plight of this animal.

Group A and B completed the original questions and Group C and D completed the revised questions, their ToD and NoD are illustrated in Table 5.8 and Table 5.9 respectively.

5.3.3.1 ToD: Question 2(a)

Revised Question 2(a) promoted long exchanges between the individuals of Group C and Group D, this is evident in the large number of utterances (81 and 153 respectively) reported in Table 5.8. Group B did not have a long exchange (37 on-task utterances) when they answered the original question and there was no evidence to suggest Group A found the bear

[56] Group A and B = 2.1 – 2.3 Worksheet A; Group C and D = 2.1 – 2.4 Worksheet B

and answered the questions.[57] Therefore, it would seem that the revised question increased curriculum-related conversation among Group C and Group D.

Table 5.8: ToD during the answering of Question 2(a) (Percentage of on-task utterances to the nearest percentage)

Group	Lower order	Medium order	Higher order	Affective	Procedural	Un-coded	Total no. of utterances
A	-	-	-	-	-		**0**
B	5	3	0	27	27	38	**37**
C	19	14	4	11	32	14	**81**
D	16	3	13	7	34	26	**153**

Much of the utterances (32% and 34%) coded for Group C and D were procedural talk, suggesting that the increased conversations were as a result of learners discussing how and where to answer Question 2(a). For example:

Group D

Boy 2: *We need three.* ***[procedural]***

Boy 3: *Need three what?*

Boy 2: *For the why are these animals under threat.* ***[procedural]***

However, Group B showed similar results with 27% of their utterances coded as procedural talk. The amount of procedural talk observed in Groups C and D was thus comparable with Group B and therefore revised Question 2(a) elicited a similar degree of procedural engagement as the original question. The increase in curriculum-related conversation can therefore be attributed to the increased lower, medium and higher order cognitive engagement by the members of Group C and D.

Higher order cognitive engagement was observed when Group C (4%) and D (13%) answered the additional question of 2(a) i.e. they created a catchy slogan to express the plight of the endangered animal. The sequence below illustrates this, specifically showing the

[57] Group A completed the question correctly, presumably due to copying (mentioned in Chapter Four) answers from another group.

process of understanding what a slogan actually is and then applying it to their animal of choice. A similar thought process was also coded for Group C's conversation.

Group D

Boy 2: *In your group come up with a catchy slogan that the zoo could use on the information board to educate the public about the plight of the cheetahs.*

Boy 4: *Ooo, cheetahs!*

Boy 3: *[laughs] Ja, that's good, write that.*

Boy 2: *Ooo, cheetahs?*

Boy 4: *Ja*

Boy 2: *Other slogan… A slogan is like, like this, like the* ***[higher]***

Boy 1: *I'm loving it!*

Boy 2: *Ja, ja*

Boy 3: *Finger licking good.*

Boy 4: *Tasty cheetahs*

Boy 2: *Something to do with*

Boy 1: *Cheetahs*

Medium order cognitive engagement, evident in all three groups, was not an intentional design of either the original or revised Question 2(a), however the sequences included below show that text-dependent questions can produce unexpected cognitive engagement.

Group B

Boy 2: *But this is the Bear Brown?*

Boy 1: *It looks more like a Black Bear, to be quite honest.* ***[medium]***

The sequence above shows that, even though Question 2(a) was text-dependent, Group B engaged with the topic of the question beyond the lower level of thinking needed to answer the question. Simiarily, Group C engaged with the topic of Question 2(a) beyond the intention of the question:

Group C

Girl 2: *Are you sure white lions are endangered?*

Girl 1: *Mmm, rare.*

Girl 2: *But it didn't say they're endangered.*

Girl 1: *That means they're endangered.*

Girl 3: *Rare. Just means they're not commonly found.*

The girls discussed the status of the White Lion on the endangered species list. Girl one chose to answer Question 2(a) on the lion, as it was her favourite animal. In answering the question, Girl two queried whether the lion was in fact endangered and what followed was a discussion between the three girls as to what the terms 'rare' and 'endangered' actually meant. This was an unexpected finding as I imagined all groups answering revised Question 2(a) would do as Group D did, and simply read the information boards, check to see if the animal was endangered and move onto another enclosure if it was not endangered. For example:

Group D

Boy 1: *[reads zoo exhibit label] Red River Hog. Wait, do we need something about this? Is this thing endangered?*

Boy 3: *No*

Boy 2: *No. So it's common.*

Revised Question 2(a) produced more frequent lower level on-task talk than the original question. This observation can be attributed to the increased level of choice offered by Question 2(a) of Worksheet B. By asking learners to write on any endangered animal housed at the zoo, they first needed to identify an endangered animal (illustrated in the sequence above). This meant groups had to read and identify relevant information from several more information boards before finding an endangered animal, resulting in high frequencies of lower level utterances when compared to Group B. It is thus evident that the revised question, included to address level of choice, question format and social interaction, did increase curriculum-related conversation and brought to fruition best-practice recommendations.

Affective utterances stemming from Question 2(a) made up 27% and 11% of the on-task talk of Group B and C respectively. Furthermore, only 7% of Group D's on-task talk was coded

as affective even though there was evidence to show the group answered the question at the cheetah enclosure, i.e. whilst observing the animal – not a common occurrence for this particular group. These results are an indication that the increased level of choice, introduced in the revised question, did not increase learners' affective experiences.

5.3.3.2 NoD: Question 2(a)

There is a distinct difference between the NoD of Group B and the NoD of Groups C and D, as illustrated in Table 5.9. One hundred percent of Group C's exchanges were coded as simple dialogue in nature which, when considered together with the type of talk (lower order 5%, medium order 3%), is an indication that the question did not promote cognitive engagement beyond the reading and writing of facts.

An example of simple dialogue interactions among learners, whilst answering Question 2(a), is included below.

Group B

Boy 3: *[reading worksheet question] Find the Speckled Bear so named for the markings around its eyes. What status does the bear have on the endangered species list?*

Boy 1: *It's…*

Boy 2: *It's endangered.*

Boy 1: *Endangered*

Table 5.9: NoD during the answering of Question 2(a) (Percentage of on-task turns to the nearest percentage)

Group	Cumulative	Exploratory	Disputational	Parallel	Simple dialogue	Monologic	Total no. of turns
A	-	-	-	-	-	-	**0**
B	0	0	0	0	100	0	**40**
C	0	50	0	29	21	0	**58**
D	48	34	0	0	18	1	**110**

By contrast, only 21% of Group C's exchanges were coded as simple dialogue talk – the majority (50%) were coded as exploratory talk. Similarly, Group D showed more cumulative (48%) and exploratory (34%) talk than simple dialogue (18%). An example of cumulative discourse is included below:

Group D

Boy 1: *Why are these animals under threat?*

Boy 3: *Because of their skins.*

Boy 1: *Really?*

Boy 3: *Yes, they hunt them because of their skins don't you know that?*

It can therefore be argued that revised Question 2(a) improved the NoD of Group C and Group D, in that conversations moved away from simple question response exchanges (observed in Group B) to deeper cognitive engagement. The improvement in NoD is supported by the increase in higher order cognitive engagement reported in Table 5.8.

Parallel talk was only recorded in Group C (29%). The sequence shown below illustrates this type of talk was indicative of typical exchanges between learners where one was trying to complete the task and the other group members were not.

Group C

Girl 1: *They say there's over, there's under 17 400*

Girl 3: *Wait*

Girl 1: *black rhino left.*

Girl 2: *This says I have to have*

Girl 1: *Tatum, we're not taking that long on a question, come. You're taking long.*

Group D had a small instance of monologic talk (1%) which was characterised, like Question 1(b), as a learner giving instructions as to which animal to report on i.e. procedural talk.

5.3.4 Analysis of on-task learner talk: Question 3(a)

Question 3(a)[58] was selected as the question was identical in each worksheet i.e. the original question had not been revised to align with best practice recommendations. This approach was taken to provide a basis for comparison between the first and second field trip. In this way, the unrevised question acted as a control so that any differences found in learner conversations (centred on revised questions) could be attributed to the revised worksheet. The question is included below:

Hippos are sometimes called "Floating Hotels", because of the symbiotic relationships they have. Describe three of these relationships and categorise them as either being mutualism, commensalism or parasitism.

Group A, B, C and D completed this question; their ToD and NoD are illustrated in Table 5.10 and Table 5.11 respectively.

5.3.4.1 ToD: Question 3(a)

Question 3(a) elicited both lower and medium order cognitive engagement in Group A, B and C, as illustrated in Table 5.10. This was an expected result as the question was of a medium order level of questioning - learners had to apply their understanding of 'symbiosis' to information they identified from one of two boards next to the hippo enclosure.

Table 5.10: ToD talk during the answering of Question 3(a) (Percentage of on-task utterances to the nearest percentage)

Group	Lower order	Medium order	Higher order	Affective	Procedural	Un-coded	Total no. of utterances
A	4	17	0	15	20	44	**109**
B	15	11	0	8	37	29	**65**
C	22	4	0	37	26	11	**27**
D	0	20	0	0	41	39	**45**

Consequently, lower order utterances tended to be evidence of learners reading relevant information from the exhibit label to the scribe of their group and medium order utterances

[58] Group A, B, C and D = 3.1 of Worksheet A and B

were evidence of learners applying their understanding of symbiosis to the information identified from the exhibit label. For example:

Group B

Boy 1: *Quickly go back and tell me one more from that sign. Birds and young crocodiles I've got, so get one more, please.*

Boy 2: *[reads zoo exhibit label] Used as a fishing perch for… **[lower]** Ox-peckers and other birds eat the dead skin of hippos. **[lower]***

Boy 1: *What is that? Parasitism? **[medium]***

And,

Group A

Girl 1: *What is it asking?*

Girl 2: *Attaches itself to... attaches itself to the hippo to feed on algae **[lower]***

Girl 1: *It's mutualism, isn't it?**[medium]***

Similar exchanges were not found in the transcript of Group D, i.e. 0% of their utterances were coded as lower order. This observation can be attributed to the fact that Group D did not answer Question 3(a) at the hippo enclosure and they, therefore, did not have access to the relevant information. This observation also explains why Group D were the only group to show 0% affective engagement with the question. The sequence below illustrates how the boys answered the question without the exhibit label.

Group D

Boy 2: *We have to describe three, so you do all 3 of them. Parasitism…*

Boy 1: *Let me see…Um, commensalism… commen …Uh commensalism because hippos eat reeds. **[medium]***

Boy 3: *Do you think, do you think hippos they eat… Do you think flies bite him also? **[medium]**[chuckles]*

Boy 1: *Do you think mosquitoes bite hippos? **[medium]***

It should be noted that the recall of definitions for commensalism, mutualism and parasitism could be coded as lower order cognitive engagement. However, in acknowledging the little experience the grade eight learners had with symbiosis, I coded these utterances as medium order cognitive engagement.

The question did not elicit any higher order cognitive engagement in any of the groups. Procedural talk was evident in all four groups - again this is an indication that the worksheet was answered through group work.

5.3.4.2 NoD: Question 3(a)

The NoD for Question 3(a) illustrates the importance of the individual in out-of-school learning, in that each group answered the same question using completely different approaches. Group A showed a higher frequency of cumulative talk (44%) than simple dialogue (32%) or exploratory talk (19%). This observation can be ascribed to the fact that two members of Group A helped a girl, from another group, to answer the question – the resulting interaction saw all three girls building on each other's understanding of symbiosis (see the sequence below).

Girl: *Just Activity Two because those are because those are the symbiotic relationship they have, [reads worksheet] describe 3 of the relationships and categorise…*

Girl 2: *I think the board has the relationships. Did you check the board? There's like a board See there's...*

Girl: *It doesn't say anything about relationships.*

Girl 2: *Then I've no idea.*

Girl 1: *Oh!!! No*

Girl 2: *It's the food chains probably.*

Girl 1: *No, no, no, no. Symbiosis I know this!*

Girl 2: *It's like you know that*

Girl 1: *Ja, I know that little bit*

Girl 2: *Let's see the birds. I know one is, one is, one is affected and one is…*

Girl 1: *Don't you remember symbiosis?*

Girl 2: *What am I just saying to her?!*

Girl 1: *Remember the parasitism? Remember parasitism?*

Girl 2: *Yes I do! What am I just saying to her?!*

At the other extreme is Group D, their interactions were coded as 100% exploratory due to their approach of not answering the question at the relevant animal enclosure. Consequently, without access to the information board, the boys of Group D built on each other's understanding of symbiosis in a critical and constructive way.

