My study investigated the Grade 10 to 12 Life Sciences curriculum support materials written for the newly implemented CAPS curriculum. This chapter first provides an appraisal of my study. A summary and the insights arising from the findings are then provided. The potential significance of the study to different stakeholders then follows. Finally, this chapter concludes by providing the recommendations on how the findings of this study may be used as a foundation for future research. Figure 17 shows an overview of Chapter 5.

**Figure 17: Overview of Chapter 5**

### 5.1 APPRAISING THE STUDY

According to Hill and Spittlehouse (2009, p. 1) "[c]ritical appraisal is the process of carefully and systematically examining research to judge its trustworthiness, and its value and relevance in a particular context." These authors point out that appraising a study is an important step in a given research endeavour. Examining “… research methodology, scrutinizing its data collection and analysis methods, and evaluating how its findings are presented will help you to determine whether that article’s conclusions should influence practical decision-making” (Hill & Spittlehouse, 2009, p. 3). In this study, appraisal involves an assessment of the credibility of the study by focusing on the strengths and limitations of the methodological approach used. This information may be used by readers in three ways. The first is to decide how rigorous the study was, which can be used to decide on the
credibility of these research findings. Secondly, this appraisal information may be used by other researchers who might like to conduct content analysis of curriculum documents, so that their methodological designs can avoid weaknesses encountered and highlighted in this study. Thirdly, it can be used to make decisions on whether to use findings from this study to inform educational practices because, according to Hill and Spittlehouse (2009, p. 4), "it is crucial to critically evaluate research evidence in order to facilitate evidence-based practice, which is the use of the best evidence available to guide decision making and program design."

5.1.1 Strengths of the study

Measures were taken throughout the entire study to maximise the credibility of my results. Chapter 3 provides specific aspects on reliability and validity for this research and these are highlighted once more to give the reader a holistic perspective of how rigour was applied throughout the entire study. Because, according to Lincoln and Guba (1985, p. 301), certain activities or steps taken by the researcher can increase "the probability that credible findings will be produced", in this study a number of steps were taken to maximise the credibility of the research results as outlined in Figure 10 of Chapter 3. Firstly, all the chapters and document sections to be investigated were selected by the researcher and checked by a biology education expert. Discussions ensued where selections did not match, until agreement was reached. This helped to ensure that no relevant sections were omitted and no irrelevant sections were included.

Secondly, the coding system, the structure of the data capture sheet, and the checklist were checked through cycles of face validation. The face validation involved checking whether, according to expert opinion, these three data collection instruments would be likely to collect data in accordance with what they were expected and designed to do.

Thirdly, piloting the textbook and teacher guide coding system and the data capture sheet. The purpose of the pilot studies involving the textbook and the teacher guides was to see if a) the coding systems catered for all the types of errors identified in the documents and b) the data capture sheets were able to accommodate all the problems found during content analysis.

Fourthly, prolonged engagement with data: According to Fetterman (1989), prolonged engagement with the data (working on the data for a long time) has a positive effect on maximising the validity of research results, as errors are more likely to be picked up. Working on the captured data in the capture spread sheets for more than 18 months enabled me to identify possible data capture errors and rectify them.

Fifthly, frequent debriefing: In this study, I was involved in frequent debriefing sessions with my project supervisor on key aspects such as developing and face validation of the research instruments, coming up with the initial coding system based on ideas found in the literature, piloting the study, data analysis or coding each document, capturing the coded text sections, and reporting and discussing the results. This frequent debriefing helped to scaffold my research through the provision of expert guidance on all the critical steps of my investigation.

Lastly, investigating the whole population instead of using a sample: Because in this study the whole population was used instead of a sample, this had the merit that the findings of this study did not have to be generalised as they are applicable to the entire population of CAPS Life Sciences curriculum support materials for Grades 10 to 12 on the Department of Education’s approved list at the time of the sampling (January 2014).
5.1.2 Limitations of the study

Despite taking all precautions the researcher may deem necessary, rigour may only be maximised and not guaranteed (Gottschalk, 1995). There are advantages of spelling out the limitations of a given research study. Firstly, this can help other researchers who may wish to do the same study in the same or different context to avoid or counter the shortfalls highlighted. Secondly, because research and practice relies on current science research knowledge (Douglas & Altman, 2002), users of such new ideas may have the opportunity to decide whether to use the particular research findings taking into account its limitations. Some limitations of this study include:

Firstly, because during photocopying two pages of each curriculum document investigated were shrunk onto a single A4 page, commenting and coding by two coders on the same document page resulted in a lot of comments that made it difficult to identify codes during data capture and accuracy checks (i.e. negative effect on reliability if some codes happen to get missed).

