July 2009

2008 Maintaining Standards Report

- English First Additional Language
- Geography
- Life Sciences
- Mathematics
- Mathematical Literacy
- Physical Science

Part 2: Curriculum Evaluation

UMALUSI

Council for Quality Assurance in
General and Further Education and Training

From NATED 550 to the new National Curriculum: maintaining standards in 2008

2008 Maintaining Standards Report

- *English First Additional Language*
- *Geography*
- *Life Sciences*
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- *Mathematical Literacy*
- *Physical Science*

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Council for Quality Assurance in
General and Further Education and Training

37 General Van Ryneveld Street, Persequor Technopark, Pretoria
Telephone: 27 12 3491510 • Fax: 27 12 3491511
Email: Info@umalusi.org.za • Web: www.umalusi.org.za

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This report was written by Dr Heidi Bolton and edited by Russell de la Porte.

The composite subject reports for the curriculum evaluation and exam paper analyses were initially compiled by Michelle Mathey (English FAL); Dr Peter Beets (Geography); Dr Edith Dempster (Biology/ Life Sciences); Lynn Bowie (Mathematics); Aarnout Brombacher (Mathematical Literacy); and Dr Sharon Grussendorff (Physical Science).

The evaluations and analyses were conducted by the following subject teams: Princess Bembe, Nandipha Nonkwelo, and Patience Voller, led by Michelle Mathey (for English FAL); John Ngobeni, Zamanyuswa Shabalala, and Peter Swart, led by Dr Peter Beets (for Geography); Elizabeth Cilliers, Peter Preethlall, and Susan Wiese, led by Dr Edith Dempster (for Biology/ Life Sciences); Dr Nicholas Heidemann, Williams Ndlovu, and Mariam Raju, led by Lynn Bowie (for Mathematics); Rajendran Govender, Hope Nkambule, and Benedict Tlala, led by Aarnout Brombacher (for Mathematical Literacy); and Don Francis, Akeda Isaacs, and Mmapaseka Stephen, led by Dr Sharon Grussendorff (for Physical Science).

The Umalusi Assessment and Statistics Committee served as the project reference group.

2008

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EXECUTIVE SUMMARY

Introduction

Most large-scale examination systems include measures to ensure consistency of learners' performance over periods of time. Umalusi currently manages a statistical moderation process whereby results obtained in final examinations by schools, colleges, and adult learners are adjusted to maintain reasonably consistent standards over time. Prior to 2008, this moderation included several measures such as adjusting raw scores on the basis of *norms* calculated from learner performance over three- or five-year periods; *pairs analysis* in which the average results for a particular subject in each instance are compared to the average results of all other subjects, in turn, for the same group of learners; and reports made by internal and external moderators.

In 2008 Umalusi needed to review its systems in this area – the main reason being that the first cohort of learners following the new curriculum for the *National Senior Certificate* (NSC) qualification had reached matric level. The first national exams for this new system took place at the end of 2008. What had to be addressed immediately was that there were no historical norms for the associated examination results. To ensure the integrity of these results, Umalusi had to have a valid understanding of the quality and levels of cognitive demand of the new curricula relative to those just superseded. Umalusi's Quality Assurance of Assessment (QAA) and Statistical Information and Research (SIR) units, together with the Statistics and Assessment Committee of the Umalusi Council, put in place a range of different strategies with regard to strengthening Umalusi's quality assurance of assessment in 2008. The overall strategy included the creation of new norms and in-depth research into the levels of difficulty of key curricula and their associated exams. These measures were aimed at NSC gateway subjects but due to budgetary and time considerations it was not possible to conduct research for all of these subjects, and the decision was made to focus the research on selected ones.

The research was specifically designed to provide Umalusi's Assessment and Statistics Committee with succinct information on the comparability of the old NATED 550 and new *National Curriculum Statement* curricula, and on the comparative difficulty of the exams associated with each. The intention was that the findings of the research involving in-depth curriculum evaluation and exam paper analysis be used to support the just use of *pairs analysis* and new norms in 2008. The aim was that all of this information would be used to adjudicate the standard of the new NSC exams in 2008, in relation to the standard of the previous *Senior Certificate* exams.

The available budget, time, and capacity meant that six subjects could be researched: the main (high enrolment) 'gateway' subjects used to assess suitability for entrance to tertiary institutions were selected. The subjects included in the research were English FAL; Geography; Life Sciences (previously Biology); Mathematics; Mathematical Literacy; and Physical Science.

The plan is to continue this research in the medium to long term. Over time the other NSC subjects will be investigated, as will the subjects in other qualifications such as the National Certificate Vocational (NCV).

Several assumptions underlay this research; first, that a comparison of the three intended curricula (NATED HG and SG, and the *National Curriculum Statement*) would provide an indication of whether the demands made by each are comparable. It was also thought that a comparison of the expressed requirements for the setting of final exit examinations would provide an indication of whether learners are required to perform at similar levels in the old and new examination systems. The underlying thought here was that the 2008 NSC exams would be posed at such a level that they would enable learners achieving at the level of 33.3% in the old Standard Grade exams to achieve 33.3% in the NSC papers. In addition, the new exams would also contain sufficient difficult items so that learners achieving at the highest levels would be earning results equivalent to the 'A

grades' achieved by previous learners at Higher Grade levels. In other words, it was expected that the new papers would contain items that distinguished accurately between learners with a range of academic proficiencies.

Teams of four researchers evaluated the NATED 550 Higher and Standard Grade, and *National Curriculum Statement* curricula for each subject. They also analysed all Higher and Standard Grade exam papers from 2005 to 2007, as well as the August 2008 exemplar and final papers for their subjects. In each case, the evaluators had to make myriad judgments prior to commenting on the respective levels of difficulty of the curricula and exams. Their final judgments are based on a series of prior judgments, for which they were required to provide trails of evidence in each instance. Research instruments used ensured consistency of reporting across individuals.

Some of the curriculum evaluation findings relate to the quality of the curricula in general, and serve to point towards the enhancement of the quality of those documents in their own right. Other findings from this evaluation pertain specifically to the levels of difficulty of the curricula and were of direct relevance for the 2008 standardisation. The exam paper analyses similarly led to some findings of immediate importance for the 2008 standardisation process, and others relevant for medium- to long-term refinement of the papers.

Main curriculum evaluation findings

There were many fine-grained findings relating to the respective subjects. Overarching trends in these findings, and recommendations, are reported in **Part 1** of this report. Detailed subject reports are presented in **Part 2** of the report.

Regarding determining the precise levels of difficulty of the respective curricula, in the process of making judgments on the relative levels of difficulty of the NATED 550 and NCS curricula, the subject teams drew on various aspects of their fine-grained analyses. All the teams drew, for example, on their findings relating to the specification, weighting, and foci of content and skill topics. The Physical Sciences, Mathematics, and Geography teams found that information on amounts and levels of difficulty of content and skill topics yielded solid evidence of the respective overall levels of difficulty of the curricula. The Mathematical Literacy team focused on cognitive types and levels of skills in order to make their decisions. The English FAL team compared degrees of specification of content and progressive increase in complexity of skills in their comparisons.

The Life Sciences team drew on a wide range of aspects including specifications for external assessment, when making their judgments. The Geography team included the nature of the organising principles, finding that the *transmission* of disciplinary knowledge and skills required in the NATED 550 curriculum was easier than the *application* of this knowledge and these skills in the NCS system.

In all, three teams (Physical Science, Life Sciences, and Mathematics) found their NCS curricula to be midway between the NATED 550 Higher and Standard Grade equivalents, in 50:50 proportions. It must be borne in mind that the Mathematics Curriculum does not include the content and skill assessed in Mathematics Paper 3. The Geography team found the NCS Geography curriculum between the NATED 550 Higher and Standard Grade levels, but closer to that of the Higher Grade, in a 60 Higher Grade : 40 Standard Grade relation. The English FAL team found the NCS curriculum for their subject more difficult than both the NATED 550 Higher and Standard Grade courses.

Main exam paper analysis findings: general comment on the difficulty levels of the 2008 final NSC papers

The subject teams commented accurately on the overall cognitive character and difficulty levels of the final 2008 *National Senior Certificate* exam papers in relation to their Higher and Standard Grade counterparts in the years 2005–2007, and August 2008 Exemplars, based on total counts ofitems or marks at specified cognitive type and difficulty levels.

Three teams (Physical Sciences; Life Sciences; and English FAL) gave differing fine-grained results for the respective final 2008 papers for their subjects, but on the *whole*, showed that the papers were closer to the old NATED 550 *Higher Grade* than the Standard Grade papers for the subjects. A fourth team (Geography) found that their 2008 final papers contained *more comprehension* and *problem-solving* questions than the previous Higher Grade papers for this subject – these (2008) questions being of a cognitively demanding type, and in addition, set at difficult levels.

Since Mathematical Literacy is a new subject and they had no previous papers to consider, the Mathematical Literacy team evaluated the 2008 final papers in relation to requirements in the *Subject Assessment Guidelines* for their subject. They found that while the spread of items in Paper1 roughly matched those in the *Subject Assessment Guidelines*, the percentage of questions at the lower cognitive levels in Paper 2 was almost three times higher than that recommended. They noted, however, that the pass rate for the subject would not be as high as expected from the levels of these questions, as a high proportion of the instructions to learners were ambiguous and confusing (see the booklet for Part 3 of this report for more detail).

The Mathematics team found the final 2008 papers closer to those of the old NATED 550 Standard than the Higher Grade papers. It must be remembered that the same content and skills were examined in Mathematics Paper 3, the question papers for which were not analysed as they were written by very few learners. However, the team noted that some of the questions regarded as reasonably straightforward were new in the NCS and thus might not have been experienced as easy by learners whose teachers were unfamiliar with the new content.

Comparability of A-grades in the NATED 550 Higher Grade and 2008 NSC papers

The subject teams commented, again based on accurate counts of the types and difficulty levels of items or marks in the exam papers, on whether the August 2008 exemplar and final papers allowed for learners who would have achieved A-grades in the old Higher Grade papers to achieve A-grades in the new NSC exams where the A-grades *were comparable to the old Higher Grade A's*.

Three Umalusi teams (English FAL; Geography and Physical Science) found that because the spread of types and levels of questions in the respective papers were similar, this pattern suggested that the A's in the 2008 NSC papers would be equivalent to A's in the NATED 550 Higher Grade papers. The Umalusi Mathematics team found that learners typically achieving at the level of high C's, B's and A's in the NATED 550 Mathematics Higher Grade exams would be able to score A's in the final 2008 NSC Mathematics papers. It was expected that the Mathematics Paper 3 would contain difficult questions, but this fact was not investigated in this research. It was found that the final 2008 NSC papers would not discriminate between top-end achievers in the subject, as the papers included on average only 22% rather than the 40% of higher cognitive-level questions recommended in the *Subject Assessment Guidelines* for the subject.

Whether the 2008 NSC papers allowed for learners scoring at levels of 33.3% in the old Standard Grade exams to pass

Notwithstanding the overall difficulty levels of the papers, two Umalusi teams (English FAL and Mathematics) found that certain percentages of the lower cognitive order *basic conceptual* items were similar to those in the old Standard Grade papers for the subjects, and would therefore allow learners achieving just-passing-Standard-Grade levels to pass. However, the team noted that some of the questions regarded as reasonably straightforward were on content that was new in the NSC and thus might not have been experienced as easy by learners, whose teachers were unfamiliar with new content. The Umalusi Mathematical Literacy team noted that while there were more than enough *easy* items to enable these learners to pass, the ambiguity of many questions would lower the pass rate from that expected, given the levels of the questions.

Three Umalusi teams (Geography, Life Sciences, Physical Sciences) found the proportions of *easy* items in the 2008 NSC final papers *lower* than those in the average Standard Grade papers for the

subjects. The Umalusi Geography team noted, for example, that the amounts of *basic conceptual* questions in the NSC papers were closer to percentages in the old Higher Grade than in the Standard Grade papers. The Umalusi Life Sciences team pointed out that the number of *easy* questions in the NSC papers was very close to that needed to pass, leaving very small margins for error at that level. The Umalusi Physical Science group found that it would be much harder for a learner achieving at this level to pass the 2008 NSC exams than it would have been to pass the Standard Grade exams: the 2008 final exams contained an average of 23% of *easy* items, while the average for the Standard Grade papers between 2005 and 2007 was 39%. The papers for these subjects would clearly have been very difficult for learners at the lower end of the achievement spectrum, and in the case of Physical Science, especially so.

Additional comment on the exam papers

The Umalusi subject teams commented on aspects of the exam papers other than their respective levels of difficulty. The relationship between the August 2008 exemplar and final papers was dealt with in each instance. The comparability of all the Higher Grade papers between 2005 and 2007 was considered. The degree of similarity of all the Standard Grade papers in that period was also looked at. The teams looked at the suitability of the 2008 NSC papers as models for future NSC exams, and considered language levels in these paper. These findings are discussed in **Part 3** of the report.

Conclusions and recommendations

Despite the inclusion of only six subjects - rather than the full range of national subjects - in the research, the project provided meaningful results for the short, medium and long term. Having an accurate evidence-based idea of the levels of difficulty of the curricula and exams assisted the standardisation process, providing means for triangulating results in relation to the research Findings; the new norms; and patterns shown through *pairs analysis*. As elaborated in **Subsection 8.1 (Part 1 of the report)**, it was possible to extend the reach of the findings by comparing learner performance in non-researched similar subjects with their performance in the researched subjects, for which there were clear descriptions of difficulty levels. The usefulness of the Umalusi evaluation instruments was confirmed in the curriculum and exam analyses.

Regarding the overall findings of the current study, four overarching comments are made. First, in terms of the levels of difficulty of the six new NCS curricula evaluated: three of these curricula (those for Life Sciences, Mathematics and Physical Science) are judged to be midway between the NATED 550 Higher and Standard Grade curricula *overall*, but at the same time have pockets of difficulty that far exceed difficulty levels in the previous Higher Grade curricula. Again, it must be borne in mind that the Mathematics Curriculum *does not include* the content and skill assessed in Mathematics Paper 3. A fourth curriculum (Geography) was found to be closer to the old Higher Grade than Standard Grade level. A fifth curriculum (English FAL) was found, because of its greater degrees of specification, to be *effectively* more difficult than the NATED 550 curricula. The sixth curriculum (that for Mathematical Literacy) was found to be so different to the NATED 550 Higher and Standard Grade Mathematics curricula that comparison was not possible.

A second major overarching finding of the research was that exam papers were *variable*. There may be broad trends - such as those showing the relatively high proportions of *difficult problem solving* questions in Higher Grade papers over the years and the relatively high proportions of *easy basic comprehension* questions in Standard Grade papers over time - but the study shows that *within these trends*, there was considerable variation in the *overall* difficulty levels of the papers.

The fact that exam papers were *not necessarily uniformly difficult* or *easy* comprises a third significant finding.

The fourth important aspect highlighted by the current study is the integrity of the Umalusi standardisation processes. No fewer than *six* means are utilised to increase the validity and reliability of these processes. When making standardisation judgments, the reports of internal and

external moderators; patterns shown in *pairs analysis*; norms showing learner performance trends over five years; systematic evaluation of associated curricula; and rigorous analysis of the exam papers, item by item, were considered in turn and then triangulated where patterns *between* the measures were taken into account.

The main recommendations regarding the curriculum are that the current set of NCS documents per subject are rationalised into single or, at most, two coherent documents per subject – and that these new documents be made universally available to *all* schools, in soft or hard copy form, as suits the contexts of the schools. There is also a need - in all subjects - for more guidance regarding teaching in differing social contexts; clarity regarding what comprises different kinds of assessment tasks and how to assess them; and teacher development of subject-appropriate assessment tools.

This guidance needs to feature in the curriculum documents themselves, as well as in teacher development workshops. Beyond these overarching curriculum recommendations, the Umalusi subject teams have also made important subject-specific suggestions.

Structure of this report

The report is structured in three Parts. **Part 1** gives an overview of the whole project and is made up of nine subsections. **Subsection 1** introduces the reader to the project. **Subsection 2** sketches the broader background informing the curriculum evaluations and exam paper analyses. **Subsection 3** presents the research questions for the evaluations. **Subsections 4 and 5** detail how the analyses were conducted and describe selection of the sample of subjects for which curricula and exams were analysed. **Subsections 6 and 7** outline broad trends in the findings of the curriculum evaluation and exam paper analysis respectively. **Subsection 8** reports on the uses and usefulness of the research, and its limitations. Concluding comments are made in **Subsection 9**.

Part 2 of the report is a separate booklet focusing on the *curriculum evaluation*. It starts with a brief introduction and reiterates the research questions, methodology followed for the evaluation and the selection of the subjects for evaluation. Most of this booklet is devoted to the individual in-depth reports on the curricula for English First Additional Language (English FAL), Geography, Life Sciences, Mathematics, Mathematical Literacy and Physical Science. Trends between the analyses are reiterated.

Part 3 of the report – the separate booklet focusing on the *analyses of the exam papers* – also starts with a brief introduction and reiterates the research questions, methodology followed for the analyses and selection of the exam papers for analysis. The bulk of this booklet focuses on the individual detailed reports on the exam papers for English FAL, Geography, Life Sciences, Mathematics, Mathematical Literacy and Physical Science in the period 2005–2008

PART 2

LIST OF ACRONYMS

Acronym	Meaning
NSC	*National Senior Certificate*
NCV	*National Certificate: Vocational*
FAL	*First Additional Language*

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1. INTRODUCTION

Although Umalusi regularly conducts curriculum evaluations towards the goal of enhancing the quality of curricula and qualifications within its ambit, the current curriculum evaluation, in addition, formed part of the measures adopted for ensuring the maintenance of standards at the end of 2008 when the first examinations for the new *National Senior Certificate* were written.

Most large-scale exam systems include measures to ensure consistency over periods of time. Umalusi's current statistical moderation process required urgent reviewing in 2008 for two reasons: First, there had been widespread criticism of its usual approach, for which it was claimed that there was too heavy an emphasis on statistics, with insufficient qualitative input. Second, there were new curricula and qualifications – the *National Senior Certificate* (NSC) and *National Certificate: Vocational* (NCV) – introduced at secondary school and college levels respectively. The first national exams for these new systems took place at the end of 2008, and there were no historical norms for the associated examination results. Further, to ensure the integrity of these results, Umalusi had to have a valid understanding of the quality and levels of cognitive demand of the new curricula, relative to those just superseded. In short, an accurate idea of the standards of the new curricula in relation to the previous Higher and Standard Grade curricula was needed.

Umalusi's Quality Assurance of Assessment (QAA) and Statistical Information and Research (SIR) units, together with the Statistics and Assessment Committee of the Umalusi Council, put in place a range of different strategies with regard to strengthening Umalusi's quality assurance of assessment in 2008. These measures were aimed at both NSC and NCV subjects. Part of this overall strategy involved conducting in-depth research into the quality, type and levels of cognitive demand in the respective curricula in order to ascertain their relative levels of difficulty. The intention of this research was to utilise the expertise of teams of subject experts to establish sound, theory-based and logically argued evidence-based judgments of the relative levels of difficulty of both the intended and examined curricula. The aim was that the findings of the research be used to further strengthen the use of pairs analysis and new norms.

Due to budgetary and time considerations, it was not possible to conduct research for both the NSC and NCV in 2008. Given the critical national importance of maintaining standards in the NSC and the sheer numbers enrolled for this qualification, the decision was made to focus this research on selected NSC subjects. The range of measures adopted to ensure the fairness of the NCV exams is documented elsewhere. A description of the strategies for maintaining standards in the NSC exams – the creation of new norms, evaluation of selected curricula and analysis of past and 2008 exam papers – is covered in Part 1 of the current report. This part of the report documents the curriculum evaluation in detail.

The main purpose of this part of the research was to provide Umalusi's Statistics and Assessment Committee with succinct information on the comparability of the old and new curricula. It was the intention that this information be used together with the findings of the exam and pairs analyses, and the new norms to adjudicate on the standard of the new NSC exams in 2008, in relation to the standard of the previous *Senior Certificate* exams.

Ideally, the subjects to be analysed by teams of evaluators would have been the so-called "gateway" subjects – subjects for which learner performance is assessed for entry to tertiary institutions – such as English Home Language, Afrikaans Home Language, English First Additional Language, Afrikaans First Additional Language, Mathematics, Mathematical Literacy, Biology/Life Sciences, Physical Science, Geography, History, Accounting, Economics, Business Economics and Agricultural Sciences.

The available budget, time, and capacity meant that six subjects could be researched, and a decision was taken to base the selection of these subjects on enrolment numbers. The subjects included in the research were English FAL, Geography, Life Sciences (previously Biology), Mathematics, Mathematical Literacy and Physical Science.

Three assumptions are worth noting here. The first was that a comparison of the three intended curricula (the NATED 550 Higher and Standard Grade curricula and the *National Curriculum Statement*) would provide an indication of whether the demands made by were comparable. It was assumed at the start of the project that the old and new curricula did require comparable levels of knowledge and skill in order to pass.

A second assumption was that if all of the related research findings were presented in a sufficiently clear and systematic manner, they would be able to support the Umalusi Statistics and Assessment Committee in making the decisions associated with the fairness, reliability and levels of the new 2008 examinations.

Finally, it was expected that the analysis of the intended curricula would range beyond the immediate requirements of the Umalusi Statistics and Assessment Committee. It was intended that the reports on the curriculum analyses provide useful formats for meaningful comparison across curricula in future. In addition, it was hoped that the findings of the Umalusi subject teams would become input for future curriculum refinement.

Structure of this part of the report

This report is the second of three for the 2008 *Maintaining Standards* project. Part 1 gives an overview of the whole project; Part 2 reports in detail on the curriculum evaluation; and Part 3 reports in detail on the exam analysis. This Part 2 of the report consists of an introductory section, followed by the in-depth reports for each subject. It then briefly draws together some trends across the curricula for different subjects. These overarching trends are dealt with in greater depth in the *Overview* section (Part 1) of this report. This Part 2 report closes by reiterating the main recommendations spelled out in more detail in the *Overview* part of the report, and makes some concluding comments.

2. QUESTIONS THE CURRICULUM EVALUATION MUST ANSWER

There were four evaluators per subject. Evaluators knew that they were evaluating each curriculum comprehensively in its own right. They were given lengthy research instruments consisting of sets of questions, on which they had to report in highly specified ways, in the tables provided as well as in specified paragraphs with specific word counts. There were eight *sets* of questions in all; these sets comprising some 75 sub-questions in total (see Part 1 of this report for more detail regarding the research tool and methodology followed, including Appendix 2 for that part of the report).

Evaluators were asked to draw on their own responses in the remainder of the instrument when answering the main research questions, which were presented as concluding tasks. Umalusi insisted that all responses to these *concluding tasks* be based on evidence emerging from the preceding 75 sub-questions, so that there would be a comprehensive and systematic paper trail for each set of findings.

The two specific research questions (or concluding tasks) for the curriculum evaluation were:

1. Is the assumption that the NATED 550 curricula and the *National Curriculum Statement* require similar levels of knowledge and skill in order to pass, a justifiable assumption? Regarding the levels of cognitive difficulty comprised by the three curricula: In an overall sense, how do the *National Curriculum Statements* rank against the NATED 550 Higher Grade curricula and the NATED 550 Standard Grade curricula respectively? Are the NCS curricula comparable to the Higher Grade or Standard Grade curricula, or to mixtures of the two previous curricula? If the level of difficulty of the NCS curriculum for the subject in question is somewhere between that of the earlier Higher Grade and Standard Grade curricula, in what proportions are the respective percentages of the levels of each of the earlier curricula? How should they be rated? For example, would it be, say, 60:40 HG to SG – based on actual counts of ratings recorded for all preceding sets of questions?

2. Based on your whole evaluation of all of the aspects of the curriculum featuring in the Umalusi curriculum evaluation instrument, what would your comments and recommendations be to the Department of Education regarding the curriculum for your subject?

Evaluators were encouraged to critique this Umalusi evaluation instrument itself; and, while they were required to adhere to its basic structure and detail, they were also asked to customise parts that needed to be adapted for particular school subjects. Differences between subjects emerge in this detailed curriculum report, as well as in Part 3 of this report.

3. HOW THE CURRICULUM DOCUMENTS WERE ANALYSED

In order to answer the curriculum-related research questions outlined in the previous subsection, it was intended that the Umalusi teams of four evaluators per subject would evaluate and compare the NATED 550 Higher and Standard Grade curricula underpinning the pre-2008 *Senior Certificate* examinations on the one hand, with the new *National Curriculum Statements* and related documents on the other.

The intention was that each team member would complete a report in the required format, that Umalusi would review these reports, and once finalised, that the team leaders would create composite reports for their subjects, based on the integration of all the individual reports in their teams. Evaluators were briefed as a group and were assisted to come to shared understandings of the task and tools required in their subject groups, but carried out the actual evaluations individually. One composite report was compiled per subject; these reports form the basis of the detailed reports in Sub-section 5, below. The research methodology followed is spelled out in more detail in the Part 1: *Overview* of this report (see Subsection 4, Part 1: *Overview*).

The inputs needed for the evaluation; outputs expected; discussion of the research instrument; and challenges emerging in relation to the *research processes* are dealt with briefly here: fuller discussions of these aspects feature in Subsection 4 in Part 1: *Overview* of this report.

3.1 INPUTS NEEDED

Three areas of input were required to conduct the current research. First, teams of experts were needed to carry out the evaluations. It was imperative to choose experienced individuals for this task; individuals who had worked for sufficient numbers of years to have detailed inside knowledge of both the NATED 550 and NCS systems. Individuals were also chosen for their ability and willingness to engage with Umalusi's theoretical tools. Each team comprised:

- An Umalusi moderator – one who had been an Umalusi moderator for at least five years. This person was to be present at the relevant 2008 standardisation meetings;
- A subject methodology expert from a university school of education – a person with at least three years of experience in that position;
- A subject advisor – an individual with at least five years of experience in that position;
- A teacher – an individual considered by subject advisors to be an excellent teacher, with at least 10 years' teaching experience *and* a year or two of exam marking experience. This teacher also needed to have taught at a school or schools in lower middle-class or working class contexts for at least two of the 10 years.

Second, the full array of NATED 550 and NCS documents per subject were needed for the curriculum analyses. Challenges related to sourcing this documentation are outlined in Subsection 4 of Part 1: *Overview* of this report, and are not addressed here. The documentation comprised:

- NATED 550 syllabus documents for the Higher- and Standard Grade (HG and SG) versions of the curriculum. Those previously used by House of Representatives schools were utilised, since these

documents were the most easily available ones and were thought to be potentially the most comprehensive;
- Examination-setting guidelines for NATED 550 HG and SG, where in existence.
- *National Curriculum Statement* for Grades 10 – 12, January 2008
- *Subject Assessment Guidelines* for Grades 10 – 12, January 2008
- *Learning Programme Guideline* for Grades 10 – 12, January 2008
- Instructions to examiners for the setting of the 2008 exams

The third input comprised research instruments for the curriculum and exam analyses. These instruments were adapted to become the reporting tools (The full instruments are presented in Appendix 2 of Part 1: Overview of this report).

3.2 OUTPUTS EXPECTED

With the submitting of individual curriculum and exam reports by the 24 evaluators, it was expected that each of these reports conformed to Umalusi expectations. In other words, each evaluator was expected to have included evidence for *all* of the many judgment tasks required, and arguments supporting their conclusions based on the evidence of their own judgments, in the reports. The process whereby versions of reports were refined until they included all of this information was followed to this end.

The fact that each evaluator was required to work individually is seen by Umalusi as increasing the credibility of the research. The composite reports constitute the *combined* results of the judgments and reasoning of four very experienced individuals in each instance. Further, if the four experts could independently come up with similar judgments, the Umalusi research instruments would be shown to be *reliable*. It was the intention that team leaders take into account the judgments of all of their team members when compiling their composite reports, and take these composite reports back to their team members for comment before submitting drafts to Umalusi.

It is expected that the composite curriculum reports, capturing as they do the combined views of all team members and being predominantly discursive in form, are valid and reliable. Where team member's judgments overlap, the views can be presented in straightforward ways. Where these judgments are complementary, narrow views can be expanded. Where judgments are contradictory, opposing views can be articulated and the merits of each argued. Team leaders were, in fact, encouraged to capture any differences that emerged. The fact that there are four experienced voices commenting fully and critically in each instance guarantees a certain degree of validity.

3.3 RESEARCH INSTRUMENTS

The full Umalusi curriculum and exam paper evaluation instruments are presented in Part 1 of this report, and will not be discussed in detail again here. Evaluators were asked to analyse the depth and breadth (the spread and weighting) of content topics and skills in the curricula for their subjects in specific ways. They considered individual content and skill topics, and analysed the overall structuring of content and skills in the documentation for their subjects. They looked at specified texts, where applicable; at organising principles and coherence in their curricula, and at sequencing, progression, and pacing within and between the years of the FET phase outlined in the documents.

Evaluators analysed curriculum aims, purpose, vision, and general outcomes and articulation within the FET years, and between these years and the Senior phase and tertiary education respectively. They looked at teaching approaches and methodologies given for their subjects; guidance provided for assessment; and at the availability and user-friendliness of the curricula (for more detail see Part 1: *Overview* of this report).

4. SCHOOL SUBJECTS CHOSEN FOR ANALYSIS

Since the main immediate aim of this project was to provide Umalusi's Statistics and Assessment Committee with information on the comparability of the old and new curricula and on the comparative difficulty of their associated exams, it would have been ideal to include as many subjects as possible in the study - or at least one of each *type* of subject (one Science, one Social Science, etc). Given budget and time constraints, however, it was feasible to include only six subjects.

The Umalusi Statistics and Assessment Committee requested that the selection of subjects be on the basis of their "gateway" status (their importance for university entrance) and high enrolment numbers. Since English Home Language, Afrikaans Home Language, English First Additional Language, Afrikaans First Additional Language, Mathematics, Mathematical Literacy, Biology/Life Sciences, Physical Science, Geography, History, Accounting, Economics, Business Economics and Agricultural Sciences could be categorised as gateway subjects, the enrolment figures for these were considered (see Department of Education, 2007) and found to be as follows:

1.	English Second Language	490 909
2.	Biology	370 622
3.	Mathematics	347 570
4.	Geography	255 716
5.	Business Economics	244 818
6.	Afrikaans Second Language	236 371
7.	Physical Science	214 510
8.	Economics	181 744
9.	Accounting	181 389
10.	Agricultural Sciences	161 633
11.	History	116 308
12.	English First Language	87 914
13.	Afrikaans First Language	53 825

It was decided to include the four subjects in this group with the highest enrolment numbers - namely, English Second Language (currently referred to as English First Additional Language, or English FAL), Biology (currently Life Sciences), Mathematics and Geography. Physical Science was included because of its national importance as a subject. Mathematical Literacy was included as it was an unknown quantity and, although it had not yet been examined, as it would have enrolment numbers; that this would therefore affect the results of many learners was known.