Table 5.11: NoD during the answering of Question 3(a) (Percentage of on-task turns to the nearest percentage)

Group	Cumulative	Exploratory	Disputational	Parallel	Simple dialogue	Monologic	Total no. of turns
A	44	19	0	0	32	4	**68**
B	21	0	0	62	13	4	**52**
C	0	0	0	88	13	0	**16**
D	0	100	0	0	0	0	**24**

Group C showed 0% cumulative and exploratory talk, the majority (88%) of their interactions were parallel in nature. The girls of the group seemed to lose interest in this question, leaving it up to the scribe to complete it whilst they haggled her to hurry up. Finally, Group B, which seems to portray a more typical approach i.e. a scribe aided by group members showed a higher frequency of cumulative (21%) talk than simple dialogue (13%). And although the majority of their interactions were parallel in nature, these were affective utterances in general.

5.3.5 Analysis of on-task learner talk: Question 6(a)

Question 6(a)[59] was selected for the same reason as Question 3(a) - the question was identical in each worksheet. Again, this approach provided a point of comparison between the first and second field trip group conversations in particular, the nature of learner conversation when tasked with completing an open-ended higher order question. The question is included overleaf:

[59] Group A, B, C and D = 6.1 of Worksheet A and B

Write a paragraph in which you describe what conservation is, why it is important to educate people about conservation and how the zoo is working to protect species from extinction. You must include in your answer whether you think the zoo is doing a good job at promoting conservation and whether you think zoos are an important part of society.

Group A, B, C and D completed this question; their ToD and NoD are illustrated in Table 5.12 and 5.13 respectively.

5.3.5.1 ToD: Question 6(a)

Given the nature of the question, i.e. open-ended higher order thinking levels, I expected to find evidence of long exchanges between group members consisting of medium and higher order cognitive engagement. Table 5.12, however, illustrates the lack of cognitive engagement all four groups had when answering Question 6(a) as the total number of on-task utterances coded ranged from just three utterances (Group B) to 45 utterances (Group C).

Table 5.12: ToD during the answering of Question 6(a) (Percentage of on-task utterances to the nearest percentage)

Group	Lower order	Medium order	Higher order	Affective	Procedural	Un-coded	Total no. of utterances
A	0	17	0	0	61	**22**	**23**
B	0	0	0	0	100	**0**	**3**
C	0	0	44	0	27	**29**	**45**
D	0	0	0	0	70	**30**	**10**

For example the exchange between the girls of Group A, included below, showed that even though the question was discussed the depth of their discussion did not correlate with the objective of the question.

Group A

Girl 1: *What is the last question?* ***[procedural]***

Girl 2: *The last question is [reads worksheet] Write a paragraph to which you describe…* ***[procedural]***

Girl 1: *Read it out loud, please. Write a paragraph what?* ***[procedural]***

Girl 2: *It says you must... Wait, you must write a paragraph and you have to, and with your answers you must say whether the zoo is doing good at promoting conservation or whether you think the zoo is…* ***[procedural]***

Girl 1: *Oh, that we can do ourselves.* ***[procedural]***

Girl 2: *No, answer... No, the thing is do you think the zoo is an important part to society? Yes.* ***[medium order]***

Girl 1: *Yes*

Figure 5.2 below shows the written response of Group A to the question. It is clear from their answer that they approached this task with a brief discussion of the question (only two members of the group participated) and then left the details of their response to the scribe of the group. This behaviour was also observed in Group B and D and did not meet my objective for the question.

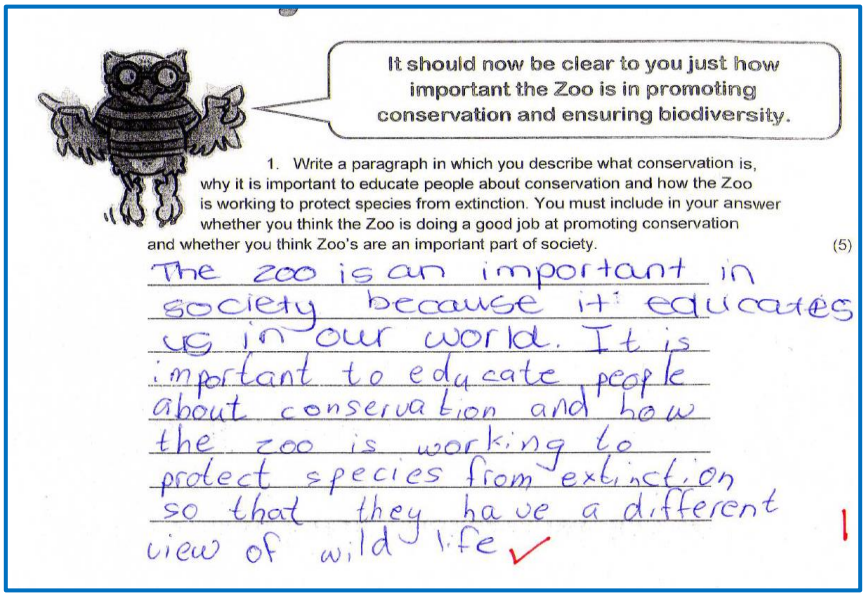


Figure 5.2: Group A learners' response to Question 6(a)

Furthermore, the majority of the utterances for Group A, B and D (61%, 100% and 70% respectively) were coded as procedural talk. This observation shows that the groups were focused on whether or not this question was the last and where they would go next, rather than on the content of the question. An example of a procedural exchange is included overleaf:

Group B

Boy 3: *[skim reads worksheet] Write a paragraph in which you…* ***[procedural]***

Boy 1: *Alright, where are we off to now?* ***[procedural]***

Boy 3: *Back to the entrance.*

Group A and Group C did however show some cognitive engagement with the question – 17% of on-task talk in Group A was coded as medium order, and 44% of on task talk in Group C was coded as higher order respectively. For example,

Group C

Girl 3: *[writes] Fresh water is running out in the world.* ***[higher]*** *Okay, how is the zoo working to protect species from extinction?*

Girl 2: *They are breeding.* ***[higher]***

Girl 1: *Ja*

Girl 2: *Are breeding extinct animals.* ***[higher]***

Girl 1: *They can't be extinct.* ***[higher]***

Girl 2: *They're breeding animals that are on the verge of extinction.* ***[higher]***

Nevertheless, even though Question 6(a) had an open-response format and a higher level of questioning, learners did not engage with the topic of the question nor collaborate with each other. It would seem that the time needed to answer this task was a deterrent and ultimately put the learners off completing it. Further evidence to support this view is the distinct absence of affective utterances in all four groups.

5.3.5.2 NoD: Question 6(a)

An analysis of the NoD (see Table 5.13) that resulted from Question 6(a) cemented my observation that learners did not engage with the task to the degree that I expected them to. Neither Group A, B or D showed any cumulative or exploratory talk. Group A and B showed very short exchanges, 15 and 3 turns respectively, of which 100% were simple dialogue. Group D also had a short exchange (10 turns) of which 100% was parallel. Thus the NoD of Group A and B would indicate very little cooperation among group members and no cooperation in Group D. Consequently, the nature of Question 6(a) is such that it is not likely to promote quality out-of-school learning.

Table 5.13: NoD during the answering of Question 6(a) (Percentage of on-task turns to the nearest percentage)

Group	Cumulative	Exploratory	Disputational	Parallel	Simple dialogue	Monologic	Total no. of turns
A	0	0	0	0	100	0	**15**
B	0	0	0	0	100	0	**3**
C	88	0	0	9	0	3	**32**
D	0	0	0	100	0	0	**10**

Only Group C showed a measure of cognitive engagement, with 88% of their 32 turns coded as cumulative talk. This unusual (compared to the other three groups) result can be ascribed to the persistence of the scribe who continued to prompt the other group members to help answer the question.

5.4 Discussion of analysed conversations

According to socio-cultural theory (Vygotsky, 1978), knowledge is constructed in the interactions among learners. Learner talk is an important component of these interactions and therefore has the potential to contribute to both cognitive and affective learning (DeWitt & Hohenstein, 2010). It therefore follows that the type of discourse, observed in the interactions of learners, can be used to provide insight into their level of cognitive and affective engagement with a particular task. Furthermore, using the CML (Falk & Dierking, 2000) as a conceptual framework, the complexities of group interactions can be unravelled to show the relationships between an individual's personal, socio-cultural and physical contexts (Falk & Storksdieck, 2005) which are crucial in out-of-school learning. Consequently, the transcripts from four learner groups were used to identify what the focus of learner talk was as they answered specific questions on a zoo worksheet and in so doing, provide a descriptive comparison of learning that took place as a result of the original and revised worksheet. The ToD framework addressed this objective by examining the kinds of statements that learners made and whether they were indicative of cognitive and affective engagement (DeWitt & Hohenstein, 2010), the NoD framework examined the quality of learner statements through the frequency of cumulative and exploratory talk.

5.4.1 Affective outcomes of zoo worksheets

In this category, I tried to capture all expressions of intrigue, surprise, displeasure and delight by identifying indicators such as "look at the rhino, its huge", "I like hippos", "this is boring" and "cute". Although S. Allen (2002) cautions that these indicators are, at best, a crude measure of the affective connection learners may have during the zoo experience, she goes on to suggest that it is worth trying to capture affective learning-talk "as best as we can" as the occurrence of these indicators in learner conversations does suggest "they carry some significant aspect of [learners'] shared experiences" (p. 277). Therefore, any positive and negative expressions learners made whilst completing a worksheet task were coded and recorded as affective.

Evidence from the transcripts (see Table 5.14) indicates that the selected questions from both the original and revised worksheet promoted a degree of affective engagement: Worksheet A promoted on average 7% utterances per question in Group A and 16% utterances per question in Group B; Worksheet B promoted on average 19% utterances per question in Group C and 2% utterances per question in Group D. The proportion of affective utterances does, at first, seem quite small however as these utterances resulted from analysis of only a small portion of the worksheets' questions tentative speculation suggests that affective engagement occurred occasionally during both zoo visits.

However, the degree to which the affective engagement was reflected in learner talk depended on the individuals of the group and their interests, not on the design of the question or specific animal. For example, data from the transcripts of Group B and C indicated that they expressed affective engagement, irrespective of the type of question, more frequently than Groups A and D. The girls in Group A were frequently heard telling each other to "walk on" and "keep moving", completely absorbed with the task of completing the worksheet and becoming irritated with each other. Their behaviour is consistent with observations made by Nyamupangedengu (2009) who noted that the need to finish a museum worksheet caused learners to rush from one exhibit to the next, hampering enjoyment of the experience. Group D showed very little affective engagement, and although there was only one recorded instance of displeasure, the small frequency of affective engagement suggests that they were not interested in the topics of the worksheet or the animals. This observation is consistent with the study carried out by DeWitt and Hohenstein (2010) who reported a high frequency

of affective statements when learners found museum exhibit content more interesting and lower frequencies when content was of little interest.

Table 5.14: A comparison of the percentage of affective utterances in on-task talk coded in Groups A, B, C and D for each selected question

Group	1(a)	1(b)	2(a)	3(a)	6(a)	Average
A	6	9	-	15	0	**7**
B	23	22	27	8	0	**16**
C	10	36	11	37	0	**19**
D	0	3	7	0	0	**2**

Table 5.14 shows that, for Group C and D, the revised questions did not elicit any more affective utterances than the original questions answered by Group A and B. For example, the revised Question 1(b) directed learners to observe the Polar Bears – the bears engendered many affective utterances in Group C (36%) but very little in Group D (3%). This observation was very similar to Group A and B who were directed to the Gibbons – i.e. Group A had a high percentage of affective utterances (22%) but Group B had very few (5%). Similarly, Question 2(a) was revised to accommodate the learners' autonomy. Numerous studies have shown learners value a sense of freedom and choice in their learning (e.g. Falk & Dierking, 2000; Griffin & Symington, 1997), and I therefore expected to find an increase in Group C and D's affective utterances. This proved not to be the case: Group D continued to respond with little enthusiasm (7% affective utterances) and Group C's transcript revealed fewer affective codes (11%) than Group B (28%) who had no choice in their task.

Also, Question 6(a) elicited 0% affective utterances in all four groups. This indicates that, unlike the learners in the study by Mortensen and Smart (2007), the learners of this study did not enjoy the object-dependent higher level cognitive task that was Question 6(a) and as such the cautioning of Green and Rollnick (2007) should be followed whereby higher order tasks are reduced, increasing the time learners have for free-exploration.