Secondly, inter-coder reliability checks were not done on all the documents investigated in this research. Because the errors made by one coder are usually countered by the second or third coders, this advantage may not have applied in those documents where inter-coder reliability was not done.

5.2 SUMMARY OF THE KEY FINDINGS AND INSIGHTS FROM THIS STUDY

Gallaudet University (2014, p. 1), points out the benefits which come with providing a summary of the key findings of the research study as being that it “… not only reduces the amount of data needed to digest, but it increases the ability to …” digest the data.

A summary of the key findings from this study is presented under three sub-headings:

5.2.1 Frequencies of manifest errors in the CAPS document, textbooks and teacher guides:

Most of the misconceptions which emerged from the textbook seemed to be associated with misunderstanding the mechanisms of evolution. Whilst no misconception under his category was found in the CAPS document, a total of 21 misconceptions associated with misunderstanding the mechanisms of evolution occurred 129 times in the textbooks (see Table 8 of Chapter 4). In the teacher guides, 17 misconceptions in this category occurred 58 times (see Table 11a of Chapter 4). Misconceptions under this category were also prevalent in the previous NCS curriculum: n=16 in six NCS Life Sciences textbooks (Tshuma, 2012); and n=12 in the six RNCS Natural Sciences textbooks investigated (Makotsa, 2012).

Misconceptions associated with religious beliefs: Only one misconception associated with religious beliefs (‘Alternatives to evolution’) was found across the three types of curriculum support materials (the CAPS document, textbooks, and the teacher guides).

Misconceptions associated with misunderstanding of the nature of science: Only one misconception under this category was found in the textbook from P#3, and none was found in the CAPS document. The fact that only one misconception was found under this category in the Grade 12 textbook could be because details on the nature of science are covered in Grade 10 where an introduction to Life Sciences is made. For instance, a Grade 10 textbook from P#5 has a section on
page 3 entitled ‘How science works’. This section deals with what science knowledge is all about and how the scientific method is used to come up with science knowledge.

Four observations emerge from the data on manifest errors found in the CAPS document, textbooks and teacher guides. The first is that the misconception found in the CAPS document (associated with religious beliefs) was also found in the textbooks and the teacher guides (see Table 8 and Table 11a of Chapter 4). The idea of including ‘Alternatives to evolution’ was puzzling because this section looked at religious and cultural ideas, which are non-science. The ‘alternatives to evolution’ are possibly included as an attempt to afford recognition of indigenous knowledge systems as part of social integration involving the inclusion of ‘humanistic knowledge’ in the curriculum in the new South Africa. It would have been appropriate to include an explanation that ‘alternatives to evolution’ are not scientific alternatives, but are belief systems of particular groups of people about how living things came to be there so as to prevent possible misinterpretations involving the thinking that creationist beliefs are acceptable to scientists. On page 9 of the CAPS document, under the sub-heading ‘Life Sciences as a School Subject,’ Life Sciences content is defined as: ‘... the study of life at various levels of organization ...’ (Department of Basic Education, 2011, p. 9). Thirteen disciplines which are related to Life Sciences are mentioned and these do not include theology.

The second observation is that none of the misconceptions associated with misunderstanding of the nature of science and mechanisms of evolution were found in the CAPS document. However, misconceptions associated with the misunderstanding of the mechanisms of evolution were prevalent in the textbooks and the teacher guides (see Table 8 and Table 11a of Chapter 4). This could be explained by two possible reasons. Firstly, the CAPS textbooks and teacher guides are probably modified versions of the NCS textbooks and teacher guides which focused on changes between the two curricula, and these modified versions did not include the sifting of evolution misconceptions which were in the NCS documents. Secondly, the idea of curriculum ‘slippages’ (discussed in detail in section 4.1.1 of Chapter 4), involving minor changes in the Life Sciences content may have occurred due to the unique interpretations by textbook writers and publishers when they made decisions about what information to include in their textbooks (perceived curriculum) based on the content found in the CAPS curriculum document (formal curriculum), a trend also noted elsewhere by Pinar (1978) and Goodlad et al. (1979).