The full results of the evaluations of the curricula for these subjects are presented in the next section.

5. CURRICULUM REPORTS PER SUBJECT

The results for the curriculum evaluations for each subject are presented in this section per subject. It must be noted that all six Umalusi subject teams reported on all of the aspects required in the Umalusi evaluation instrument, including the specification, weighting, and foci of content and skills; as well as on overarching aspects such as underlying principles, aims and objectives, sequencing, progression and pacing of the curriculum. The teams also reported on the fundamentals of pedagogic approaches advocated and facilitated by the curriculum documents, and on the guidance given for internal and external assessment. They concluded with commentary on the user-friendliness and use of the sets of curriculum documents and, importantly, with responses to the main tasks of the evaluation.

The main tasks involved, first, a judgment in each case regarding the respective levels of difficulty of the NATED 550 and NCS curricula for the subject concerned. The tasks also include a pronouncement in each instance on the usefulness and fairness of the Umalusi evaluation

instrument for evaluating the subject concerned. All of the subject teams were able to base their responses to these two final curriculum tasks on the solid evidence presented in their responses to all prior tasks in the Umalusi instrument.

Each team used the evidence from all questions answered to gauge the relative difficulty levels of the curricula in slightly differing ways. An overview of all the findings is provided in Subsection 6, which follows the curriculum reports per subject. The reader is invited to proceed directly to this section on overarching trends emerging from the curriculum evaluation, if he or she wishes to skip the detailed subject reports.

5.1 ENGLISH FIRST ADDITIONAL LANGUAGE

The Umalusi English First Additional Language (FAL) team – like the teams for Geography, Life Sciences and Physical Science – reported separately on content and skills in the respective curricula evaluated. It considered curriculum organising principles; sequencing, progression and pacing in the curricula; curriculum aims; pedagogic approaches advocated; and guidance for internal and external assessment. The English FAL curriculum evaluation ends with a judgment regarding the respective levels of difficulty of the curricula and comments on the Umalusi evaluation tool – based on the findings of the preceding tasks listed.

It must be noted that what is currently referred to as English First Additional Language (FAL) in the new NCS curriculum was previously known as English Second Language in the NATED 550 curriculum. For convenience, this subject is referred to by its current name, English FAL, in this report.

5.1(1) Content and skills specification, weighting, and foci in English (FAL)

The English FAL team reported on the specification, weighting, and foci of content and skills, in turn, in the following six subsections making up this section of the report.

5.1 (1.1) Content specification and coverage in English FAL

In an attempt to comparatively evaluate the content specification and coverage of the two curricula under investigation, the team made a detailed analysis of the full range of documents for the NATED 550 and National Curriculum Statement (NCS) curricula for English First Additional Language (FAL).

Both the NATED 550 and NCS curriculum documents specify the traditional four aspects of the subject, namely, *Listening and Speaking, Reading and viewing, Writing, and Language in context*, although the terminology and grouping of sub-topics has changed slightly, as indicated in Table 5.1.1, below. The NATED 550 curriculum specifies *Listening and Speaking* as two separate components; these aspects are collapsed into one learning outcome in the National Curriculum Statement (NCS).

Table 5.1.1: Major content topic groups in English FAL

NATED 550: ENGLISH SECOND LANGUAGE	NATIONAL CURRICULUM STATEMENT: ENGLISH FIRST ADDITIONAL LANGUAGE (FAL)
Listening	Learning Outcome 1: Listening and Speaking
Speaking	
Reading	Learning Outcome 2: Reading and Viewing
Writing	Learning Outcome 3: Writing
Language in action	Learning Outcome 4: Language in action

The NCS and NATED 550 curricula specify only slightly differing content for Grades 10–12. The main difference between the two curricula is that there is an attempt to show progression in the NCS,

while no such progression is evident across the grades in the NATED 550 documents. An example of this progression in the NCS curriculum can be seen in the item relating to the construction of sentences - namely, for Grade 10, the item is written as "translate *short* sentences"; for Grade 11 it becomes "translate *sentences*" (in other words, the sentences can be longer or shorter ones); for Grade 12 these sentences become the more complex 'whole paragraphs', in "translate *short paragraphs*" (see Document 3 for English FAL).

In contrast, in the NATED 550 documents there is no differentiation between content covered at Higher and Standard Grade levels.

In both curricula there is specification that learners' production of texts should be based on specific levels of difficulty: in Grade 10, less complicated content such as the *descriptive essay* should be taught; and in Grades 11 and 12, there is gradual progression from slightly to considerably more complex texts such as *argumentative essays*. More specific suggestions regarding these levels of difficulty are given in Annexure A of the NCS *Learning Programme Guidelines* (see Document 4 for English FAL, pages 42-52). Although most of the content specified here is applicable to all grades, some items are specified only for Grades 11 and 12 (see, for example, the '*panel discussions*' and '*forums*').

This additional information in the NCS documents is not easy to access, however: teachers would need to work with the NCS and *Learning Programme Guidelines* documents (Documents 3 and 4 for English FAL) in tandem, in order to find it. In other words, while there is some guidance for teachers in the NCS curriculum, it needs to be assembled by the teachers themselves. Another challenge for teachers of English FAL using the NCS curricula in terms of content is that they would have to source appropriate texts for the teaching and learning of the specified content *themselves*, as well as facilitate the attainment of associated assessment standards. This selection might be done through textbooks that have already chosen content; but in schools where there are no textbooks, teachers would have to develop their skills as material developers and designers of learning programmes in order to teach the content, *as well as* teach the content.

However, on the whole, the NCS curriculum is very clear about specified content for the FET phase (Grades 10–12): the items are clearly listed (see English FAL Document 4, Pages 42-52). Overall, the NCS curriculum is much more comprehensive than its NATED 550 equivalent regarding the explication of content. Table 5.1.2, below, shows the combined number of items in the NATED 550 and NCS curricula: 311 items in all. The NATED 550 curriculum specifies 94 of these content items (31% of the total content specified in both curricula) whereas the NCS documents specify 211 items (69% of the total number of content items).

Table 5.1.2: Content specification in English FAL

LEARNING OUTCOME: ENGLISH CURRICULUM	SPECIFICATION OF NATED ITEMS	SPECIFICATION OF NCS ITEMS	TOTAL OF BOTH NATED AND NCS ITEMS
1. Listening & Speaking	31 (33%)	44 (21%)	
2. Reading	24 (25%)	63 (30%)	
3. Writing	32 (34%)	68 (33%)	**305 (100%)**
4. Language in Action	07 (7%)	36 (16%)	
TOTAL	**94 (100%)**	**211 (100%)**	
% Overall	**31%**	**69%**	**100%**

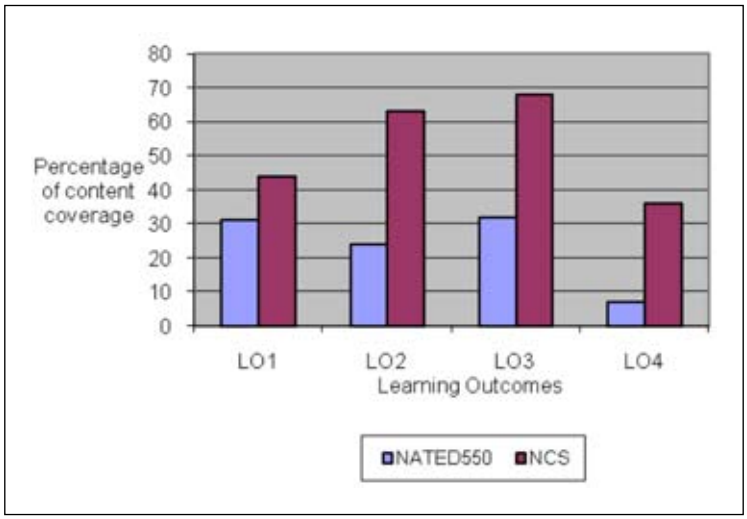
Two important sets of content items in the NATED 550 curricula are not included in the NCS documents. The first concerns a set of *reading* skills; including the creation and use of conventions such as a *contents page*, a *title*, an *index*, *footnotes*, *cross-references*, and *abbreviations when cross-referencing and making footnotes*. The English FAL team felt that omission of these items was regrettable, since these content and skill topics enable learners to write better quality reports and essays in the academic genre than would otherwise be the case.

The second set of skills omitted in the NCS curriculum is part of the *listening and speaking* group, and includes *greeting, responding to greetings, paying and responding to compliments, taking leave, apologising* and *offering condolences*.

A further difference between the two curricula is that *prepositions and tone* are not explicitly specified in the NCS under Learning Outcome 2 (*reading*), where it might be expected. It is instead part of the *writing* outcome, featuring as a general comment regarding *register and style*. Tone is a difficult concept and forms the basis of a common question in both English FAL Papers 1 and 2. Teachers need to know that this sub-topic must be taught, and if they refer to the subject frameworks (see English FAL Documents 3 and 4), they will not find it mentioned as part of the *Reading and Viewing* learning outcome.

To reiterate the point made earlier however, content is far more comprehensively specified in the NCS than in the NATED 550 curriculum. Figure 5.1.1 (below) illustrates this pattern clearly. It must be borne in mind that the main difference between the curricula is this degree of specification: content in the curricula is essentially the same, but its greater specification in the NCS both appears to extend curriculum coverage and ensure that more teachers than would otherwise be the case actually cover this range of topics in their teaching.

Figure 5.1.1: Number of content areas specified



The *weighting* of content is considered in the next section.

5.1 (1.2) Content weighting in English FAL

In the NCS, content weighting is conceived as the amount of content to be covered in the amounts of time specified in the curriculum documents. Thus, the English FAL curriculum must be covered over 4.5 hours per week (see Document 4 for English FAL, Page 29).

According to the *National Curriculum Statement* (Document 3 for English FAL), Learning Outcome 4 (LO4: *Language in action*) must be integrated with Learning Outcomes 1, 2 and 3 (*Listening and speaking; Reading; and Writing*). Learning outcomes 1, 2 and 3 must receive equal weighting in the classroom (in other words, 33,3% of the class time each) and each learning outcome is to be integrated with Learning Outcome 4 within this time. It should be noted that practice differs from the policy. The *Literature* component covers a wide range of content including poetry, drama, plays and short story study. Although only two of these genres are compulsory, the learning outcome of which they are a part takes up far more than its allocated one third of teaching time.

The NATED curriculum does not stipulate the number of periods in which curriculum content should be covered. However, it does advise teachers to teach all aspects in an integrated way.

Content weighting can also be inferred from exam allocations (see Documents 1, 2, and 5 for English FAL). Table 5.1.3, below, illustrates the exam time weighting per examination paper for English FAL in the NCS and NATED 550 curricula.

Table 5.1.3: Exam time weighting for the different papers in the NCS and NATED 550

Content	Exam time weighting	
	NATED 550	NCS
1. Listening and Speaking	Time not identified, and internally examined	Time not identified, but internally examined as Paper 4 (50)
2. Reading Paper 1: Comprehension, summary and language Paper 2: Literature study	 2½ hrs (80 marks) 2½ hours (80 marks)	 2 hrs (80 marks) 2 hrs (70 marks)
3. Writing: Paper 3	2½ hours (80 marks)	2½ hours (100 marks)
4. Language in action	*0 (integrated with all of the above)*	*0 (integrated with all of the above)*

From the exam time weighting information in Table 5.1.3 (above), some comments can be made. The NCS examination appears to disadvantage learners in terms of time allocations because of the following:

a) There is an increase in the mark weighting of Paper 3. In the NATED 550 curriculum, this paper is out of 80 marks, and is written in a period of two-and-a-half hours. The mark allocation is increased to 100 marks for the NCS exam. Even if learners are writing for the same word counts, the reduction in time with an increase in marks is not beneficial for English FAL learners - particularly with the writing of Paper 3, where it is often the case that learners are required to write creatively under stressful conditions; and

b) There is a reduction in time for both the *Literature* and *Language* papers, from two-and-a-half hours each for the NATED 550 curriculum to two hours each for its NCS equivalent, while the amount of work to be covered by learners remains the same. This change is not beneficial to English FAL learners, who need time to read through the questions and texts in order to answer as best as they possibly can.

The particular foci in content topics in the curricula are reported in the next section.

5.1 (1.3) Content foci in English FAL

The English FAL evaluation team attempted to categorise content in the two curricula in terms of the degree to which it is *disciplinary*, or relevant to the discipline of English; *generic*, or relevant for subjects across the school curriculum; or *life-related*, relevant for life outside of school. The evaluators found it difficult to answer this question, since the tool delineated each aspect as though there were not crossovers between categories. The team found that the content of English FAL could not easily be confined to one of these three categories. In many cases, it was not possible to determine whether an aspect of the content was either one or the other. See for example the following findings:

a) Most of the NATED 550 and NCS content topics were neither *disciplinary* nor *generic* – in fact, almost 95% of the NATED 550 and 64% of the NCS content topics are classified as being *life related* as well as *generic* or *disciplinary*. This categorisation is in line with the purposes of both curricula concerning the use of language in real-life contexts: to explore human experience and alternate world views; to access and manage information for learning across the curriculum and in a wide range of other contexts; as well as for life-long learning in the NCS (see English FAL Document 4, Page 9); and of enabling learners to communicate successfully for "… personal, social, educational and occupational purposes …" in the NATED 550 documents (see English FAL Document 1, Page 2).

b) The NCS has a heavier *disciplinary* weighing than does the NATED 55O curriculum (23% and 7% of topics respectively). The evaluators were of the opinion that this weighting is more likely to be due to the comprehensive nature of content specification in the NCS documents than to differing levels of difficulty between the two curricula.

Skills will now be similarly discussed.

5.1 (1.4) Skills specification and coverage in English FAL

In an attempt to answer the question relating to the specification of skills in the NATED 550 and NCS curricula, the English FAL team considered all of the available curriculum documents, including the *Subject Assessment Guidelines* and *Learning Programme Guidelines* for the NCS curriculum.

The team found that the NATED 550 curriculum does not differentiate *between* skills across school Standards 8, 9, and 10 (now referred to as Grades 10, 11, and 12) and does not show progression in content and skills over the three years. However, it does stipulate *minimal* skills that learners should attain by the end of Standard 10 (now Grade 12). Each aspect of the curriculum (*listening, reading, writing* and *language in action*) is stipulated *vis-à-vis* the statement that activities in this category should "… enable the pupils at least to …", followed by the minimal skill (see English FAL Document 1, Pages 2-9). Thus while the minimum skills are described, there is no acknowledgement that some skills may be regarded as being more cognitively complex than others.

In contrast, the NCS curriculum specifies progression in terms of increases in the cognitive complexity of skills across the three school years in the FET phase (Grades 10, 11, and 12). Each learning outcome has specific assessment standards detailing the skills necessary for attainment of that assessment standard. Looked at globally across the phase, the progression in skills is made evident through the use of verbs, adjectives and concepts that stipulate progressive conceptual understanding (see English FAL Document 4, Page 35; and English FAL Document 3, Pages 14-45). In addition to the example provided in Section 5.1 (1.1) of this English FAL report, a further example of progression is provided in Table 5.1.4 (below) In each column, the verb indicating progression is highlighted in bold text.

Table 5.1.4: Progression of skills across school grades in the NCS curriculum

LO2 Reading	Grade 10 skill	Grade 11 skill	Grade 12 skill
	Recognise how word choices, imagery and sound devices affect mood, meaning and theme	**Explain** how word choices, imagery and sound devices shape mood, meaning and theme	**Interpret** how word choices, imagery and sound devices shape mood, meaning and theme

An implication of this specified progression in the NCS curriculum is that teachers using the documents are made aware of the increasing complexity of skills across school grades: the curriculum potentially encourages teachers to teach in cognitively 'scaffolded' ways to ensure that Grade 12 learners actually acquire the skills required for successful performance in the Grade 12 English FAL examination. In short, this specification should serve to enhance the teaching, learning and assessment of learners. The success of this enterprise will of course depend on teachers sufficiently trained to use the policy documents, and suitably qualified in the discipline of English.

5.1 (1.5) Skills weighting in the English FAL curricula

After careful analysis of both curricula in an attempt to answer the question of skills weighting, the English FAL evaluation team found that neither the NATED 550 nor the NCS curricula stipulate classroom time to be spent on individual skills; neither is there any indication of the exam weighting for each individual skill.

However, the NCS curriculum relates each skill to a specific learning outcome, and these outcomes are allocated class time and exam weightings. In other words, all the skills listed are categorised under one of the following Learning Outcomes (LOs):

- LO1: Listening and Speaking
- LO2 : Reading and viewing
- LO3: Writing
- LO4: Language in context

Within these learning outcomes, teachers are advised to integrate Learning Outcome 4 (*language in context*) with the other three outcomes (*listening and speaking; reading and viewing; and writing*), and the three outcomes are to be given equal weighting in class time, that is, 33.33% of available class time each – as already discussed (see Section 5.1 (1.1)).

5.1 (1.6) Skills foci in English FAL

As for the content focus task (see Section 5.1 (1.3), above), the Umalusi English FAL evaluation team attempted to categorise skills in the two curricula. Skills were categorised in three different ways: First, in terms of the degree to which they are *disciplinary* or, relevant to the discipline of English; *generic*, relevant for subjects across the school curriculum; or *life-related* – relevant for life outside of school. The evaluators again found it difficult to answer this question, since – as for the content topics – it was not always possible to classify individual skills as belonging to a single category: skills often belonged to two or all of the categories.

As for content, a high proportion of English FAL skills are relevant for life outside school. This finding is unsurprising, given the linked-to-life purposes of both curricula. The NCS has a heavier *disciplinary* weighting of skills than does the NATED 55O curriculum – possibly because of the greater number of types of skills included in the NCS curriculum.

Second, skills were classified as being *difficult*, *moderate* or *easy*. The results of these categorisations can be seen in Table 5.1.5 (below).

Table 5.1.5: Percentages of English FAL skills at particular difficulty levels in the NATED 550 and NCS curricula

LEARNING OUTCOME	DIFFICULT		MODERATE		EASY	
	NATED 550	NCS	NATED 550	NCS	NATED 550	NCS
Listening and Speaking	18	13	17	3	13	6
Reading	12	27	11	4	9	3
Writing	7	12	5	11	0	0
Language	9	11	0	9	0	1

From Table 5.1.5 it can be seen that there are more skills in the *difficult* category in the NCS than in the NATED 550 curriculum. *Reading*, in particular, has 27% *difficult* questions in the NCS curriculum in comparison to the 12% for NATED 550. This finding has implications for both Papers 1 and 2 (*Language and Literature* respectively) where the skills examined are at Higher Grade level. In the new *National Senior Certificate* exams, candidates working at levels typical for the old NATED 550 Standard Grade papers are likely to struggle.

Third, skills were classified in terms of type of cognitive demand. Items were identified as comprising *basic conceptual understanding, application of skills in familiar contexts* or *application of skills in new contexts (problem solving)*. Table 5.1.6 below illustrates the findings of this analysis.

Table 5.1.6: Percentages of skills classified according to cognitive type in English FAL

LEARNING OUTCOME	BASIC CONCEPTUAL UNDERSTANDING		APPLICATION/ANALYSIS IN FAMILIAR CONTEXT		APPLICATION/ ANALYSIS IN NEW CONTENT	
	NATED 550	NCS	NATED 550	NCS	NATED 550	NCS
Listening and Speaking	16	8	16	5	17	14
Reading	11	6	9	4	12	28
Writing	0	0	6	11	5	12
Language	0	2	2	9	6	1

Table 5.1.6, above, shows that there are generally more *application*-type skills and fewer basic conceptual skills in the NCS than in the NATED 550 curriculum, especially in relation to *reading*, *writing*, and *language*. This finding again has implications for both *National Senior Certificate* Papers 1 and 2 (*Language* and *Literacy* respectively): skills called for in these papers are likely to be closer to those required at Higher than at Standard Grade level.

Overall, it appears that the NCS English FAL curriculum includes more *difficult*, *disciplinary*, *application*-type skills than does its NATED 550 predecessor.

5.1 (1.7) Text specifications in the English FAL curricula

The English FAL team compared the numbers and types of texts required in the NATED 550 and NCS curricula. In order to complete this text-specification task, the team consulted English FAL Documents 10, 11 and 12.

It was found that although learners have to answer two text-related questions in the final exams linked to both curricula, the NCS curriculum allows provinces greater freedom regarding the selection of appropriate recommended texts than does its NATED 550 counterpart. For example, the NATED 550 curriculum recommends one novel, whereas the NCS recommends three. Some nine to 10 short stories were nationally recommended during the period of the NATED 550 curriculum, whereas the NCS curriculum recommends 10 - but provinces select only two of these 10.

Since provinces currently have more choice to select appropriate texts from national lists than in the past, a question arises as to consistency in terms of the levels of cognitive difficulty of the chosen texts, as well as to subjectivity in relation to choice of the selection panels in each province: On what basis are panels, and texts, selected? The Umalusi team had no information in this regard.

When referring to English FAL Documents 10, 11, and 12, it appears that the genres of texts are similar across both curricula.

5.1 (2) Organising principles and coherence in the English FAL curricula

The organising principle of the NATED 550 curriculum is framed within an understanding of the diverse contexts that impact on the learning needs of English second language learners. It recognises the multilingual nature of South African learners, for whom English is not a mother tongue, but also validates the role of the mother tongue in the acquisition of a second language. To this end, it supports the approaches of *Communicative language teaching* (see Document 1 for English FAL) which requires purposeful, meaningful and integrated learning of *reading, writing, listening, speaking*, and *language* skills. It also supports the approach of *Language across the curriculum* (ibid.), emphasising the linguistic resources that learners bring to the classroom as well as the important principle that teachers across the curriculum are, in effect, language teachers.

There are nine organising principles that frame the NCS curriculum across all subjects and learning areas. These principles are social transformation; *Outcomes Based Education*; high knowledge and high skills; integration and applied competence; progression, articulation and portability; human rights and inclusivity; environmental and social justice; valuing indigenous knowledge systems; and credibility, quality and efficiency. However, the principle of *Outcomes Based Education* is the main foundational principle for English FAL: The NCS curriculum is designed to facilitate learners' reaching of their maximum potential through the setting of learning outcomes and assessment standards to be achieved at the end of each grade. *Outcomes Based Education* also includes the *critical and developmental outcomes* on which the learning outcomes are based (see Document 4 for English FAL, Pages 1-4).

It is clear that the organising principles underpinning the NATED 550 curriculum are not as explicitly articulated as are those underscoring the NCS. The principles of the NATED 550 curriculum are contained within the lens of diverse linguistic contexts and learning needs, and are supported by the validation of the mother tongue. In contrast, the foregrounding of principles in the NCS documents orients teachers and - through teachers - learners, to the integrated nature of English FAL learning outcomes. It is not possible just by analysing the English FAL documents to comment on whether or not the detailed specification of aims in the NCS documents assists teachers in their understanding of the new curriculum.

5.1 (3) Sequence, progression and pacing in the English FAL curricula

Sequencing, progression and pacing of knowledge and skills were considered in the two sets of curriculum documents. The Umalusi English FAL team reported on progression within each of the school years in the FET phase; progression across years in the FET phase; and increases in cognitive complexity in the three years concerned, and commented on work to be completed by the end of each year of study for English FAL in the FET phase.

5.1 (3.1) Sequencing, progression and pacing within years in the FET phase

Regarding sequencing, progression and pacing of content and skills in the two curricula *within each year* of the FET phase, in the NATED 550 curriculum, there is no differentiation in the sequence, progression and pacing of content or skills within each specific year for Grades 10, 11, and 12. The *National Curriculum Statement* for English FAL, in contrast, shows sequencing and progression in content across all learning outcomes, but does so very minimally.

No detailed guidance is available for teachers beyond incidental suggestions in the NCS documentation. However, there is delineation of specific learner achievement levels or exit skills across all learning outcomes in each school grade in this curriculum (see English FAL Document 5 for English FAL, the *Subject Assessment Guidelines*). Sequencing is achieved by identifying comprehensive competence descriptors, codes and relevant rating skills for each school grade. For example, a Code 7 rating (outstanding achievement) has a scale of 80–100%, and the skills necessary for this achievement level in each school grade are listed under each learning outcome.

5.1 (3.2) Progression across the years of the FET phase for English FAL

Sequencing and progression of skills and content *across the three years* of the FET phase is also more obvious in the NCS than in the NATED 550 curriculum documents. Several examples have been outlined in Sections 5.1 (1.1–1.6), above.

In the NATED 550 curriculum, minimal skills and content topics to be mastered by the end of Grade 12 are identified. For example, each aspect of the curriculum (*listening, reading, writing and language in action*) is foregrounded with the statement that activities in this category should "enable the pupils at least to…." (see Document 1 for English FAL, Pages 2-9).

The NCS curriculum, in contrast, specifies skills and sub-skills associated with each assessment standard, for each school grade. Further, the production of texts is sequenced. For example, in

Grade 10, the less complicated *descriptive essay* is stipulated; while *discursive* or *argumentative essays* are to be attempted in Grades 11 and 12. The delineation of specific levels of learner achievement in terms of competence descriptors, codes and ratings, discussed in Section 5.1 (3.1), also contributes towards sequencing across school grades.

To conclude the discussion of sequencing, then, it should be noted that in neither of the sets of curricula are progression, pacing and sequencing of content within and across grades specified to a great degree. In the case of the NCS curriculum, this specification is not as vague as that in the NATED 550 curriculum, since there are suggestions in various places in the *National Curriculum Statement, Learning Programme Guidelines*, and *Subject Assessment Guidelines* for English FAL. Teachers would, however, need to be familiar with all three documents in order to affect effective sequencing.

5.1 (3.3) Progressive increase in cognitive demand in English FAL

As noted in Section 5.1 (3.1 and 3.2), it was found that there was no increase in the levels of cognitive demand of skills covered in the NATED 550 curriculum over the three years of Standards 8, 9, and 10 (now Grades 10, 11, and 12).

The Umalusi team found, however, a variety of sources of evidence that progression is built into the NCS English FAL curriculum for the last three years of secondary schooling (Grades 10, 11, and 12). This progression is achieved primarily through the use of verbs and adjectives which show development in cognitive complexity across assessment standards (see, for example, Document 3 for English FAL, Pages 14-45, and Document 4 for English FAL, Pages 32 and 42-52). For an example, see Table 4 in Section 5.1 (1) above.

One criticism of this guidance, or potential challenge with respect to this approach regarding progression, is that it assumes that all teachers have the requisite knowledge and understanding of the concepts comprising these progressively developing skills. The English FAL team noted that there is no guidance regarding the parameters of cognition implicit in the skills. The team suggested that including a basic summary of a taxonomy of the cognitive types and levels of skills would assist teachers to ensure that the required progression is achieved by the end of Grade 12. Specific texts could be used to illustrate, for example, which taxonomic levels can be used to engage actively with particular skill levels per learning outcome and school grade.

5.1 (3.4) Work to be covered by the end of each FET year, for English FAL

The NATED 550 curriculum does not stipulate what should be covered by the end of each school grade in the FET phase. Instead, it gives holistic guidelines for *listening, speaking, reading, writing* and *language in action* over the three years of Standards 8, 9 and 10 (Grades 10, 11, and 12).

In contrast, the NCS curriculum describes the four learning outcomes (*Listening and Speaking; Reading and Viewing; Writing*; and *Language*) and associated assessment standards that should be covered at the end of each school grade, comprehensively (see English FAL Document 3, Pages 14-45). It also supplies competence descriptions for each grade and level of achievement, from *outstanding* (80%–100% which equates with a *Level 7* achievement), through various descriptors, to *not achieved* (0%–29%, equating with a *Level 1* achievement) (see English FAL Document 3, Pages 57-66; and English FAL Document 5, Page 5). These competence descriptions give clear indications of how well-covered and less well-covered work should appear.

5.1 (4) Aims, purpose, vision, and outcomes in the English FAL curricula

In this section the Umalusi team considered the aims expressed in both curricula; guidance provided for achieving these stated aims; suitability of the aims for classroom contexts in which they will be enacted; and articulation between English FAL in the FET phase under consideration and other parts of the education system.

5.1 (4.1) Aims and outcomes in the English FAL curricula

There are seven general aims identified in the NATED 550 curriculum (see English FAL Document 1, Pages 2-3). These aims are generated by the purpose of the syllabus, which is to "…enable pupils to communicate successfully for personal, social, educational and occupational purposes…" (ibid.). In a nutshell, the curriculum aims to develop proficiency and critical skills in *listening and speaking, reading, writing*, and *language use*.

The NCS curriculum is similarly explicit in its references to its aims and purposes (see, for example, English FAL Document 3, Pages 9-10). The aims in the case of this curriculum are linked to the assessment standards and learning outcomes for the subject across the school grades in the FET band (ibid., Pages 14-45). The purpose of the subject is to produce "…citizens who are able to communicate across language barriers and foster cultural and linguistic respect and understanding…" (ibid., Page 9) This information is reinforced elsewhere (see, for instance, English FAL Document 4, Pages 42-52).

Thus, to some extent, for example, through its reference to multilingual challenges and the range of literacies necessary for different contexts, the aims in the NCS curriculum mirror the objectives of the NATED 550 documents. The NCS curriculum, however, deals more comprehensively with contemporary issues, such as the challenges of HIV/AIDS; tolerance of difference; the value of home languages; and information literacy.

5.1 (4.2) Guidance provided in the English FAL curricula for achieving stated aims

The English FAL team found that the NATED 550 curriculum does not provide any guidance for achieving its stated aims, beyond listing 'specific aims' (see English FAL Document 1, Pages 3-7). This specific list is essentially the subject framework (the outline of subject content).

The NCS English FAL curriculum (see English FAL Document 14, Page 45), however, provides extensive guidance for the achievement of its identified aims. This guidance is to be found in the subject framework that details the learning outcomes and assessment standards to be covered (see English FAL Document 3). Even more detailed and specific guidance is given in English FAL Document 3 (see Pages 18-23 and 42-52). It is the intention that this detail facilitates understanding of the aims – an effort expected by the team to have potential for success.