The frequency of affective utterances shows that the personal and socio-cultural components of the Falk and Dierking (2000) model are addressed by both worksheets - although the extent of these utterances suggests that these components could be expanded on to allow

more choice and control; and acknowledge the interests, motivations and expectations of all learners. Nevertheless, the revised questions did not promote affective engagement any more than the original questions did and the affective outcomes depended on the dynamics of the group and the individuals therein.

5.4.2 Cognitive outcomes of zoo worksheets

Under the broad category of cognitive outcomes, I tried to identify all instances of learners cognitively engaging with the tasks of the worksheet and related animal enclosures. I coded indicators of cognitive engagement as lower order, medium order and higher order levels of thinking; and in this way was able to determine the level of engagement with specific worksheet tasks. Transcripts from all four groups suggested that there was a degree of cognitive engagement with the zoo experience. This is an important finding as cognitive engagement, through learner interactions, has the potential to contribute to learning in informal contexts (DeWitt & Hohenstein, 2010). Certainly, there are limitations to this study (see Chapter Six), however from the small sample there is an indication that cognitive engagement deepened as a result of the revised questions of Worksheet B.

The questions that were text-dependent requiring written responses and lower levels of thinking, elicited lower order utterances. These questions typified Worksheet A and as a result, on-task talk seldom varied from the simple interaction of reading information from an exhibit label to the scribe who wrote it down. Medium order utterances resulted unintentionally as a result of the questions, i.e. as a result of a poorly designed question or in response to some aspect of an enclosure information board that I had not considered relevant. By comparison, questions revised to acknowledge best-practice recommendations (see Chapter Two and Chapter Four), engendered medium and higher order levels of engagement in Group C and Group D. However, Question 6(a) did not promote any medium or higher order levels of engagement, in any group, that you might expect from an open-ended question. This finding, as well as the varied response to Question 3(a) highlights the complexities of learning in informal contexts.

Another development from the analysis of transcripts was the large degree of procedural talk in all four groups. In general, there does not appear to be any correlation between the frequency of procedural talk and a particular worksheet. However, it should still be viewed as an important part of out-of-school learning as many studies have shown that visitors to informal contexts show a large amount of non-exhibit related learning (Falk et al., 1986). In

this study, procedural talk varied from where to find the next animal to who would answer the next question. These types of interactions point to the inherently social nature of informal contexts (S. Allen, 2002) and a degree of cooperation that facilitates learning (DeWitt & Hohenstein, 2010).

5.4.3 Nature of learner talk

In general, evidence from the data provided by the transcripts indicates that most of learners' talk in the context of Worksheet A tended to be simple dialogue (see Table 5.15) which is consistent with group cooperation. However, the nature of simple dialogue talk i.e. simple back and forth statements between learners whereby questions are asked, answers given and written down, suggests a superficial level of engagement that is less likely to foster learning than cumulative or exploratory talk. Both cumulative talk, where learners responded and added to the conversation, and exploratory talk, where learners really pushed each other forward in their thinking (DeWitt & Hohenstein, 2010), occurred very infrequently (see Table 5.15) and as such the potential of Worksheet A to contribute to cognitive learning was very small.

DeWitt and Hohenstein (2010), in their study of student discussions in museums and classrooms, had similar findings for exploratory talk in that there was very little evidence in either setting. This suggests that the skill of exploratory talk is one that has not been developed in classrooms (Mercer, Dawes, Wegerif, & Sams, 2004) and as such a zoo worksheet, even one aligned with best-practice recommendations, will not promote deep discussion among learners without scaffolding from teachers or museum educators (Nyamupangedengu, 2009) as evidenced by the findings reported for Question 6(a). DeWitt and Hohenstein (2010) did, however, report that the majority of museum discourse was cumulative in nature. This was not the case for Worksheet A and it can be argued that as DeWitt and Hohenstein (2010) did not include a category for cooperation at its lowest and most basic level, that is simple dialogue talk, their results reported for cumulative talk may have included statements that this study would have otherwise coded as simple dialogue. With this assumption in mind, simple dialogue talk combined with cumulative talk for Worksheet A would show results that align with DeWitt and Hohenstein (2010) – that is the dominance of cumulative talk during the zoo visit.

Table 5.15: The average percentage of NoD turns in on-task talk for Worksheet A

Ques. No.	Cumulative	Exploratory	Disputational	Parallel	Simple dialogue	Monologic	Ave no. of turns
1(a)	30	0	4	22	40	3	**43**
1(b)	0	0	0	19	80	2	**24**
2(a)	0	0	0	0	100	0	**40**
3(a)	32	10	0	31	22	4	**61**
6(a)	0	0	0	0	100	0	**9**

Disputational, parallel and monologic talks are indicative of instances when groups did not work together cooperatively. In terms of disputational and monologic talk, these instances are infrequent and therefore group interactions are consistent with positive affective outcomes (DeWitt & Hohenstein, 2010). Parallel talk, however, was reflected in on-task conversations for Question 1(a), 1(b) and 3(a). Although parallel talk is less likely to promote learning, it should be noted that Group B tended to express affective engagement in parallel exchanges – it would appear that members of Group B often added to the positive musings of one boy in such a way as to contribute to the conversation without actually commenting on each other's positive affective talk. In this way parallel talk enabled the boys to express positive feelings in a safe 'space' without fear of being teased (unlike the girls of Group A who, in one instance, critically commented on and disagreed with each other's affective remarks). It can therefore be argued that the frequency of parallel talk is not a clear indication of a lack of cooperation in groups. Nevertheless, the findings of Worksheet A suggest a low level cooperation and collaboration in groups and therefore interactions that are less likely to promote out-of-school learning when viewed using the CML (Falk & Dierking, 2000).

Worksheet B, by comparison, shows a definite increase in cumulative talk (see Table 5.16). Furthermore, for all five selected questions (with the exception of Question 3(a)) cumulative talk was coded more frequently than simple dialogue talk. Thus, it seems that the revised questions of Worksheet B are more likely to foster learning than Worksheet A. Question 3(a) and 6(a) of Worksheet B were not revised from Worksheet A and yet produced very different results. In particular, high percentages of exploratory and cumulative talk for Question 3(a) and Question 6(a) respectively. These results are due to the unusual behaviour of Group C who answered Question 6(a) as a collaborative group – a behaviour not observed in any of

the other three groups; and the tendency of Group D to answer worksheet tasks without visiting the related animal enclosure, instead drawing on prior knowledge through cumulative talk and exploratory talk.

Table 5.16: The average percentage of NoD turns in on-task talk for Worksheet B

Ques. No.	Cumulative	Exploratory	Disputational	Parallel	Simple dialogue	Monologic	Ave no. of turns
1(a)	58	0	0	16	25	2	**85**
1(b)	44	0	0	53	4	0	**23**
2(a)	24	42	0	15	20	1	**84**
3(a)	0	50	0	44	7	0	**20**
6(a)	44	0	0	55	0	2	**21**

Worksheet B did engender high frequencies of parallel talk. In particular Question 1(b) and 6(a) showed the highest percentage of parallel talk – this may be due to the open-ended nature of the question which encouraged group discussion. As previously mentioned, learners are unlikely to enter into exploratory discussion without having practised the necessary skills in the formal classroom and, as such, when presented with a question that required said skills learners tended to revert to parallel talk. Even so, the frequency of parallel, disputational and monologic talk cannot take away from the clear increase in cumulative and exploratory talk. It can thus be argued that the group interactions, as a result of the revised questions of Worksheet B, are more likely to promote out-of-school learning than Worksheet A.

5.5 Conclusion

The findings from this part of my study indicate that both Worksheet A and Worksheet B acknowledge and accommodate the socio-cultural context of the CML (Falk & Dierking, 2000). Although, the structure of Worksheet A did not explicitly encourage group discussion the findings suggest that both Group A and Group B engaged with each other and with the content of the worksheet at the lower end of the cognitive taxonomies. Worksheet B made use of revised questions that did encourage discussion and accommodated the learner's choice and control during the zoo experience. As such Group C and Group D engaged with each other and with the worksheet at a higher cognitive level. On the other hand, analysis also identified weaknesses of the worksheet experience in that questions were answered without

learners actually visiting the relevant animal enclosure and some groups answered the worksheet to the exclusion of any other animal enclosures resulting in low affective outcomes. Also, a higher level of cognitive engagement did not necessarily equate to answers that were correct in terms of content. Nevertheless, it can be said that Worksheet B improved on Worksheet A's effectiveness in facilitating learning through curriculum-related conversations through the use of higher cognitive level questions that explicitly encouraged discussion between group members and not simply reading information boards out loud for the group's scribe to copy down. Questions characterised within the higher cognitive domains encouraged learners to draw on their own prior knowledge, information boards as well as their problem solving skills to answer Worksheet B questions in such a way that groups engaged with each other and the material at hand more so than those groups answering Worksheet A. The next chapter presents a summary of the findings and the conclusions of my study.

Chapter Six

Conclusions and implications

6.1 Introduction

This chapter presents a summary of the findings, conclusions and implications of the study. The study consisted of two parts: the first included an analysis of a worksheet of my own design (Worksheet A) and the subsequent revision of the worksheet, resulting in the construction and analysis of Worksheet B, and the second part included an analysis of on-task learner talk resulting from the worksheets.

The intention of the study was to answer the following questions:

1. How can I improve on a worksheet, designed for use by Grade eight learners during a zoo field trip, using best-practice criteria in such a way that promotes free-choice learning?
2. To what extent does the revised worksheet promote curriculum-related conversation?

In order to answer these research questions I will:

- summarise the findings of part one of the study,
- summarise the findings of part two of the study,
- discuss the implications of the study for the stakeholders,
- reflect on the research process, and
- provide suggestions for future studies.

6.2 Findings from the analysis of zoo worksheets: Part one of the study

An analysis of Worksheet A showed that the worksheet contained factors that would hinder free-choice learning in the zoo. These factors are described below, along with recommendations I took note of in my revision of Worksheet A to produce Worksheet B.

High task density – free-choice learning calls for free-exploration of the zoo, and the high task density of both worksheets impeded learners from following their own agendas. In this case learners responded by: focusing on answering the worksheet questions to the exclusion of free exploration of the zoo; neglecting their worksheet and exploring their own agendas; and/ or copying answers from other groups. The high task density also meant that the

worksheet was very long, with the result that some grew tired and bored of the zoo experience and arrived at the rendezvous point earlier than required. To improve on task density, the zoo worksheet should have fewer questions requiring fewer animal enclosures and a shorter period of time to complete the worksheet as it has been reported that learners are motivated by tasks that are manageable (Jarvis & Pell, 2005). The field trip could also be structured such that once learners completed the worksheet they have time to freely explore their own interests.

Absence of orientation cues – an effective zoo worksheet should include clear directions or information about where to find animal enclosures. Worksheet A did not make much use of orientation cues except for a map of the layout of the zoo. The lack of orientation cues in Worksheet A appeared to hinder learning, with the result that Worksheet B incorporated more orientation cues (used in conjunction with the map). Free-choice learning may be restricted by too many orientation cues in a worksheet and it is therefore recommended that a worksheet reflect a balance between orientation cues and free-exploration – this was addressed in Worksheet B by not giving directions and locations for every animal enclosure and allowing groups to plot their own route on the zoo map. Worksheet B thus acknowledges the physical context of the CML.

Absence of tasks that promote observation – Worksheet A did not promote observation as many questions focused on text information sources rather than at the animals themselves. The zoo provides real-life objects and a worksheet that does not make use of these resources effectively reduces the experience to one that could be achieved using the Internet or textbooks. Worksheet A also contained very few tasks that required the use of prior knowledge – key in facilitating learning (Rennie & Johnston, 2004). To improve the information source of Worksheet A, Worksheet B needed less text-dependent questions and more object-dependent and prior knowledge questions. This, however, proved difficult due to the context of the zoo where all animal enclosures were accompanied by information boards. Furthermore, learners accustomed to finding a single correct answer using text sources had difficulty in answering the object-dependent questions. Also, prior knowledge questions tended to reduce the zoo experience to one similar to the formal classroom. Worksheet B, therefore, did not fully meet the criteria for an effective zoo worksheet and consequently, did not address the physical context of the CML.