The third observation is that some misconceptions had high frequencies in both the textbooks and the teacher guides (see Tables 8 and Table 11a of Chapter 4). Misconceptions which had high frequencies in both the textbooks and the teacher guides emerged as overgeneralisations probably associated with the ‘survival of the fittest’ or ‘adapt or die’ framework (discussed in Section 2.5.2 of Chapter 2). Teachers may think that such misconceptions are trivial wording matters, and not important. However, Barrass (1984) warns that misconceptions influenced by this framework are widespread in the science education literature and many teachers are unable to dispel them.

5.2.2 Frequencies of latent problems in the CAPS document, textbooks and teacher guides

Unsatisfactory explanations: A total of 5, 415 and 162 instances of unsatisfactory explanations were found in the CAPS document, textbooks and teacher guides respectively.

Five instances of unsatisfactory wording found in the CAPS document include ‘misleading wording’ or statements whose wording implies something incorrect. For example: Pressure leads to extinction or successful adaption (Department of Basic Education, 2011, p. 61). This statement is misleading in that it portrays ‘pressure’ as a purposeful force that is directional and leading towards extinction. Because
misconceptions may arise from science ideas which are not carefully presented in textbooks (Devetak & Vogrine, 2013), unsatisfactory explanations are potentially problematic as they could be misconstrued leading to the development of evolution misconceptions.

There were no instances of **anthropomorphic and teleological statements** in the CAPS document (see Table 9a of Chapter 4) but these were prolific in most of the textbooks and the teacher guides.

**Anthropomorphic statements** occurred 53 and 36 times in the textbooks and teacher guides respectively. Central to anthropomorphic reasoning is the inappropriate attribution of evolutionary changes to the environment or the intentional plans of an organism (Gregory, 2009). Such thinking has the potential to lead to the inaccurate idea that the environment causes evolution and that organisms evolve during their lifetime.

**Teleological statements** found in textbooks and teacher guides had frequencies of 69 and 11 respectively. Teleological reasoning is the inference that structures of organisms are purposefully designed for a particular purpose or to perform certain functions which benefit their possessors (Kampourakis & Zogza, 2007; Gregory, 2009). Tamir and Zohar (1991) state that most problematic teleological statements in science are associated with the complementarity between structure and function, a common and important theme in biology. Teleological statements on structure and function are problematic because they are often used without careful thought that they may lead to Lamarckian interpretation of evolution (Jungwirth, 1975). For instance, the inaccurate thinking that xerophytes developed thick cuticle so as to prevent water loss, rather than thinking that xerophytes loose less water because they have thick cuticle. Van Dijk and Reydon (2010) point out that Lamarckian thinking is an inaccurate alternative framework which has the potential to influence the development of a host of misconceptions about evolution.

Whilst Tamir and Zohar (1991, p. 58) point out that teleological and anthropomorphic reasoning may have “… a pedagogical heuristic value in helping students organize facts and better understand natural phenomena and processes,” Sanders (2014a) warns that teleological and anthropomorphic statements involving the concept of ‘adaptation’ and body structures of organisms being ‘designed so as to’ serve particular purposes are not just a simple semantic issue but a serious cause for concern because they seem to be associated with many misconceptions associated with the ‘evolution on demand’ framework.

**Use of risk terms:** Because ‘risk terms’ are words which need to be used when explaining science, their frequency count is not reported here. To avoid confusion and possible misinterpretation, ‘risk terms’ could be explained to the reader the first time they are used. If risk terms are not dealt with appropriately (explained to the reader), this is of concern because, as claimed by Sanders (2014b), they may be misconstrued and this may cause the development of misconceptions. However, in all the documents where the use of ‘risk terms’ was investigated (the CAPS document, Grades 12 textbooks and Grades 12 teacher guides), only one book from P#1 had evidence of such an explanation which attempted to avoid the problem of misinterpretations. This explanation involved the risk term ‘Cradle of Humankind’, a term open to the misconception that humans first originated in the Cradle of Humankind in South Africa.