5.1 (4.3) Suitability of the English FAL aims for school contexts in which they are likely to be enacted

The NATED 550 curriculum acknowledges a range of linguistic contexts (*multilingual backgrounds and concomitant differences in terms of pronunciation, syntax, intonation,* and *accent*) and social contexts (*purposes, audience*) which frame the attainment of the aims. However, the acknowledgement of these contexts does not translate into specific guidance on how to manage them in such a way that the aims become achievable. Instead, teachers are cautioned to bear contexts in mind when assessing learners, and to focus on "…effective language use rather than correct use of a single standard variety…" (English FAL Document.1, Page 1).

Similarly, the NCS curriculum refers to a range of contexts that might affect the aims of the syllabus. Firstly, these contexts are categorised as barriers that might prevent access to the language and to the production of appropriate texts. These barriers are discussed under 'Inclusivity' (see English FAL Document 3, Pages 10-11) and include suggestions for *verbal and non-verbal communication, including signed communication and communication aids; lip-reading* and *watched sign language*. A number of intervention strategies as well as definitions of contexts are suggested.

Further, more detailed discussion appears elsewhere in the NCS (see English FAL Document 3, Pages 31-33), which describes a comprehensive range of contexts. For example, those including learners with particular characteristics - *gifted learners; learners with particular mobility and fine motor skills, learners with language barriers; visually impaired learners; learners with particular learning*

styles and levels of prior learning - including those in particular settings - *contexts with gender and cultural diversity; rural and urban contexts; well-resourced and less-resourced contexts*. Appropriate teaching strategies are suggested to accommodate these contexts.

Notwithstanding the discussion around these contexts, in the opinion of the Umalusi team there is not sufficient guidance for the average South African teacher of English FAL to employ usefully in his or her teaching. More information around these contexts needs to be given, possibly in workshops and (although we are loathe to say it for fear of more policy overload) well-designed documentation. This additional information is particularly necessary for teachers who have not been trained to identify and to harness the abilities of learners who fall into these categories.

5.1 (4.4) Articulation between English FAL at FET level, and other phases of the education system

There is no mention of articulation in the NATED 550 curriculum. In contrast, the articulation and portability of English FAL is clearly described in the NCS documents (see, for example, English FAL Document 3, Pages 3 and 12; English FAL Document 4, Page 12).

The Further Education and Training (FET) band is positioned between the General Education and Training (GET) and Higher Education bands and, as such, must articulate with the GET as well as with qualifications in similar learning pathways in the Higher Education bands. This articulation is achieved through "…close scrutiny of the exit level expectations in the GET learning areas and of the learning assumed to be in place at the entrance levels of cognate disciplines in Higher Education…"(see English FAL Document 3, Page 3). The English FAL evaluation team was of the opinion that this information is sufficient for the purposes of English FAL teachers working at FET level.

5.1 (5) Teaching approaches and subject methodologies in the English FAL curricula

Initially the English FAL team analysed the two sets of curriculum documents through different lenses, those of *general teaching approaches*, on the one hand, and those of *subject-specific approaches*, on the other. It was then decided to conflate the two analyses, given that the guidance for these two levels of pedagogy is very integrated in both curricula.

The team thus reported on teaching approaches and methodologies advocated in the English FAL curricula, and on the alignment between the approaches advocated and curricular aims. It also commented on the suitability of the advocated approaches for contexts within which they are likely to be implemented, for the subject English FAL, and for the types of learners concerned.

5.1 (5.1) Teaching approaches and methodologies advocated in the English FAL curricula

The Umalusi team analysed documents making up the NATED 550 and NCS curricula, looking particularly at discussions around teaching approach and subject methodology. The NATED 550 curriculum is not specific about a general approach to teaching; instead it identifies the specific approaches of *Communicative Language Teaching* (CLT) and *Language across the Curriculum* (LAC) as sufficient to cover teaching and learning. These approaches are based on pedagogical principles that allow for the development of learners' proficiency in a second language while validating their mother tongues.

In addition, CLT uses language skills that learners already possess as the basis for further development, the focus being on the realities of learners' actual levels of attainment instead of ideal notions of achievement. The focus is on effective language use rather than correct use of a single standard variety of English (see English FAL Document 1).

The specific approaches of CLT and LAC are outlined in the NATED 550 curriculum (see English FAL Documents 1-2), and teachers should be able to derive a basic understanding of both approaches from the outlines. However, there is minimal guidance regarding details as to exactly what the approaches entail and how they might be implemented.

In contrast, the NCS curriculum is very clear regarding the fact that *outcomes based education* (OBE) is the *general* teaching approach for English FAL and all other subjects and learning areas in the new curriculum. OBE is designed to "… allow all learners to reach their maximum potential through the setting of learning outcomes and assessment standards to be achieved by the end of each Grade …" (English FAL Document 3, Page 2, the *National Curriculum Statement*). However, no further detail is given in this document, and one has to refer elsewhere (to English FAL Document 4, Pages 9-10, the *Learning Programme Guidelines* for English FAL) for a comprehensive description of this foundational approach. The Umalusi team felt that this guidance was indeed sufficient for the average South African teacher.

The NCS specifies two *subject-specific* approaches to the teaching of English FAL: the *Text-Based Approach* (TBA) and *Communicative Language Teaching* (CLT) (see English FAL Document 3, Page 2). In addition, there are comprehensive descriptions of these approaches, convincing rationales for implementing them, and suggested strategies for this implementation (see English FAL Document 4, Pages 9-10).

The *Text-Based Approach* incorporates the use of a range of texts, genres and registers specifically selected to develop competent, confident and critical readers, writers, viewers and designers of texts (see the *critical outcomes*, English FAL Document 3, Page 3). In addition, this approach validates the cultural, social and political backgrounds of learners, and recognises the importance of indigenous knowledge systems in an attempt to develop learners' understanding of bias and prejudice.

Regarding pedagogic guidance, then, it can be said that although CLT and LAC are common to both the NATED 550 and NCS curricula, the latter is the more comprehensive of the two in its discussion of overarching principles for the teaching of English FAL. In addition, the approach (OBE) is more inclusive (the *Text-Based Approach* is added to CLT and LAC). It is intended that for delivery of the NCS curriculum, the *Text-Based approach* facilitate acquisition of the *critical* and *developmental* outcomes.

5.1 (5.2) Alignment of teaching approaches advocated, and curriculum aims in the English FAL curricula

Regarding the extent to which general and subject-specific teaching approaches are aligned with aims in the curricula, the team found that the NATED 550 curriculum shows little in terms of how the CLT and LAC approaches are aligned with the expressed curricular aims, except perhaps in a brief reference to assessment (see English FAL Document 2, Page 10). However, this alignment is implied, and if the reader probes further, it appears that the approaches of CLT and LAC are aligned to the curriculum aims where the teaching and learning contexts are suitable. Learners' attainment of the aims in the syllabus would then allow them to cope in a multilingual society. Although this is the intention, it was found that the NATED 550 curriculum fails to deliver on this principle, due to its failure to delineate skills and content within and across school standards, and its assumption that all teaching and learning contexts are optimal.

With respect to the general approach in the NCS – *Outcomes-Based Education* – and its alignment with curricular aims, the team found that the approach is indeed aligned to the aims of producing "… citizens who are able to communicate across language barriers and foster cultural and linguistic respect and understanding …" (English FAL Document 3, Pages 9-10). This document, in fact, explains the links between the approach and aims. OBE embraces the *Text-Based approach* and *Communicative Language Teaching*. OBE is also aligned with the critical and *developmental outcomes* that frame the teaching of English FAL (ibid.). In order to assure the success of the methodology in line with the curricular aims, more information is given regarding ways of designing *learning programmes* across phases, *work schedules* per school grade, individual *lesson plans* (ibid., pages 26-37).

5.1 (5.3) Suitability of the teaching approaches advocated for English FAL, for contexts in which the curriculum is likely to be enacted

Regarding the suitability of the general and subject-specific approaches to contexts in which the curricula might be enacted, it became evident that - although NATED 550 does not give comprehensive details outlining how CLT and LAC are suited to the contexts in which the curriculum might be enacted - the documents do offer a rationale for the implementation of the approaches in multilingual contexts. For example, CLT emphasises the validation of mother tongue as a resource to be used in acquiring additional languages and warns against idealistic notions of learning achievement (Eng FAL Document 1, Page 1). LAC is endorsed as an approach through an injunction that all teachers are language teachers, and in this way, they can support additional language learners by working together to reinforce the acquisition of English in all subjects (ibid.). The link between approach and context of delivery is evident but implicit.

In the NCS curriculum, in contrast, the *Text-Based Approach explicitly* validates the cultural, social and political backgrounds of learners, and recognises the importance of indigenous knowledge systems in an attempt to overcome and challenge bias in South Africa's democratic social context. The suitability of *Text-Based* and *Communicative Teaching* approaches is comprehensively discussed in the discussion on OBE (see English FAL Document 4, Pages 9-10). In addition, the approaches are implicit in the discussion of the principles of the NCS (see Eng FAL Documents 3, Pages 1-4; 4, Pages 8-14). Here, the variety of teaching and learning contexts in the country – linguistic, social, economic, learning needs, and others – are constantly referred to.

The NCS curriculum has received much criticism regarding the suitability of both its general approach (OBE) and its specific approaches to language teaching (TBA and CLT). These criticisms relate to the potential contexts in which the curriculum will be enacted. The South African context is characterised by inequitable teaching resources, inadequately qualified teachers and inequitable teaching and learning contexts. These differences present sizeable barriers to the achievement of curriculum aims – especially in socially disadvantaged contexts. Nevertheless, the NCS attempts to address this criticism through its guidance regarding the two pedagogical approaches (see Eng FAL Document 4, Pages 9-10).

In short, although the NCS curriculum documents offer detailed guidance for teaching approaches advocated within them, the suitability of these approaches for learners in disadvantaged social and educational contexts has been questioned.

5.1 (5.4) Suitability of approaches advocated, for the subject English FAL

The Umalusi team attempted to address the question of the suitability of the general and subject-specific approaches advocated in the NATED 550 and NCS curricula, for the teaching and learning of English FAL. The use of CLT and LAC in the NATED 550 curriculum, while laudable, is not aligned with its outline of skills and content in the different aspects of language learning. No distinction is made between Higher, Standard and Lower Grade levels; neither is there distinction between the attainment of skills and content in each of the school standards. The teacher is advised in these documents to formulate different exams for these grade levels and school standards (see English FAL Document 2, Page 9), but no guidance as to how to accomplish this stipulation is given in the document. The Umalusi team received verbal reassurances that these guidelines were supplied by the provincial departments of education, but - despite requests to particular provinces, and attempts to locate the documents - none were obtained by the team.

The English FAL team supports the idea that the *Text-Based* and *Communicative* approaches to teaching endorsed in the NCS (English FAL Document 4, Pages 9-10) are suited to the levels of content and skills identified in the NCS (English FAL Document 3, Pages 14-45).

5.1 (5.5) Suitability of approaches advocated for English FAL, for learners at FET level

In terms of the general approach of OBE, incorporating subject specific approaches (*Text-Based* and *Communicative* approaches), the assumption can be made that OBE is suited to learners'

interests, since it would incorporate activities that are intended to be learner-centred, meaningful and relevant to learners. In addition, it allows for varying degrees of capability in learners, as well as being inclusive of many types of diversity under the principles of human rights, inclusivity, and environmental and social justice (see English FAL Document 3, Page 4).

The CLT approach is proposed in both the NATED 550 and the NCS curricula (English FAL Document 1, Page 1; English FAL Document 3). The integrated nature of language skills implicit in CLT is a strong indication of its suitability, for both the interests and capabilities of pupils, since this approach reinforces the vocabulary and concepts of the language whilst simultaneously creating thematic coherence across the skills.

However, where the NATED 550 and NCS documents differ is in terms of evidence given to support the suitability of the approaches for learners' abilities. Despite lip service being paid to the suitability of the CLT approach in the NATED 550 curriculum, the document does not *show* how learners could be differentiated according to capacity, ability, and skills. In contrast, the NCS for English FAL does this through its subject framework (English FAL Document 3, Pages 14-42), as well as in its extensive competence descriptors that cater for a range of abilities (ibid. 3, Pages 60-71).

The inclusion of the *Text-Based Approach* in the NCS is particularly suited to learners' interests, since it provides for a range of texts to be incorporated in the teaching of the subject. This range is interesting, since it includes multimedia texts, audio-visual texts as well as written texts. In today's technological society, the inclusion of multimedia and audio-visual texts is an exciting resource for teachers – however, the social contexts in which many English FAL classes exist might preclude them from using these innovative resources.

5.1 (6) Guidance for assessment of English FAL

The English FAL team reported on guidance given in the two curricula, for internal and external assessment.

5.1 (6.1) Guidance for internal assessment

The team considered the clarity and types of guidelines for internal assessment. It was found that the NATED 550 curriculum gives minimal guidance regarding internal assessment (English FAL Document 2, Pages 9-11), with no specific mark allocations being stipulated. Continuous assessment is dealt with generically (English FAL Document 1, Page 10). Oral (reading aloud) and writing processes are mentioned briefly, with the proviso that marks "… arrived at for each section may be used to supplement the examination up to a maximum of 50% ..." (ibid.). This instruction is confusing – the modality of the language comprising it is weak – giving the impression that various alternatives can be implemented, but with no mention of such alternatives. The oral component is examined internally, with the only guidance given being the total mark allocation (60 marks) and a note that the oral mark will be 15–20% of the final mark (English FAL Document 1, Page 10). No document – other than those where 60 marks were allocated – could be found with explicit mark allocations for the *Oral*.

However, from 2002 a supporting document was made available for guidance in Papers 1 and 3 associated with the NATED 550 curriculum (Document 2). This document gives detail regarding the types of tasks as well as the weighting for each task, making up the total mark for the subject. Consequently, the internal tasks and marks are broken down into four tasks: T1 (essay) =29%; T2 (shorter piece of writing) =14%; T3 (other shorter piece of writing) =14%; T4 (Oral) = 43 % (see English FAL Document 11, Pages 1, 6 and English FAL Document 2, Page 10).

With regard to the clarity and types of internal assessment in the NCS curriculum, it is clear that extensive coverage is given to internal assessment through the *Subject Assessment Guidelines* (see English FAL Document 5). Section 4 of the *Subject Assessment Guidelines* (English FAL Document 5, Pages 5-23) introduces assessment in the NCS, describing daily assessment (Page 15), giving actual

examples in Appendix 3, and prescribing the number and types of assessment required for the formal *Programme of Assessment* in Grades 10 and 11 (Pages 15-18) and Grade 12 (Pages 18-21).

It is important to note that detailed information is given regarding the NCS *Programme of Assessment*. Fourteen tasks to be conducted across all four specified terms are identified (English FAL Document 5, Page 20). This *Programme of Assessment* is worth 25% of the final mark of 400 in each school year (ibid., Page 19). Examples of assessment rubrics, different types of assessment, and examples of certain types of questions are all included in this very comprehensive document. In addition, further supporting documents are available (see English FAL Documents 7, 8, 9, 10, 11 and 12).

5.1 (6.2) Guidance for external assessment

The team considered the guidance given for external assessment within the two curricula. The NATED 550 curriculum gives minimal guidance regarding external assessment (see English FAL Document 1, Pages 9-11). Guidelines referring to *Reading* are directed towards the *Literature* paper and suggest that it will consist of two comprehension works – one may be based on a prescribed work, and the other on an unseen literary text. The user of the documents is asked to bear a range of questions in mind, but no guidance is given in the form of examples. There is a note to the effect that if examiners choose to examine prescribed works internally, in either oral or written form, then at least one comprehension question on a literary text must be included in the final exam (see English FAL Document 1, Page 11).

In the NATED 550 syllabus, the total mark for the subject is set at 300 (English FAL Document 1, Page 11). Prescriptive direction is given regarding the number of papers (three), the duration of these papers (1½ hours each) and the weighting of each paper (approximately equal weighting). The team felt that satisfactory guidelines were supplied for Papers 1 (Language) and 3 (Writing) for the English 2nd language Higher and Standard Grade exams (see English FAL Document 2). The breakdown of marks for the Language paper is explicit, and mention is made of skills that must be assessed. However, teachers are advised to refer to the *Core Syllabus* (English FAL Document 1) for additional skills that need assessing. It is assumed that this is a reference to the content and implied skills in Document 1.

The *National Senior Certificate Examinations Guideline* document (English FAL Document 2) provides more substantial guidance for external assessment on Higher and Standard Grade levels for Papers 1 and 3 for 2002, being more specific in terms of total marks per component of the curriculum as well as per paper. Guidelines are given regarding aspects to be assessed as well as marks to be allocated per aspect. Paper 1 (80 marks) was changed from a writing paper to the Comprehension, Summary and Language paper, and is discussed in detail (English FAL Document 2, Pages 2-3). Literature, now referred to as Paper 2 (80 marks), is discussed in terms of competences, format per grade, marks per aspect of the paper, topics to be examined, and types of questions as well as their mark allocations. Mention is made that these papers would be set provincially.

Writing, formerly Paper 1, is now referred to as Paper 3 (80 marks). This paper is clearly described in terms of duration, mark allocation and format, and a description of the type of genres to be examined is given. There is also guidance (rubrics) given regarding how these pieces should be marked (English FAL Document 2). The final component (Oral) is assessed internally and is worth 60 marks (English FAL Document 2, Page 1).

This process towards increasing clarity in the guidelines for external assessment has continued through successive curriculum revisions. The guidelines for external assessment in the NCS are clearer than are those for the NATED 550 curriculum. The NCS *Subject Assessment Guidelines* give comprehensive coverage of the external assessment process (English FAL Document 5, Page 22). In addition to the conventional papers (Paper 1 = Language in context; Paper 2 = Literature; Paper 3 = Writing), this curriculum includes Paper 4 (oral tasks) done throughout the year). Specific directions

are given as to the type of tasks to be included, as well as the relevant mark allocations for Paper 4. These papers are externally moderated (ibid. Page 22).

In contrast to the practice relating to the NATED 550 curriculum, the Writing paper associated with the NCS is examined externally, and detailed guidelines are given as to the structure of this paper and its mark allocations. The mark allocation per paper is slightly different to that in the NATED 550 papers (see English FAL Document 2), in that writing is now prioritised in terms of weighting of marks (P1 = 80 marks; P2 =70 marks; P3 =100 marks and P4 = 50 marks).

Finally, the NCS *Programme of Assessment* (100 marks in all) is added to the final mark of 300 each year, bringing English FAL in the new curriculum to a total of 400, in comparison with the NATED 550 total of 300 marks. The weighting in the NCS is stipulated at 25% from the *Programme of Assessment*, and 75% from the external examination component (English FAL Document 5, Page 19) – potentially making assessment more fair (equivalent) across all educational contexts.

5.1 (7) Availability, user-friendliness and use of the English FAL curriculum document

In an attempt to determine the user-friendliness and use of the documents for the two curricula, the Umalusi English FAL team found it impossible to ascertain the accessibility of the NATED 550 curriculum without investigating this availability with teachers themselves. The general perception of the team members was that teachers were not using the document to underpin their teaching.

It is felt that the NCS curriculum is easily available, both in hard copy and on the Thutong and DoE websites of the Department of Education. However, although the documents are available, in some cases teachers are not familiar with them despite provincial attempts to cascade the information. In addition, having to work with three documents (NCS Subject Guidelines, Learning Programme Guidelines and Subject Assessment Guidelines) is perceived as a complicating matter by teachers. Each of the three documents is not stand-alone, but deals with differing aspects of the curriculum: users need to know how to combine the information, and which parts of it are most up to date.

New policies explaining current and appropriate assessment practices and tasks, portfolio guidelines and literature texts are issued at intervals by the DoE on a frequent basis. Notwithstanding the fact that these documents are of vital importance for teaching, learning and assessment, this stream of information is confusing for teachers who need to integrate each new document with existing information: each time there is a new document, only parts of the previous documents become out of date.

Finally, it was also strongly felt by the team that many teachers are not underpinning their classroom practice with the information contained in the NCS policy documents – possibly due to lack of training; lack of confidence and knowledge of the subject, and confusion around which policy documents to consult.

5.1 (8) Concluding comments for English FAL

The English FAL team made concluding comments on the basis of information discussed in Sections 1–7 above, on the respective levels of difficulty of the NATED 550 and NCS curricula, and on the usefulness of the Umalusi curriculum instrument, for English FAL.

5.1 (8.1) Respective levels of difficulty of the NATED 550 and NCS curricula

The comparative analysis of the two curricula yielded the following information that is useful for judging the relative levels of cognitive difficulty of the two curricula:

a) Table 5.1.2 illustrates content coverage in the NCS and NATED 550 curricula. Looking at the number of content items in each curriculum in relation to the total number of content items,

it can be seen that the ratio of items of NCS to NATED 550 is 69%:31% of the total combined content for both curricula. In other words, the volume of content in the NCS curriculum is far greater than that in its NATED 550 equivalent. Caution should be observed when making evaluative judgments regarding the simplicity of the NATED 550 curriculum because of its limited explication of content: content was 'there' but implicit. The fact that very similar content features in the NCS and is simply more spelled out for the user than in the NATED 550 documents means that, potentially, there is more content to be covered in the NCS, especially for teachers lacking in subject specialisation skills in English.

One example of this elaboration can be seen in Learning Outcome 2 (Reading and Viewing). While specification in the NATED 550 is very general in this regard, in the NCS there are detailed suggestions with regard to the different textual genres to be included. In addition, this learning outcome includes sections on reading for comprehension and appreciation; reading and evaluating the meaning of a wide range of written, visual, audio and audio-visual texts; assessing bias in texts; and includes a wide range of types of texts such as transactional, literary, poetic, drama, film study, audio and multimedia texts.

In another example, in the NATED 550 curriculum, the writing component is vague and not as comprehensive as it is in the NCS curriculum. The NATED 550 documents specify only two types of essays: narrative or descriptive. The NCS in contrast lists all six genres. These differences have a bearing on the relative difficulty of the two curricula, since it is likely that teachers did not teach the more difficult genres in NATED 550 since they were not stipulated.

b) With reference to skills coverage, the NCS curriculum again specifies more items than does that for NATED 550 (see Table 5.1.5) with a comparative ratio of 63%:37%.

c) There has been a reduction in the duration of the exams associated with the NATED 550 and the NCS curricula. For example, the time allocated for Paper 1(Language) and Paper 2 (Literature) has been reduced from two-and-a-half hours for the NATED 550 papers to two hours for the *National Senior Certificate* papers. Bearing in mind the additional coverage of skills and content in the NCS, this reduction is cause for concern, especially since the learners in additional language contexts need time to read for understanding.

With respect to the relative difficulty of the two curricula, the team made three comments.

First, the NATED 550 curriculum and supporting documents do not distinguish between Higher and Standard Grades; neither do they distinguish between levels of cognitive ability within these grade levels. What is mentioned is that learners should be *at least able to …*, with no further indication of cognitive difficulty. In contrast, the NCS curriculum shows marked progression in terms of cognitive difficulty in the choice of questions applied to texts used in each school grade, as well as the skills associated with the assessment standards under each learning outcome. This specification suggests that learners will be led towards increasing levels of complexity, but it was the opinion of the team that this is an ideal outcome, since the team believed that many teachers do not understand how to get to these greater levels of complexity.

Second, regarding the levels of cognitive difficulty, the data in Table.5.1.5 (above) reveal that the NCS is particularly cognitively demanding in comparison to the NATED 550 curriculum. This difference is particularly the case for Learning Outcomes 2 and 3 (*reading and writing*), the outcomes externally assessed in Grade 12.

Last, the NCS is far more comprehensive than the NATED 550 curriculum in its specification of skills and content. While this explication is likely to ensure that the associated teaching is more comprehensive, it could be said that the NCS may be more time consuming to complete than the NATED 550 curriculum. If the pace of teaching and learning has to increase to accommodate this coverage, the level of difficulty of the NCS may be relatively higher than that of the NATED 550 curriculum.

5.1 (8.2) Usefulness of the Umalusi curriculum evaluation tool for English FAL

The English FAL team considered the usefulness of the general Umalusi curriculum evaluation tool for the subject English FAL. It reported here on the usefulness of the tool to evaluate the adequacy of the curricula as guides for classroom practice, for examiners, for moderators, and for materials developers. It also reported on the fairness of the instrument, in terms of facilitating the emergence of a balanced curriculum evaluation. It concluded with a few additional comments.

Regarding the usefulness of the instrument for evaluating curricula as guides for teachers, examiners, moderators, and materials developers

The following commentary was made:

a) It was generally felt that the questions in the evaluation tool were important in providing reliable indicators of the usefulness of the curriculum.

b) Challenges arose when using the questions with respect to the NATED 550 curriculum, particularly because the skills and content aspects of the NATED 550 curriculum had to be teased out of a rather vague description of what needed to be taught and achieved.

c) The tool served to highlight important curriculum characteristics. Through the answers to the questions, it became clear that the NCS curriculum and its supporting documents (English FAL Document 4, English FAL Document 5) provide evidence of a thorough immersion into content, skills, pacing, assessment, performance descriptors, inclusivity and methodologies to achieve optimal learning. The documents, if used optimally, develop all seven roles of a teacher, particularly the roles of designer of learning programmes, assessor, learning mediator, lifelong learner and pastoral care worker. Thus, the three documents (English FAL Documents 3, 4 and 5) are invaluable for teachers, subject advisors and materials developers.

The questions also highlight the high difficulty levels of Learning Outcomes 2 and 3, and relatively high content and skills coverage in the NCS curriculum.

d) There were some aspects that the tool did not address. Some members of the team expressed concern about the number of documents to work with in order to benefit from the information in the NCS and its supporting documents. However, it is believed that the time and effort put into familiarising oneself with the documents will prove invaluable. Another concern raised is that the language used in the NCS curriculum documents is inaccessible.

Additional insights

In the English FAL curriculum, Learning Outcome 1 (*Listening and Speaking*); Learning Outcome 2 (*Reading and Viewing*), Learning Outcome 3 (*Writing*) and Learning Outcome 4 (*Language in context*) will, in practice, not each be taught and learned within their allocated thirds of classroom time. Since Learning Outcomes 2 and 3 are externally examined and are heavily weighted in terms of content and skills coverage, levels of difficulty and cognitive demands, these two outcomes will take up the bulk of available teaching time.

In addition, with the setting and assessing of Paper 2 being provincial, care needs to be taken to ensure that the examination papers are comparable in terms of coverage and skills across the provinces. In the opinion of the English FAL team, this paper should be standardised nationally by the setting of one Paper 2 examination for all provinces.

SUMMARY OF CURRICULUM EVALUATION: ENGLISH FAL

There are three main findings regarding the difficulty level of the new NCS curriculum for English FAL:

- First, the NATED 550 curriculum and supporting documents do not distinguish between Higher and Standard Grade; neither do they distinguish levels of cognitive difficulty within these levels. What is mentioned here is that learners should be *at least able to* … with no further indication of

cognitive level. In contrast, the NCS curriculum shows marked progression in terms of cognitive difficulty in the choice of questions applied to texts used in each school grade, as well as in the skills associated with assessment standards for each learning outcome. This specification is likely to lead teaching and learning towards increasing levels of complexity over time. Without extensive in-service training, however, it is possible that many current teachers will not understand how to proceed towards these greater levels of complexity.

- Second, regarding the levels of cognitive difficulty across the curricula, the data in Table 5.1.5 in the English FAL curriculum report show that the NCS is more demanding than the NATED 550 curriculum, especially with respect to Learning Outcomes 2 and 3 (*Reading and Writing*) – the learning outcomes externally assessed in Grade 12.
- Third, the NCS is far more comprehensive than NATED 550 curriculum in terms of its specification of skills and content. While this explication is likely to ensure that teaching is more comprehensive, the NCS curriculum may, as a result, be more time consuming to complete. If the pace of teaching and learning has to increase to accommodate this coverage, the level of difficulty of the NCS curriculum may be relatively higher than that of the NATED 550 curriculum.

5.2 GEOGRAPHY

The Geography team reported separately on content and skills in the respective Geography curricula. It considered curriculum organising principles; sequencing, progression and pacing in the curricula; curriculum aims, both general and subject-specific; pedagogic approaches advocated; and guidance for internal and external assessment. The Geography section of this report concludes with a judgment regarding the respective levels of difficulty of the curricula, and comments on the Umalusi evaluation tool – based on the findings of the preceding tasks listed.

5.2 (1) Specification, weighting, and focus of content and skills in the Geography curricula

In the following six subsections, the Umalusi Geography team comments on the specification, weighting, and foci of content and skill topics in the NATED 550 Higher and Standard Grade curricula and the NCS curriculum.

5.2 (1.1) Specification of content topics in the Geography curricula

The broad content topics to be covered in Grades 10, 11, and 12 in both the NATED 550 and NCS curricula are listed in Table 5.2.1, below (topics in the NCS curriculum not prescribed in the NATED 550 curricula are underlined). It is worth noting that all content is assessed both internally (via portfolio tasks) as well as externally (in final examinations).

The Geography content indicated in both the Higher and Standard Grade NATED 550 syllabi, and in the NCS curriculum can be broadly divided into Physical and Human Geography. This division provides the broad framework of the examination for the theory part of the subject (see Table 5.2.1). Geographical themes covered in these *Physical* and *Human* Geography sections in Grades 10, 11 and 12 ensure a reasonable degree of continuity across school years. In most cases, the specific content covered in a school grade (previously referred to as a *school standard*) is different from the content prescribed for the preceding or following grade. In both of the NATED 550 and NCS curriculum frameworks, the matriculation examination for Geography was/is based mainly on work done in Standard 10 or Grade 12. On analysing Table 5.2.1, a number of broad similarities and differences emerged and are discussed briefly here:

a) The content selections for Grade 12 in both curriculum frameworks show a very high degree of similarity (see Table 5.2.1). With the exception of the section on "*Soil studies, ecosystems and environmental conservation*" in NATED 550, all the broad Geographical themes are nearly the same in the NCS. In the NCS curriculum, smaller subtopics representing contemporary human-

environmental realities and issues have been added. For example, under the theme *People and Places: urban settlements*, topics like *post-modern urban settlements (changing urban centres), governance of urban settlements (local authorities, Agenda 21)* have been included. These and other similarly small changes do not add significantly to the content to be covered, but serve to ensure greater Geographical relevance.

b) Another new trend in the NCS for Geography is a greater emphasis than was previously the case on how humans contribute to environmental problems, as well as how they respond to natural and environmental phenomena and issues. This trend is in line with developments in the subject as an academic discipline.

c) The NATED 550 Higher Grade curriculum stipulates *more* content, as well as expecting a *higher order type of cognitive demand* when dealing with these topics than does its Standard Grade equivalent (see Geography Document 7). Content topics as well as action words that are in *italics* indicate what is expected in HG – these learners are expected to demonstrate comprehension, apply knowledge and skills, and solve problems.

d) Apart from the few exclusions and new additions, the difficulty level of the NCS curriculum compares favourably with what is expected at NATED 550 Higher Grade level. This trend is further enhanced by the focus on the gazetted learning outcomes for Geography in the NCS, where learners are expected to demonstrate the ability to use enquiry and Geographical skills and techniques (Learning Outcome 1) in the process of constructing Geographical knowledge and understanding (Learning Outcome 2) which they should be able to apply (Learning Outcome 3) in familiar and unfamiliar situations (See Geography Document 3, Pages 14-16). If it is assumed that the majority of learners are likely to perform at typical Standard Grade level (as was the case in the past), then it can be expected that many learners may find the 2008 NSC examinations based on the NCS curriculum evaluated challenging.