Presence of many close-ended 'no-choice' questions – both Worksheet A and Worksheet B were dominated by close-ended questions that provided learners with no choice in their responses. The questions categorised as 'some choice' questions were also not strictly free-choice in nature. An effective worksheet should accommodate learners' sense of autonomy and interests (Kisiel, 2003b; Mortensen & Smart, 2007) and as such, 'some choice' questions should be designed to encourage these factors through the use of open-ended tasks and tasks that encourage learners to choose where and how to apply them. Although, it should be noted that when learners were presented with a task that encouraged choice in where they applied it, i.e. choice of animal, groups tended to report on the animal closest to them at the time of reading the question.

High cognitive demand – an effective worksheet is one that contains varying levels of cognitive demand and matches the learners' age and developmental level (Mortensen & Smart, 2007). Worksheet A had many medium order tasks, few higher order tasks and very few lower order tasks. As field trips are constrained by time, higher order questions should be reduced as they take longer to answer. Worksheet B, however, showed an increase in higher order questions – which came as a result of the revision of some questions to align with recommendations made for other worksheet characteristics.

Presence of a limited variety of response formats – Worksheet A was comprised of written response questions. It is recommended that a worksheet use a variety of written and non-written responses. Worksheet B was revised to include questions that required a pictorial response, however the extent of these in Worksheet B did not comply with the recommendations made for best-practice worksheets nor acknowledge the personal context of the CML. Also, it would seem that the learners do not possess the necessary biological drawing skills needed to complete these types of questions. Furthermore, given the nature of the zoo field trip, where teacher supervision is low, verbal responses could not be incorporated into Worksheet B as there was no way for the teachers to monitor and control learner responses.

Outlined above are the features of Worksheet A and Worksheet B that will not facilitate free-choice learning. The worksheets do, however, have some features that will facilitate out-of-school learning. These features are:

Presence of learner-learner interactions – both worksheets were designed to be answered in groups, however only Worksheet B explicitly instructed learners to discuss particular questions as a group. This revision was made as a consequence of my observation that the worksheet was answered by individuals in Worksheet A groups rather than collaboratively as a group. Nevertheless, out-of-school learning is unequivocally social in nature (S. Allen, 2002) and both Worksheet A and Worksheet B accommodated the importance of social interactions between learners and thus the socio-cultural context of the CML.

Presence of tasks with a link to the classroom curriculum – it is important for worksheet tasks to connect to the school curriculum (Bamberger & Tal, 2007). The majority of both Worksheet A and Worksheet B questions related to topics taught in the classroom. Learners were able to draw on their prior knowledge and therefore their personal context of the CML.

From the summary of findings described above, it is evident that improving my original worksheet was easier in theory than in practice. Worksheet A is best described as a survey-orientated worksheet and, as such, will not promote free-choice learning (Kisiel, 2003b). Worksheet B, by comparison, is also categorised on the survey end of the scale although it has some aspects that are moving towards the concept-orientated end of the scale. I was therefore not completely successful in improving my original worksheet to align with best practice recommendations to promote free-choice learning. The mitigating factors against my success can be ascribed to my own agenda and the context of the field trip. That is: the worksheet could not deviate very far from the survey end of the scale as it functioned as an assessment tool and therefore needed to be 'marker friendly' (i.e. having taken into consideration the number worksheets that would need to be marked and the consequent extra demand placed on the Natural Sciences teacher's workload, the worksheet needed to be constructed in such a way so as to allow the teacher to mark quickly and accurately) – a strictly free-choice learning worksheet would not have accommodated my agenda and would have made marking the worksheet difficult as the memo would have to had been designed to accommodate each individual learner's autonomy (this would have resulted in the teacher having to 'fact check' each individual learner's answers – a very time consuming process); I also viewed a field trip to the zoo as one which should take advantage of all that the setting offered and therefore my worksheet continued to reflect a high site specificity; as well as, the zoo was very well sign posted with information boards which resulted in many questions, designed with objects as their information source in mind, reverting to questions that

encouraged text-dependent label reading questions. However, I was successful in accommodating the social context out-of-school learning and allowing a degree of free-choice learning in that learners could select which animal they would answer a few questions on as well as plan and follow their route through the zoo.

6.3 Findings from the analysis of on-task learner conversations: Part two of the study

Analysis of on-task talk revealed that both Worksheet A and Worksheet B promoted curriculum-related conversation among groups and hence the interaction of the socio-cultural context of the CML with the personal and physical contexts. The findings also suggest that there may be an improvement in the nature and type of learner talk as a result of the revised questions in Worksheet B. However, due to the small sample size, these results cannot be generalised to all groups. The findings for part two of the study are outlined below:

The **first finding** was that the type of discourse observed in the interactions of learners could be used to provide insight into their level of cognitive and affective engagement. This provides further evidence of the usefulness of learner conversations in investigating learning in informal contexts. Also, knowledge is constructed in the interactions of learners (Vygotsky, 1978) and the frequency of on-task talk would suggest that both worksheets encouraged social construction of knowledge.

The **second finding** was that affective engagement by learners did not necessarily depend on the task or animal. Although selected questions from both worksheets promoted a degree of affective engagement, the extent to which affective talk was reflected in learner interactions depended on the individuals of the group. This finding confirms that learners' prior interests, motivations and agendas play a role in how they view and experience a field trip. Consequently, the personal and socio-cultural contexts should be expanded on to accommodate all learners' interests – a very challenging notion (DeWitt & Storksdieck, 2008).

The **third finding** was that both worksheets promoted a degree of cognitive engagement, an important finding as cognitive engagement through interactions has the potential to promote out-of-school learning. Furthermore, there is evidence to suggest that the revised questions of Worksheet B did promote deeper cognitive engagement. The revised questions, in general, promoted more medium and higher order levels of engagement whereas the lower order text-

dependent questions of Worksheet A tended to promote lower levels of cognitive engagement. A large proportion of the cognitive engagement for both worksheets was reflected as procedural talk –which points to cooperation among groups in how the worksheet was completed. It also highlights the complexity of out-of-school learning, that is, it includes both exhibit and non-exhibit related learning.

The **fourth finding** was that the nature of learner interactions supports the view that learners showed cooperation in how they approached the task of completing the worksheet. However, Worksheet B groups reflected more cumulative and exploratory talk suggesting the revised questions promoted deeper cognitive engagement. Furthermore, the nature of learner talk shows that learners do not have or have never practised the necessary skills, e.g. language, argumentation and critical analysis, needed to be able to discuss topics on deep cognitive levels.

6.4 Implications for the stakeholders

The findings that I have outlined have some implications for my own practice as well as my colleagues, teachers in the wider community and museum educators. These implications are as follows:

Teachers must identify their agenda and goals for a field trip before producing a worksheet. Concept-orientated worksheets may be viewed as allowing too much freedom with too little structure and as a consequence, teachers may be of the view that learners are unfocused showing little cognitive and affective engagement. If teachers share my belief that worksheets should be used as behaviour controlling tools, then keeping learners under control is the driving force in the construction of informal worksheets and not the desire to see maximum cognitive and affective outcomes. Therefore, even though teachers may be aware of researcher recommendations, their experiences of field trips make them not partial to adopting best-practice recommendations.

Teachers who do opt to use survey-orientated worksheets should minimise the amount of time learners spend completing the tasks. This is because learners grow bored of completing long worksheets and these negative feelings then extend to the field trip experience as well. Teachers should rather allow time free exploration after learners have completed a short worksheet. In this way, the field trip still makes use of the uniqueness of the informal context and accommodates the expectations of both the teacher and his or her learners.

The quality of learners' educational experiences depends on the ability of their teacher to constantly appraise and change their own professional practice. It is, therefore, important that teachers are aware of best-practice recommendations so that they can make these necessary changes - the use of a worksheet analysing instrument, like the one used in this study, is a helpful tool teachers can use in critically analysing their own construction of informal context worksheets.

Worksheets, used in informal contexts, effectively promote cooperation among learners working together in groups – this is a crucial factor of out-of-school learning and as such worksheets, whether concept-orientated or survey-orientated, should maximise this unique feature. However, it should also be noted that worksheets in informal contexts also encourage the copying of answers from other groups. It is important that teachers develop effective strategies to eliminate this practice, if their agenda is one where the field trip forms part of his or her assessment, among their learners for example: a Draconian approach might include not marking copied responses or sharing marks received for copied answers by the number of groups with the same answer.

Learners need to be adequately prepared for the worksheet experience, especially one that aligns with best-practice recommendations. Learners may not possess the necessary skills needed to answer questions that require: observation of objects, critical analysis and application of prior knowledge, appraisal of subjects, exploratory discussions and biological drawings. Consequently, a worksheet may align with best practice recommendations by including questions that focus learners on object-dependent sources of information, instruct learners to draw their response or discuss with their group, but if learners have not been prepared to engage with the worksheet in this way then cognitive engagement will be reduced to that facilitated by a survey-orientated worksheet.

Finally, from the findings in this study it would seem that the free-choice worksheet, in the strictest sense of the word, may be elusive in the context of South African field trips. Resource poor schools in South Africa tend to be under staffed and therefore worksheets are used to ensure that all learners on a field trip have the same experience – regardless of whether they have teacher supervision or not – this would be challenging if the worksheets were concept-orientated. Additionally, scientific literacy in South African schools tends to be low and as such, learners tend not to possess the skills described previously to engage with a free-choice worksheet. Consequently, South African learners might benefit more from a

structured field trip that makes use of more text-dependent lower order questions than those recommended by researchers working in overseas countries. However, it is important to note that if we adopt this view, of out-of-school learning in South Africa, we will perpetuate the 'divide' between Western countries and resource poor countries.

6.5 A reflection on the research process

The study has several limitations: wearing audio-recorders may have influenced the conversations of learners; worksheets were completed by most groups through copying answers from other groups and without observation of the relevant animal enclosure; transcripts were analysed from a small sample of the groups who participated; and the study was conducted using a single, independent and privileged, school. Nevertheless, valuable information about the nature of my own zoo worksheets and their effectiveness in facilitating learning was obtained from the study. Furthermore, valuable methodological and theoretical observations were also derived from the study:

Firstly, action research as a methodology is described as having two crucial points: research that feeds back into practice, and is on-going. As the study only cycled through two spirals of research, it is better described as a discrete piece of research rather than an on-going cyclical process. As a consequence, the scale and scope of the changes I made to my field trip practices were limited and constrained by the short cycle of research I undertook. The nature of my study, i.e. independent action research, also posed a problem in that my findings were constrained by my own bias. True action research requires collaboration, so that the researcher might be made aware of alternative perspectives. Consequently, it is very likely that I over looked aspects of the study that would have been identified by an objective outsider e.g. cognitive level of questioning assigned to worksheets. However, action research as a methodology did spark my professional development such that I am encouraged to continue to reflect on and change my practice for the better.

Secondly, the CML as a conceptual framework allowed for the identification of factors, within the socio-cultural, personal and physical contexts, that were not specifically addressed or acknowledged by the worksheets. The CML thus, used in conjunction with Kisiel's characteristics and hypothetical informal context worksheet, provided a concise framework for the detailed analysis of my zoo worksheets and learner conversations.

6.6 Suggestions for future studies

The study employed a very small sample and only cycled through two spirals of action research. It is, therefore, important that the study is repeated whereby Worksheet B would be revised using several more spirals of critically informed action research. It is also important that future studies audio-record and transcribe the on-task talk of as many groups as possible so that a more detailed and representative sample of learner interactions is obtained and analysed. Nevertheless, to my knowledge a study of this kind has not been conducted in South Africa and its findings, although not generalizable, provide some interesting insight into the difficulty I had in implementing researcher recommendations in real-life contexts

6.7 Concluding remarks

In this study I have presented a detailed description of what best-practice characteristics one needs to consider when constructing an informal context worksheet. I then used the same characteristics, in a worksheet analysing instrument, to critically analyse my own zoo worksheet. This worksheet was categorised as survey-orientated and, therefore, one which was unlikely to facilitate free-choice learning within the context of a zoo field trip. The resulting revision of this worksheet to align with best-practice recommendations resulted in the construction of a new worksheet that did not fully meet the necessary requirements to facilitate free-choice learning – the revised worksheet retained many characteristics of a survey-orientated worksheet. The study also showed that, although both worksheets encouraged social-interaction and cooperation among groups, cognitive engagement with worksheet tasks tended towards a superficial level as characterised by parallel and simple dialogue talk. Furthermore, both an analysis of completed worksheets as well and on-talk showed that the learners did not possess the necessary skills needed to complete tasks that aligned with best-practice recommendations, for example: biological drawings, observation of animals and exploratory talk. Consequently, both the teacher and the ability of his or her learners influence the field trip experience. It is my desire to share this knowledge, on the construction and use of worksheets as well as the barriers that need to be overcome to facilitate free-choice learning during a field trip, by informing the stakeholders (such as my colleagues, teachers in the wider community and museum educators) so that we as a community of teachers may improve our own professional practice and continue to bridge the gap between what researchers recommend and the real life context.