> When scientists refer to the ‘Cradle of Humankind …, they are referring to the place where our earliest hominid ancestors have come from. Since the oldest hominid fossil has been found in Chad in central Africa, central Africa has a better claim to being the ‘Cradle of Humankind’ than South Africa’s Sterkfontein, Swartkrans, Kromdraai and Environ World heritage Site humankind” (Publisher 1, p. 230).
Such an explanation is necessary to avoid the misconception that humans originated in South Africa.

5.2.3 Teacher guides addressing teachers' PCK

Because textbooks are meant to emphasise content for the learners, they are not expected to address pedagogical issues on how to teach the topic of evolution. Teacher guides, however, were checked to find out if they assisted teachers with the pedagogical knowledge for teaching the topic of evolution in ways that could help to make the learning of this potentially problematic topic easier, and to address the problem of evolution misconceptions. Two observations emerged from this investigation.

Firstly, some teacher guides provided advice that promoted the teachers’ engagement into inappropriate practices. The use of debates during the teaching of evolution (n=6) was recommended in four of the seven teacher guides, and advising that students should be told to decide if evolution is ‘true’ (n=6) occurred in two of the seven teacher guides. However, the use of debates when teaching evolution is problematic as it implies that students should use debating as means of categorising scientifically acceptable ‘facts’ from non-scientific beliefs. Furthermore, the making of a choice between religion and evolution is a potential source of conflict amongst learners and may cause emotional stress to some students who may find themselves having to debate against what they believe in. Because for the past 150 years ago, scientists have come to accept that evolution happened/is happening and the only point they do not agree upon is on the mechanisms of how it occurs. Advising students to decide if evolution is true is an inappropriate attempt to reinvent the wheel as it takes the students thoughts from what the scientific community is dealing with at the moment.

Secondly, teacher guides varied in their approach to assisting teachers with the PCK for teaching the topic of evolution. Two of the teacher guides from P#1 and P#4 did not assist teachers with PCK for teaching the topic of evolution (see Table 12 of Chapter 4). Five of the teacher guides made attempts to assist teachers with the PCK for teaching the topic of evolution.

The teacher guides assisted teachers with the PCK for teaching the topic of evolution in the following ways: pointing out common evolution misconceptions (n=26; 4 out of 7 teacher guides); countering misconceptions by explaining where the error lies and giving the correct science (n=6; 2 out of 7); pointing out pre-requisite knowledge which ought to be learnt first in order to understand the topic of evolution (n= 8; 3 out of 7 teacher guides); suggesting the need to be sensitive to religious diversity (n=15; 5 out of 7 teacher guides); drawing teachers’ attention to potential problems for religious children (conflict between religious beliefs and the science) (n=3; 2 out of 7 teacher guides); warning teachers about specific difficult terminology (n=7; 1 out of 7 teacher guides); and advising teachers to be objective (not to influence learners by stating what they believe in) (n=2; 2 out of 7 teacher guides). Teacher guides that do not provide advice for teachers on the best teaching approaches for the topic of evolution disadvantage those teachers who use them, especially the novice ones in terms of assisting their students to deal with the problem of evolution misconceptions.

Some teacher guides seem to be aware of the need to guide teachers. The teacher guide from P#3 was the most helpful in this regard: it pointed out common misconceptions 14 times, warned teachers about specific difficult terminology for the students seven times, warned teachers about typical difficulties students encounter with the topic of evolution thrice, suggested the need for teachers to be sensitive to religious diversity among the learners nine times, and is one of the two guides that advised teachers to be objective and not influence students with their own religious beliefs when teaching evolution (see Table 12 of Chapter 4).
5.3 POTENTIAL SIGNIFICANCE OF THIS STUDY

The purpose of research in science education is to lead to ideas that inform and improve classroom practice (Novak, 1977). Empirical evidence shows that workshops on misconceptions about evolution for teachers significantly increased their awareness of such erroneous ideas (Ngxola & Sanders, 2009). The findings of my study will be shared through this dissertation, as post graduate work at this university is made available online. The results will also be shared with science education stakeholders through workshops, conferences, and science education journals so that they are informed about possible problems in the new Life Sciences curriculum documents.

My study is of significance to a number of stakeholders.