Regarding stipulations for the examined curriculum, the Umalusi Geography team found that:

a) The matriculation examination under both curriculum frameworks is set on the content stipulated for Grade 12, although much of the knowledge and understanding assessed is a continuation of work started and/ or covered in Grades 10 and 11.

b) Where the NATED 550 curricula for Higher and Standard Grade emphasises specific content to be mastered, assessment in the NCS curriculum is in relation to selected content topics and assessment standards for Grade 12 (skills). Learners in the current system are not only expected to recall information, but also to show understanding; demonstrate that they can apply knowledge and skills; as well as solve problems. The NCS curriculum requires that learners understand content, and can apply their newly acquired insights.

Table 5.2.1: Comparison between NATED 550 HG and SG and NCS theory/content for Grade 12

NATED 550 HG and SG Grade 12 Content	NCS Grade 12 Content
PHYSICAL GEOGRAPHY	
Paper 1: SECTION A (Questions 1 & 2)	**Paper 1: SECTION A (Questions 1 & 2)**
Climatology (*40% of each question*) • The mid-latitude cyclone • The tropical cyclone • Major controls of South Africa's climate on regional scale • Travelling disturbances • Synoptic maps/satellite image reading and interpretation • South African climate on local scale • Valley climate • Urban climate	**Climate and Weather** (*50% of each question*) • Changes in energy balance • Global air circulation and resultant weather patterns • Mid-latitude cyclones • Subtropical anticyclones and resultant weather over South Africa • Tropical cyclones • Synoptic maps/satellite image reading and interpretation • Climate at local scale • Human-made climates (city/urban climates) • Climate hazards and human response – risk and vulnerability

<table>
<tr><th>NATED 550 HG and SG Grade 12 Content</th><th>NCS Grade 12 Content</th></tr>
<tr><td colspan="2">PHYSICAL GEOGRAPHY</td></tr>
<tr><td>Paper 1: SECTION A (Questions 1 & 2)</td><td>Paper 1: SECTION A (Questions 1 & 2)</td></tr>
<tr><td>Geomorphology (40% of each question)
• Drainage basins
• Characteristics of drainage basins
• Drainage patterns
• Stream profiles
• Stream channel/flow characteristics
• River capture (stream piracy)
• Superimposed and antecedent streams
• Topography associated with horizontal rock strata
• Topography associated with inclined rock strata
• Topography associated with massive igneous rocks
• Slope characteristics</td><td>Fluvial Processes (50% of each question)
• Concepts; sources of water supply; types of rivers; factors influencing run-off and infiltration; characteristics of drainage basins; laminar and turbulent flow; discharge of a river; river capture/ stream piracy; river profiles; superimposed and antecedent rivers; drainage basins; catchments and river management
• Topography associated with horizontal layers
• Topography associated with inclined rock strata
• Topography associated with massive igneous rocks
• Slopes
• Mass movements and human responses</td></tr>
<tr><td>Soil studies, ecosystems and environmental conservation (20% of each question)
• Soil profile; soil-forming processes; soil erosion
• Ecosystems
• Ecological processes
• Human impact</td><td></td></tr>
<tr><td colspan="2">HUMAN GEOGRAPHY</td></tr>
<tr><td>Paper 1: SECTION B (Questions 3 & 4)</td><td>Paper 1: SECTION B (Questions 3 & 4)</td></tr>
<tr><td>Rural Settlements (40% of each question)
• Settlements
• Nucleated and dispersed settlements
• Site and situation of settlements
• The internal structure and form of rural settlements
• Rural depopulation</td><td rowspan="3">People & places: rural & urban settlement (50% of each question)
• Concepts
• Classification of settlements
• Site and situation
• Hierarchy
• Structures and patterns of settlements
• Land use zones and characteristics
• Key human-environment interactions in rural settlements: settlement issue – rural depopulation; governance of rural settlements
• Key human-environment interactions in urban settlements – settlement issues/urban problems; post-modern urban settlements; governance of urban settlements
• Key sustainability-related strategies: rural- and urban-specific strategies</td></tr>
<tr><td>Urban Settlements (60% of each question)
• Processes and characteristics of urbanisation
• Site and situation
• Functions of urban settlements
• Distribution of urban centres
• Urban morphology; the morphological structure of a city
• The physical expansion of cities
• Land use zones; urban models
• Urban problems and possible solutions</td></tr>
<tr><td>Paper 1: SECTION C (Questions 5 & 6)</td></tr>
<tr><td>South African Geography
• Distribution maps (10% of each question)
• Population (20% of each question)
• Environmental problems and possible solutions (20% of each question)
• Economic Geography (50% of each question)
- economic activities of SA: economy –definitions
- primary activities
- secondary activities
- tertiary activities
- economic development</td><td>People and their needs (50% of each question)
• Economic activities
- primary, secondary, tertiary, quaternary
- factors influencing above activities
- perceptions of decision makers on location of industries and other economic activities
- impact of humans on location of economic activities
- responses of people to injustices linked to economic activities
- impact of the change of location of activities on people
- importance and challenges of informal sector
- influence of globalisation on economies and change
- agriculture as economic activity
- transport and trade
• Water as a critical resource
- availability of water
- distribution and supply of water to SA citizens
- sustainable use and management of water</td></tr>
</table>

5.2 (1.2) Content weighting in the Geography curricula

No clear indications are provided for time allocations for specific sections or topics in either the NATED 550 Higher and Standard Grade curricula (See Geography Documents 1 and 2) or the *National Curriculum Statement* for Geography (See Geography Documents 3-6). In the NATED 550, curricula there are no allocations for class time: planning in this regard was left to the professional competence of teachers and, in certain previous departments of education, to the additional guidance of subject advisors. The same situation continued with the introduction of the NCS, with the only difference being that teachers were supplied with exemplars of learning programmes and work schedules (See Geography Document 5: Pages 10 and 15; Geography Document 6: Pages 35-46). These exemplars, however, do not indicate the specific time to be spent on particular content, and serve as planning guides only for teachers.

The Umalusi Geography team estimated amounts of time needed for particular topics and has indicated the total percentage of time needed to cover core content and skills (see Table 5.2.2 below). While in the case of the NATED 550 curricula, at times the relationship between class time recommended for certain topics and the weighting of the associated sections in exams did not correspond (see, for example, the amounts of time and weighting for Human and Physical Geography), in the NCS there is more balance between percentages of class time suggested and examination weightings for topics.

Table 5.2.2: Estimated class time required for content in NATED 550 HG and SG, and NCS in Grade 12

CONTENT / SKILLS SECTION	NATED 550 SG		NATED 550 HG		NCS	
	% Class time	% Exam weighting	% Class time	% Exam weighting	% Class time	% Exam Weighting
Climatology/Climate and weather	20		19		20	20
Geomorphology/Fluvial processes & landforms	20	26.67	19	26.67	20	20
Soil studies, ecosystems & environmental conservation	4		5		*	*
Settlement Geography/ People and places	20	26.67	19	26.67	20	20
Regional Geography/People and their needs	20	26.67	19	26.67	20	20
General Geographical techniques/Geographical skills	16	20	19	20	20	20
Total	**100**	**100**	**100**	**100**	**100**	**100**

Table 5.2.2 above shows definite similarities between the times used by teachers for specific sections in the NATED 550 and *National Curriculum Statement* frameworks. When considering solely content topics in the two curricula, it appears that the two curricula are similar. It must, however, be mentioned that the new context-relevance of content in the *National Curriculum Statement*, and the *application* of knowledge and skills required by Learning Outcome 3 aligns the NCS more closely to the Higher than the Standard Grade NATED 550 curriculum.

5.2 (1.3) Content focus in the Geography curricula

A careful analysis of the content in the NATED 550 and NCS helped the Geography research team to determine the focus of the content in each of the curricula. The content focus is described as *discipline-specific* when it forms the core of Geography-specific disciplinary knowledge; *generic* when it is applicable to Geography as well as other school subjects; and *life-related* when it is useful for life outside school in *addition* to being disciplinary or generic.

Determining the focus of particular content topics was a difficult process because of the integrated nature of Geographical knowledge. Although most content topics were regarded by the team

as being *discipline-specific* (see Table 5.2.3), there are a number of topics such as *environmental education* or *economic processes and patterns* that are also addressed in Life Sciences and Economics respectively (although seen from different points of departure). Geography is regarded by many as the 'mother of all sciences': many of its constituent topics are also addressed in other subject contexts, from other points of view.

As Table 5.2.3, below, indicates, most Geography core content sections can be classified as primarily disciplinary *as well as* life-related. The section categorised as *generic* in the NATED 550 curricula is not included in the *National Curriculum Statement* for Geography. The team assessed content foci in sections covered in Grade 12 only, as the matriculation examination is based on work covered in that grade only.

Table 5.2.3: Estimated content focus of Geography core content

GEOGRAPHY CORE CONTENT SECTION	NATED 550 SG			NATED 550 HG			NCS		
	Disciplinary	Generic	Life-related	Disciplinary	Generic	Life-related	Disciplinary	Generic	Life-related
Climatology/ Climate and weather	95.2	4.8	100	95.2	4.8	100	90.5	9.5	100
Geomorphology/ Fluvial processes and landforms	100	0,0	100	100	0,0	100	100	0.0	100
Soil studies, ecosystems & environmental conservation	16.7	83.3	100	16.7	83.3	100	*	*	*
Settlement Geography/ People and places	100	0.0	100	100	0.0	100	100	0.0	100
Regional Geography/ People and their needs	87.5	12.5	100	87.5	12.5	100	68.7	31.3	100

The percentages indicated in Table 5.2.3 (above) clearly highlight trends in the nature of Geography content as prescribed in the NATED 550 Higher and Standard Grade curricula and now in the *National Curriculum Statement*. These trends are itemised as follows:

a) Most (98.9%) of the content in both curricula is aligned with knowledge important for Geographers – it is *discipline-specific*. This trend is the case despite changes from the old NATED 550 to the new NCS curriculum (see Section 5.2 (1.1) above). The most profound of these changes is in the Grade 11 curriculum where issues of development and sustainability are foregrounded (see Geography Document 3, Pages 28-30). These changes reflect responsiveness to epistemological developments in Geography as both an academic and an applied discipline.

b) All the geography content addressed in both curriculum frameworks provides a platform from which learners are prepared to understand their own environments with the intention of equipping them to operate functionally in areas in which they live. This preparation is partly the case because Geography seeks to develop an understanding of the physical structure of the earth and the human content imposed on it, as well as the interactions between them. Where the focus in the NATED 550 Higher and Standard Grade curricula was mainly on *knowing about* … (see topics under "Subject Matter" in Geography Document 1), the shift in the NCS is from not only knowing about something, but also about *using this understanding* (see the general critical outcomes and Geography learning outcomes in Document 3 for Geography, pages 14-16)

c) The content section *soil studies, ecosystems, and environmental conservation* prescribed in the NATED 550 Higher and SG curricula is not included in the NCS curriculum. There are, however, many topics in the NCS that create space for the infusion of the notions of ecosystems and environmental conservation across Grades 10 to 12. How and when these notions will be integrated is not always indicated clearly, and will depend on the professional pedagogic knowledge of the teacher.

d) The most significant content changes in the NATED 550 and NCS curricula for Grade 12 can be seen in Table 5.2.4 (above) under the heading *People and their needs*. The themes of *economic geography* and *resources* in the NCS were addressed (with a different emphasis) in the NATED 550 Higher and SG documents, as *regional Geography: South Africa* (see Geography Document 1, Page 7). As indicated in the contents table for the *National Curriculum Statement* (Document 3 for Geography), a number of new topics are included which reflect current global and national realities, needs and challenges. Again, these changes reflect epistemological developments in the discipline as well as a focus on understanding factors contributing to current challenges, with a view to finding solutions and management strategies for sustainable solutions.

5.2 (1.4) Skills specification in the Geography curricula

A broad summary of differences between NATED 550 Higher and Standard Grade curricula on the one hand, and the NCS on the other - in terms of skills examined mostly in Geography Paper 2 - is shown in Table 5.2.4 (below). The themes listed in the table are those that will be assessed. There are, however, a number of other skills developed in the course of teaching and learning Geography that are not stipulated in the curriculum documents, but are associated or implied with specific Geographical content. These skills include reading, orating, literacy, numeracy, graphicacy, etcetera (see for, example, Geography Document 2, Page 2).

Most of the general Geographical skills and techniques prescribed in the NATED 550 Higher and SG curricula still form part of the NCS curriculum (see Table 5.2.4, below). The most significant additions in the NCS are:

- Map projections (see Geography Document 3, Pages 26, 28 and 30): these skills serve as a context for understanding scale, size, shape, etcetera; and the application of these concepts and related principles when reading and interpreting different types of maps used in teaching and learning Geography.
- Fieldwork (see Geography Document 3, Pages 26, 28 and 30): this is emphasised as a necessary teaching and learning activity aimed at supporting learners in the collecting, organising, analysis, and interpretation of information as they construct Geographical knowledge and understanding. Fieldwork in the NATED 550 Higher and SG curricula is not indicated as a specific Geographical skill that forms part of learning geography. Instead, in Document 2 for Geography (Page 25), the only reference that is made to fieldwork is as one of the types/forms of assessment that may be used as part of the Geography teacher's continuous assessment programme for learners.
- Geographical Information Systems (GIS)(see Geography Document 3, Pages 26, 28 and 30): this is the most significant addition to Geographical skills and techniques in the FET band. 'Real' integration of GIS in teaching and learning Geography is currently not uniform nationally, but it is to a large extent dependent upon availability of necessary software and hardware as well as expertise, all of which are in many cases non-existent.

Table 5.2.4: Comparison between NATED 550 HG and SG, and NCS Skills and Techniques for Grade 12

NATED 550 SG & HG Gr. 12 Skills	NCS Gr. 12 Skills
Paper 2 (Basic map work skills = 20%) (Application of theory to map work = 80%)	**Paper 2** (Basic map work skills = 20%) (Application of theory to map work = 80%)
	Using atlases
Reading, analysis and interpretation of aerial photographs • types of photographs • interpretation	**Map use and map skills** • types of photographs • techniques • interpretation
Reading, analysis and interpretation of topographic maps • techniques • interpretation	
	Map projections **Fieldwork** **Geographical Information Systems (GIS)**

On analysing Table 5.2.4, the following points emerge:

a) Significantly, more aspects are included and will be assessed as part of Paper 2 in the NCS than in the NATED 550 curricula. These skills can be described as Geographical skills and techniques.

b) The inclusion of Geographical Information Systems (GIS) in the NCS definitely increases the difficulty level of this section of the curriculum. The 2008 exemplar question Paper 2 for Grade 12 focused mainly on theoretical understanding of GIS concepts. Although this topic is also part of Grades 10 and 11 skills and techniques, the real expectation of the inclusion of GIS with regard to teaching and learning will only become clear once the nature of the assessment of this section is known.

5.2 (1.5) Skills weighting in the Geography curricula

Although Paper 2 of the matriculation examination for both the NATED 550 Higher and Standard Grade curricula and the NCS aims to assess learners' acquired competence in map skills and techniques, no direct indication was (or is) given in any of the documentation regarding the amount of classroom time that should be allocated to the development and use of enquiry and map skills. The team's estimation of class time allocated to the development of Geographical skills and techniques in the average NATED 550 Geography classroom is 16% for SG and 19% for HG (see Table 5.2.5, below). As a higher priority is placed on the integration of skills and techniques in the construction of Geographical knowledge in the NCS than in the NATED 550 curricula, 20% of class time was allocated to its development.

Table 5.2.5: Estimated class time required for skills and techniques in NATED 550 HG and SG, and NCS in Grade 12

CONTENT / SKILLS SECTION	NATED 550 SG		NATED 550 HG		NCS	
	% Class time	% Exam weighting	% Class time	% Exam weighting	% Class time	% Exam weighting
Climatology/Climate and weather	20	26.67	19	26.67	20	20
Geomorphology/Fluvial processes & landforms	20		19		20	20
Soil studies, ecosystems & environmental conservation	4		5		*	*
Settlement Geography/People and places	20	26.67	19	26.67	20	20
Regional Geography/People and their needs	20	26.67	19	26.67	20	20
General Geographical techniques/ Geographical skills	16	20	19	20	20	20
Total	**100**	**100**	**100**	**100**	**100**	**100**

The following conclusions can be drawn from the information in Table 5.2.5 (above):

a) With more aspects included as general Geographical skills and techniques in the NCS than in the NATED 550 curricula (as seen in Table 5.2.5), and the allocation of more classroom time to cover these aspects (see Table 5.2.6), it is clear that learners will have to show greater competence in these skills and techniques than was previously required. As learners are expected to apply these skills and techniques in familiar and unfamiliar contexts (see Learning Outcome 3, Document 3 for Geography), it is also clear that the level of difficulty of the NCS examinations will be higher than those associated with the NATED 550 Higher and Standard curricula. It is imperative that additional classroom time be allocated for this purpose, especially for those learners functioning at a Standard Grade-type level.

b) A significant shift in the NCS is that emphasis is not only on map skills and techniques, but also on generic enquiry skills. Assessment standards associated with Learning Outcome 1 capture the important elements of enquiry skills (see Document 3 for Geography, Pages 18 and 19). It can be inferred that the NCS curriculum is therefore more cognitively demanding than its NATED 550 Higher and Standard Grade equivalents.

5.2 (1.6) Skills foci in the Geography curricula

Skills stated in the curriculum documentation for both the NATED 550 Higher and SG curricula (See Geography Documents 1, 2 and 7) and the NCS (see Geography Documents 3, 4, 5, and 6) indicate specific Geographical skills and techniques with applications mainly in Geography, but possible also in other school subjects at times. Skills in the NCS documents are *using atlases; map use and map skills; map projections; fieldwork; and skills related to Geographical Information Systems*.

In Geography - and especially in the NCS - skills and content cannot easily be separated, as skills support the processes of knowledge construction and application. It was found that the levels of difficulty of skills and techniques were more demanding in the NCS than in the NATED 550 Higher and Standard Grade curricula.

5.2 (2) Organising principles and coherence in the Geography curricula

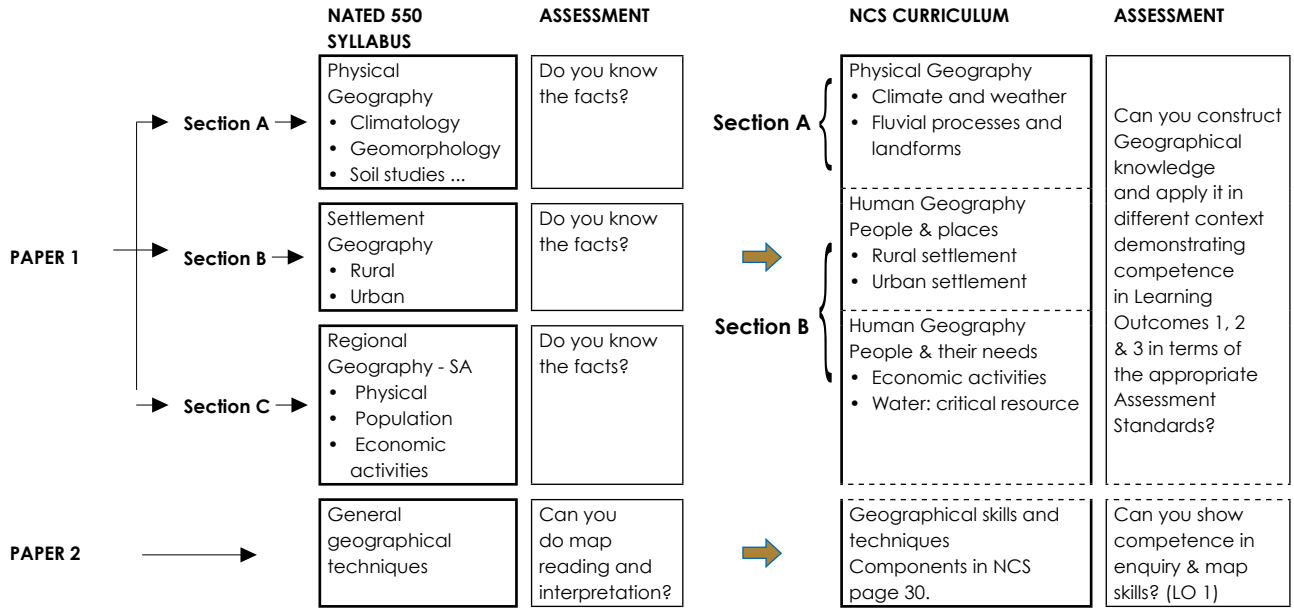
With the central teaching and learning principle being content transmission in pre-1994 curricula, the NATED 550 Geography curricula were organised around three content sections, namely physical, human and regional geography as well as general geographic techniques. The way both the NATED 550 HG and SG syllabi were organised as well as the structure of all question papers (Grades 10 to 12) entrenched this organising principle in the teaching and learning of the subject. The absence of an emphasis on the integration of these sections in many instances led to the teaching of different but epistemologically intertwined elements of the same body of Geographical knowledge, as 'independent compartments'. This practice resulted in highly fragmented Geographical knowledge and understanding for learners, as illustrated in Figure 5.2.1 (below).

The broken lines between content topics in the NCS curriculum in Table 5.2.7, below, indicate a significant shift, where there is now a greater emphasis on integration between physical and human geography (this approach is evident in the definition of the subject Geography[1] as well as in approach to be followed by teachers[2], in Document 3 for Geography, Pages 9 and 11 respectively).

1 "Geography is a science that studies physical and human processes and spatial patterns on earth in an integrated way over space and time. It examines the spatial distribution of people and their activities, physical and human-made features, ecosystems and interactions between humans, and between humans and the environment in a dynamic context."

2 "The scope of Geography, as described, emphasises the integration of physical and human geography. In the past, these components of Geography have been treated as separate elements. However, a study of physical processes that influence soil erosion, for example, must consider how human activities on the land also contribute to the process."

Figure 5.2.1: The NATED 550 HG and SG, and NCS for Geography curricula in terms of organising principles and coherence



The organising principle in the NCS is the focus on achievement of pre-defined learning outcomes (see Table 5.2.6). The final outcome of teaching and learning for this curriculum is the integration of Geographical skills and techniques (Learning Outcome 1); knowledge and understanding (LO 2); and application (LO 3) in order to develop applied competence. This competence is achieved as learners address the learning outcomes in particular contexts; in terms of the content topics of Physical and Human Geography; and in using specialised methods of enquiry and Geographical skills. It is likely that since the emphasis in the NATED 550 curricula is primarily on the recall of facts, the focus on acquisition of these complex competences in the NCS makes it a more cognitively demanding curriculum.

5.2 (3) Sequencing and progression in the Geography curricula

Curriculum sequencing and progression were considered by the Umalusi Geography team. Six points are noted here, with a concluding statement following these.

First, regarding sequencing: It is known that good teaching is characterised by sound subject knowledge and thorough preparation, but it is good and detailed planning that is fundamental to effective teaching and purposeful learning throughout different phases of the education system. Continuity and progression are elements of curriculum implementation and delivery crucial for synchronising policy, teaching, assessment and learning.

Second, the NATED 550 Higher and Standard Grade syllabi as well as the NSC curriculum for Geography show a high degree of *continuity* across the FET band in terms of content themes covered in Physical, Human and Regional Geography, and in terms of Geographical skills and techniques. For example, in the NATED 550 curricula, Physical Geography comprised Climatology (Grades 10, 11 and 12) and Geomorphology (Grades 10, 11 and 12). In Human Geography, Regional Geography was done in each FET grade focusing on a developed and a developing country in Grades 10 and 11, followed by a focus on South Africa (with its dualistic economy) in Grade 12. General Geographical techniques were also part of the syllabi for each year (See Document 7 for Geography).

Similar measures of continuity are evident across Grades 10, 11, and 12 in the NCS for Geography (see Document 3 for Geography, Pages 25-32). Geographical skills and techniques form the core of Learning Outcome 1 in each of the three school grades. Continuity is ensured by themes associated with the broad division of Physical and Human Geography. For instance, in Physical

Geography *atmosphere, weather and climate* and *the structure and changing landforms of the Earth* are covered in Grade 10; *the significance of water masses* and *Ecosystems (biotic and abiotic)* is dealt with in Grade 11; while *climate and weather* and *fluvial processes and landforms* are covered in Grade 12. Similar continuity can be seen across Grades 10, 11, and 12 in the Human Geography section.

Third, there is *progression* in terms of content and skills covered over the three years in the FET band in the NATED 550 Higher and SG curricula. For example, concepts that were covered in Climatology in Grade 10 form the basis on which more complex work is done in Grade 11, and likewise in Grade 12. In this way, and with the help of clear content and skills topic specifications in the Interim Syllabi (Document 7 for Geography), teachers were able to know the depth at which these topics were supposed to be taught and learned.

In the NCS, *progression* is indicated by the assessment standards allocated to each school grade. Progression is further entrenched by the moving from a global perspective in Grade 10 to a continental perspective in Grade 11 and a national perspective in Grade 12. However, as only broad topic themes are gazetted in the NCS (see Geography Document 3, Pages 25-32), teachers find it difficult to determine the depth and breadth with which they need to cover content topics in different grades. The NCS curriculum certainly demands more of teachers in this respect than do the NATED 550 curricula. Further, amid these uncertainties, it is likely that many learners will be disadvantaged by this lack of specification.

Fourth, the *skills* (or skill themes) that are recommended are more or less the same for all the school grades in both the NATED 550 and NCS curriculum frameworks. The task of ensuring appropriate progression within and between school grades is left to teachers. There is some guidance in the NCS, in that assessment standards are stipulated for each learning outcome (see Document 3 for Geography, Pages 18–23). It is, however, doubtful that this guidance is sufficient for all teachers in South Africa. Here, too, much is demanded of the teacher.

Fifth, the assessment guidelines for both the NATED 550 Higher and Standard Grade curricula (see Document 2 for Geography, Page 9) and the NCS (Document 4 for Geography, Pages 11 and 16) indicate the proposed increase in cognitive demand expected over the three FET years. Although this progression is not explicitly outlined in the documentation, the level of cognitive demand does increase over the three years in the NATED 550 curricula, as the topics become more cognitively and practically demanding in the later years (see Geography Document 7). A similar trend is evident in the NCS, with content topics being dealt with in each year at increasing levels of complexity (outlined in Document 3, Pages 25-32). This increasing level of cognitive demand is not so much a product of different content topics, but rather of the increasing cognitive expectations embedded in the assessment standards across the FET band. Table 5.2.6 (below) indicates the different levels, related cognitive skills, and weightings per grade.

Table 5.2.6: Different levels, related cognitive skills and weightings per grade in NATED 550 HG and SG, and the NCS

	LEVEL	COGNITIVE SKILLS	Gr. 10		Gr. 11		Gr. 12	
			HG	SG	HG	SG	HG	SG
NATED 550 SG & HG	Lower order	Knowledge (recall and reading-off type)	30%	50%	30%	50%	30%	50%
	Middle order	Comprehension	50%	40%	50%	40%	50%	40%
	Higher order	Application, Analysis Synthesis, Evaluation	20%	10%	20%	10%	20%	10%
NCS	LEVEL	COGNITIVE SKILLS	Gr. 10		Gr. 11		Gr. 12	
	Lower order	Knowledge (recall and reading-off type)	40%		30%		30%	
	Middle order	Comprehension	40%		50%		40%	
	Higher order	Application, Analysis Synthesis, Evaluation	20%		20%		30%	

Sixth, the documents for both the NATED 550 and the NCS curricula state the content and skills that should be covered by the end of each year. There is no differentiation between the Higher and Standard Grades of the NATED 550 curriculum in some of the documents issued (see Document 1 for Geography), while there is in others (see Document 7 for Geography). What must be covered in each year is made clear in the NCS (see Documents 3, 4, and 6 for Geography).

In conclusion, regarding sequencing and progression, then, it was found that both curriculum frameworks show similar degrees of continuity and progression. The team found, however, that operationalising these features when using the NATED 550 curricula would have been easier than it is when using the NCS and related documents for Geography.

5.2 (4) Aims, purpose, vision, and outcomes in the Geography curricula

In terms of aims, purpose, vision and outcomes in the Geography curricula, the team found that the NCS shows far more clarity than do the NATED 550 Higher Grade and Standard Grade curricula. This conclusion is based on the following points:

a) In the initial NATED 550, interim documents (see Document 1 for Geography), no aims are listed. The provincialised interim syllabi at the time reflected the aims of particular provinces (see, for example, Document 7 for Geography, Page 2 under the topic *Mission Statement*) as derived from the core Geography curricula. More recently, the NATED 550 *National Assessment Guideline* (see Document 2 for Geography, Pages 2 to 4) listed a set of common objectives in four categories: knowledge, skills, perception and appraisal.