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Appendices

Appendix A: Zoo worksheets and Worksheet Analysing Instrument[60]

Appendix A1 – Worksheet A

Animal Adaptations and Conservation Research Project

Grade 8 Biology

NAME: _____ **GRADE 8** ___

[60] Analysis using the worksheet analysing instrument is indicated in red i.e. this was not present on the original learner worksheet

Introduction

Welcome to the Johannesburg Zoo, 55 hectares of park boasting over 320 animal species!

The Johannesburg Zoo takes up 55 hectares of the original 81 hectare Herman Eckstein Park. In 1904, this land was donated to the people of Johannesburg for recreational use by the firm of the late Herman Eckstein.

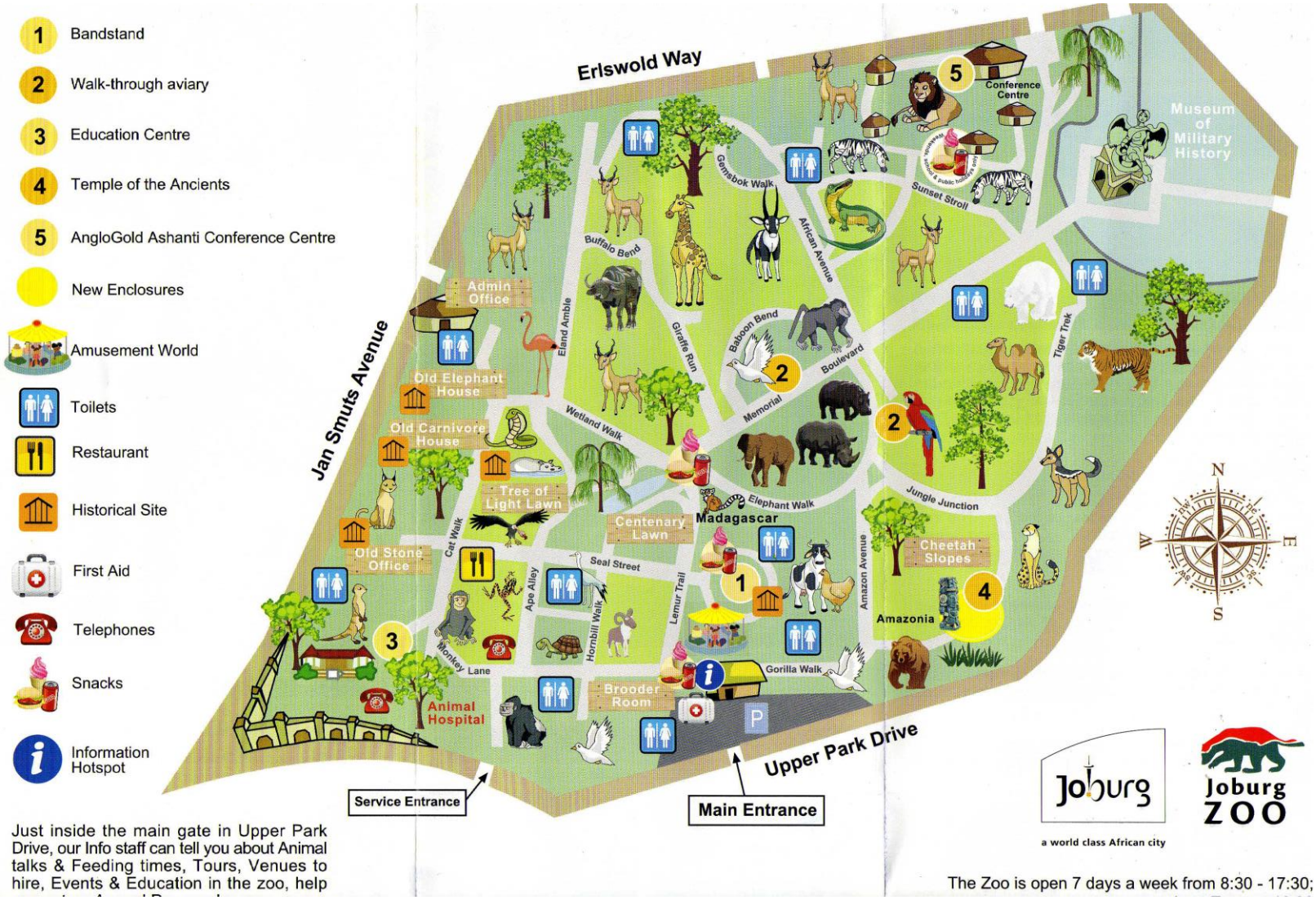
The original animal collection consisted of 1 lion, 1 leopard, 1 giraffe, 2 Sable antelope bulls, 1 baboon, 1 genet, 1 pair of Rhesus monkeys, 1 pair of porcupines and 1 Golden eagle. Some of these were collected by Sir Percy Fitzpatrick who also wrote the famous book “Jock of the Bushveld”.

Today is your opportunity to be educated and inspired by the wealth of information and menagerie of animals at the Zoo.

Instructions

- A map is included in your answer booklet to help you navigate the park.
- This visit serves as a research project and will be counted towards your report mark for biology.
- Read each question carefully and answer in the spaces provided.
- All information can be found in the Zoo grounds, or was covered previously in class.
- Your answer booklet must be completed neatly and handed in for marking at the end of your visit to the Zoo.
- The Zoo is a park and must be kept clean and tidy. Throw your rubbish away in the recycling bins.
- You are ambassadors of Waterstone College and bad behaviour will not be tolerated.
- Good luck and have fun!

Map



Just inside the main gate in Upper Park Drive, our Info staff can tell you about Animal talks & Feeding times, Tours, Venues to hire, Events & Education in the zoo, help

The Zoo is open 7 days a week from 8:30 - 17:30;

GROUP CODE:

Activity 1: Animal adaptations

Find the animal, pictured below, in the farmyard. 12(c)

Worksheet question has a picture to identify the animal

1. What is this animal's common name? 1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a) (1)

2. When and where did this animal originate? (2)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(a) 8(b) 9(a) 10(a)

1(b)

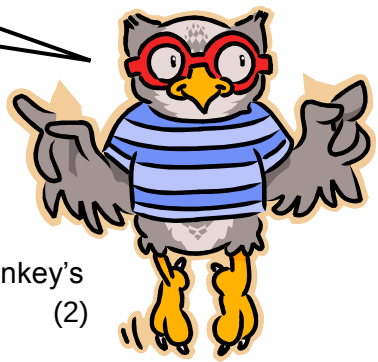
3. What type of feeding behaviour does this animal display? Give two examples of the type of food this animal eats. (3)

Type of feeding behaviour: 1(a) / 3(e) 4(a) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

Type of food:

1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

Visit the Black Spider Monkey…



4. Compared to the “old world monkeys” how has this particular monkey evolved differently? (1)

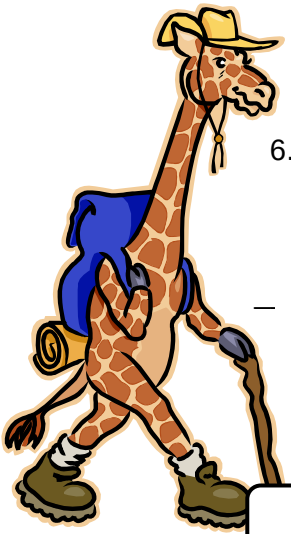
1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

1(b)

5. What physical adaptation developed as a result of the Spider Monkey’s unique evolution?How does it benefit the monkey? (2)

1(a) / 3(a) 4(a) 5(c) 6(e) 7(b) 8(a) 9(a) 10(a)

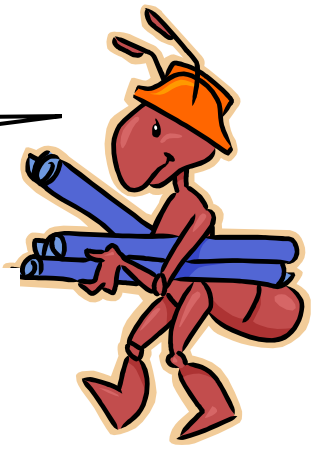
Find the Gibbons in Madagascar…



6. The Gibbons swing from branch to branch, sometimes over 10 metres, with the help of their specially adapted long arms. What name do we use to describe this type of movement? (1)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

Now find the Caracal and Hyena!



1(b)

7. Describe one physical adaptation and one behavioural adaptation for each of these animals. (4)

Caracal: Physical = 1(a) / 3(b) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

Behavioural = 1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

1(b)

Hyena: Physical = 1(a) / 3(b) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

Behavioural = 1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

1(b)

8. Give five interesting physical adaptations of the crocodile. (5)

1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

1(b)

9. Find the Cape vulture. What kind of feeding behaviour does this bird display? (1)

1(a) / 3(e) 4(a) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

10. How is it physically adapted for the behaviour described above? (2)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

Activity 2: Endangered animals

The Johannesburg Zoo is actively involved in preserving biodiversity through animal breeding and conservation programmes.

1(b)

1. Find the Spectacled Bear, so named for the markings around its eyes. What status does this bear have on the Endangered Species List? (1)

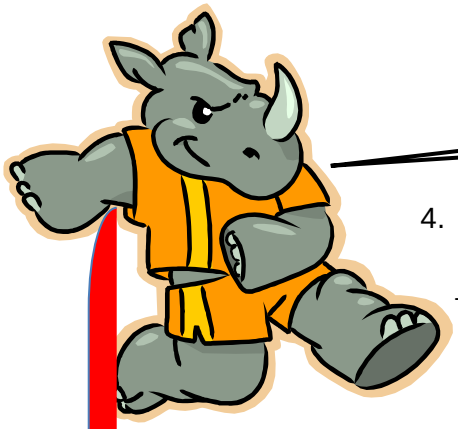
1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

2. How many of these bears are left in the wild? (1)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

3. Why are these animals under threat? (3)

1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)



The White Rhino is listed as critically endangered, having existed successfully for 50 million years!

4. Why are rhinos poached for their horns? (2)

1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

5. Draw and complete a table to show the number of individuals of each species of rhino estimated, in 2007, to be left in the wild. Remember to give your table a suitable title. (5)

1(b)

1(a) / 3(a) 4(a) 5(c) 6(c) 7(b) 8(a) 9(a) 10(a)

Look out for the bat boxes around the zoo. Find out how you can attract bats to your garden.

6. Why is it a good idea to attract bats to you garden? (1)

1(b)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

1(b)

Find the Wattled Cranes – CAREFUL THEY BITE!

7. Explain how the zoo raises the Wattle Crane chicks, without imprinting on them. (1)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

Activity 3: Symbiosis

1(b)

1. Hippos are sometimes called “Floating Hotels”, because of the symbiotic relationships they have. Describe three of these relationships and categorise them as either being mutualism, commensalism or parasitism. (6)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

1(a) / 3(e) 4(a) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

Activity 4: Fun facts

1(b)

1. What are the names and ages of the zoo's two elephants? (4)

_____

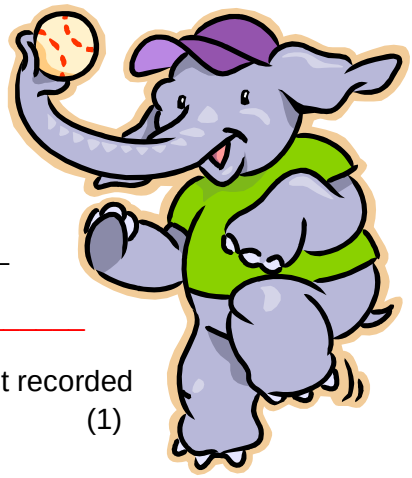
1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

1(b)

2. What is the Rock Hyrax's closest relative? (1)

_____

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)



1(b)

3. Which animal's call is as loud as a rock band? (1)

_____

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

1(b)

4. According to the Guinness Book of Animal Facts, what is the fastest recorded speed that a Cheetah can run? (1)

_____

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

1(b)

5. Give the highest recorded mass of the biggest animal in the cat family. (1)

_____

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

1(b)

6. How much taller is the polar than you. Give your answer in cm. (4)

My height: _____ 1(a) / 3(f) 4(a) 5(c) 6(e) 7(b) 8(a) 9(a) 10(a) –

Polar Bear height: _____

_____

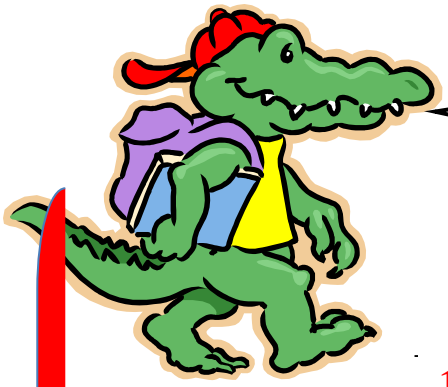
1(b)

7. Bust the myth that states that snakes are deaf. (1)

_____

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

Activity 5: Water conservation



Water in the Zoo is recycled through a Wetland system, cleaning it for re-use for gardens, ponds and cleaning enclosures.