5.3.1 Potential importance, and recommendations for curriculum designers

A syllabus is important for teaching and learning (Parkes & Harris, 2002) because it is a guiding document for content depth coverage and student assignments (Matejka & Kurke, 1994), a permanent record of what students ought to do (Glassick, Huber, & Maeroff, 1997), spells out the sequence in which the content should be covered for enhanced student understanding (Leeds, 1992), and it is used to guide textbook writers when writing their books. Given these indispensable roles of a syllabus, it is inconceivable to have manifest errors, latent problems, fragmented ideas, and poorly sequenced content in the national curriculum document without all these key stakeholders (users of the syllabus) being made aware of the errors.

My study is important for the curriculum designers; they need to be made aware that the CAPS document contains manifest and latent errors. Furthermore, they need to be made aware that the misconception in the curriculum document is problematic as is has the potential to infiltrate to the student textbooks and teacher guides. This problem is compounded if the intended curriculum (CAPS) is made available for what Johnson et al. (2011 & 2015) term, using Bernstein’s terminology, ‘recontextualisation’ into the perceived curriculum (textbooks) within a short space of time. For instance, the CAPS document was published in 2011 and the first set of textbooks (Grade 10) were expected to be ready for use a year later (2012). Such a relatively short space of time may mean that authors may not have adequate time to revise their books for errors before publishing. This places students at risk of picking up the misconceptions from textbooks. This may help the curriculum document designers realise the need to revise the curriculum document so that it is free from manifest and latent errors.

5.3.2 Potential importance, and recommendations for publishers and textbooks writers

Because documents writers are entrusted with the role of educating the readers, they have “…. a responsibility to ensure that their publications are honest, clear, accurate, complete and balanced, and should avoid … selective or ambiguous reporting” (Wager & Kleinert, 2011, p. 2). My study revealed that both the textbooks and teacher guides from all the publishers contained actual misconceptions, as well as latent problems. Wager and Kleinert (2011, p. 5) point out that “[a]uthors should work with the editor or publisher to correct their work promptly if errors or omissions are discovered after publication”. The findings of this study could be used by authors and publishers of Life Sciences curriculum support materials when revising the next editions of their current documents so that their textbooks:

• are error free.
point out common misconceptions to the readers and provide correct scientific explanations to counter the pointed out misconceptions.

- provide an explanation the first time they use each risk term in the textbooks and reminding teachers (in the teacher guides) to reinforce this so as to avoid misinterpretation.

- avoid inadequate, incomplete, or misleading explanations because such statements have the potential to be misconstrued.

- are edited by publishers who use English as a first language so as to address language-related latent errors during publication.

In the case of the teacher guides, publishers could use findings from this study to produce guides that are error-free. In addition to the points listed above, teacher guides could improve on pedagogical content knowledge for teaching the topic of evolution by:

- summarising for teachers the topics which need to be taught before evolution can be taught (i.e. identify pre-requisite knowledge).

- warning teachers about difficult terminology.

- warning teachers that children find interpretations of timescales on phylogenetic diagrams difficult.

- avoiding implying that learners should decide for themselves if evolution is true.

- giving advice on how to be sensitive to the religious diversity of learners.

- drawing teachers attention to potential problems for religious children (conflict between religious beliefs and science).

- avoiding the use of debates about evolution when teaching evolution.

- advising teachers to be objective (not to influence learners by stating what they believe in).

5.3.3 Potential importance, and recommendations for other teachers, and me as a classroom practitioner

Because, as already pointed out, the ultimate purpose of undertaking any research is to yield results that can inform and improve practice (Novak, 1977; Hill & Spittlehouse, 2009), the results of this study are important for teachers. These results may provide teachers with information that might help them make efficient use of curriculum support materials during their teaching. As a classroom practitioner, I have been using the ‘approved’ teacher support materials with total conviction that they are error free. Because of the presence of evolution misconceptions in curriculum support materials, this study is important in that it helps me, and probably other classroom practitioners, realise that:

- before providing textbooks to learners for use as a learning support resource, it is important for the teacher to scrutinise them for errors because teachers have a role to filter misconceptions in the curriculum documents so that they do not get to their learners (Olakanmi & Baba, 1996, p.19).

- empirical evidence could assist them make decisions on the best Life Sciences textbooks to order for their students.

- it could be helpful for teachers to be aware of the types of manifest errors and latent problems (about the topic of evolution) in the textbooks they give to their students so that their teaching strategies can be aligned towards countering those errors.
• it could be helpful for the teacher to explain risk terms and language-related problems (to their students) that are not explained in textbooks. A problem arises if teachers do not explain language-related problems to students as confusion may arise (Merzyin, 1987) when their students misinterpret ideas during learning, which may lead to the development of misconceptions (Barrass, 1979, 1984).