In the NCS (Document 3 for Geography, Page 1) a list of social principles (social transformation; *Outcomes-Based Education*; high knowledge and skills; integration and applied competence; progression; articulation and portability; human rights, inclusivity, environmental and social justice; valuing indigenous knowledge systems; and credibility, quality and efficiency) are foregrounded. In the same document (ibid., Page 9), the purpose of Geography is explained focusing on the three Geography learning outcomes in the document.

b) In the NATED 550 curriculum, no clear guidance is provided for achieving any aims except for reference to the use of key Geographical questions (see Geography Document 7, Page 3). In the NCS for Geography (Document 3, Pages 2-4) the principles underlying the curriculum are spelled out in detail, together with an explanation of how these ideals can be achieved. For example, on page 11 of the latter document, the development and application of Geographical knowledge, understanding and skills are explained. Based on the greater clarity of the principles and outcomes to be addressed, the NCS creates increased possibilities for teachers to achieve them. However, this achievement still depends to a large extent on the pedagogical content knowledge of the teacher.

c) Regarding guidance for teaching and learning in differing social contexts where learners and environments may be resourced to differing degrees, there is no evidence in the NATED 550 documentation that varying contexts have been considered. In contrast, in the NCS, the context of social transformation in South Africa is clearly addressed (Document 3, Pages 2-4). The same can be said of the differing contexts of learners. This consideration is demonstrated in the valuing of indigenous knowledge systems, and in an acknowledgement of human rights, inclusivity and socio-economic and environmental justice. The *Learning Programme Guidelines* (Geography Document 6) accompanying the NCS explain how teachers could address these aspects in Geography classrooms.

d) Similarly, spatial contexts are elaborated in the NCS and not in the NATED 550 curricula. Spatial context is not mentioned in relation to *climatology* in the *Interim Syllabus*, for example (see Document for Geography 7, Pages 14, 25 and 36). It is likely that an experienced teacher would address it on a global scale in Grade 10, on a continental scale in Grade 11, and on a local scale in Grade 12. The same goes for other content areas. The NCS documents, in contrast,

clearly state the spatial contexts in which content areas should be taught and learned (see Geography Document 3, Pages 26, 28 and 30).

e) With respect to articulation between Geography at FET level and the subject at GET or Higher Education levels, while this alignment may potentially have been in place with the NATED 550 curricula, there is no explication of how it could or should operate. The *interim syllabus* (Geography Document 7, Page 7) only provides an explanation, for instance, of how the subject contributes to the development of learners' Geography skills, knowledge, values, understanding and application.

In the NCS, in contrast, there is a paragraph describing articulation and portability with other parts of the education system (see Geography Document 3, Page 3). This text, however, appears to be a statement of intent rather than providing evidence of articulation. The document elsewhere describes links between the three Geography learning outcomes in the GET, FET, and Higher Education levels (ibid., Pages 12-13).

Foundations are laid via these learning outcomes in the GET and FET phases, and knowledge and skills thus gained form the basis for specialised studies in certain fields at Higher Education level. Careers with Geography as a founding subject are stated (ibid., Page 13). It is increasingly evident from official reports and other related research projects, however, that articulation between GET and FET levels is not as smooth as policy intends it to be. This disjunction occurs chiefly because the depth and breadth of content and skills as well as levels of cognitive demand required at FET level are much greater than those needed at Senior-phase level.

5.2 (5) Teaching approaches and subject methodologies for Geography

The Umalusi Geography team reported on general and subject-specific teaching approaches and subject methodologies separately.

5.2 (5.1) General teaching and learning approaches advocated for Geography

The Umalusi team's analysis of teaching and learning approaches advocated in the respective curricula highlights the following:

a) There is no description of desired general teaching and learning approaches in the core NATED 550 documentation (see Geography Document 1). In the provincial *interim syllabus* considered, regional and thematic approaches are foregrounded, emphasising problem-solving, enquiry, interdisciplinary, and applicability to real life (see Geography Document 7, Page 5).

The NCS, in contrast, explicitly states its general teaching and learning approach, namely, *Outcomes-Based Education* (OBE). This approach is described early in the documentation (see Geography Document 3, Page 2) and is supported throughout with descriptions, for example, of learning outcomes and assessment standards, and detailed guidance on content and skills to be taught, in the *Learning Programme Guidelines* (Geography Document 6). Integration of knowledge, skills and techniques is strengthened by using regional or thematic studies with the infusion of systems and issue-based approaches.

b) Since both the aims as well as the teaching and learning approaches are vague in NATED 550 documentation, no clear alignment between them is apparent. In contrast, the NCS shows a closer alignment between the teaching/learning approaches and the curriculum aims. *Outcomes-Based Education* is explicitly framed as the main principle underlying the curriculum (see Geography Document 3, Pages 1 and 2); how the subject should be approached is then explained in each of the three learning outcomes (ibid., Page 11).

c) The suitability of approach for learners in differing social contexts is neither addressed nor clear in the NATED 550 Higher and Standard Grade documents. In the NCS, the clearly advocated

Outcomes Based Education is a learner-centred approach that emphasises inclusivity and potentially increases the involvement of learners in the subject (see Geography Document 3, Page 4). It must be noted, however, that OBE relies on resource-rich learning environments and well-trained teachers, characteristics not the case in the majority of South African classrooms.

d) Regarding the suitability of the OBE approach for the school subject geography, the approach aligns with modern pedagogies in Geography as a discipline, as well as with Geography content. Working holistically with learning outcomes, for example, can lead to the desired integration of Physical and Human Geography. Using the systems and issues-based approaches advocated would potentially strengthen the integration of Geography skills, knowledge, attitudes and values. However, explanation as to how these approaches are to be used in relation to different Geography themes covered in the NCS is lacking, and is very much needed. How these approaches are to be used in the different school grades at FET level is also not discussed. It is therefore concluded that if teachers are not meaningfully supported in their use of pedagogies that create opportunities for learners to become more actively involved in the construction of Geographical knowledge, then due to the theoretical nature of the subject, rote learning may become the order of the day and textbooks the only source of information.

e) With respect to the suitability of the OBE approach for Geography learners at FET level, the approach was highly recommended, as learners at this level have naturally enquiring and questioning minds, and tend to challenge knowledge that is not validated and integrated. An approach in which they are encouraged to begin with questions and hypotheses (Learning Outcome 1), followed by hands-on collection of information/data, potentially satisfies their need for authenticity and involvement in the generation and validation of knowledge. However, strategies for teacher engagement with learners in relation to different Geography content topics in different contexts are notably lacking. It is doubtful whether all teachers would know how to proceed in this respect.

5.2 (5.2) Subject-specific methodologies advocated for Geography

In terms of subject-specific methodologies, the Umalusi Geography team found the following:

a) There is limited reference to subject-specific teaching and learning approaches in the NATED 550 curriculum, especially in terms of practical and subject-specific work to be covered in Geography (see Geography Documents 1 and 2). In the NCS, there is a strong alignment between these two aspects (subject-specific theoretical and practical work), since the principles of OBE are followed through in the statement of subject-specific learning outcomes and assessment standards (see Geography Document 3, Pages 18 to 23, for instance). Further explanation is given for Geography teaching approaches involving regional and thematic studies (ibid., Pages 12-13), where systems and issues-based approaches are advised. Unfortunately, the usefulness of the NCS documents ends here – they do not help teachers to implement the approaches, as there are no examples as to how the approaches are to be used for different topics or in different teaching contexts. Unless teachers are guided effectively through well-planned and thorough in-service and pre-service training, the quality of both teaching and learning is likely to be limited.

b) The subject-specific approaches in the NATED 550 curriculum, although implicit, focus mainly on teacher-centred knowledge transmission, which suits learners with the ability to recall facts as initially presented. Whether the systems and issues-based approaches advocated in the NCS will be attainable will depend largely on the competence levels of the teachers concerned, and on the availability of resources. One example of a resource-dependent area is the access of learners to GIS software and hardware. The NCS curriculum documents only provide teachers with broad guidelines, with no detailed explanation of how subject-specific methodologies can be used for particular topics in specific school grades. There are no exemplars of best practice in terms of these methodologies, and it is left to teachers to make sense of them.

c) Regarding the suitability of subject-specific teaching and learning methodologies advocated in the respective curricula, for Geography content there is no clear link between methods and content in the NATED 550 curricula. Similarly, despite there being a clear description of the link between selected content and subject-specific assessment standards in the NCS (see Geography Document 3, Pages 18 to 23), policy is silent as to how teachers are to use learning outcomes via assessment standards to support learners in the use of Geographical knowledge in familiar and unfamiliar situations. Working in this way demands changed practice from what was previously followed, requiring considerable policy support as well as thorough school-based curriculum support.

d) Practical approaches are encouraged in both the NATED 550 and NCS curricula, to a far greater extent in the latter than in the former. This approach is beneficial for learners at FET level as they are encouraged to engage actively in the acquisition of knowledge, lending authenticity and validity to their learning experience. The NCS encourages evaluation of knowledge claims and the application of acquired skills, aspects highly suited to the questioning and challenging minds of learners at this level. It must be noted that these advantages are significantly minimised by factors such as resource poor environments, insufficient teacher training, and limited school-based curriculum support.

5.2 (6) Assessment guidance in the Geography curricula

The Umalusi Geography team comments separately here on guidance given for internal and external assessment.

5.2 (6.1) Guidance for internal assessment

Regarding internal assessment, in both the NATED 550 and NCS curricula clear guidelines are given with regard to quantities of work needed from learners for internal assessment (see Geography Document 2, Pages 24-27 and Document 4, Pages 14-17 for Grade 12).

Continuous assessment for Grade 12 in both of the NATED 550 Higher and Standard Grade curricula consisted of eight tasks: three controlled tests; one examination with Papers 1 and 2; and four other forms of assessment (see Geography document 2, Page 25). Different types of assessment from which teachers could choose are described in some but not extensive detail. These tasks include presentations, debates, interviews, demonstrations, role-playing, projects, simulations, research, case studies, practical tasks, data-handling, creative response tasks and contextual analyses. The possibilities are mentioned elsewhere in these guidelines, but nowhere are examples of best practice or exemplar tasks provided. The onus rested on teachers to make choices for their learners based on their own knowledge. The quality of learners' tasks depended on their teachers' knowledge and skills.

In the NCS documentation, the *Subject Assessment Guideline* document outlines a *Programme of Assessment* for each school grade, including Grade 12, in which only seven tasks are required in all. These tasks consist of two examinations in all; two (as opposed to the NATED 550 three) tests; and three (as opposed to the NATED 550 four) additional tasks – in this instance specified as a practical task (map skills and analysis), a research project, and another project. Although some details are given with respect to numbers of tasks required and the weighting and mark allocations for these tasks, no or limited guidance is given with regard to what ensures quality in these tasks, or for questions that would produce substantial evidence from which teachers could make valid inferences about the progress of learners. An important omission is the lack of any guidance for designing assessment tasks, and of examples of assessment tools such as rubrics or checklists. Some tasks, such as research and other projects, are not at all clearly defined in the *Subject Assessment Guidelines*. From the experience of the Umalusi geography team, it is known that teachers rely on old exam question papers and on assessment activities in text books, when designing such tasks.

In all, while there is greater prescription of assessment tasks in the NCS than in the NATED 550 documents, in the absence of clear evaluation criteria for these tasks, it is not likely that this prescriptiveness will aid thorough and valid assessment. It could easily happen that assessment tasks are set at levels that are too easy or too difficult, or are inadequate in some other way. The absence of explicit and clear evaluation criteria is likely to result in a high degree of variation in assessment across schools in differing social contexts.

5.2 (6.2) Guidance for external assessment

In both the NATED 550 and NCS curricula, guidelines are given for the structuring of the external examinations (see Geography Document 2, Pages 4-24, and Document 4, Page 16 respectively). In the NATED 550 curricula, these guidelines are brief but extremely clear, consisting of a description of content and skills to be examined in each of the two papers, and weightings to be used.

However, there is a problem that could cast doubt on the integrity of the final 2008 examinations - namely, the confusing messages emerging from the NCS documents when read together (in hard copy or electronic form). Confusion is created by the document *Geography Examination Guidelines, Grade 12, 2008* because it includes topics not in the NCS for Geography (Document 3) and differing from the guidelines in the *Subject Assessment Guidelines*. The section *changes in the energy balance* (see *Subject Assessment Guidelines* for Geography, Page 22) is one example of this confusion. In the *Subject Assessment Guidelines*, this section comprises *four pressure belts*; the relationship between *temperature, air pressure and wind, pressure gradient* and *geotropic flow*. In the *Examination Guideline, Grade 12, 2008*, however, *global warming* and the *greenhouse effect* are added. It must be noted that *global warming* and the *greenhouse effect* are indicated as topics to be covered in Grade 10 (see *Subject Assessment Guidelines*, Page 22),whereas learners are examined at the end of Grade 12, on Grade 12 content only. Further examples of content topics found only in the *Examination Guidelines, Grade 12, 2008* are *transnational corporations multinational corporations; footloose industries; Brownfields sites; Greenfield sites; and the Accelerated Shared Growth Initiative for South Africa (ASGI-SA)*.

The only document with any weight in the NCS curriculum is the curriculum statement itself (Geography Document 3): this is the only gazetted document for this curriculum. There are discrepancies between information in this document and others such as the *Learning programme Guidelines*; *Subject Assessment Guidelines*; and *Examination Guideline, Grade 12, 2008* making up the NCS curriculum (see Document 4, Pages 20-30; Document 5, Pages 2-14 and Document 6, Pages 43-46).

In both curriculum frameworks, there is a similar degree of clarity in terms of the formats of examinations. For the NATED 550 curricula, there are two external examinations, one on theory (Paper1) and one on general geographic techniques (Paper 2), as illustrated in tabular form in Document 2 (Pages 7 and 8 respectively). External assessment in the NCS comprises two similar papers, with topic weightings and mark allocations similarly clearly indicated (see Document 4, Pages 16-17).

5.2 (7) Availability, user-friendliness and use of the Geography curriculum documents

In terms of specific content and skills learners are expected to know and demonstrate in the examinations, the NATED 550 Higher and Standard Grade policy and guidance documentation is much clearer than that in the NCS. When it comes to actual competences relating to enquiry and knowledge, understanding, and application of Geography topics and skills to be taught and learned, the NCS documentation is more specific than that of the NATED 550 curricula.

In the case of the NCS, assessment standards form the basis of clarification in each of the three school grades. Discrepancies between the *Examination guideline* and other NCS documents (*National Curriculum Statement; Learning Programme Guidelines; Subject Assessment Guidelines*)

need urgent attention to avoid misleading teachers and learners. In its current state, NCS documentation is likely to cause confusion amongst users. This circumstance diminishes the user-friendliness and support provided by the NCS documents. There is an urgent need to audit these documents for consistency, and to ensure that all teachers have access to them. A serious dimension of this problem is that of the uneven dissemination of this curriculum across different provinces and districts.

5.2 (8) Concluding comments for Geography

In this section, the Geography team commented on the respective levels of difficulty of the Geography curricula, and the usefulness of the Umalusi evaluation tool. These concluding comments are based on prior aspects of the evaluation.

5.2 (8.1) Respective levels of difficulty of the Geography curricula

In the process of ascertaining the respective levels of cognitive difficulty and whether or not the NATED 550 and NCS curricula require similar types of knowledge and skills of learners, the Umalusi Geography team discussed the findings in this Geography report up to this point.

It was found that the content in the NCS curriculum closely but not entirely resembles that covered in the NATED 550 curricula. If the new additions to the NCS curriculum (see, for example, *map projections; Geographical Information Systems (GIS); climatic hazards; human responses in climatology*, and other sections – see the underlined topics in Geography Tables 5.2.3 and 5.2.6 above) are taken into account, it is clear that more is expected of learners in the NCS than in the NATED 550 curricula.

Further, the underlying pedagogic principles of the two curriculum frameworks are significantly different: the NATED 550 curricula focus chiefly on the recall of Geographical facts, while the NCS focuses on the competences required to demonstrate the three learning outcomes in which learners are required to use enquiry and map skills and techniques to construct knowledge, which they then apply in familiar and unfamiliar contexts. This requirement in itself demands far higher cognitive levels than does recall.

From discussion so far in this report, it can be inferred that the NCS curriculum is closer to the NATED 550 Higher Grade curriculum than it is to that at Standard Grade level. The NCS demands critical thinking and the application of knowledge and skills to solve problems – an approach found at Higher and (to a far lesser extent) at Standard Grade level. Learners studying with teachers who do not understand this pedagogic and epistemological shift may experience problems at the end of 2008.

The team's estimation of the level of difficulty of the NCS geography curriculum, based on the topic and skill counts and weightings, and judgments - carefully weighed in relation to sequencing, progression, curriculum aims, pedagogic approach, and assessment requirements - is that it is between that of the earlier NATED 550 Higher and Standard Grade curricula, at a 60:40 Higher to Standard Grade ratio. It is expected that with the new content and skills; and with the focus on understanding, application, and problem solving, rather than on recall, learners with average abilities and teachers without the necessary subject and pedagogic knowledge and skills may struggle. This difficulty applies especially to teachers who have not attended in-service workshops or who receive insufficient curriculum support, and who may not have co-operation from their learners and associated parent communities.

5.2 (8.2) Usefulness of the Umalusi curriculum evaluation tool for Geography

Three comments are made in relation to the usefulness of the Umalusi evaluation instrument for Geography.

The Umalusi Geography team considered the appropriateness of questions and tasks in the curriculum evaluation tool for judging the curricula as guides for teachers, examiners, moderators, and materials developers. The team found the instrument useful in that it addresses key areas of the curriculum. The format of the instrument was also useful in that its categories became the headings of the report it generated. Its requirements for systematic observation, analysis, and reporting made comparing results across individuals and teams easier and more reliable than would have been the case with more loosely framed questions.

The types of questions themselves, and the requirements that judgments be awarded numerical values as well as being expressed as arguments based on evidence in the curriculum documents, encouraged rigorous evaluation. In short, the process followed by evaluators helped insightful policy analysis. In addition, the differing professional backgrounds of the evaluators (higher education, school teaching; curriculum advising; moderating) enhanced the validity of the qualitative analyses and added richness to the insights gained.

It is worth noting, however, that although the NCS appears to perform very well according to criteria in the instrument, the extent and complexity of the documentation makes it likely to be inaccessible for the average South African teacher. So, although on paper the curriculum appears very good, in practice it may be falling far short of what is required in South Africa. These elements need further exploration. There could be more focus in future on the differing types of learning environments in which the curriculum is likely to be enacted, and on teaching and learning resources in these contexts. It would also be useful to analyse the accessibility of language in the documentation, particularly for second language users.

Finally, most textbooks were developed before the final content guidelines were issued, and resulting variations in the content of the various NCS documents make the narrow use of specific textbooks problematic. The impact of the use of specific textbooks on the performance of learners needs to be explored. Further, textbook writers struggle with aspects such as determining the cognitive levels and breadth at which topics should be dealt with; how to interpret OBE; the nature of assessment activities; and others. This evaluation tool could be used throughout the education system (by moderators, examiners, curriculum designers and advisors, and teachers) to enhance the clarity and quality of curricula and their assessment.

SUMMARY OF CURRICULUM EVALUATION: GEOGRAPHY

The following findings were reported from the comparative evaluation of the NATED 550 and NCS Geography curricula:

- *Content* selections for Grade 12 in the NATED 550 and NCS curricula are similar, with the exception of a few newly added topics relating to contemporary human responses to environmental issues in the latter. These relatively small additions do not add significantly to the curriculum content to be covered, but do ensure greater (Geographical) curriculum relevance. There are considerably more Geographical *skills and techniques* in the NCS, however. These new additions include *map projections, fieldwork* and *Geographical Information Systems (GIS)*. In this sense, the NCS indeed appears to be more demanding than both NATED 550 curricula. Again, more classroom time is needed to cover this work than was previously the case. Further, these new areas require the integration of skills and techniques when exploring different content topics – a cognitively challenging task.
- The difficulty level of the NCS curriculum is more like the NATED 550 Higher Grade curriculum than that of the Standard Grade. Since the majority of learners in the country are operating at an SG-type level, the NCS curriculum is likely to be experienced as being difficult and needs more time than its NATED 550 counterparts, to cover. The team's estimation is that the overall level of difficulty of the NCS curriculum is somewhere between that of the earlier NATED 550 Higher and Standard Grade curricula, in a 60:40 Higher to Standard Grade ratio.

5.3 LIFE SCIENCES (PREVIOUSLY BIOLOGY)

The Umalusi Life Sciences team began the curriculum analysis by compiling separate lists of content and skills from the NATED 550 and NCS curricula. The team of four analysts worked together to merge overlapping content statements in the two curricula, and to list separately content statements and skills unique to each curriculum. Content and skills listings were compiled from all available documents (Documents 1-8).

The Life Sciences team used the two NATED 550 documents (Documents 1 and 2) for the required information for the NATED 550 curriculum, and five NCS documents with differing amounts of detail (see Documents 3, 5, 6, 7, and 8) for the NCS curriculum. The sequence in which documents were used was *National Curriculum Statement: Life Sciences* (Document 8); followed by the *Learning Programme Guidelines for Life Sciences* (Document 3); *Assessment Syllabus for Grades 10* and *11 Life Sciences* (Documents 6 and 7) and *Examination Guidelines for Grade 12 Life Sciences* (Document 5).

This team was the only one to make the theoretical framework underpinning the study explicit, and this foregrounding of the abstract concepts influenced their reporting format (see detailed explanation of this theory in Appendix 1 in the booklet for Part 1 of this report). The evaluators started by focusing on the concepts of classification and framing (power and control), and then reporting on the aspects of the curriculum required in the Umalusi instrument, *in relation* to these ideas. All of the tasks in the Umalusi instrument have been addressed by the Life Sciences team, but the reader will see that in this Life Sciences report; the subheadings have been regrouped to give descriptions of overall *framing* and *classification* in the NATED 550 and NCS curricula respectively. Clustering subsections in terms of *classification* and *framing* helped to show differences between the two curricula clearly. The team also clustered all items giving an idea of the respective levels of difficulty of the curricula. Accommodation of contextual features; pedagogic and assessment approaches; and the user-friendliness of the documents are addressed after classification (power relations); framing (control relations); and levels of difficulty have been discussed.

A note regarding classification and framing in the Life Sciences (Biology) curricula

The team applied the concepts of classification and framing to ideal types of curricula (see Table 5.3.1, below), in order to discuss similarities and differences between the NATED 550 and NCS curricula in a systematic way. They defined external framing as referring to the degree of control exerted by curriculum documents (as opposed to by teachers) over the selection, sequencing, pacing, and evaluation criteria of curriculum content and skills (see also Bernstein, 1971). They described internal framing as referring to the degree of control of teachers (as opposed of learners) over these aspects. The team used the idea of classification in relation to the strength of the boundaries between the contents and skills of different school subjects. In other words, where classification was strong, contents would be well differentiated from each other by strong boundaries (ibid.).

Table 5.3.1: Characteristics of weakly and strongly framed and classified official curricula

Strength	Classification	External framing	Internal framing
Strong	Subject is clearly differentiated from other school subjects; content is closely aligned with the academic discipline(s) on which it is based.	Prescriptive document; detailed instructions for educator; little freedom allowed for teacher's choice.	Teacher plays dominant role in learning activities; learners have little control over their learning activities.
Weak	Subject overlaps with other school subjects; content is loosely aligned with the academic discipline(s) on which it is based.	Non-prescriptive document; teacher has much freedom to select content, sequencing, pacing, and progression.	Learners play dominant role in learning activities; educator acts as facilitator.

Table 5.3.1 shows extremes. Curricula could be somewhere between *strong* and *weak*; curricula could be made up of any combinations of *strong* and *weak*, with different consequences for learners.

The Umalusi Life Sciences team looked for the strength of *framing* in the NATED 550 and NCS curricula by analysing the documents for evidence of guidance (or prescription) for choice of content and skills, teaching approach and subject methodologies, sequencing, progression, pacing, and assessment. The team looked for *classification* strength by categorising content and skills as *discipline-related, generic*, or *life-related*. *Discipline-related* refers to content that is acknowledged as canonical biological content knowledge. *Generic* is used with respect to knowledge or skills needed by or useful for more than one school subject. *Life-related* here is defined as content or skills that are related to life in general, but are not necessarily immediately useful in everyday life. Skills required for the study of Biology include a diverse array of skills required for investigating living phenomena as well as the *generic* scientific skills of measuring; collecting and manipulating data; constructing fair tests; accessing, synthesizing and presenting information; and writing in acceptable genres.

The Umalusi Life Sciences team also distinguished between *official pedagogic discourse* or what curriculum developers count as valid knowledge for school subjects, what informs the intended curriculum (Neves and Morais, 2001) on one hand, and the transmission and assessment of that knowledge – the *enacted curriculum* – on the other. They made it clear that by focusing on the analysis of official curriculum documents drawn up and released by national and provincial departments of education, they were working with only official pedagogic discourse.

A note on the respective levels of difficulty: NATED 550 and NCS

The Umalusi team noted that there is an element of subjectivity in judgments on the levels of difficulty of content and skills in the Life Sciences: these judgments are based on the perceptions and experience of the evaluators. It asserts that most scientific knowledge is counter-intuitive or outside the sphere of knowledge that can be constructed on the basis of everyday encounters with natural phenomena. In this sense, all scientific explanations can be classed as *difficult* relative to intuitive, everyday knowledge. However, in Biology layers of difficulty are added by terminology, where the language of Biology is not the language of everyday conversation and, by the abstract nature of phenomena investigated in Biology, such as cells, molecules, physiological processes, and ecological processes.

Levels of difficulty were thus seen to depend on the level of abstraction of a topic, the terminology used to describe the phenomenon, and the cognitive challenge required to understand the complexity of the phenomenon. The answer to the question: '*Is this topic easy, moderate or difficult?*' is, therefore, that *it depends on the depth and level of abstraction and how you teach it*.

Evaluators took these factors into account, and assigned topics as *easy, moderate* and *difficult*, based on their experience of how easily learners understand each of these topics, and what research has identified as topics that students internationally find difficult to understand. After combining the four individual evaluations, consensus among the four evaluators was evident in certain topics, which were rated as *difficult* by two or three evaluators and moderate by the remaining evaluators, while other topics were rated as easy by three or four evaluators. Despite the Umalusi team's initial misgivings about assigning levels of difficulty, the evaluation revealed a reliable consensus about topics that members regarded as *easy* and *difficult* in the curriculum. These ratings are identified throughout the results section.

A note regarding content and skills

The Umalusi Life Sciences team distinguished between content and skills. Content and skills specification, weighting and focus were considered. Content and skills weighting was analysed through the amount of class time allocated to each topic and/or the examination weighting of topics. Judgments regarding content and skills are reported in the section on framing in the Life Sciences/ Biology curricula (Section 5.3 (1)) and classification in these curricula (see Section 5.3 (2)).

5.3 (1) Curricula framing: selection, sequencing and pacing of content in the Life Sciences (Biology) curricula

The NATED 550 curriculum (Biology Documents 1 and 2) consists of a short introductory section and a long list of prescribed content for each grade (Grades 10, 11, 12). It is strongly framed in terms of the *selection* of content, but the sequencing, pacing and progression are not prescribed, and therefore, can be said to be weakly framed. The NATED 550 *Grade 12* syllabus is more strongly framed in terms of selection of content than those for Grades 10 and 11. For example, the main national NATED 550 document (Biology Document. 1, Pages 6-9) specifies exactly what practical work should be carried out by Grade 12 learners. Additional specification is provided: "… a simple outline of the process, emphasising its role in storage of energy and the factors affecting the process. An experimental approach is recommended. (A study of the biochemical mechanisms is not required) …" (ibid., Page 42). Details such as the specific investigations to be carried out are listed in the addendum (ibid., Addendum, Page 7). Such specific elaboration is lacking in the parts of the NATED 550 syllabi for Grades 10 and 11.

The NCS Life Sciences curriculum, in contrast, unfolds through a sequence of documents beginning with the *National Curriculum Statement* brought out in 2003 (see Life Sciences Document 8), and including the more recent *Learning Programme Guidelines* (Life Sciences Document 3) and a series of assessment syllabi and examination guidelines (see Life Sciences Documents 5, 6 and 7). The NCS policy (Life sciences Document 8) is written in a way that prioritises the three learning outcomes and assessment standards as organisers of all teaching activities, with very little guidance provided for the selection, sequencing, pacing and progression of content. The later *Learning Programme Guidelines* and assessment and examination guidelines (Life Sciences Document 3, 5, 6, and 7), however, together make up for this lack. Document 3 outlines the content to be taught in each school grade. The three assessment syllabus documents and examination guidelines (Life Sciences Documents 5, 6 and 7) have content as the primary organiser of classroom activity, and provide comprehensive lists of topics to be covered, with time allocations for each topic. In one example, the *Learning Programme Guidelines* list *DNA fingerprinting and forensics* as a content topic (see Document. 3, Page 39), while the examination guideline (Life Sciences Document 7, Page 7) elaborates, "…Explain DNA fingerprinting with respect to what it is; its uses; debates around its usage (costs, ethical considerations, consequences of interpretation errors) …". In this way, substantial guidance is provided to teachers: this degree of detail encourages strong *internal* framing of curriculum information or, in other words, teacher-control in the classroom.

Although sequencing is not prescribed, it is implicit in the structure of each document. Teachers are expected to use all available NCS documents when drawing up learning programmes for their Grade 10, 11, and 12 classes. Overall then, the NCS curriculum is strongly *externally* framed in terms of the selection, sequencing, and pacing of content: the Department of Education frames these aspects of the curriculum.

It appears that both the NATED 550 and NCS curricula are strongly framed in terms of the *selection* of content. Further, the NCS curriculum is more strongly framed than that of the NATED 550 in terms of the sequencing and pacing of this content. This strong framing – the comprehensiveness and explicitness of the information provided – is suited to the South African context, where teachers are not always qualified and resourced to optimal degrees.

5.3 (2) Classification in the respective Life Sciences (Biology) curricula: organising principles; aims; selection of content and skills

Classification in the curricula is considered in relation to the organising principles; curricular aims, and selection of content and skills in the curricula.

5.3 (2.1) Classification as seen in the organising principles of the Life Sciences (Biology) curricula

The curriculum organising principles, the principles indicating the priority or focus in the curricula and providing frameworks for judging whether they achieve their objectives are outlined for the NATED 550 and NCS curricula in Table 5.3.2 (below).

Table 5.3.2: Organising principles for NATED 550 and NCS

NATED 550	The organising principles for the Higher and Standard Grade NATED 550 curricula are to "… Develop an understanding of fundamental biological principles, an awareness of biological relationships, and investigative skills appropriate for biology, communicate findings clearly and appropriately, develop a respect, love and appreciation for South African natural environment …" (see Document 1, Page 10).
NCS	The organising principles in the NCS are: "… systematic study of life in the natural and human-made environment. Understanding basic life processes and interdependence between living and non-living components of the environment are priorities. Skills of inquiry, problem solving, critical thinking, and application of knowledge are developed. Learners also gain an understanding of the relationships between science, technology and society with a view to becoming responsible citizens …" (see Document 3, Page 7).

The organising principle for the NATED 550 curriculum clearly prioritises specialised Biology disciplinary knowledge and the methods of investigation appropriate for the discipline. This approach is stated unambiguously. The NCS on the other hand prioritises the understanding of life and living systems and different ways of inquiring, thinking, problem solving and applying knowledge. These principles are worded in a general way.