1. How did the river in the Zoo become polluted? (2)

1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

2. How does the Wetland purification system work? (4)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

1(b)

3. Is there proof that this system works? (2)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

4. Why are the plants planted in a zig-zag pattern? (2)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

Activity 6: Conservation

It should now be clear to you just how important the zoo is in promoting conservation and ensuring biodiversity.

1. Write a paragraph in which you describe what conservation is, why it is important to educate people about conservation and how the zoo is working to protect species from extinction. You must include in your answer whether you think the zoo is doing a good job at promoting conservation and whether you think zoos are an important part of society. (5)

1(a) / 3(e) 4(b) 5(c) 6(e) 7(a) 8(a) 9(a) 10(b)

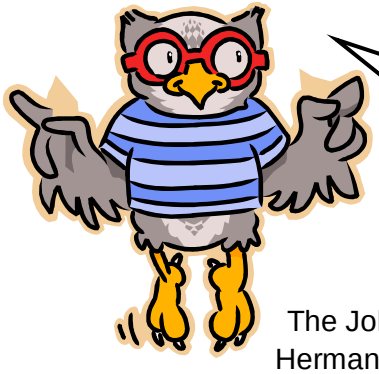
Appendix A2 – Worksheet B

Animal Adaptations and Conservation Research Project

Grade 8 Biology

NAME: _____ GRADE 8 ___

Introduction



Welcome to the Johannesburg Zoo, 55 hectares of park boasting over 320 animal species!

The Johannesburg Zoo takes up 55 hectares of the original 81 hectare Herman Eckstein Park. In 1904, this land was donated to the people of Johannesburg for recreational use by the firm of the late Herman Eckstein.

The original animal collection consisted of 1 lion, 1 leopard, 1 giraffe, 2 Sable antelope bulls, 1 baboon, 1 genet, 1 pair of Rhesus monkeys, 1 pair of porcupines and 1 Golden eagle. Some of these were collected by Sir Percy Fitzpatrick who also wrote the famous book “Jock of the Bushveld”.

Today is your opportunity to be educated and inspired by the wealth of information and menagerie of animals at the Zoo.

Instructions

- A map is included in your answer booklet to help you navigate the park.
- This visit serves as a research project and will be counted towards your report mark for biology.
- Read each question carefully and answer in the spaces provided.
- All information can be found in the Zoo grounds, or was covered previously in class.
- Your answer booklet must be completed neatly and handed in for marking at the end of your visit to the Zoo.
- The Zoo is a park and must be kept clean and tidy. Throw your rubbish away in the recycling bins.
- You are ambassadors of Waterstone College and bad behaviour will not be tolerated.
- Good luck and have fun!

Map


1 Bandstand
2 Walk-through aviary
3 Education Centre
4 Temple of the Ancients
5 AngloGold Ashanti Conference Centre
Amusement World
New Enclosures
Toilets
Restaurant
Historical Site
First Aid
Telephones
Snacks
Information Hotspot
Just inside the main gate in Upper Park Drive, our Info staff can tell you about Animal talks & Feeding times, Tours, Venues to hire, Events & Education in the zoo, help
Jan Smuts Avenue
Erlswold Way
Upper Park Drive
Service Entrance
Main Entrance
Animal Hospital
Old Stone Office
Old Carnivore House
Old Elephant House
Admin Office
Cat Walk
Monkey Lane
Ape Alley
Tree of Light Lawn
Eland Amble
Wetland Walk
Hornbill Walk
Seal Street
Brooder Room
Centenary Lawn
Lemur Trail
Madagascar
Elephant Walk
Giraffe Run
Buffalo Bend
Baboon Bend
Memorial Boulevard
Gemsbok Walk
African Avenue
Gorilla Walk
Amazon Avenue
Amazonia
Cheetah Slopes
Jungle Junction
Tiger Trek
Sunset Rise
Conference Centre
Museum of Military History
W
N
S
E
Joburg
a world class African city
Joburg ZOO
The Zoo is open 7 days a week from 8:30 - 17:30;

GROUP CODE:

Activity 1: Animal adaptations

Find the animal, pictured below, in the farmyard. 2(c)

Question has a picture of the animal to help learners identify it – advance organiser

1(b)

11. What is this animal's common name? 1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) (1)

12. This animal was domesticated in China in 8000 BC. Discuss with your group what you think the word 'domesticated' means and then write a definition for this word below. (2)

1(a) / 3(e) 4(a) 5(c) 6(e) 7(b) 8(b) 9(a) 10(a)

13. What type of feeding behaviour does this animal display? Circle the correct answer below. (1)

1(a) / 3(e) 4(a) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

Herbivore **Carnivore** **Omnivore**

14. Give two examples of the type of food this animal eats. (2)

1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10 (a)

Visit the Black Spider Monkeys in Amazon Avenue… 2(c)

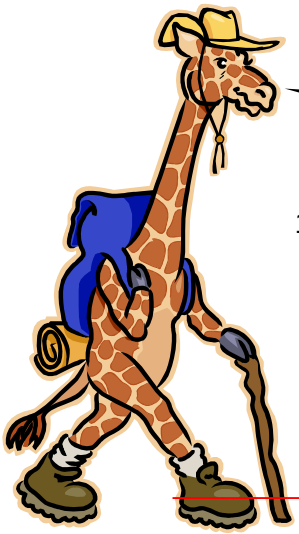
15. Compared to the "old world monkeys" the Black Spider Monkey has evolved differently? Draw and label a diagram to show how the hand of these monkeys is different to other species. (2)

1(a) / 3(b) 4(a) 5(c) 6(c) 7(b) 8(b) 9(a) 10 (a)

1(b)

16. The Black Spider Monkey has a 'gripping' tail. How is this type of tail different to the tails of "old world monkeys" for example the baboons? (1)

1(a) / 3(b) 4(a) 5(c) 6(e) 7(a) 8(b) 9(a) 10 (a)



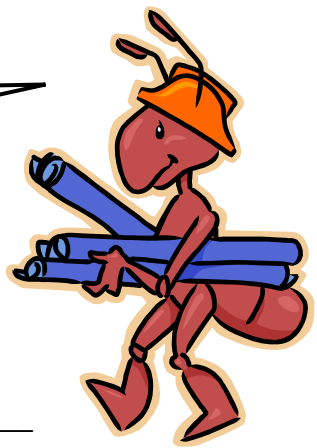
Find the Polar Bears at the top of Memorial Boulevard…

17. Give two physical characteristics that you can observe that show these bears are not adapted to the African environment. (2)

1(a) / 3(b) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10 (a)

1(b)

Now find an animal that you think is interesting or unusual…



1(b)

18. Describe one physical adaptation and one behavioural adaptation for this animal. (2)

Physical =

1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10 (a) _____

Behavioural = _____

1(a) / 3(b) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10 (a) _____

1(b)

19. Visit the crocodiles in Crocodile Country. In winter the crocodiles spend their days in the hot house. Why do you think this is so? (2)

1(a) 2(c) 3(e) 4(a) 5(b) 6(e) 7(a) 8(b) 9(a) 10 (a) _____

_____

---

20. Where are the crocodiles today? Circle the appropriate answer below. (1)

1(a) / 3(e) 4(b) 5(a) 6(e) 7(b) 8(a) 9(a) 10 (a)

inside **outside**

1(b)

21. Find the Cape vulture on the corner of Cat Walk and Seal Street. These birds are scavengers. How do you think they are physically adapted for the behaviour described above? (2)

1(a) 2(c) 3(a) 4(a) 5(a) 6(e) 7(b) 8(a) 9(a) 10 (a) _____

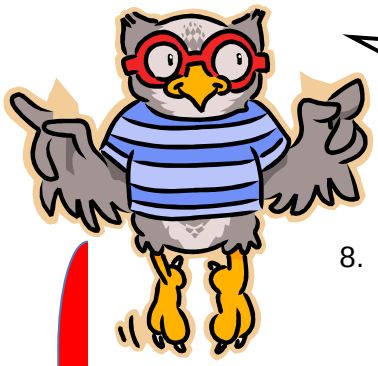
22. Make a biological drawing of the vulture's beak below. Annotate the diagram to show how it is physically adapted for its function. (3)

1(a) / 3(b) 4(a) 5(c) 6(c) 7(b) 8(a) 9(a) 10 (a)

23. Why are scavengers important in an ecosystem? Discuss with your group and then write down two of the group's suggestions. (2)

1(a) / 3(e) 4(b) 5(c) 6(e) 7(a) 8(a) 9(a) 10 (b)

Activity 2: Endangered animals



The Johannesburg Zoo is actively involved in preserving biodiversity through animal breeding and conservation programmes.

8. Find an animal that is protected by the zoo but under endangered in the wild.

Give the name of this animal. _____

What is this animal's status on the Endangered Species List? (1)

1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10 (b)

9. How many of these animals are left in the wild? (1)

1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10 (b)

1(b)

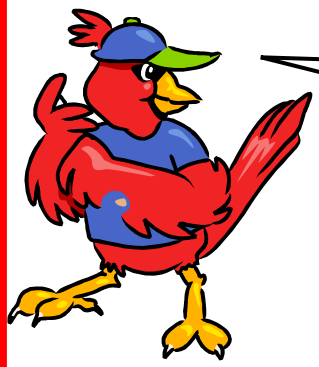
10. Why are these animals under threat? (3)

1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10 (b)

11. In your group come up with a catchy slogan that the zoo could use on their information boards to educate the public about the plight of this animal. (2)

1(a) / 3(e) 4(b) 5(c) 6(e) 7(b) 8(a) 9(a) 10 (b)

1(b)



Find the Wattled Cranes on Hornbill Walk – CAREFUL THEY BITE!

12. Explain how the zoo raises the Wattle Crane chicks, without imprinting on them. (1)

1(a) 2(c) 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10 (a)

Activity 3: Symbiosis

1(b)

2. Hippos are sometimes called “Floating Hotels”, because of the symbiotic relationships they have. Describe three of these relationships and categorise them as either being mutualism, commensalism or parasitism. (6)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(a) 9(a) 10 (a)

1(a) / 3(e) 4(a) 5(b) 6(e) 7(b) 8(a) 9(a) 10 (a)

Activity 4: Fun facts

1(b)

8. What are the names and ages of the zoo's two elephants? (4)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(bb) 9(a) 10 (a) _____

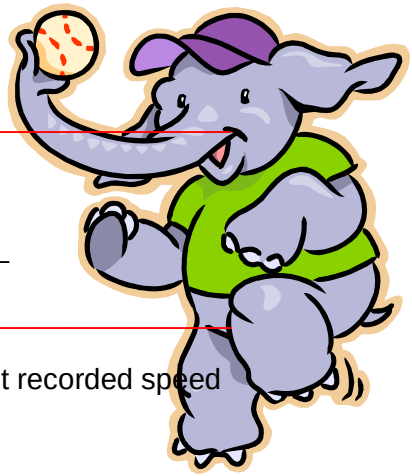
_____

1(b)

9. What is the Rock Hyrax's closest relative? (1)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10 (a) _____

_____



1(b)

10. Which animal's call is as loud as a rock band? (1)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10 (a) _____

_____

1(b)

11. According to the Guinness Book of Animal Facts, what is the fastest recorded speed that a Cheetah can run? (1)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10 (a) _____

_____

1(b)

12. Give the highest recorded mass of the biggest animal in the cat family. (1)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10 (a) _____

_____

13. How much taller is the polar than you. Give your answer in cm. (4)

My height: _____

Polar Bear height: 1(a) / 3(f) 4(a) 5(c) 6(e) 7(b) 8(a) 9(a) 10 (a) _____

_____

_____

1(b)

14. Bust the myth that states that snakes are deaf. (1)

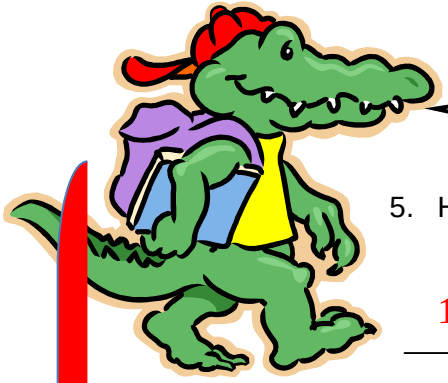
1(a) / 3(a) 4(a) 5(c) 6(e) 7(b) 8(b) 9(a) 10 (a) _____

_____

15. Choose three animals you have seen today and draw a food chain to show the relationship between these animals as it would be observed in the wild. (4)

1(a) / 3(b) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10(b)

Activity 5: Water conservation



Water in the Zoo is recycled through a Wetland system, cleaning it for re-use for gardens, ponds and cleaning enclosures.