5.3.4 Potential importance, and recommendations for Department of Education officials

The identification of manifest errors and latent problems in the CAPS document, textbooks and teacher guides on the Department of Education approved list is of significance to the Department of Education officials as they could use the information to:

• organise workshops for teachers in an attempt to make efficient use of their (the Department of Education) approved curriculum documents.

• realise that approval of textbooks takes more than just having textbooks that are presumed to be ‘CAPS compliant’. At the moment the criteria include meeting Curriculum and Assessment Policy Statement (CAPS) requirements in terms of “content knowledge”, “practical approach/ activities”, “form of assessment”, and “textbook design and layout” (Department of Basic Education Textbook Evaluation Form, n.d, p. 1). Because the CAPS document contains errors, the “content knowledge” criterion is too vague. The criteria for approving textbooks could include elaborations of the broad phrase “content knowledge” to include specific details to do with accurate content knowledge that is free of misconceptions. Information from this study may therefore be used by the Department of Education officials to revise the criteria used as a yardstick to approve or reject textbooks for use in South African schools.

5.3.5 Potential importance, and recommendations for other researchers

Rajasekar, Philominathan and Chinnathambi (2013, p. 31) point out the importance of having the research findings of a given researcher being shared so that they benefit other researchers:

“We do research by conceiving information and openings from important research papers published by other researchers in the topic of interest and continue in our own directions. The work of some other researchers might have formed the basis of our research. Similarly, our research outcomes should help other researchers. That is, the work should be such that it should invite others to read and more importantly use it and cite it in their research work. Our work should lead to recognition and respect. It should fetch joy and benefit others and as well as us”.

There are a number of methodological insights that arise from this study for other researchers who may want to do content analysis of school curriculum documents. Firstly, a study of Life Sciences textbooks by content analysis that includes the curriculum document and teacher guides tends to give a broader view of the nature and extent of the phenomenon being investigated rather than just investigating textbooks alone, as is common with most studies.

Secondly, there is an advantage if researchers do not predetermine all the codes they use for coding the data during content analysis. Codes used in this study were not imposed on the data from the start and many new codes emerged inductively during content analysis. This approach allowed a flexible coding system that suited and accommodated all types of problems found in all the curriculum documents.
Thirdly, there is an advantage to giving codes that represent similar misconceptions or related problems, numbers that are numerically close and which use the same letters of the alphabet for code categories that represent the same cluster of problems, as this allows easier identification of the codes from the coding system during content analysis. The abbreviated codes had a meaning known to the coders, e.g. MM codes represent those codes for ‘Misconceptions associated with the Mechanisms of evolution’; and MR codes for ‘Misconceptions associated with Religious beliefs.’

Fourthly, there is an advantage to coding documents using photocopies rather than coding and commenting on the original book during content analysis. The use of photocopies allows new copies to be made if the first copy becomes too messy with corrections after discussion between the coders, which may make it difficult to identify the codes or read the added comments during data capture.

Fifthly, there are two advantages to capturing data using electronic data-capture instruments after document analysis. It makes it easy to make corrections if mistakes are made during data capturing. Furthermore, direct quotes from the investigated documents can easily be transferred to the results analysis chapter from an electronic data-capture spreadsheet, instead of starting to type each of them from scratch (e.g. from a hard copy).

5.3.6 Filling a research gap

As far as I know, no research has been conducted in South Africa to investigate the recently introduced *Life Sciences* CAPS document, *Life Sciences* textbooks, and their respective teacher guides for evolution misconceptions. Elsewhere in the world, studies conducted on textbooks have focused on the depth of coverage of evolution in textbooks (e.g. Skoog, 1984; Rosenthal, 1985; Woodward & Elliott, 1987; Jiménez-Aleixandre, 1994; Linhart, 1997; Skoog & Bilica, 2002; Takayama & Wakabayashi, 2008; MacDowell & Nappo, 2012) and such studies did not involve an investigation of misconceptions. Other studies that have investigated science misconceptions in textbooks (e.g. Narendra & Veena, n.d; Selden, 2007) did not involve an investigation of the syllabus document (used in the context of their countries). Two other South African studies that investigated evolution misconceptions in textbooks and curriculum documents (Sanders & Makotsa, 2016; Tshima & Sanders, 2015) did not include an investigation of teacher guides. Furthermore, a literature review on studies on evolution misconceptions in teacher guides yielded no results. This study therefore helps to fill a research gap on evolution misconceptions in teacher guides.