The respective organising principles lead one to expect that the NATED 550 curriculum is more strongly classified (more specialised) than is the NCS curriculum. The expectation is that the NATED 550 curriculum will be more closely aligned to canonical biology content, whereas in the NCS content is more humanistic (people-centred). Current debate around which approach is more beneficial is ongoing and unresolved.

5.3 (2.2) Classification as evident in the curriculum aims, purpose, vision, and outcomes in the Life Sciences (Biology) curricula

Curriculum aims, objectives and/or learning outcomes reveal the priorities of curriculum developers. Aims in the NATED 550 and NCS curriculum are stated in Documents 1 and 2 for Biology (Pages 10 and 2, respectively); and in the three learning outcomes and associated assessment standards (Life Sciences Document 3, Pages 10-11 and 19-21) respectively. Both curricula include objectives or outcomes pertaining to the development of knowledge and skills in Biology/ Life Sciences which are strongly classified (specialised), and objectives/ outcomes pertaining to the development of attitudes and values which are weakly classified (generally relevant in school contexts). The learning outcomes of the NCS curriculum are mapped onto the objectives of that for NATED 550 in Table 5.3.3, showing that the objectives in the two curricula are very similar.

Table 5.3.3: Mapping of NCS learning outcomes against NATED 550 objectives

NATED 550 objectives	NCS learning outcomes
An understanding of the fundamental biological principles based upon a study of living organisms	LO2: Construction and application of Life Sciences knowledge. The learner is able to access, interpret, construct and use Life Sciences concepts to explain phenomena relevant to Life Sciences
An awareness of biological relationships	

NATED 550 objectives	NCS learning outcomes
An ability to make critical, accurate observations of biological material, and to make meaningful records of such observations	LO1: Scientific inquiry and problem solving skills. The learner is able to confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills
An ability to analyse and evaluate biological information, to formulate hypotheses and to suggest procedures to test them	
An ability to communicate clearly when reporting information and expressing ideas	
A respect for all living things and an urgent awareness of man's responsibilities in the preservation of life, particularly in the South African context	LO3: Life Sciences, Technology, Environment and Society. The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society.
A love and appreciation for the South African fauna and flora and recognition of the urgent need for conservation	

Regarding guidance for achieving curricular aims, the NCS curriculum provides more assistance than does that of the NATED 550. It does so through a recommended pedagogic approach (discussed in the section on pedagogy, below) and clarity about how teaching and learning should be organised (see the section on sequencing of content above). The NCS states that achievement of the learning outcomes is the primary focus of the curriculum; the assessment standards provided create the detailed steps for achieving the learning outcomes.

5.3 (2.3) Classification in the selection of content and content foci in the Life Sciences (Biology) curricula

The Life Sciences team made a full list of detailed content topics and clustered these topics in order to show differences between the curricula (see Table 5.3.4, below). It is worth noting that plant biology - which formed an important component of the NATED 550 curriculum - is much reduced in the NCS, with the omission of a large section on plant-water relations. Animal biology, encompassing a range of phyla in the animal kingdom in the NATED 550 curriculum, is narrowed to life processes in humans only in the NCS.

Making up the subsequent loss in volume of content in the NCS is achieved through the significant additions of sections on evolution by natural selection and both local and global environmental issues. Learners studying the NCS curriculum will omit important concepts in the broad study of life, but they will gain exposure to the most important theory in Biology, and to important current issues.

Table 5.3.4: Major differences in content topics – NATED 550 and NCS curricula

Present in NATED 550 but not NCS		Present in NCS but not NATED 550
Content topics	• Biological molecules. • Flowering plant physiology. • Structure, life processes and ecological roles of lower plants, fungi, protists, invertebrates and vertebrates other than humans.	• Evolution by natural selection. • Diseases and disorders, especially of humans, but also some crop diseases. • Indigenous knowledge and beliefs. • Environmental issues.

The analysis of content in terms of *discipline-related* (relevant only for Biology/ Life Sciences), *generic* (relevant for other school subjects) or *life-related* (relevant for life outside school) provides a measure of the strength of classification of each curriculum; where a *discipline-related* focus is a strongly classified (specialised) one, a *generic* focus is less strongly classified (less specialised), and a *life-related* focus is weakly classified (relatively unspecialised). The results of this analysis are shown in Table 5.3.5 (below).

Table 5.3.5: Average (of four evaluators) percentages of topics with particular content foci in the curricula

Curricula/ content foci	Discipline-related topics	Generic topics	Life-related topics
NATED 550 SG	86.7	3.9	8.9
NATED 550 HG	88.2	4.2	7.6
NCS	67	8.1	25

Table 5.3.5 captures an essential difference between the NCS and NATED 550 curricula: the change in the proportion of *discipline-related* and *life-related* content; where the NCS has less *discipline-related* content and more *generic* and *life-related* content than does the NATED 550 curriculum. It shows clearly that the NCS curriculum is less strongly classified – it contains less specialised content – than that of the NATED 550.

The increased percentage of *life-related* content in the NCS curriculum is consistent with its stated goal of providing an education for everyday living. As Aikenhead (2006) points out, there are many approaches to selecting content relevant for everyday life in school science, depending on the priorities of the curriculum developers. In its broadest definition, *life-related* skills could include all content related to the human body and its functioning, as well as to global and local environmental issues. Using this definition, approximately 55% of the NCS curriculum could be assigned to content relevant to everyday life. In contrast, in the NATED 550 curriculum, only 25% of the total content could be so assigned.

The breakdown of *life-related* science topics in the NCS curriculum shows that it is a mixture of topics relevant for everyday living (healthy living, local environmental issues); potential personal relevance with an element of relevance for curiosity (including organ transplants; in vitro fertilisation, dialysis, and cloning); and environmental issues of importance for the survival of life on earth. What would be an indication of the usefulness of this content?

There are different views as to how Biology/ Life Sciences should be taught. On the one hand, it could be said that traditional science curricula that are embedded in discipline-based content fail to produce scientifically literate school graduates, as well as failing to attract marginalised learners into science (see, for example, Aikenhead 2006). In this view, science curricula constructed around humanistic policies that prioritise science needed in non-school contexts, and content that is relevant to learner's everyday lives, is potentially more inclusive and can serve to induct learners in a wide variety of social contexts into science.

A counter-view argues for school science constructed around the knowledge structures of parent disciplines such as Biology. The power of the discipline lies in the access it provides to specialised ways of thinking hierarchically, and to specialised knowledge. Disciplines enable working at different levels of abstraction. The *Linnaean Classification System* is one example of such a nested hierarchical system; the whole knowledge structure of Biology can be visualised as another such hierarchical system. In this view, evolution by natural selection is the highest level of abstraction (the theory) that explains all structures, functions and processes below it (see Dempster & Hugo, 2006). It could be argued that by ignoring the disciplinary structure of a subject like Biology/Life Sciences, one denies learners access to particular high-level cognitive processes (see, for example, Donelly, 2006). Access to the disciplinary structure of Biology makes it possible to broaden the school subject beyond human biology and to enable the making of generalisations about living systems in general: it enhances a deep understanding of the living world.

Placing the two curricula within a discipline-based, everyday-living continuum, it is clear that the NATED 550 curriculum is closer to the discipline-focused pole. This curriculum, however, fails to achieve the highest ordering principle in Biology by ignoring evolution by natural selection. Further, although the Umalusi Life Sciences team could determine an organising principle within each school year in the FET phase (Grades 10, 11, and 12), these principles are not explicitly identified in the curriculum documents. The curriculum incorporates some elements of everyday living in limited ways, mainly through mentioning commonly occurring diseases of the organ systems, and through global and local environmental issues.

The NCS curriculum can be placed closer to the science-for-everyday-living pole of the continuum. It is, however, ambiguous about what it means by 'relevance to everyday life'. Recommendations for healthy living - such as good nutrition and prenatal care - are clearly appropriate in all contexts, but the relevance of some topics - like advanced medical procedures and biotechnology - is questionable. Topics such as town planning, sanitation, sources of water and refuse collection and disposal, found in the Ghanaian *Senior Secondary Curriculum for Biology* (see Allais, Dempster, and Barlow-Zambodia, 2008), would possibly be more relevant for daily living in South Africa. On the other hand, the inclusion of indigenous knowledge in the NCS is laudable. This knowledge, which includes topics such as *medical uses of indigenous plants* and *traditional methods of food preservation*, is important for attracting learners from non-Western cultures into science (see, for example, Aikenhead, 2006).

In terms of its representation of canonical Biological knowledge, the NCS curriculum improves on that of the NATED 550 in that it uses *evolution by natural selection* to explain the fossil record, and incorporates *genetics* into the explanation of the *mechanisms of natural selection*. These concepts are key to the discipline of Biology and many current scientific developments across the globe (see Dempster & Hugo, 2006). It can thus be said that the NCS curriculum provides more access to these key principles than does that for NATED 550. However, the replacement of other *discipline-based* content with more applied topics in the NCS results in horizontal extension of the subject rather than vertical development of concepts. Also, the life-related content included in the NCS curriculum is arguably not necessarily the most relevant for the average South African learner.

This discussion around classification of content, while useful for highlighting differences between the curricula, also has its limitations. While both curricula weaken the *discipline-related* classificatory boundaries to allow for some *life-related* content, it has been shown here that the NCS curriculum does so more than does that for NATED 550. *What* the curricula include, however, is a separate issue. There is less to be said about skills than content in the Biology/Life Sciences curricula, but it is nevertheless worth noting the classification of skills in the respective documents.

5.3 (2.4) Classification in the selection of skills and skills foci in the Biology/Life Sciences curricula

Most of the skills listed in both the NATED 550 and NCS curricula are *generic* to all academic subjects. These skills include the broad range of practical skills required for conducting investigations into (Biological) phenomena; skills for accessing and manipulating relevant information; and skills for communicating specialised information in a variety of ways. The spread of skills foci between *discipline-specific, generic*, and *life-related* is shown in Table 5.3.6 below.

Table 5.3.6: Average percentage skills foci in the two curricula

Curriculum	Life-related	Generic	Discipline-specific	Average # skills rated
NATED 550	11.7	63.3	24.8	38.3
NCS	15.6	71.1	13.3	45

Both curricula include high percentages of *generic* skills: the classification of skills is relatively weak in both curricula. Since the distribution of skills foci in the NATED 550 curriculum mirrors more closely the types of investigative skills used by professional Biologists, it is slightly more strongly classified (specialised) than in the NCS curriculum.

Although the NATED 550 documents contain a more disciplinary representation of skills than do the NCS curricula, both curricula fail to capture the full range of activities that characterise Biological research. Further, some assessment standards in the NCS documents are contrived to satisfy the requirement of progression in terms of the increasing cognitive complexity of skills, but it is questionable as to whether NCS learners at Grade 12 level will be in a position to meaningfully apply some of these standards; such as "… *evaluate concepts, principles, theories and laws* …" (see Life Sciences Document. 7, Page 25), or "… *evaluate scientific ideas of past and present cultures* …" and "… *resources used in the development of biotechnological products* …" (ibid., Page 29).

An important difference between the NATED 550 and NCS curricula is the priority given to skills (expressed as outcomes) in the NCS documents. In the NCS policy, achievement of the outcomes is the primary goal of the curriculum. This goal is most clearly expressed by the following excerpt: "… The knowledge areas are neither Learning Outcomes nor Assessment Standards, *but are vehicles to attain the Assessment Standards* …" (see Life Sciences Document 8, Page 32)[emphasis added by the Biology/Life Sciences team]. One could infer from this statement, that content is not as important in its own right, as it is as a vehicle for attaining skills in the NCS curriculum. In subsequent documents (see the *Learning Programme Guidelines, Subject Assessment Guidelines*, and assessment syllabuses), the learning outcomes and assessment standards have receded somewhat, to become assessment activities rather than guiding the whole teaching programme.

The emphasis on skills in the NCS curriculum may lead to the better development of these skills for learners, than was the case for the NATED 550 curriculum. In the next section, the Life Sciences team reports on whether the resulting learning in the NCS curriculum is more or less difficult than that in the NATED 550 curricula.

5.3 (3) Levels of cognitive difficulty of the respective Biology/Life Sciences curricula

The respective levels of cognitive difficulty of the three curricula were ascertained by taking four aspects into account. The first aspect is the cognitive difficulty of the content topics included the curricula. The second aspect is the types and levels of skills. The third and fourth aspects comprise cognitive difficulty engendered by the sequencing and weighting of content respectively. Each aspect is dealt with separately in this section.

5.3 (3.1) Cognitive difficulty of content topics in the curricula

Each content topic in the NATED 550 and NCS curricula was evaluated in terms of whether it was inherently *easy, moderate* or *difficult*. The analysis was conducted by the four evaluators working independently, and judgments were then averaged for the four evaluators. Results are shown in Table 5.3.7.

Table 5.3.7: Average *easy, moderate* and *difficult* content as percentages of the total number of content statements in the curricula

Curriculum/ difficulty levels	Easy	Moderate	Difficult	Total content statements
NATED 550 SG	50.5	47.0	12.5	148
NATED 550 HG	47.3	37.2	15.5	164
NCS	45.4	41.2	13.5	178

Overall, the NCS has slightly fewer content topics that are easy, and it falls between the NATED 550 Higher and Standard Grade curricula with respect to *moderate* and *difficult* topics. Importantly, although there were more content topics in the NCS than in the NATED 550 curriculum, this number is due to the way content topics are listed rather than the NCS having a larger volume of content. On the whole, this analysis shows that there are no *significant* differences in the levels of difficulty of the NCS and NATED 550 curricula.

The sequence in which topics are covered across the three final years of senior secondary school is very different in the two curricula – to the extent that the Grade 12 curricula of each cannot be compared directly. Some *difficult* topics previously taught in Grade 12 are now taught in Grade 10. Table 5.3.8 (below) lists the topics deemed *difficult* by the team, and their placement in the NATED 550 and NCS curricula respectively.

Table 5.3.8: Placement of difficult topics by grade, in NATED 550 and NCS curricula

Difficult topics	NATED 550	NCS
Photosynthesis	Grade 12	Grade 10
Cellular respiration	Grade 12	Grade 10
Evolution	-	Grade 12
DNA structure & function	Grade 11	Grade 12
Plant-water relations	Grade 12	-
Nervous and chemical coordination	Grade 12	Grade 11
Homeostasis	Grade 12	Grade 10
Life cycles of plants	Grade 11	-

Table 5.3.8 (above) shows that in the NATED 550 curriculum, none of the *difficult* topics were taught in Grade 10, and that three *difficult* topics taught in NATED 550 Grade 12 are now taught in NCS Grade 10. Two *difficult* topics from NATED 550 have been removed from the NCS curriculum, and one has been added. The distribution of *difficult* topics across Grades 10, 11 and 12 in the NCS curriculum is uneven.

5.3 (3.2) Skill types and difficulty levels in the Biology/Life Sciences curricula

There are similar skills for conducting Biological investigations in the two curricula. The overlaps are specifically with respect to skills related to designing investigations, collecting and recording data, analysing data and drawing valid conclusions, and evaluating investigations. Additional skills appear in the NCS documentation, which are absent in the NATED 550 curriculum, such as skills relating to accessing and working with information (see Learning Outcome 2, Life Sciences Document 8), and considering the relationship between science and society (see Learning Outcome 3).

The skills listed in the NCS curriculum pose higher levels of cognitive challenge than those included in the NATED 550 documentation, as they are graded between Grades 10, 11, and 12. The assessment standards in the NCS, phrased as skills, are deliberately worded to provide graded increase in cognitive demand by year of study. Here is an example showing increasing complexity through the use of verbs (see Life Sciences Document 8, Pages 28-29):

> Grade 10: **Describe** different ways in which resources are used and applied to the development of products, and **report** on their impact on the environment and society (Life Sciences Document 8, Page 28).
>
> Grade 11: **Compare** different ways in which resources are used in the development of biotechnological products and **analyse** the impacts on the environment and society (Life Sciences Document 8, Page 29).
>
> Grade 12: **Analyse** and **evaluate** the different ways in which resources are used in the development of biotechnological products, and **make informed decisions** about their use and management in society for a healthy, sustainable environment (Life Science Document 8, Page 29).

Skills are, in fact, explicated to a far lesser degree in the NATED 550 than in the NCS curriculum. No attempts were made to analyse the respective skills as *easy, moderate* or *difficult*, as this categorisation would afford skills in the NATED 550 far more importance than they are explicitly

given. Table 5.3.9, below, shows percentages of differing skill types in the two curricula. *Basic skills* are the simplest skills required; applying skills in *familiar contexts* was possibly easier than applying skills in *new contexts*.

Table 5.3.9: Analysis of skills by cognitive demand (Average % of total skills)

	NATED 550	NCS
Basic skills	38.3	22.2
Application in familiar context	42.3	37.8
Application in new context	19.5	40.0
Total number of skills	37	45

It was easier to grade content topics than skills as *difficult, moderate* or *easy* for the Biology and Life Sciences curricula; this grading is discussed in the following subsection.

5.3 (3.3) Cognitive difficulty engendered by sequencing of content in the Biology/Life Sciences curricula

Biology as a discipline generally involves an understanding of life at different levels of organisation; for example, *cells, whole organisms*, and *ecosystems*. Each of these levels of organisation can be understood in terms of its structure, processes and control mechanisms. For example, *cell structure and function of organelles* may be studied in Grade 10, with more detailed study of *cellular processes*, such as *photosynthesis* and *cellular respiration* in Grade 11. *Control of the structures and functioning of cells* involving *DNA, RNA, protein synthesis* and *genetics* may then be taught in Grade 12. In general, basic facts, concepts and processes should ideally be taught before higher order integrating concepts.

This description of Biology presents a specialised *disciplinary* model. The NATED 550 curriculum is laid out in a way that largely mirrors this model, but this curriculum fails to achieve progression to the highest-order integrating concepts because it omits *evolution by natural selection*. It does, however, start with basic life processes in Grade 10 and build towards complex concepts such as *homeostasis* in Grade 12. It develops a foundational knowledge of cells and tissues in Grade 10, but reverses the logical progression of processes before control mechanisms so that *genetics* and *protein synthesis* are dealt with in Grade 11, and processes of *photosynthesis* and *cellular respiration* in Grade 12.

Sequencing of content in the NCS curriculum is far less aligned with the knowledge structure of Biology as a discipline than it is in the NATED 550 curriculum. For example, cell *structures and processes* are studied in Grade 10, with the control mechanisms of *genetics* and *protein synthesis* being studied in Grade 12. *Homeostasis* is taught in Grade 10; *life sustaining processes* are spread across Grades 10 and 11; *reproduction* is taught in Grade 12. *Evolution by natural selection* is taught in Grade 12, with no development of foundational concepts in the preceding two years (Dempster & Hugo, 2006). An implication of this relatively random sequencing of knowledge is that learners may not achieve vertical development of disciplinary knowledge.

The average percentage of *difficult*, *moderate* and *easy* content was analysed by year of study for each curriculum. Results are shown in Table 5.3.10 (below).

Table 5.3.10: Average percentage of easy, moderate and difficult content for Grades 10, 11 and 12 in NATED 550 Biology and NCS Life Sciences (averages for four evaluators)

Difficulty level	Curriculum	Grade 10	Grade 11	Grade 12
Easy	NATED 550 SG	57.8	56.3	44.2
	NATED 550 HG	56.8	50.9	40.3
	NCS	50.5	44.8	34.5
Moderate	NATED 550 SG	40.6	31.3	38.8
	NATED 550 HG	40.9	31.4	39.7
	NCS	37.5	42.7	49.1
Difficult	NATED 550 SG	1.6	12.5	18.5
	NATED 550 HG	2.3	17.7	20
	NCS	12	12.5	16.4

Difficulty level	Curriculum	Grade 10	Grade 11	Grade 12
Total statements	NATED 550 SG	32	48	66
	NATED 550 HG	33	55	75
	NCS	102	58	29

Table 5.3.10 (above) shows that in all three curricula, there is a decrease in easy content between Grades 10 and 12, and a corresponding increase in the proportion of *difficult* content. *Moderate* content decreases from Grades 10 to 11 and increases from Grades 11 to 12 in the NATED 550 curriculum, and increases steadily across the three grades in the NCS curriculum.

As shown in Table 5.3.9 the NCS curriculum has more *difficult* content in Grade 10 than do those for NATED 550, and less *difficult* content in Grade 12 than both the NATED 550 HG and SG curricula (16.4% versus 20% and 18.5% respectively). In Grades 11 and 12, the NCS curriculum has less easy content than the NATED 550 curricula, but a larger proportion of *moderate* content. The interpretation of the finding with regard to the proportion of *moderate* content is ambiguous: it could be *moderately easy or moderately difficult*.

Level of difficulty could be affected by volume of work, and here Table 5.3.10 points to the possibility of a much lower volume of work in the Grade 12 NCS curriculum than in those for NATED 550. The Umalusi Biology/Life Sciences team did not agree on this point, citing evidence from teachers who experience Grade 11 as an extremely content-loaded year, despite the team's finding of 58 content statements for Grade 11, compared with 102 for Grade 10.

The overall implication of this part of the analysis is that there is a smaller volume of content and less *difficult* content in Grade 12 of the NCS curriculum than there was at the same level in the NATED 550 curricula.

5.3 (3.4) Cognitive difficulty engendered by the weighting of content and skills in the Biology/Life Sciences curricula

Skills were allocated classroom time weightings neither in the NATED 550 and NCS main curriculum documents, nor in the assessment grids for NATED 550. In the NCS assessment guidelines, however, Learning Outcomes 1 (Scientific inquiry and problem-solving skills) and 2 (Construction and application of Life Sciences knowledge) are allocated 40% of the teaching time each, while Learning Outcome 3 (Life Sciences; technology, environment, and society) requires 20% of the assessment time (see Life Sciences Document 4). How the weighting of Biology/Life Sciences *content* is presented is possibly more closely linked to the level of difficulty of the respective curricula than are the skills.

Content weighting cannot be compared for Grade 12 because different content is assessed in the NATED 550 and NCS curricula.

While class time is not indicated in the main NATED 550 documents, weighting of content is closely specified in the exam guidelines for Grade 12 (see Biology Document 1). Content weighting in the NATED 550 curriculum is thus strongly framed through assessment, rendering the examination papers very predictable. The same level of guidance is not provided for Grades 10 and 11, which therefore, could be said to be weakly framed with regard to content weighting.

For the NCS, in contrast, the *Learning Programme Guidelines* (see Life Sciences Document 3) specify the amount of class time to be dedicated to each knowledge area, and the assessment syllabuses provide guidelines for the amount of teaching time that should be given to each *topic* within the knowledge area (Life Sciences Documents 5, 6 and 7). The content weighting is thus strongly framed in terms of classroom time. Since the examination weighting of content is prescribed per learning outcome and the exam weighting per knowledge area is given only broadly. However, the net effect of this weak framing is to increase the level of unpredictability of *National Senior Certificate* examination papers, thereby indirectly increasing the level of difficulty of these papers.

5.3 (4) Appropriateness of the Biology/Life Sciences curricula for the South African context

The degree of success with which any curriculum is implemented depends on the learning contexts concerned. These contexts include both physical and skills-related resources. The Life Sciences team did not achieve consensus regarding the appropriateness of each curriculum for the range of contexts of South African schools. The main points of dissention centre around what constitutes useful knowledge for everyday living for most South Africans, and the availability of physical resources in many schools. Some details of the dimensions of discussion are provided in the paragraphs that follow.

The issue of resources

It was agreed that the NATED 550 curricula are meaningful in school contexts with access to well-resourced laboratories (see Biology Document 2, Page 2). The practical work prescribed in Document 1 (see Pages 6-9) requires laboratory equipment not available in many schools. Further, the NATED 550 curricula do not encourage a variety of teaching/learning approaches, such as discussion, debate, production of posters or models. Most of the content topics in these curricula are context-free, based on a positivist notion of a single, culture-independent Biological knowledge system. The curricula focus on disciplinary content, the responsibility of humanity for the preservation of life, and nature conservation.

Resources are also an issue for full implementation of the NCS curriculum in schools across the country. Examples of equipment and materials that are unavailable in many schools include microscopes (see Life Sciences Document 3, Page 23); fresh material for dissection, models and charts and equipment for simple experiments (see Life Sciences Document 3, Page 24); and resource material for research projects, such as "latest medical practices" (see Life Sciences Document 3, Page 25). As a result, Learning Outcomes 1 (Scientific inquiry) and 3 (Life Sciences, technology, environment and society) will be difficult to implement across the range of South African school contexts.

What counts as appropriate content?

The content specified in the NCS curriculum is far more context-sensitive than that in the NATED 550 curricula. Many NCS topics in all three school grades lend themselves to adaptation in differing teaching and learning contexts; others need to be taught with great sensitivity on the part of teachers. An example of the attempt to make practical investigation widely accessible, for instance, is the suggestion that household detergents be used to conduct practical work on *the extraction of DNA*. An example of a topic requiring sensitivity is *the role of bacterial DNA in the manufacture of insulin*, taught in Grade 12. This is an aspect of Biotechnology that raises many socio-cultural-religious issues, and needs to be taught in appropriate ways within the contexts concerned.

One of the evaluators in the Umalusi Biology/Life Sciences team, embracing a humanistic approach to Life Sciences, pointed out that the NCS curriculum seeks to integrate the subject into the whole life of the learner, in ways that will contribute to healthy lifestyle and the sustainable management of resources (see Life Sciences Document. 8, Page 9). An illustration of this 'Life Science for everyday living' approach can be seen in the Grade 10 curriculum, where learners are expected to research cell Biology-related Biotechnologies such as *tissue culture* and *chemotherapy*; and indigenous knowledge systems, ethics and legislation around *tissue sampling, tissue culture, and cloning* (see Life Science Document. 3, Page 23).

Another team member, speaking from a more strictly disciplinary point of view, commented that the links between *life-related* knowledge suggested in the curriculum and aspects of Biology are not necessarily clear. This team member noted further that the relevance of some of the more sophisticated examples provided in the curriculum could not be assumed for the majority of South African learners. One example of content seen as questionable is *tissue culture and cloning*. Another is part of the section on *human reproduction*, which includes possibly useful information on

ante- and post-natal care; the advantages of breast-feeding compared to the use of formula milk; and a wide variety of methods of contraception. Debate arose around the relevance of a sub-section on the *causes* and especially the *treatment of infertility* – including *fertility drugs, artificial insemination, in-vitro fertilisation, and GIFT techniques* – given the elitist nature of these treatments.

The second evaluator was very aware of and foregrounded the price tags in some areas of practice, as these would be out of reach for most South Africans. The first evaluator defended the inclusion of expensive medical procedures like *chemotherapy*, on the grounds that it is a treatment for cancer, which is frequently a secondary disease of HIV/AIDS. This evaluator noted that *cloning* is used to cure lifestyle diseases such as diabetes, which is quite common among South Africans. According to this line of argument, knowledge of medical procedures might prove useful in making decisions in later life, and there is no price tag attached *to knowledge* of existing procedures.

The inclusion of *life-related* knowledge in the Life Sciences curriculum sharply differentiates the subject from tertiary-level Biology courses. While this differentiation may be useful for learners in their daily lives, and for induction into a subject loosely aligned with tertiary-level Biology, it must be noted that an over-emphasis on everyday knowledge detracts from the vertical development of specialised disciplinary knowledge and could hamper learners in their progressive understanding of concepts later on.

5.3 (5) Teaching approaches and subject-specific methodologies for Life Sciences (Biology)

The Umalusi Life Sciences team conceive of general and subject-specific teaching approaches in terms of the concept of *framing*. The reader is reminded that *weakly framed* official documentation comprises non-prescriptive documentary guidance, where there is user-choice of content, sequencing, pacing and progression. *Strongly framed* curricula, on the other hand, prescribe particular teaching styles and approaches.

The team found that the NATED 550 curriculum is neither strongly framed with regard to general pedagogic approach, nor in relation to Biology-specific teaching. A transmission (information-dispensing) type of pedagogy is, however, suggested in the first line of the objectives, which states that the syllabus provides a course which will "develop in pupils … important attributes" (Biology Document 2, Page 2), seeming to negate a view of learners actively engaged in developing the attributes themselves. In balance, the documents could be said to implicitly advocate a learner-centred, active-learning approach, which is aligned with the aims of the curriculum. For example, learners should make their own observations wherever possible; handle apparatus and set up experiments; and observe organisms in their natural habitats. Teachers are expected to emphasise understanding rather than memorisation (see Biology Document 2, Page 2). This type of pedagogy is appropriate for learners with a range of learning styles, and suitable for the content of the Biology curriculum.

The NCS documents are, in contrast, strongly framed in relation to general pedagogy, but weakly framed with regard to approaches specific to the Life Sciences. The original NCS Life Sciences document (see, for example, Life Sciences Document 8, Page 2) specifies that the pedagogic approach to the curriculum in South Africa should be outcomes-based. *Outcomes-Based Education* is a learner-centred, activity-based approach that encourages integration within and across subjects and fields of learning. The NCS curriculum does not permit any alternative pedagogies. It does provide practical guidance for teachers highly qualified in their subject specialisations, for implementing the approach in the classroom. Under-qualified teachers, especially those lacking in domain-specific (Biology-specific) knowledge, will find it challenging to implement this approach.

Guidance provided in the *Learning Programme Guidelines* for Life Sciences emphasises the integration of learning outcomes and assessment standards; learning through experience; and/or simulations (see Life Sciences Document 3, Page 11). Such activity-based pedagogy is aligned

with the outcomes for Life Sciences: activities potentially facilitate learners' development of skills, knowledge, and values. A fair amount of guidance for classroom activities is provided in this document as well as in the assessment/ examination guidelines for Grades 10, 11 and 12 (Life Sciences Documents 5, 6 and 7). For an example of the level of detail provided, under the topic *human nutrition*, the *Learning Programme Guidelines* indicate the following approaches: "… use charts and torso/dissections to investigate the structure of the digestive system; analyse the ingredient list on the labels of various food items to explore the importance of the ingredients to (sic) a healthy life …" (see Life Sciences Document 3, Page 27). The pedagogy is, therefore, not entirely weakly framed, but relatively so with regard to discipline-specific pedagogy.

The activity-based pedagogy in the NCS curriculum is aligned with the aims, content and age groups of learners studying Life Sciences. *Outcomes-Based Education*, however, needs well-qualified, competent teachers and well-equipped schools for its success, and it is questionable as to whether these essential requirements exist across the board in South African schools.