5. How did the river in the Zoo become polluted? (2)

1(a) / 3(a) 4(b) 5(b) 6(e) 7(b) 8(a) 9(a) 10(a)

6. What is the proof that this system works? (2)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

1(b)

7. Why are the plants planted in a zig-zag pattern? (2)

1(a) / 3(a) 4(a) 5(b) 6(e) 7(b) 8(b) 9(a) 10(a)

8. Discuss with your group one other way in which the zoo can be water-wise. Write your group's suggestion down. (1)

1(a) / 3(e) 4(b) 5(c) 6(e) 7(a) 8(a) 9(a) 10(b)

Activity 6: Conservation

It should now be clear to you just how important the Zoo is in promoting conservation and ensuring biodiversity.

2. Write a paragraph in which you describe what conservation is, why it is important to educate people about conservation and how the Zoo is working to protect species from extinction. You must include in your answer whether you think the Zoo is doing a good job at promoting conservation and whether you think zoos are an important part of society.
(5)

1(a) / 3(e) 4(b) 5(c) 6(e) 7(a) 8(a) 9(a) 10(b)

Appendix A3 – Worksheet Analysing Instrument for Worksheet A

Characteristic of worksheet (categories)	Sub-categories		Frequency		Comments
1. Task density	*(a) Number of tasks in the worksheet*	*Time/question (T/Q)*	**35**	**4.29**	**Designed for a 2 1/2 hour (150 min) duration**
	(b) Number of displays to be visited to complete the worksheet	*Time/Display*	**20**	**7.5**	
2. Orientation Cues	*(a) Pre-visit orientation tasks*		**0**		
	(b) During visit orientation tasks		**0**		
	(c) Is there a map or directions in the worksheet		**2**		**Map included in worksheet booklet**
3. Information Source	*(a) Tasks requiring information from text/labels*		**28**		
	(b) Tasks requiring information from objects		**2**		
	(c) Tasks requiring information from audio-visual presentations		**0**		
	(d) Tasks requiring information from the teacher/ museum educator/ tour guide		**0**		
	(e) Tasks requiring prior knowledge		**4**		
	(f) Tasks requiring information from practical activities		**1**		
4. Level of Choice	*(a) Tasks with 1 correct answer only (no choice*		**25**		
	(b) Tasks with 2 or more correct answers (some choice)		**10**		
5. Cognitive Level	*(a) Lower order tasks (knowledge)*		**3**		
	(b) Medium order tasks (comprehension and application)		**27**		
	(c) Higher order tasks (analysis, synthesis and evaluation)		**5**		
6. Response Format	*(a) Tasks requiring oral answers only*		**0**		
	(b) Tasks requiring oral and written answers		**0**		
	(c) Tasks requiring pictorial presentation for answers		**1**		
	(d) Tasks requiring action only, no verbal answers		**0**		
	(e) Tasks requiring answers in the form of written text		**34**		

Characteristic of worksheet (categories)	Sub-categories	Frequency	Comments
7. Question Format	*(a) Open-ended tasks*	**1**	
	(b) Closed-ended tasks	**34**	
8. Classroom Connection	*(a) Tasks connecting to classroom topics*	**20**	
	(b) Tasks with no connection to classroom	**15**	
9. Social Interaction	*(a) Tasks requiring learners to work in groups or pairs*	**35**	
	(b) Tasks requiring teachers/ tour guides to work with learners	**0**	
	(c) Tasks requiring learners to work individually	**0**	
10. Site specificity	*(a) High*	**34**	
	(b) Low	**1**	

Appendix A4 – Worksheet B Analysing Instrument for Worksheet B

Characteristic of worksheet (categories)	Sub-categories		Frequency		Comments
1. Task density	*(a) Number of tasks in the worksheet*	*Time/question (T/Q)*	**34**	**4.41**	**Designed for a 2 1/2 hour (150 min) duration**
	(b) Number of displays to be visited to complete the worksheet	*Time/Display*	**16**	**9.38**	
2. Orientation Cues	*(a) Pre-visit orientation tasks*		**0**		
	(b) During visit orientation tasks		**0**		
	(c) Is there a map or directions in the worksheet		**7**		**Map included in worksheet booklet**
3. Information Source	*(a) Tasks requiring information from text/labels*		**18**		
	(b) Tasks requiring information from objects		**6**		
	(c) Tasks requiring information from audio-visual presentations		**0**		
	(d) Tasks requiring information from the teacher/ museum educator/ tour guide		**0**		
	(e) Tasks requiring prior knowledge		**8**		
	(f) Tasks requiring information from practical activities		**1**		
4. Level of Choice	*(a) Tasks with 1 correct answer only (no choice*		**20**		
	(b) Tasks with 2 or more correct answers (some choice)		**14**		
5. Cognitive Level	*(a) Lower order tasks (knowledge)*		**4**		
	(b) Medium order tasks (comprehension and application)		**21**		
	(c) Higher order tasks (analysis, synthesis and evaluation)		**9**		
6. Response Format	*(a) Tasks requiring oral answers only*		**0**		
	(b) Tasks requiring oral and written answers		**0**		
	(c) Tasks requiring pictorial presentation for answers		**2**		
	(d) Tasks requiring action only, no verbal answers		**0**		
	(e) Tasks requiring answers in the form of written text		**32**		

Characteristic of worksheet (categories)	Sub-categories	Frequency	Comments
7. Question Format	*(a) Open-ended tasks*	**6**	
	(b) Closed-ended tasks	**28**	
8. Classroom Connection	*(a) Tasks connecting to classroom topics*	**19**	
	(b) Tasks with no connection to classroom	**15**	
9. Social Interaction	*(a) Tasks requiring learners to work in groups or pairs*	**34**	
	(b) Tasks requiring teachers/ tour guides to work with learners	**0**	
	(c) Tasks requiring learners to work Individually	**0**	
10. Site specificity	*(a) High*	**24**	
	(b) Low	**10**	

Appendix B: Ethics forms

Appendix B1 – Letter to college Principal

To Mr Botha,

As you know I am completing my master's degree at the University of the Witwatersrand and I would like to request your permission to conduct my research on the grade 8 learners of Waterstone College.

The purpose of the research

Every year I take the grade 8 learners on a field trip to the Johannesburg Zoo and I would like to improve the way in which these field trips are conducted so that learners learn from the visit but still enjoy the experience of the zoo. This study will help me identify which parts of the zoo visit are successful and which areas need to be improved. This study will help to make sure that future grade 8 learners at Waterstone College experience the zoo in a meaningful and enjoyable way.

What being involved requires of you

The annual field trip to the Johannesburg Zoo involves the learners spending the day exploring the park to answer questions on a worksheet. The same field trip is scheduled for later this year. If you are willing, I would like to use this annual field trip to collect data on the use of worksheets during school trips to museums. This would involve observing learners during the zoo visit as well as their pre- and post-visit Natural Science lessons. Also, answers to the worksheet will be collected and used in my research. Some learners will be asked to wear a small microphone to record the discussions their group may have while answering the worksheet.

The visit to the zoo will take place during school hours on two separate days. The first group visit will consist of two of the four register classes. The second visit will take place after approximately one month later and will consist of remaining two register classes. The learners will be accompanied by Mrs Venter, Mrs Even, and me. Every effort will be made to ensure the safety of the learners during the visit.

What I promise you

I promise you that:

- I will not use the College's name or reveal its identity in my research report
- all data I collect will be kept on a password protected computer and in a locked cupboard
- learners do not have to participate if they do not want to
- learners may withdraw from the study at any point
- if a learner chooses not to participate they will not be disadvantaged in any way

Kind regards

Jenna Dick

Appendix B2 – Information sheet for learners

Dear Grade 8 Learner,

Many of you may already know me but for those who don't, my name is Miss Dick and I teach Life Sciences to the grade 10, 11 and 12 learners. What you don't know about me is that, just like you, I also attend "school". I am completing my master's degree at the University of the Witwatersrand and I would like to invite you to be part of my study on school trips to museums.

The purpose of the research

Every year I take the grade 8 learners on a field trip to the Johannesburg Zoo and I would like to improve the way in which these field trips are conducted so that you learn from the visit but still enjoy the experience of the zoo. This study will help me identify which parts of the zoo visit are successful and which areas need to be improved. By being part of this study, you will help to make sure that the grade 8 learners who follow you in years to come also experience the zoo in a meaningful and enjoyable way.

What being involved requires of you

The annual field trip to the Johannesburg Zoo involves spending the day exploring the park to answer questions on a worksheet. You will be doing the same field trip later this year and fill in a worksheet (just like in previous years). If you are willing to be involved in the study I would like to use your answers in my research and observe how you go about completing the worksheet. Also, if you are willing, some of you will be asked to wear a small microphone to record the discussions your group may have while answering the worksheet.

The visit to the zoo is during school hours and you will be accompanied by your Natural Science teacher, Mrs Venter, our laboratory assistant, Mrs Even, and me.

What I promise you

I promise you that:

- I will not use your name or reveal your identity in my research report
- all data I collect will be kept on a password protected computer and in a locked cupboard
- you do not need to participate if you do not want to
- you may withdraw from the study at any point
- if you choose not to participate you will not be disadvantaged in any way

How I can be contacted

If you have any questions or concerns please contact me at Waterstone College:

Telephone: 011 943 2682 or Email: jennad@waterstonecollege.co.za

Jenna Dick **Glenn Botha**

Appendix B3 – Informed consent form: Learner

PARTICIPANT CONSENT FORM

I _____ in grade 8 ____ agree that (please place a ✓or **X** next to each statement):

1. I have read and understand the information sheet given to me by Miss Dick.

2. I understand that I do not have to participate and that I am free to withdraw at any time, without giving any reason.

3. I understand that any information collected from me during the zoo visit may be used in future reports, articles or presentations by Miss Dick.

4. I understand that my name will not appear in any reports, articles or presentations.

5. I agree to my answers being used in the study.

6. I agree to be observed during the visit.

7. I agree to be audio-recorded during the visit.

_____	_____	_____
Name of Participant	**Date**	**Signature**
_____	_____	_____
Researcher	**Date**	**Signature**

PLEASE RETURN TO YOUR NATURAL SCIENCES EDUCATOR BY 12 August

Appendix B4 – Information sheet for parent/guardian

To Grade 8 Parents,

Many of you may already know me but for those who don't, my name is Miss Dick and I teach Life Sciences to the grade 10, 11 and 12 learners. I am completing my master's degree at the University of the Witwatersrand and I would like to invite your child to be part of my study on school trips to museums.

The purpose of the research

Every year I take the grade 8 learners on a field trip to the Johannesburg Zoo and I would like to improve the way in which these field trips are conducted so that learners learn from the visit but still enjoy the experience of the zoo. This study will help me identify which parts of the zoo visit are successful and which areas need to be improved. By being part of this study, your child will help to make sure that future grade 8 learners at Waterstone College experience the zoo in a meaningful and enjoyable way.