This research showed that teacher guides could include details that may help teachers with the pedagogical content knowledge for teaching evolution by: pointing out common misconceptions; providing the correct science to counter specific evolution misconceptions; and pointing out typical difficulties students encounter when learning the topic of evolution. Teacher guides that do not address these aspects are deficient in terms of assisting teachers teach the topic of evolution.

5.4 RECOMMENDATIONS FOR FURTHER RESEARCH

The problem of evolution misconceptions in curriculum documents is a broad one as it is influenced by many stakeholders, including publishers, textbook writers, curriculum designers and the Department of Education. In order to provide an in-depth overview of the source and nature of evolution misconceptions in curriculum documents, future studies on content analysis of curriculum documents could involve:
• interviewing the curriculum document designers, authors and publishers of textbooks so that they share their insights in terms of the presence of misconceptions about evolution in the curriculum documents. The use of such an approach lies in what Shenton (2004, p. 66) terms “triangulating via data sources” which enables gathering of data to answer the same research question from more than one perspective which would assist in bringing a broader overview of the trends in the phenomenon.

• finding out the nature and extent of presumed ‘problems’ in the textbooks that were rejected and excluded from the ‘approved list’ by the Department of Education for being ‘CAPS non-compliant.’ This could help see whether the criterion used is actually accurate in helping excluding problematic textbooks from being used in South African schools.

• investigating whether students and teachers who use these curriculum documents which have misconceptions actually acquire these errors from the books.

• investigating the content on the discs which accompany the newly introduced CAPS textbooks. Most of the newly introduced Life Sciences CAPS text books have support information loaded on compact disks, which this study did not investigate.

5.5 CONCLUDING REMARKS

This study did not investigate whether the unscientific evolution ideas in the curriculum support materials actually influenced learners’ misconceptions about evolution, but looked at whether the materials had the potential to have such an influence. Devetak and Vogrine (2013) provide a summary pointing out that the way ideas are presented in textbooks, by authors and publishers, have the potential to influence users of those textbooks:

Author(s) of these educational materials, especially textbooks, can present the concepts in the form of text or different pictorial elements and can have an influence on developing students’ understanding of these concepts. With textbooks, authors and publishers can also influence teachers as they use them for lesson planning. … If the material is presented inadequately, it can cause the development of students’ mental models incorporating misconceptions (Devetak & Vogrine, 2013, p. 13).

The findings from this study found evolution misconceptions in the curriculum support materials. Because textbooks are generally considered as authoritative sources of knowledge (with accurate science ideas) upon which teachers and students rely (Carvalho et al., 2009; Barrass, 1984; Aguillard, 1999), the presence of misconceptions in the curriculum support materials poses a risk that users of such documents could pick up these misconceptions during teaching and learning (Devetak & Vogrine, 2013; Smith, diSessa, & Roschelle, 1993).

Latent problems were prevalent across all the three curriculum support materials. Readers of these documents could misinterpret these latent problems and as pointed out by Merzyin (1997), this has the potential to lead to the development of misconceptions about evolution.

The presence of manifest errors and latent problems in the investigated documents is a serious problem because curriculum support materials are supposed to be ‘catalysts for teaching’ (Ottevanger, 2001) and this important role is undermined if these support materials have errors. To address this problem calls for a multifaceted approach involving all key stakeholders: curriculum designers, publishers, textbook writers, Department of Education officials, and also some input from the ultimate users — teachers. These stakeholders may need to realise that “[b]ecause misconceptions affect the
way children understand a variety of scientific ideas” (Eaton et al., 1984, p. 366), there is a need for them to be aware of the nature and extent of misconceptions about evolution in the curriculum support materials. If these stakeholders became aware of these threats, they may see the need to work together to minimise these misconceptions in these documents. The threats posed by misconceptions on the understanding of science ideas cannot be underestimated, as noted by one of the most renowned scholar of all times:

“False facts are highly injurious to the progress of science, for they often endure long; …” (Charles Darwin, 1809-1882, cited by Chicago Style Citation, 2015).