5.3 (6) Assessment in the respective Biology/ Life Sciences curricula

Although the official pedagogic discourse may be linked with weakly framed and weakly classified curricula, allowing teachers a great deal of freedom of choice with respect to the selection of content to be covered, high-stakes external assessment has the power to constrain both pedagogy and content. This situation is the case in South Africa, where the new *National Senior Certificate* – as was its predecessor the *Senior Certificate* – is an extremely high-stakes examination, and one used as the benchmark for the whole national education system. The backwash effect of high-stakes examinations often results in a mismatch between the originally intended curriculum and the implemented curriculum. In this section, the framing of assessment in the respective curricula is considered.

5.3 (6.1) Outline of internal assessment

Internal assessment plays an important role in producing prior-to-examination marks for the continuous (year-long) assessment (CASS) that forms part of learners' final marks. It can also assist in preparing learners for the final examinations.

For the NATED 550 curriculum, a national guideline document (Life Sciences Document 10) provides the general requirements for Grade 12, but not for Grades 10 and 11. A CASS portfolio guideline document in each of the nine South African provinces provided detailed lists of the numbers and types of tasks to be completed. A description of each of the 17 pieces of work (evidence) required in Grade 12 was provided by the national Department of Education. A Grade 11 guideline was produced by Gauteng Province (see Life Sciences Document 9), but there were no guidelines for Grade 10. It was assumed that teachers extrapolated from the available Grade 11 and 12 documents, for Grade 10 work.

The CASS for Grade 11 learners following the NATED 550 curriculum was fairly strongly framed in the Gauteng Province (see Document 9), and for Grade 12 learners this framing was the case across the country. The relative clarity of this guidance would ideally have ensured that teachers implemented the requirements for CASS appropriately in Grade 12. However, in practice, implementation was often not appropriate, possibly because of the lack of guidance with respect to the evaluation criteria differentiating tasks such as class exercises and practical tasks. In other words, the framing of CASS could have been even stronger (requirements could have been spelled out even more clearly) in these documents.

Guidance for internal assessment in the NCS curriculum for Grades 10, 11, and 12 is provided nationally in the *Subject Assessment Guidelines* (see Life Sciences Document 4). This guidance, like that for the NATED 550 curriculum, is strongly framed. In Document 4 (Page 2), it is clearly explained that there must be (informal) daily assessment as well as a formal *Programme of Assessment*. Internal assessment has a weighting of 25% of learners' final assessment marks. The numbers and types of assessment tasks making up the *Programmes of Assessment* for each school year

are clearly tabulated and described (see Life Sciences Document 4, Page 3). While there is an attempt to provide sufficient guidance for these tasks in the *Subject Assessment Guidelines* – by, for example, describing a *hypothesis-testing practical*; an *assignment*, and a *project*, together with providing appropriate examples of such tasks – this guidance is in some cases not sufficient, as it is sometimes misinterpreted by teachers. It may be that this situation arises due to teachers' lack of specialist subject-specific knowledge.

To conclude this subsection, it should be noted that while both the NATED 550 and NCS curricula include fairly strong framing of internal assessment (relatively clear guidance for this assessment), in the NATED 550 documents it could be even stronger. Further, the NCS curriculum provides strongly framed guidance for all three years making up senior secondary school, while that for NATED 550 provides such guidelines for Grade 12 only.

5.3 (6.2) Types and clarity of internal assessment tasks

The numbers and types of internal assessment tasks required are specified clearly for Grade 12 learners in the NATED 550 curriculum (see Life Sciences Document 10) and for all Grade 10, 11, and 12 learners in the NCS curriculum (see Life Sciences Document 4). The spread of tasks for Grade 12 learners in each curriculum is shown in Table 5.3.11 (below).

Table 5.3.11: Summary of internal assessment requirements in the NATED 550 and NCS Grade 12 curricula

Type of task	Classwork	Assignment	Practicals	Tests (Class & Controlled)	Midyear and trial exams
Weighting, NATED 550	50 %	10 %	20 %	20 %	-
No. of pieces, NATED 550	4	1	5	7	-
Weighting, NCS	-	20%	40%	20%	20%
No. of pieces, NCS	-	1	2	2	2

Sources: NATED 550 Gauteng CASS document (Life Sciences Document 9); *Subject Assessment Guidelines*: Life Sciences (Life Sciences Document 4)

Table 5.3.11 shows that there are more formal internal assessment tasks (17) for Grade 12 learners in the NATED 550 curriculum than in that for the NCS (there are four standardised tests – exams and three other tasks such as practical work, projects; and assignments – seven tasks in all – in the latter). It is intended that these formal internal assessment tasks be supplemented with informal assessment in the NCS curriculum. The sets of tasks in both curricula are weighted heavily with tests and examinations.

Formal examinations are usually written at mid-year and at the end of the year in Grades 10, 11, and 12, with additional examination sessions in September for Grade 12 learners. Guidelines are provided for the structure of the Grade 12 examinations in the NATED 550 curriculum, but not for those in Grades 10 and 11. For the NCS curriculum, they are provided for Grades 10, 11, and 12. It is expected that this repeated structuring across the three final years of secondary school will familiarise NCS learners with the examination formats, possibly aiding their performance in the final Grade 12 exams.

Exam papers are structured similarly in the two curricula; weighting grids are provided for learning outcomes, knowledge areas, and cognitive levels.

On the whole, CASS in the NATED 550 curriculum is less strongly framed than that in the NCS, since the new curriculum provides more detailed guidance for teachers. The examination guidelines are, however, strongly framed in both curricula, although to a greater extent in the NATED 550 curriculum. The effect of such strongly framed examination guidelines is to reduce uncertainty about the structure and weighting of content in the examination papers, thus increasing their predictability and making *preparation* for examinations easier.

5.3 (6.3) Types and clarity of guidelines for external assessment

Both the NATED 550 and NCS curricula provide clear guidelines for external assessment, those for the NATED 550 curriculum in *Guideline Document for National Senior Certificate Examinations, 2002* (see Biology Document 1). This document provides details of the allocation of topics to the two papers; weighting of topics within each paper for Higher and Standard Grade levels (ibid., Page 1); formats of the papers (ibid., Pages 2-3); cognitive-level weighting in terms of an adapted Bloom's taxonomy for Higher and Standard Grade levels (ibid., Page 5); and clarification of details of the syllabus (ibid., Pages 6-15). The *Subject Assessment Guidelines* (Life Sciences Document 4) provide similar information for external assessment in the NCS. Weighting of questions at particular levels of cognitive difficulty is shown for the three curricula under consideration in Table 5.3.12, below.

Table 5.3.12: Percentage marks allocated to questions at specific cognitive levels in the three curricula

Adapted Bloom's taxonomy	NATED 550 HG	NATED 550 SG	NCS
Knowledge & comprehension	60%	80%	50%
Application & higher abilities	40%	20%	50%

Table 5.3.12 (above) shows that the NCS external examinations (the *National Senior Certificate* exams) should fall between those of the NATED 550 Higher and Standard Grade (*Senior Certificate*) in terms of the levels of cognitive difficulty of questions within them. As with internal assessment, the weighting of topics is more tightly specified for the external *Senior Certificate* than for the *National Senior Certificate* exams. The effect of this stronger framing is to increase the predictability of papers associated with the NATED 550 curriculum, and to decrease the possibility of questions that integrate topics. These conditions may serve to make the NCS-related external assessment the more difficult of the two.

5.3 (7) Availability, user-friendliness and use of the Biology/Life Sciences curriculum documents

The two documents making up the NATED 550 curriculum were simple, straightforward, and easy to use: they did not require the reinterpretation necessary for the NCS. It was difficult to locate all the pertinent and most recent versions of documents making up the NCS curriculum. The sequence of NCS documents begins in 2003 with the strongly outcomes-based, content-light *National Curriculum Statement* policy document (Life Sciences Document. 8), and continues through a few versions of, and ending with the most recent, *Learning Programme Guidelines* (see Life Sc Document. 3) and *Subject Assessment Guidelines* (see Life Sciences Document 4).

The *Learning Programme Guidelines*, although revised annually, are not yet fully developed. Even in the latest 2008 version of this document, there are some entries that indicate that the authors have not yet interpreted the NCS for a specific learning outcome and knowledge (content) area. For example, for Learning Outcome 1 for Grade 10, the knowledge area *diversity, change and continuity* (Life Sciences Document 3, Page 30) includes: "… Plan and conduct an investigation on plants and animals – comparison …" and "… Analyse given data and findings to evaluate growth and behavioural issues among population..." These activities are meaningless, and no further activities are suggested for this knowledge area within this outcome. The topics, however, are repeated for this knowledge area in Grade 11 (ibid., Page 37) and Grade 12 (ibid., Page 42). A similar repetition of topics occurs within Learning Outcome 3, for example, the requirement to cover "… Historical developments: indigenous knowledge systems, biotechnology, environment, legislation, social behaviour and ethics …" recurs in several places (ibid., Pages 29, 30, 33, 34, 36, 37, 39, 40, 41, and 42). Only Learning Outcome 2 is fully developed in this document.

The assessment syllabuses for Grades 10 and 11 (Life Sciences Documents 6 and 7) and the *Examination Guidelines* for Grade 12 (Life Sciences Document 5) detail requirements for individual assessment standards with more clarity, providing listings of content topics without separating

them into learning outcomes. In short, the formats of the NCS assessment guidelines (Life Sciences Documents 5, 6, and 7) are similar to those for the NATED 550 curriculum, but they are more structured through the use of verbs that state more clearly what learners need to be able to do. These verbs are mostly of the recall type, including words such as *describe, list, state, define, explain*, and *discuss*, which are all at the lowest level of Bloom's taxonomy of levels of cognitive demand.

5.3 (8) Concluding comments for Life Sciences (Biology)

In this closing section, the Life Sciences team commented on three aspects of the current evaluation: a summary of classification and framing in the respective curricula; an overall comment on the levels of difficulty of the curricula; and a critique of the usefulness of the Umalusi instrument.

5.3 (8.1) Summary of framing and classification in the NATED 550 and NCS curricula

This analysis has used the tools of framing and classification to analyse the NATED 550 and NCS curriculum documents. A summary of results is shown in Table 5.3.13.

Table 5.3.13: Framing and classification in the NATED 550 Biology and NCS Life Sciences curricula

Parameter	Framing		Classification	
	NATED 550	NCS	NATED 550	NCS
Aims/objectives	Strong internal	Weak internal	Mixed	Mixed
Content	Strong internal (teacher in control)	Weak internal (learner apparently in control)	Strong	Policy weak, assessment syllabus stronger
Sequencing, pacing and progression	Weak external	Policy weak external; assessment syllabus strong external	N/A	N/A
Weighting	Gr 12: Strong external; Gr's 10, 11: Weak external	Strong external	N/A	N/A
Skills	Weak external	Strong external	Weak	Weak
Pedagogy	Weak external	Strong external	N/A	N/A
Assessment	Grade 12: Very strong external	Strong external	N/A	N/A

The overall analysis of classification and framing values shows that neither curriculum has the potentially 'dangerous' combination of weak classification and weak framing, where the potential exists for *disciplinary, generic* and *life-related* information to be mixed within the curriculum, and there is little guidance for teachers regarding how to proceed.

Through the various versions of the NCS (*National Curriculum Statement; Learning Programme Guidelines*; various assessment syllabi and *Examination guidelines*), a relatively strongly framed curriculum has emerged, while it has been shown that the NATED 550 curriculum is more weakly framed in all respects, barring assessment in Grade 12.

Research has shown that strong external framing of a curriculum is desirable in contexts where many teachers may have inadequate qualifications, as it provides the guidance needed in the absence of fully adequate professional knowledge (see, for example, Bolton, 2005; Morais *et al.*, 1992 and 1995; Reeves, 2005; and others). In this sense, the NCS curriculum is more appropriate for the South African context than is its NATED 550 counterpart, as it provides clearer guidance for teachers. The choice of *Outcomes-Based Pedagogy* as the main general pedagogic approach in the South African context has, however, been heavily criticised (see, for example, Jansen, 2008). *Outcomes-Based Education* requires highly skilled and inventive, resourceful teachers. In the main, the implementation of the NCS in South Africa has been problematic, in that teachers are under-

qualified, lack sufficient rigorous training, and are generally ill-equipped to deliver on the mandate of this curriculum.

5.3 (8.2) Overall levels of difficulty of the three Biology/Life Sciences curricula

Section 5.3 (3) above elaborates on different ways in which the Umalusi Life Sciences team attempted to ascertain the levels of cognitive difficulty of the respective curricula. The cognitive difficulty of content topics was discussed, as were skill types and levels, content sequencing, and the weighting of content and skills. The overall levels of difficulty of the curricula can be judged by considering curriculum content and skills, and framing of aspects of the curricula.

A note on content in the curricula

The NATED 550 and NCS curricula cover similar content, but with different sequencing and pacing, and different aims. Due to the priority given to skills (via assessment standards) in the NCS curriculum, the structuring of questions in the two sets of exam papers was expected by the evaluation team to be different.

The most striking difference between the curricula is that the NCS includes very little plant Biology, and no animal Biology, other than human Biology. The NCS includes evolution, environmental issues, biotechnology, a number of social issues, and indigenous knowledge, all of which were absent in the NATED 550 curriculum. While there is some overlap, the focus has shifted from Biology that was strongly *discipline-based* to Life Sciences, which includes more *life-related* current issues and other topics of human interest. Second, the sequence in which life processes are taught has changed so that some *difficult* topics which featured in the Grade 12 NATED 550 syllabi are now taught as part of the NCS, in Grade 10.

The *overall* levels of difficulty are very similar in the two curricula. The NCS is intermediate between the Higher and Standard Grade levels of the NATED 550 curriculum in terms of the *overall amount of difficult* content. However, when analysed by Grade (see Table 5.3.14, below), it is clear that the Grade 12 NCS curriculum contains a smaller proportion of *difficult* content than either the Standard or Higher Grade levels of the Grade 12 NATED 550 curriculum. Conversely, the amount of *easy* material in the Grade 12 NCS curriculum is also less than that in the Grade 12 sections of the NATED 550 Higher- and Standard Grade documents, but the amount of *moderate* material at Grade 12 level in the NCS is higher than that in either the Higher or Standard Grade curricula. It is difficult to say whether this division of content means that the NCS is easier overall than the NATED 550 curriculum, given that *moderate* could encompass *moderately easy* and *moderately difficult* levels. The Umalusi Biology/ Life Sciences team's sense was that the NCS Grade 12 curriculum is easier than its Grade 12 NATED 550 equivalent, but this judgment would need to be verified against the examination papers.

Unexpectedly, the volume of content increases from Grades 10 to 12 in the NATED 550 curriculum, and appears to decrease markedly across the same school grades for the NCS. It has been noted that teachers experience Grade 11 of the NCS as more content-dense than Grade 10, which contradicts the impression gained from a consideration of the number of content statements.

Table 5.3.14: Average percentage content designated *easy*, *moderate* or *difficult* for Grades 10, 11 and 12 in the NATED 550 Biology and NCS Life Sciences curricula (average of four evaluators)

		Grade 10	Grade 11	Grade 12
Easy	NATED 550 SG	57.8	56.3	44.2
	NATED 550 HG	56.8	50.9	40.3
	NCS	50.5	44.8	34.5
Moderate	NATED 550 SG	40.6	31.3	38.8
	NATED 550 HG	40.9	31.4	39.7
	NCS	37.5	42.7	49.1

		Grade 10	Grade 11	Grade 12
Difficult	NATED 550 SG	1.6	12.5	18.5
	NATED 550 HG	2.3	17.7	20
	NCS	12	12.5	16.4
Total statements	NATED 550 SG	32	48	66
	NATED 550 HG	33	55	75
	NCS	102	58	29

A note on skills in the curricula

Skills, expressed in the NCS as assessment standards, appear to be more difficult in the NCS than in the NATED 550 curriculum. Overall, 40% of these skills (in the NCS) are at the highest level (*requiring analysis in new contexts*), whereas in the NATED 550 curriculum, only 19.5% of the skills involve *analysis in new contexts*. This finding should be treated with caution, since the skills in the NATED 550 curriculum were added a while after original circulation of the documents; and its associated exam papers are not bound to this list of skills, as they are for the NCS. It should be noted, nevertheless, that although the supposed focus of the NCS is the outcomes (with their assessment standards), passing a school grade is determined, not by achievement of the assessment standards (skills) for the grade, but by achieving the minimum 30% mark in the overall assessment for the year.

A note on assessment in the curricula

Quantities and structuring of assessment tasks required effect the difficulty levels of curricula. For the NCS, learners' final marks comprise 75% from the external examination and 25% from their portfolios of internal assessment tasks; this weighting is identical for the NATED 550 curricula. Fewer portfolio tasks are required for the NCS than for the NATED 550 curricula (7 and 17 respectively). However, continuous assessment in the NCS focuses more closely on skills than was previously the case in the NATED 550 curricula. Class tests are excluded from continuous assessment in the NCS, but standardised tests and exams are included (four out of seven tasks), thereby making continuous assessment in the NCS more difficult than that in the NATED 550 curricula.

The percentage required to pass for the NCS is 30%, compared with 33% for the Standard Grade level and 40% for Higher Grade in the NATED 550 curriculum, seemingly making it easier to pass the new *National Senior Certificate* than it was to pass the *old Senior Certificate* exams. The weighting given to higher-level cognitive skills in the examination papers, on the other hand, is higher for the NCS (50%) than for the NATED 550 curriculum at Standard Grade level (20%), but lower for that at Higher Grade level (60%).

Evaluators in the Umalusi Life Sciences team disagree about the overall levels of difficulty of assessment in the two curricula. One evaluator claimed with confidence that learners on a Standard Grade-type level would not perform very well in the 2008 NCS papers and that Higher Grade-type learners who would have scored A-symbols in the NATED 550 exams would still be likely to score A-symbols for the NCS exams, where these symbols would be of similar quality to what they were in the previous exams. Other team members were more hesitant to pronounce final judgments, since so many of the aspects of the old curriculum had changed in the NCS. It was generally felt that continuous assessment in the NCS appears to be more difficult than that in the NATED 550 curriculum and that the relatively heavy weighting of higher order cognitive skills in the NCS curriculum appears to disadvantage learners working on the level of the old Standard Grade. The examination analysis report explores this debate further.

Overall judgment regarding the cognitive difficulty of the respective curricula

A tentative judgment, based on all of the factors discussed - including the levels of difficulty of content; skill types and levels; the sequencing and weighting of content and skills; volumes of work; guidance given for teachers; and the predictability of examinations - is that the NCS Grade 12 curriculum is somewhat less demanding intellectually than that represented by the NATED 550 documents. It may initially appear to be more demanding because of the inclusion of unfamiliar

topics (such as evolution), and the use of unfamiliar assessment styles, but after a small number of years, these aspects will become familiar. The final judgment regarding levels of difficulty will be borne out by the 2008 examination results.

5.3 (8.3) Usefulness of the Umalusi curriculum evaluation tool for Biology/Life Sciences

The Umalusi Life Sciences team comments on the Umalusi tool in terms of its usefulness for researching, first, guidance for classroom practice; second, guidance relating to the work of examiners and moderators; and third, guidance for materials developers.

With respect to researching guidance provided for teachers in the classroom, the team reported the following about the Umalusi instrument:

a) It was felt that in the instrument, questions relating to pedagogic approaches prescribed in the curriculum documents do adequately probe the guidance provided by curricula for classroom practice. There are some elusive characteristics regarding classroom practice that are difficult to capture, such as what content to teach, how to present it, and how to carry out practical investigations. This information falls under pedagogic content knowledge, and is not the role of the curriculum to provide, but is lacking in the South African context. The Biology/Life Sciences evaluators including the team leader found it challenging to work with the NCS documents, which have gone through several revisions as elaborated in Section 5.3 (7), above, (see Life sciences Documents 3-8). The NATED 550 curriculum (Biology Documents 1-2) presents an outdated version of Biology, yet its simplicity and ease of interpretation makes it appealing, and this was difficult to capture using the existing evaluation instrument. It is expected that teachers would experience the same frustrations with the new documents, and this too was not captured through the questions in the Umalusi tool.

b) One team member noted that the questions asked about the curriculum led to answers that are potentially very useful for classroom practice. For example, calculating the percentage class time spent on particular topics and skills would certainly help future planning and implementation of the curriculum. This evaluator noted that there is currently a great deal of apprehension and uncertainty among many teachers and materials developers, in relation to the curriculum. While the policy and guideline documents have unravelled some of the difficulties, studies such as the present one would enhance the process.

Regarding the usefulness of the instrument for researching guidance provided for examiners and moderators, the team noted that questions relating to assessment did permit evaluators to provide comprehensive information on how much guidance is provided for internal examiners and moderators.

Regarding the usefulness of the tool to research guidance provided in the curricula for materials developers and others who may have an interest in the curricula, the Biology/Life Sciences team reported the following:

a) The questions permitted a detailed analysis of the framing and classification of aspects of the curricula, as defined by Bernstein (1971). This approach makes possible the potential comparison of the results of this research with a wide range of findings of other similar projects. Questions in the tool highlighted aims/outcomes and focused attention on the amount of guidance given for these and other related aspects, which was often found to be considerable. The questions also highlight the sequencing, progression and pacing of content and skills within and across school years, all of which are important for teaching and learning so that understanding and competence in the subject is achieved by learners. The fact that many teachers do not recognise the guidance provided in the documents as such, however, may be one of the reasons for poor implementation of the curriculum.

b) Questions in the Umalusi instrument did not, however, allow for qualitative comments about the breadth and depth of content and skills included in the curricula. The task closest to this type

of commentary was the categorisation of content and skills as *discipline-specific, generic*, or *life-related*, but evaluators were not asked about 'what is missing in the curriculum'. Suggested future questions in this respect are: "Are there any significant gaps apparent in the content and skills included, and if so, what are these items?" and "Is there anything you would add to or omit from the content and skills?"

c) The Umalusi questions correctly included whether different contexts were taken into account in the guidance provided for pedagogy and content and skills coverage. These items indeed represent important foci in a deeply stratified educational context such as the South African education system.

SUMMARY OF CURRICULUM EVALUATION: LIFE SCIENCES

The curriculum documents for the NATED 550 Higher and Standard Grade curricula for Biology, on the one hand, were compared with the new NCS curricula for Life Sciences, on the other. The most important points regarding the difficulty level of the new NCS curriculum are the following:

- With regard to content coverage, the NATED 550 curriculum is more closely aligned with its parent discipline (Biology), while the NCS is closer to everyday knowledge. The NATED 550 curriculum is more coherent and contains more vertical conceptual development than does its NCS counterpart, but it omits evolution by natural selection (the highest integrating principle possible when such an approach is adopted). The NCS curriculum, in contrast, develops more horizontally than its NATED 550 equivalent, through the incorporation of relatively large numbers of everyday knowledge and life-related issues of similar (rather than increasing) difficulty levels. Specification of content is more detailed in the new NCS curriculum than in the older NATED 550 documents: the higher number of content statements in the new curriculum provides evidence for this view. If the Grade 10, 11, and 12 curricula are *seen together as a whole*, it could be said that the NCS for Life Sciences is at an intermediate level of difficulty, between the levels of the NATED 550 Higher and Standard Grade curricula.
- Regarding analysis by school grade, two points can be made. First, the NCS Life Sciences curriculum is more difficult than that for the NATED 550 Higher Grade Biology at Grade 10 level; about the same as that for NATED 550 Standard Grade Biology at Grade 11 level; and less difficult than those for both Higher and Standard Grade curricula at Grade 12 level. Second, the volume of content decreases across Grades 10, 11 and 12 in the Life Sciences curriculum. These two findings make it possible to conclude that the NCS Grade 12 Life Sciences curriculum is clearly less conceptually demanding – easier – than those for both the Higher and Standard Grade NATED 550 curricula at Grade 12 level.

5.4 MATHEMATICS

Introductory note to the Mathematics report

In this research, the Umalusi Mathematics team was tasked with looking at the syllabus document (NATED 550) and examination-setting guidelines for the old South African Mathematics Higher Grade (HG) and Standard Grade (SG) curricula, and comparing this curriculum with the new National Curriculum Statements (NCS) for Mathematics. However, locating 'the' official NATED 550 curriculum documents proved difficult. The team attempted to source the NATED 550 curriculum documents from a variety of official sources. The documents received from these sources all differed, and from this situation the team understood that between 1993 and 2007 a number of different versions of what was known as the NATED 550 curriculum for Mathematics were in operation. The *Mathematical content* of these various versions differs only in detail, and the team felt reasonably confident in their comparison of the old curriculum and the NCS in terms of changes in content and skills covered. However, the various curriculum documents received for the NATED 550 curriculum do differ substantially with respect to amounts of information relating to *issues beyond content* and skills covered. For this reason, there are various points in this report at which it is noted that the team had difficulties making firm judgments because of differences in the various documents obtained for the old curriculum.

The documentation for the new NCS curriculum for Mathematics was more readily attainable and, as different versions of the *Subject Assessment Guidelines* and *Learning Programme Guidelines* for the NCS for Mathematics are clearly dated, the team was easily able to work from the latest versions of these documents.

All documents referred to in this Mathematics report are listed in the references section. Each is given a document number, which is used to refer to this document throughout the report. Because of the differences in the documentation collected for the old curriculum, where appropriate, some indications of the sources of the documents are given.

Terminology used

When the Mathematics team refers to the NATED 550 curriculum in this report, it is referring to the curriculum that can be gleaned from the commonalities between Mathematics Documents 1-5; 9-11; 13 and 14. When the team needs to differentiate clearly between the Higher and Standard Grade versions of the NATED 550 curriculum, it refers to these as HG and SG respectively. When the team refers to the NCS curriculum in the report, it means the curriculum that can be gleaned from Mathematics Documents 6, 7, and 8.

Dealing with core and optional aspects of Mathematics

The *Subject Assessment Guidelines* for the NCS Mathematics curriculum (see Mathematics Document 6) indicate that certain assessment standards from the NCS for Mathematics have been designated as core and others as optional. Only the core assessment standards are to be examined in Papers 1 and 2 in 2008, 2009 and 2010. It is intended that the optional assessment standards will be examined separately in an optional paper, Paper 3.

Learners who elect to do the optional assessment standards will have their results for these assessment standards reported separately on their National Senior Certificates in 2008. It should be noted that enrolment figures for Paper 3 were very low in 2008. In addition, there are indications that the optional assessment standards will remain optional for the foreseeable future (even beyond the 2010 examinations). For these reasons, the Mathematics team reports here on core assessment standards only.

5.4 (1) Content and skills topics in Mathematics: difficulty levels and foci

An attempt was initially made, in line with requirements for the broader project of which this analysis is part, to divide the Mathematics curricula into skills and content and then to look at these two aspects separately. This task proved to be impossible, as within mathematics, skills and content are inextricably linked, and it does not make sense to talk about one without the other. In addition, neither the NATED 550 nor the NCS Mathematics curricula attempt to separate content and skills.

As the intention has been to compare the old and new curricula in terms of both content and skills, the team created tables to best facilitate this comparison. The creation of the tables required a process of extensive working and reworking – working from the various curriculum documents to create structured lists of content and skills; testing these items against their ability to talk to the requirements of this research, and then revising them as appropriate. This process resulted in highly detailed tables with extensive lists of topics that have been categorised into the following content and skill areas for convenience: (1) *Algebra and equations*; (2) *Patterns, sequences and series*; (3) *Functions and graphs*; (4) *Calculus*; (5) *Linear Programming*; (6) *Annuities and finance*; (7) *Analytical geometry*; (8) *Trigonometry*; (9) *Euclidean geometry*; (10) *Transformation geometry*; (11) *Data handling*; and (12) *other*.

In this section, the team attempts to contrast the NATED 550 and NCS curricula for Mathematics in terms of the level of difficulty of the skills and content items, and whether the skills and content were *discipline-specific* (relevant for mathematics only), *generic* (relevant for a variety of school subjects), or *life-related* (relevant for life outside school). This latter task proved to be difficult, as

it was not always easy to characterise items in terms of these categories. As a starting point for comparison, the team needed to find some method of weighting the skills and content. Three possible weighting methods were considered by the Mathematics team; each of these is discussed immediately below. For ease of explanation the method used is illustrated with a discussion around designating each content and skill area as either *easy, medium* or *difficult*.

First weighting method

In the first weighting method, the comparison is made on the basis of the percentage of the total number of content and skill topics that fall into each category (i.e. *easy, medium* or *difficult*). The inherent problem with this method is that it makes the assumption that each content and skill topic is (or can be) equally weighted. This weighting is clearly not so as any list of skills and content topics can be rewritten in a different, yet logical manner that provides a different number of items in the list of skills and content topics. For example, 'find the roots of a quadratic equation by factorising, completing the square or using the formula' can be listed as one skill or as three separate skills (namely, 'find the roots of a quadratic equation by factorising; 'find the roots of a quadratic equation by completing the square'; and 'find the roots of a quadratic equation by using the formula'). For this reason, the Mathematics team found that this weighting method will not provide useful information.

Second weighting method

In the second weighting method, the comparison is made on the basis of the percentage of class time allocated to the various content and skills topics. Although this approach might in future be a feasible method for comparison, currently very little reliable information exists on which to base the percentage of class time spent on each item in the list of content and skills topics in the NCS curriculum. For the NATED 550 curriculum, to decide on the percentage of class time for the content and skills topics, the team was able to draw on a suggested scheme of work from the KwaZulu-Natal Department of Education (see Mathematics Documents 9 and10). Although this scheme of work was merely a suggestion, and clearly there will be variation among teachers as to how much time they actually spend on the various content and skill areas. Because the team had had a number of years of experience of teaching with the NATED 550, it was able to suggest that this work scheme might provide a reasonable approximation of how the work could be allocated to class time.

However, as one full cycle of the NCS curriculum had not been completed at the time of this research, the team did not have sufficient insight into how this curriculum could and should play out in classrooms. The team thus looked at the suggested work scheme for the NCS provided in the *Subject Assessment Guidelines* (Mathematics Document 6) and, as this is an official document, used it to calculate the percentage class time using the highly detailed content tables simplified into Table 5.4.1, below. This calculation was done despite the team's view that the work scheme is unrealistic and is unlikely to reflect the practices in most classes. The most obvious indicator of its inadequacy was seen to be that the schedule of work allocates a number of weeks to the optional assessment standards, which are not being offered in the vast majority of schools. In addition, reports from those schools who are offering Paper 3 suggest that they are offering additional classes to do this work, as they are finding that they need all their allocated class time to complete the content and skills required for Papers 1 and 2.