What being involved requires of you

The annual field trip to the Johannesburg Zoo involves the learners spending the day exploring the park to answer questions on a worksheet. Your child will be doing the same field trip later this year and will fill in a worksheet (just like in previous years). If you are willing to let your child be involved in the study, I would like to use your child's answers in my research and observe how they go about completing the worksheet. Also, if you are willing, your child may be asked to wear a small microphone to record the discussions their group may have while answering the worksheet

The visit to the zoo is during school hours and learners will be accompanied by their Natural Science teacher, Mrs Venter, our laboratory assistant, Mrs Even, and me.

What I promise you

I promise you that:

- I will not use your child's name or reveal their identity in my research report
- all data I collect will be kept on a password protected computer and in a locked cupboard
- your child does not need to participate if they do not want to
- your child may withdraw from the study at any point
- if your child chooses not to participate they will not be disadvantaged in any way

How I can be contacted

If you have any questions or concerns please contact me at Waterstone College:

Telephone: 011 943 2682 or Email: jennad@waterstonecollege.co.za

Jenna Dick **Glenn Botha**

Appendix B5 – Informed consent form: Parent/guardian

PARENT CONSENT FORM

I _____ parent of _____

in grade 8 ____ agree that (please place a ✓or **X** next to each statement):

1. I have read and understand the information sheet given to me by Miss Dick.

2. I understand that my child does not have to participate and that he/she is free to withdraw at any time, without giving any reason.

3. I understand that any information collected from my child during the zoo visit may be used in future reports, articles or presentations by Miss Dick.

4. I understand that my child's name will not appear in any reports, articles or presentations.

5. I agree to my child's answers being used in the study.

6. I agree to my child being observed during the visit.

7. I agree to my child being audio-recorded during the visit.

_____	_____	_____
Name of Parent	**Date**	**Signature**
_____	_____	_____
Researcher	**Date**	**Signature**

PLEASE RETURN TO YOUR CHILD'S NATURAL SCIENCES EDUCATOR BY 12 August

Appendix B6 – Information sheet for Natural Science teacher

Dear Mrs Venter,

As you know, I am completing my master's degree at the University of the Witwatersrand and I would like to invite you to be part of my study on school trips to museums.

The purpose of the research

Every year I take the grade 8 learners on a field trip to the Johannesburg Zoo and I would like to improve the way in which these field trips are conducted so that there is meaningful learning but still enjoyment in the experience of the zoo. This study will help me identify which parts of the zoo visit are successful and which areas need to be improved. By being part of this study, you will help to make sure that the grade 8 learners experience the zoo in a meaningful and enjoyable way as well as assist in developing my professional practice.

What being involved requires of you

As you know every year the grade 8 learners go on a field trip to the Johannesburg Zoo where they spend the day exploring the park to answer questions on a worksheet. You will be doing the same field trip later this year and if you are willing to be involved in the study I would like to use your learners' answers in my research as well as observe how they go about completing the worksheet. Also, if you are willing, some of your learners will be asked to wear a small microphone to record the discussions their groups may have while answering the worksheet. Additionally, if you are willing, I would like to observe your pre- and post-visit lessons.

What I promise you

I promise you that:

- I will not use your name or reveal your identity in my research report
- all data I collect will be kept on a password protected computer and in a locked cupboard
- you do not need to participate if you do not want to
- you may withdraw from the study at any point
- if you choose not to participate you will not be disadvantaged in any way

How I can be contacted

If you have any questions or concerns please contact me at Waterstone College:

Telephone: 011 943 2682 or Email: jennad@waterstonecollege.co.za

Kind regards

Jenna Dick **Glenn Botha**

Appendix B7 – Informed consent form: Natural Science teacher

PARTICIPANT CONSENT FORM

I _____ the Natural Science educator at Waterstone College agree that (please place a ✓or **X** next to each statement):

1. I have read and understand the information sheet given to me by Miss Dick.

2. I understand that I do not have to participate and that I am free to withdraw at any time, without giving any reason.

3. I agree to Miss Dick observing my pre- and post-visit classroom lessons

4. I understand that any information collected from me during the pre- and post-visit lessons may be used in future reports, articles or presentations by Miss Dick.

5. I understand that my name will not appear in any reports, articles or presentations.

6. I agree to the study taking place during the annual trip to the zoo.

_____	_____	_____
Name of Participant	**Date**	**Signature**
_____	_____	_____
Researcher	**Date**	**Signature**

Appendix B8 – Letter to Johannesburg Zoo

To whom it may concern,

My name is Jenna Dick and I teach Life Sciences to the grade 10, 11 and 12 learners at Waterstone College. I am also completing my master's degree at the University of the Witwatersrand and I would like to invite you to be part of my study on school trips to museums.

The purpose of the research

Every year I take the grade 8 learners on a field trip to the zoo and I would like to improve the way in which I conduct these field trips so that learning during the visit is meaningful but still enjoyable. This study will help me identify which parts of the zoo visit are successful and which areas I need to improve. By being part of this study, you will help me to develop my professional practice.

What being involved requires of you

Every year the grade 8 learners go on a field trip to the zoo where they spend the day exploring the park to answer questions on a worksheet of my own design. This annual field trip will take place later this year. If you are willing I would like to conduct this study at the Johannesburg Zoo. Learners will be observed answering the worksheet as well as their conversations audio-recorded.

What I promise you

I promise you that:

- all data I collect will be kept on a password protected computer and in a locked cupboard
- I will make every effort to ensure that my learners follow the rules stipulated for visits to the zoo.

How I can be contacted

If you have any questions or concerns please contact me at Waterstone College:

Telephone: 011 943 2682 or Email: jennad@waterstonecollege.co.za

My supervisor, Dr Anthony Lelliott, can be contacted via email: Tony.Lelliott@wits.ac.za

Kind regards

Jenna Dick

Appendix C: Completed worksheets analysis results

Appendix C1 – Analysis of completed worksheets from the first zoo visit (Worksheet A)

Question number	Mark allocation	Total number of groups per mark allocation							Omitted
		6	5	4	3	2	1	0	
1.1	1						9	1	0
1.2	2					1	8	1	0
1.3.1	1						3	7	2
1.3.2	2					9	0	1	1
1.4	1						7	3	1
1.5	2					4	4	2	1
1.6	1						10	0	0
1.7	4			0	5	3	1	1	1
1.8	5		0	1	5	0	1	3	0
1.9	1						5	5	1
1.10	2					0	2	8	2
2.1	1						8	2	1
2.2	1						7	3	1
2.3	3				3	2	4	1	1
2.4	2					6	4	0	0
2.5	5		1	4	1	3	1	0	0
2.6	1						9	1	0
2.7	1						9	1	1
3	6	1	1	0	0	2	3	3	0

Question number	Mark allocation	Total number of groups per mark allocation							Omitted
		6	5	4	3	2	1	0	
4.1.1	2					10	0	0	0
4.1.2	2					8	0	2	0
4.2	1						4	6	4
4.3	1						1	9	4
4.4	1						2	8	1
4.5	1						0	10	7
4.6	4			4	1	3	1	1	1
4.7	1						6	4	2
5.1	2					5	5	0	0
5.2	4			0	2	2	6	0	0
5.3	2					3	1	6	0
5.4	2					6	3	1	0
6	5		0	0	0	4	3	3	2

Appendix C2 – Analysis of completed worksheets from the second zoo visit (Worksheet B)

Question number	Mark allocation	Total number of groups per mark allocation							Omitted
		6	5	4	3	2	1	0	
1.1	1						10	1	0
1.2	2					2	9	0	0
1.3	1						6	5	0
1.4	2					8	3	0	0
1.5	2					2	1	8	5
1.6	1						8	3	1
1.7	2					2	2	7	0
1.8	2					2	8	1	0
1.9	2					2	9	0	0
1.10	1						11	0	0
1.11	2					1	2	8	1
1.12	3				1	1	2	7	3
1.13	2					5	6	0	0
2.1	1						11	0	0
2.2	1						9	2	0
2.3	3				0	6	5	0	0
2.4	2					5	4	2	2
2.5	1						9	2	0
3	6	0	0	4	1	0	3	3	0

Question number	Mark allocation	Total number of groups per mark allocation							Omitted
		6	5	4	3	2	1	0	
4.1.1	2					10	1	0	0
4.1.2	2					10	1	0	0
4.2	1						7	4	2
4.3	1							10	1
4.4	1						1	9	0
4.5	1						2	8	0
4.6	4			2		7	2	0	0
4.7	1						6	4	2
4.8	4			0	3	4	0	3	3
5.1	2					6	4	1	1
5.2	2					2	2	7	1
5.3	2					0	4	7	2
5.4	1						9	2	1
6	5		0	4	0	3	1	3	3

Appendix D: Analysis of on-task learner conversations raw data

Figure D1: Total number of ToD utterances coded for Group A

Question number	Total number of utterances	Number of utterances coded					
		Lower	Medium	Higher	Affective	Procedural	Un-coded
1.1 – 1.3	78	15	14	0	5	30	14
1.4 – 1.5	No evidence in transcript						
1.6	22	1	0	0	1	14	6
1.9 – 1.10	No evidence in transcript						
2.1 – 2.3	No evidence in transcript						
3.1	109	4	19	0	16	22	48
6	23	0	4	0	0	14	5

Figure D2: Total number of ToD utterances coded for Group B

Question number	Total number of utterances	Number of utterances coded					
		Lower	Medium	Higher	Affective	Procedural	Un-coded
1.1 – 1.3	60	6	11	0	14	11	18
1.4 – 1.5	14	4	2	0	1	1	5
1.6	50	12	0	0	11	11	22
1.9 – 1.10	8	1	0	0	2	2	0
2.1 – 2.3	37	2	1	0	10	10	14
3.1	65	10	7	0	5	5	19
6	3	0	0	0	0	0	0

Figure D3: Total number of ToD utterances coded for Group C

Question number	Total number of utterances	Number of utterances coded					
		Lower	Medium	Higher	Affective	Procedural	Un-coded
1.1 – 1.4	89	16	13	0	9	37	14
1.5 – 1.6	7	0	2	0	0	3	2
1.7	50	2	4	0	18	13	13
1.11 – 1.13	11	0	0	0	0	8	3
2.1 – 2.4	81	15	11	3	9	32	11
3.1	27	6	1	0	10	7	3
6	45	0	0	20	0	12	13

Figure D4: Total number of ToD utterances coded for Group D

Question number	Total number of utterances	Number of utterances coded					
		Lower	Medium	Higher	Affective	Procedural	Un-coded
1.1 – 1.4	41	3	16	0	0	15	7
1.5 – 1.6	No evidence in transcript						
1.7	26	0	15	0	1	4	6
1.11 – 1.12	No evidence in transcript						
2.1 – 2.4	153	25	5	20	11	52	40
3.1	44	0	9	0	0	18	17
6	10	0	0	0	0	7	3

Figure D5: Total number of NoD utterances coded for Group A

Question comparison code	Total number of turns	Number of turns coded					
		Cumulative	Exploratory	Disputational	Parallel	Simple dialogue	Monologic
1(a)	50	23	0	4	0	20	3
1(b)	17	0	0	0	0	17	0
2(a)	0	0	0	0	0	0	0
3(a)	68	30	13	0	0	22	3
6(a)	15	0	0	0	0	0	15

Figure D6: Total number of NoD utterances coded for Group B

Question comparison code	Total number of turns	Number of turns coded					
		Cumulative	Exploratory	Disputational	Parallel	Simple dialogue	Monologic
1(a)	34	5	0	0	15	14	0
1(b)	30	0	0	0	11	18	1
2(a)	40	0	0	0	0	40	0
3(a)	52	11	0	0	32	7	2
6(a)	3	0	0	0	0	3	0

Figure D7: Total number of NoD utterances coded for Group C

Question comparison code	Total number of turns	Number of turns coded					
		Cumulative	Exploratory	Disputational	Parallel	Simple dialogue	Monologic
1(a)	58	26	0	0	18	14	0
1(b)	28	8	0	0	18	2	0
2(a)	58	0	29	0	17	12	0
3(a)	16	0	0	0	14	2	0
6(a)	32	28	0	0	3	0	1

Figure D8: Total number of NoD utterances coded for Group D

Question comparison code	Total number of turns	Number of turns coded					
		Cumulative	Exploratory	Disputational	Parallel	Simple dialogue	Monologic
1(a)	27	19	0	0	0	7	7
1(b)	17	10	0	0	7	0	0
2(a)	110	53	37	0	0	26	1
3(a)	24	0	24	0	0	0	0
6(a)	10	0	0	0	10	0	0