Other examples of suggested work schemes for the NCS curriculum provide different allocations of time (see, for example, Mathematics Document 13). The work scheme in Document 3 is taken from a textbook. All textbooks seen by the team suggest work schemes based on the textbook authors' interpretations of the curriculum. These work schemes all differ in their allocation of class time to the various content and skill areas. The team therefore concluded that it did not have any reliable indicators of percentage class time for the NCS on which to base reasonable comparisons.

Third weighting method

In the third weighting method, the comparison is made on the basis of the weightings of content and skills topics intended to be reflected in the final examinations (as specified in Mathematics

Documents 5 and 6). For this method, official information is available about the weighting of content for the NATED 550 and for the NCS examinations. This weighting is used by the examination committees when they draw up the examinations. It thus seemed to the Mathematics team that this method might be the most reliable one for making the required curriculum comparisons.

It should be noted, however, that the examination weightings are only provided for broad content areas and not at any level of detail. This broadness has meant that in order to make meaningful comparisons, the team used the quantitative information summarised in Table 5.4.1, below, and combined it with qualitative information interpreted from the highly detailed tables simplified here in Table 5.4.1, below. The discussion of this comparison features in Section 3, which follows immediately after Table 5.4.1, below.

Table 5.4.1: Specified examination weighting of topics as percentages

	NATED 550 SG	NATED 550 HG	NCS 2008	Paper
Algebra and equations	21.6	18.75	6.7	1
Patterns, sequences and series	8.3	7.5	10	1
Functions and graphs	8.3	7.5	11.7	1
Calculus	11.7	12.5	11.7	1
Linear programming	0	3.75	5	1
Annuities and finance[3]	0	0	5	1
Analytical geometry	13.3	12.5	13.3	2
Trigonometry	20	21	20	2
Euclidean geometry	16.7	16.5	0	2
Transformation geometry	0	0	8.3	2
Data handling	0	0	8.3	2

The third weighting method was used by the Mathematics team in their comparisons of the levels of difficulty, specification, and foci of content and skills topics in the respective curricula.

5.4 (1.1) Difficulty levels of content and skills topics in the Mathematics curriculum

In this section, the Mathematics team compares the curricula by looking at the apparent cognitive complexity level of each area/ sub-area of content, as *difficult, moderate*, or *easy*. In the attempt to carry out this task, the team noted that it was really only possible to accomplish it on the basis of 'gut feel', informed by the kind of examination questions and textbook tasks typically seen for this content area, on the one hand, and teaching experience, on the other. For Mathematics, there is nothing inherent in content areas that makes them *difficult, moderate*, or *easy*. As one of the team members pointed out, it is possible for almost any content area to set trivial exercises or to set heavy problems. It is also possible that as the NCS curriculum unfolds in classrooms, particular types of typical tasks will emerge for particular topics. The Mathematics team notes that it is with these cautions in mind that the following analysis should be read.

Comparison of NATED 550 Higher Grade and NCS curricula with respect to content areas examined in Paper 1

Table 5.4.2, below, shows key points of difference between the NATED 550 Higher Grade and NCS curricula with respect to content areas examined in Paper 1. This content has been divided according to the categories for which the team had examination weightings. One of the categories (*calculus*) has been omitted, as there was no significant difference between the curricula for this topic. For each of the other categories, information has been included on what content and skills are present in one curriculum (denoted by 'Y' for *yes*) and not in the other

3 Although compound interest is covered in the SG curriculum, it is specified in this curriculum under patterns, sequences and series which is why the weighting for SG is 0 here.

(denoted by 'N' for *no*). The team also included the level of cognitive complexity of that item (E = *easy*; M = *medium*; D = *difficult*; M-D = *both medium and difficult items*).

Table 5.4.2: Differences between NATED 550 Higher Grade and NCS curricula in terms of content areas covered in Paper 1

Content/skill topic	Level	NATED 550 HG	NCS 2008
Algebra and equations		**18.75**	**6.7**
absolute value	D	Y	N
log equations and inequalities	D	Y	N
Patterns, sequences and series		**7.5**	**10**
general term quadratic and other number patterns	M	N	Y
investigation of number patterns emphasised	GAP	N	Y
Functions and graphs		**7.5**	**11.7**
absolute value graph	M	Y	N
investigation of shifting and scaling graphs emphasised	GAP	N	Y
Linear Programming	**D**	**3.75**	**5**
Annuities and finance	**M-D**	**0**	**5**

From Table 5.4.2, the following can be observed:

a) There is a significant decrease in the weighting of *algebra* in the NCS curriculum in comparison to that in the NATED 550 Higher Grade curriculum. The topics of *absolute values* and *logarithmic equations and inequalities* in the NATED 550 Higher Grade curriculum, which often provided the basis for difficult questions, are omitted in the NCS. There is also decreased emphasis on complex manipulations of *algebraic expressions and equations* in the NCS curriculum. This decrease is underscored by the statement in the NCS (see Mathematics Document 7, p13) "… The emphasis is on the objective of solving problems and not on the mastery of isolated skills (such as *factorisation*) for their own sake …". 'Tricky' algebraic manipulations are thus unlikely to be a feature of the NSC Mathematics examinations, whereas using algebra in problem solving might be. However, this being said, the team queried the diminished emphasis on *logarithms*, which have many applications.

b) In the NCS curriculum, one could argue that the marks that were allocated to *algebra and equations* in the NATED 550 Higher Grade curriculum have now shifted to *patterns, sequences and series; functions and graphs; linear programming*, and *annuities and finance*. Within *patterns, sequences and series* and within *functions and graphs*, the main shift is towards the focus on investigations in the NCS curriculum. The increased emphasis on *linear programming* and the introduction of *annuities and finance* in the NCS can be seen as a shift towards applications and modelling. This emphasis on mathematical processes (e.g. investigating, conjecturing, justifying) and on application and modelling is referred to throughout the NCS curriculum. For example, "… the learner will explore real-life and purely Mathematical number patterns and problems which develop the ability to generalise, justify and prove … a fundamental aspect of this outcome is that it provides learners with versatile and powerful tools for understanding their world, while giving them access to the strength and beauty of Mathematical structure" and "the power of algebra is that it provides learners with models to describe and analyse such situations" (Mathematics Document 7, Page 12). Mathematical modelling and investigations are high order skills and are likely to be realised in difficult tasks.

In summary, the Mathematics team suggested that although there have been significant changes in the content and skills of the Mathematics Paper 1 associated with the NATED 550 Higher Grade curriculum and that linked to the NCS curriculum, the downgrading of complex manipulative skills has been accompanied by an increased emphasis on Mathematical processes and modelling (different but still complex skills). These changes make the level of cognitive demand of content areas covered in Paper 1 associated with the NATED 550 Higher Grade and NCS curricula, roughly equal.

Comparison of the NATED 550 Standard Grade and NCS curricula with respect to content areas examined in Paper 1

Table 5.4.3, like Table 5.4.2, has been created to compare the NATED 550 and NCS curricula in terms of content areas examined in Paper 1; the focus in this instance is on the Standard rather than the Higher Grade Mathematics curriculum.

Table 5.4.3: Differences between NATED 550 SG and NCS curricula in terms of content areas covered in Paper 1

Content/skill topic	Level	NATED 550 SG	NCS 2008
Algebra and equations		**21.6**	**6.7**
Linear and quadratic inequalities	D	N	Y
Patterns, sequences and series		**8.3**	**10**
general term quadratic and other number patterns	M	N	Y
sum to infinity of geometric series	M	N	Y
investigation of number patterns emphasised	GAP	N	Y
Functions and graphs		**8.3**	**11.7**
Inverses	M	N	Y
investigation of shifting and scaling graphs emphasised	GAP	N	Y
Linear Programming	**D**	**0**	**5**
Annuities and finance	**M-D**	**0**	**5**

As with the comparison of the NATED 550 Higher Grade and NCS curricula, so are there shifts towards Mathematical processes and modelling when considering the Standard Grade in relation to the NCS curriculum. It must be noted that there are no topics that could lead to complex algebraic manipulations in the Standard Grade curriculum. *Moderate* to *difficult* topics in the NCS curriculum such as *linear and quadratic inequalities, patterns with general term quadratics, the sum to infinity of a geometric series*, and *inverses of function* do not feature in the Standard Grade curriculum at all: exam papers associated with the NCS curriculum are likely to be more cognitively demanding than those linked to the NATED 550 Standard Grade curriculum.

Comparison of NATED 550 Higher Grade and NCS curricula in terms of content areas examined in Paper 2

As for Tables 5.4.2 and 5.4.3, Table 5.4.4, below, has been created to compare the NATED 550 Higher Grade and NCS curricula in terms of content areas examined in Paper 2. In this table the *analytical geometry* content area has been omitted, as there were no significant differences between the two curricula in this respect.

Table 5.4.4: Differences between the NATED 550 Higher Grade and NCS curricula in terms of content areas covered in Paper 2

Content/skill topic	Level	NATED 550 HG	NCS 2008
Trigonometry	**GAP**	**21**	**20**
include ratios sec, cosec, cot	GAP	Y	N
Euclidean geometry	**M-D**	**16.5**	**0**
Transformation geometry	**E**	**0**	**8.3**
Data handling	**M**	**0**	**8.3**

The key difference between the NATED 550 Higher Grade and NCS curricula for Paper 2 is the exclusion of *Euclidean geometry* from the NCS curriculum and the inclusion of *transformation geometry* and *data handling* in its place. Although an exam weighting of about 5% was allocated to *Euclidean geometry (previously seen proofs)* in the papers associated with the NATED 550 Higher Grade curriculum, the remaining 11.7% of the exam weighting for *Euclidean geometry* was allocated to *unseen riders* and *proofs*. Learners have traditionally performed poorly in this section,

which by its nature, requires high-level insight and problem solving. In contrast, the nature of the type of tasks likely to be assessed in the *transformation geometry* and in the core sections of *data handling* in exams linked to the NCS is in fact fairly routine. This distribution of content areas suggests that, in relation to the content areas examined in Paper 2, the NCS curriculum is likely to be less cognitively demanding than that for NATED 550 Higher Grade.

In relation to trigonometry, the only real difference between the NATED 550 Higher Grade and NCS curricula is the exclusion of the ratios *sec, cosec and cot* in the NCS curriculum. Although this omission reduces the number of *trigonometric formulae and identities* learners need to deal with, it does not fundamentally alter the cognitive demand of this section as *sec, cosec and cot* can simply be rewritten in terms of *sin, cos and tan*.

Comparison of the NATED 550 Standard Grade and NCS curricula in terms of content areas examined in Paper 2

As for Tables 5.4.1, 5.4.2, 5.4.3, and 5.4.4, Table 5.4.5 has been created to compare the NATED 550 Standard Grade and NCS curricula in terms of content areas examined in Paper 2.

Table 5.4.5: Differences between the NATED 550 Standard Grade and NCS curricula in terms of content areas covered in Paper 2

Content/skill topics	Level	NATED 550 SG	NCS 2008
Trigonometry		**20**	**20**
include ratios sec, cosec, cot	GAP	Y	N
ratios and equations on *unrestricted* domain	M-D	N	Y
compound angle formulae	M	N	Y
shifting and scaling trig graphs on any domain	D	N	Y
Applied problems solving in 3D	D	N	Y
Euclidean geometry	**M-D**	**16.7**	**0**
Transformation geometry	**E**	**0**	**8.3**
Data handling	**M**	**0**	**8.3**

As with the move from the NATED 550 Higher Grade to the NCS curriculum, the replacement of *Euclidean geometry* in the Standard Grade curriculum with *transformation geometry* and *data handling* in the NCS replaces more *difficult* with easier content. However, comparing *trigonometry* in the respective curricula shows that while the NCS curriculum requires learners to know the *trigonometric ratios* and to be able to solve *trigonometric equations* and deal with *trigonometric graphs* over any domain, in the NATED 550 Standard Grade curriculum *trigonometric ratios and equations* are confined to angles between 0° and 360°, and here learners deal with *trigonometric graphs* only in the domain 0° - 360°. In addition, NCS learners are required to deal with the *horizontal shift of trigonometric graphs*, which can be challenging, and from which Standard Grade learners were exempt. The *compound angle formulae* are studied and applied in the NCS curriculum, but not in its Standard Grade counterpart. Finally, the NCS curriculum includes the use of *trigonometry* to solve problems in three dimensions, whereas in the NATED 550 Standard Grade equivalent, problem solving is done in two dimensional contexts only.

All of these content and skill items in the *trigonometry* of the NCS curriculum but absent from its Standard Grade counterpart are of *difficult* or *moderate-to-difficult* complexity. These inclusions suggest that *trigonometry* in the NCS curriculum is more cognitively demanding than that in its Standard Grade counterpart. In summary, then, although the *Euclidean geometry* in the Standard Grade curriculum is more cognitively demanding than the *transformation geometry* and *data handling* of the NCS, the *trigonometry* of the NCS is more cognitively demanding than that in the Standard Grade curriculum. These differences could be said to balance out so that in terms of content areas covered in Paper 2, the NCS and Standard Grade curricula are roughly comparable in terms of levels of cognitive demand.

A summary of levels of cognitive demand in Papers 1 and 2 for the two curricula is given in Table 5.4.6 (immediately below).

Table 5.4.6: Summary of comparison of cognitive demand across Papers 1 and 2 for the two curricula

Content/skill topics	NATED 550 SG	NATED 550 HG	NCS 2008	change from HG to NCS	change from SG to NCS
Algebra and equations	21.6	18.75	6.7	Decreased emphasis on complex manipulations	Decreased emphasis on manipulations
Patterns, sequences and series	8.3	7.5	10	Increased emphasis on investigations	Increased emphasis on investigations
Functions and graphs	8.3	7.5	11.7	Increased emphasis on investigations	Increased emphasis on investigations
Calculus	11.7	12.5	11.7	no significant change	No significant change
Linear Programming	0	3.75	5	Increased emphasis on this applied topic	This applied topic was not in SG
Annuities and finance	0	0	5	this applied topic was not in HG	This applied topic was not in SG
Content areas examined in Paper 1	50	50	50	Decrease in complex manipulations, but increase in applications and investigations suggests similar cognitive demand	Increase in applications and investigations and inclusion of some more complex manipulations suggests increase in cognitive demand
Analytical geometry	13.3	12.5	13.3	No significant change	No significant change
Trigonometry	20	21	20	Exclusion of sec, cosec, cot, doesn't alter cognitive demand significantly	No restrictions of domain in NCS and inclusion of more content and skill items increases the cognitive demand of NCS
Euclidean geometry	16.7	16.5	0	This difficult topic is not in NCS	This difficult topic is not in NCS
Transformation geometry	0	0	8.3	This fairly easy topic was not in HG	This fairly easy topic was not in SG
Data handling	0	0	8.3	This moderate topic was not in HG	This moderate topic was not in HG

5.4 (1.2) Content and skills foci in the Mathematics curricula

The Mathematics team attempted to judge whether each of the content and skills listed for the NATED 550 and NCS curricula are *discipline-specific* (relevant just for mathematics), *generic* (relevant for several school subjects), or *life-related* (relevant for life outside school). The task proved difficult because, although almost all of school Mathematics is applicable to other disciplines, and much of it has everyday life-related application, most of school Mathematics is firmly rooted in the disciplines of the mathematical sciences. This category overlap meant that an item-by-item analysis was not productive. However, by referring to Table 5.4.6, above, some broad-level comments can be made about the shifts from the NATED 550 to the NCS curriculum.

The inclusion of *data handling* in the NCS curriculum means that aspects of the discipline of Statistics, and not only pure Mathematics have been incorporated. In addition, the inclusion of topics like *annuities and finance* and the increased focus on the applications of ideas and modelling further suggest incorporation of elements of applied Mathematics. It could thus be argued that in the move from the NATED 550 to the NCS curriculum, there has been a broadening of school Mathematics to include a 'region' of disciplines (i.e. the mathematical sciences) rather than a focus on a single discipline (pure Mathematics).

The NATED 550 curriculum does state as one of its aims, "… an appreciation of the place of Mathematics, and its widespread applications in other subjects and our world …" (see Mathematics Document 2, Page 3). However, in the section of the NATED 550 curriculum where constituent content and skills are outlined, applications are mentioned only very rarely. In contrast, the application of Mathematics to everyday contexts is emphasised in the introductory chapters and throughout the NCS assessment standards (see Mathematics Document 7). For example, in each school grade there is an assessment standard dealing specifically with Mathematical modelling of real-life contexts (see Assessment Standards 10.2.6; 11.2.6, and 12.2.6 in Mathematics Document 7). A number of other assessment standards also reflect this desired focus, as can be seen, for example, in the statement "… critically analyse investment and loan options and make informed decisions as to the best options …" (Assessment Standard 12.1.5, in Mathematics Document 7). Content areas such as *annuities and finance* and *data handling* in the NCS also have an overt application focus.

To reiterate, there is a much stronger and more upfront notion of mathematics as applicable to other disciplines and everyday life in the NCS then there is the NATED 550 curricula. Some members of the evaluation team noted that the de-emphasis of *proof* in the NCS curriculum (particularly with the vastly reduced section on *Euclidean geometry*) means that learners will not be given access to a cornerstone of disciplinary Mathematics.

5.4 (2) Organising principles and coherence in the Mathematics curricula

In this section, the Mathematics team attempted to describe ideas according to which the curricula are organised. The organising principle for both the NATED 550 Higher and Standard Grade curricula is the division of Mathematical knowledge and skills into the broad content areas of Mathematics, namely, *algebra; differential calculus; Euclidean geometry; analytical geometry* and *trigonometry*. These areas are written in the curriculum documents as the headings of various sections under which more detailed content and skills are listed (see Mathematics Document 5, for example).

The organising principle for the NCS is the four learning outcomes: *number and number relationships; functions and algebra; space, shape and measurement*; and *data handling and probability*. The assessment standards, which contain more detail regarding skills and content to be covered, are grouped under each of these learning outcomes (see Mathematics Document 7).

The team noted that the NATED Higher and Standard Grade curricula are organised into themes from Mathematics as a discipline; and the NCS curriculum is more broadly defined by categories from the Mathematical Sciences. They argue that each of these curricula is complete in its own right: it is not as if one is better than the other, but rather that each is simply different from the other. That some of the evaluation team noted the de-emphasis of *proof* and the reduction of *Euclidian geometry* in the NCS curriculum, and that this shift bars access to a key part of disciplinary Mathematics has already been noted.

5.4 (3) Sequence, progression and pacing in the Mathematics curricula

The team looked at sequencing, progression and pacing of skills and content in the curricula. The hierarchical nature of Mathematics means that sequencing and progression are often inherent in the content. In other words, a certain sub-topic is pre-requisite knowledge for another sub-topic

and so *has* to be taught first. Further to this inherent sequencing, there are no significant differences between the NATED 550 and NCS curricula in terms of the *appropriateness* of the sequence and progression suggested within them.

Similarities and differences between the curricula are considered in relation to first, sequencing and progression *within* and *across* the school years concerned (across Grades 10, 11, and 12). Second, the respective levels of increase in cognitive complexity are analysed. Third, the section ends with a consideration of the allocation of particular content and skill topics to Grades 10, 11, and 12 in each curriculum.

5.4 (3.1) Sequencing, progression and pacing within and across the three final years of senior secondary school in the Mathematics curricula

With respect to within- and between-year sequencing, the guidance given to teachers in the case of all three curricula is presented in the form of suggested work schedules (see Mathematics Documents 8; 9; 10; 11; and 13). None of the documents are prescriptive. In the case of the Higher and Standard Grade curricula, the documents analysed (mathematics Documents 9, 10, and 11) were issued by a particular province. It is possible that similar documents existed in other provinces, and suggested differing sequencing. In the case of the NCS curriculum, the two documents with guidance regarding sequencing provide differing sequences (see Mathematics Document 8, the official *Learning Programme Guidelines*, and Mathematics Document 13, for which the origin and status is unknown).

For the Higher and Standard Grade curricula (Mathematics Documents 9; 10, and 11) provide substantial guidance for teachers. They include, for example, a suggested order in which the topics should be taught over the three final years of secondary school, as well as the number of periods that should be allocated to each topic within each year. The sequencing appears to be based on the desire to have a mix of algebra, geometry and trigonometry in each school term and to ensure that prerequisite knowledge is in place before new knowledge/skill requiring that knowledge is taught.

The NCS curriculum provides a fair degree of guidance in the form of a suggested work schedule for the three school years (see Mathematics Document 8, Pages 25-48). The schedule allocates assessment standards to particular weeks within the Grade 10, 11 and 12 years of schooling. However, this work schedule is not as detailed as that for the Higher and Standard Grade curricula, since it allocates assessment standards to weeks, and not topics to numbers of lessons. The rationale for the sequencing of work in the NCS curriculum is less clear than it is for the NATED 550 curricula, but it does provide for prerequisite knowledge to be in place before skills requiring application of that knowledge are taught.

The work schedule does not, however, reflect the reality in most South African classrooms, as it provides space for the optional assessment standards to be taught – something not happening in most schools. In addition, some time allocations appear unrealistic; for example, a full week is devoted to *recurring decimals* – a topic needing far less time. Document 13 provides a more detailed layout of content and skills than does Mathematics Document 8. However, the sequencing here is problematic, in that certain prerequisite skills are not encountered prior to the time when they are needed (for example, *compound angle formulae* in *trigonometry* are covered after *rotation through any angle* in *transformation geometry*).

The suggested work schedule in NCS Mathematics Document 8 is thus probably not going to be useful in its entirety to teachers. However, it is likely that as teachers and subject advisors gain experience in implementing the NCS curriculum in classrooms, more appropriate documents, similar to those work schedules for the NATED 550 curricula (in Mathematics Documents 9, 10 and 11) will become available.

All three curricula make clear what content and skills need to be taught at each grade level. In each case, it is clear that this specification ensures that prerequisite knowledge is in place prior

to it being needed as a basis for new knowledge in later grades. Within the Higher and Standard Grade curricula, certain topics follow a sequential order from Grades 10 to 11 and Grades 11 to 12 (see, for example, aspects of *trigonometry*, the various *functions*, and some aspects of *algebra*). However, in both of these curricula, some topic areas are covered in one grade only (see, for example, *calculus, arithmetic and geometric series*, and *financial Mathematics* in the Standard Grade curricula, and *analytical geometry* and *absolute value* in the Higher Grade documents).

In the NCS curriculum, there are explicit guidelines for ensuring conceptual progression (see Mathematics Document 8, Page 16): the curriculum states that this progression should be evident across the assessment standards. For most of the topics in this curriculum, the progression across school years is clear; for example, the basics of *analytical geometry* are dealt with in Grade 10, and expanded to include *lines* in Grade 11 and *circles and tangents* in Grade 12. Although this structuring is in many cases true, there are a number of instances where the separation into various grade levels has no obvious progression-related justification. For example, *simple and compound growth* are both dealt with in Grade 10, whereas *decay* is covered in Grade 11; *arithmetic sequences* are covered in Grade10 and *geometric sequences* in Grade11. There is no real progression in this sequencing. It instead perhaps reflects a desire to revisit a topic area each year.

The Mathematics team points out that one could thus say that the NCS curriculum has a stronger spiral element with the same topic being revisited each year, than do the two NATED 550 curricula. This structuring can, in the hands of a good teacher, provide opportunities to deal with topics at increasing levels of complexity over time.

5.4 (3.2) Increase in cognitive complexity over Grades 10, 11 and 12 in the Mathematics curricula

In relation to the question as to whether or not there is an increase in the cognitive complexity of content and skills from grade to grade in the three final years of secondary school, the team felt that the hierarchical nature of Mathematics as a discipline means that new knowledge builds on old knowledge, and so cognitive demand increases each year as additional knowledge is integrated into existing knowledge. The allocation of skills and content to specific school grades reflects the hierarchical nature of Mathematics and naturally provides for an increase in cognitive demand over the years.

5.4 (3.3) Allocation of content/ skills to each grade in the Mathematics curricula

In each of the curricula, there is clear specification of what needs to be covered in each school grade. For the NCS curriculum, Mathematics Documents 6 and 7 (see Pages 15-22 and 16-61 respectively) list what must be covered in each grade for Grades 10, 11 and 12.

For the NATED 550 curricula, Mathematics Document 5 (Pages 8-29) lists what needs to be covered in Grades 11 and 12. For the Standard Grade curriculum, Mathematics Document 1 (Pages 9-25) lists what needs to be covered in each of Grades 10, 11 and 12; as does Mathematics Document 2 (Pages 9-27) for its Higher Grade counterpart. However, Mathematics Documents 1 and 2 (Pages 4 respectively) both state that "… the partitioning of work for Standards 9 and 10 (levels now referred to as Grades 11 and 12) is not prescriptive …". Notwithstanding this reminder, most textbooks and teachers would have kept to the suggested allocations of content for particular grades.

5.4 (4) Aims, purpose, vision, and outcomes in the Mathematics curricula

In this section of the Mathematics report, there are four subsections. First, the stated aims in each curriculum are discussed. Second, the guidance provided for achieving these aims is considered. Third, the suitability of the respective aims for the school contexts in which they are likely to be implemented is assessed. Fourth, articulation of this part of the Mathematics curriculum (that for Grades 10, 11, and 12) with other parts of the system is described.

5.4 (4.1) Stated aims of the Mathematics curricula

The Mathematics team considered the nature and clarity of curricular aims in the respective curricula. It was found that all three curricula list their aims and purposes clearly. However, this is an area where the confusion over which documents determine the NATED 550 curriculum creates a problem. Documents 1 and 2, the draft core syllabi for Mathematics Higher and Standard Grade from a previous provincial Department of Education, provide different aims to Documents 14 and 15, the Mathematics syllabi for Standards 8, 9 and 10 (Grades 10, 11, 12) from another provincial Department of Education.

From Documents 1 and 2 for the Higher and Standard Grade curricula respectively, the aims "… have been selected with the intention of fostering general formative educational goals …" (see, for example, Mathematics Document 2, Page 3). These curricula aim to develop in learners an understanding of number; measurement; space and relationships; the ability to use Mathematical processes (such as comparing, generalising, etcetera); the ability to apply Mathematics knowledge in problem solving, and logical reasoning; the ability to use Mathematical language and methods and an appreciation of its applicability; and the Mathematical skills needed for further study and employment (see Mathematics Documents 1 and 2).

In the second set of provincial Higher and Standard Grade syllabi (Mathematics Document 14) and 15), the aims are broader than those just discussed, and are to "… enable pupils to gain Mathematical knowledge and proficiency; apply Mathematics to other subjects and in daily life; develop insight into spatial relationships and measurement; enable pupils to discover Mathematical concepts and patterns by experimentation, discovery and conjecture; develop number sense and computational capabilities and to judge the reasonableness of results by estimation; develop the ability to reason logically, to generalise, specialise, organise, draw analogies and prove; to enable pupils to recognise a real-world situation as suitable for Mathematical representation, formulate an appropriate Mathematical model, select the Mathematical solution and interpret the result in the real-world situation; develop the ability to understand, interpret, read, speak and write Mathematical language; develop an inquisitive attitude towards Mathematics; develop an appreciation of the place of Mathematics and its widespread application in society; provide basic Mathematical preparation for future study and careers; create an awareness of and an appreciation for the contributions of all peoples of the world to the development of Mathematics; to encourage a multi-cultural approach to Mathematics; and to make Mathematics accessible to all…" (Ibid.: Page 2)

The aims in the NCS curriculum partly overlap with those in the NATED 550 curricula, the NCS aims being "… to give learners a functioning knowledge of Mathematics to make sense of society and to develop an appreciation of the discipline itself, to open them to extended study of the mathematical sciences. Mathematics enables learners to communicate using various representations; use Mathematical knowledge in problem solving; organise and manage activities in substantial Mathematical ways; work collaboratively to enhance Mathematical understanding; collect and use quantitative data to evaluate and critique conclusions; and engage responsibly with quantitative arguments …" (see Mathematics Document 7, Pages 9-10)

Perhaps a key difference between the NATED 550 and NCS curricula is the explicit acknowledgment in the NCS aims, of the inclusion of aspects of *statistics* and a stronger focus on *Mathematical modelling*. However, as elements of *Mathematical modelling* are also present in the aims sections of both versions of the NATED 550 curricula (in their discussions of *applications*), and the inclusion of *statistics* does not substantially alter the cognitive demands of the curriculum, one cannot draw any conclusions about the relative character or respective levels of cognitive difficulty in the curricula by considering the stated aims of each. The Mathematics team noted that the stated aims re-emphasise the idea that in the NCS, there is a broadening of school Mathematics from a more narrow disciplinary Mathematics to the broader mathematical sciences, as evidenced by the relatively strong focus on *modelling* and the inclusion of *data handling* and *statistics*.

5.4 (4.2) Guidance for achieving stated curricular aims in the Mathematics curricula

The Mathematics team considered the amount of guidance given in the documents for achieving stated curricular aims. Much of the NATED 550 Higher and Standard Grade curriculum documents are couched in content. In some cases, the information linking this content to aims is contained in the preambles of the documents, in statements such as "… in implementing the Mathematics curriculum, due attention should be accorded, not only to the provision of Mathematical knowledge, skills and concepts in the planned curriculum, but also to the Mathematical processes by means of which pupils are actively and productively involved in learning …" and "… problem solving should be the central focus of teaching and learning Mathematics …" (see Mathematics Documents 1 and 2). The fact that the ways in which the aims can be achieved are couched in these general terms and in the preambles means that guidance given for implementation is not sufficiently specific to assist implementation. Further, this general guidance is placed in sections of the curriculum documents not regularly referred to.

In other instances almost no guidance is provided for achieving the NATED 550 aims (see, for example, Mathematics Documents 14 and 15). However, in some of these cases, explanatory notes are given alongside content. A few of these notes could be useful in terms of providing guidance for achieving curricular aims. For example, alongside the content item relating to formulae for *surface area and volume of various solids* is the explanatory note "… The use of formulae from other subjects is recommended in order to illustrate the relevance of the work …" (see mathematics Document 15, Page 5). However, the majority of explanatory notes relate more to providing further detail of stipulated content and establishing what exactly is examinable than to forming explicit links to stated aims. The implicitness of this link is illustrated particularly well in the example "… Factorising, completing the square, and the quadratic formula are required as methods of solution. Derivation of the quadratic formula is examinable" (see Mathematics Document 15, Page 11). Thus, the Umalusi Mathematics team argues that in these documents, there is insufficient clear guidance for achieving the aims of the Higher and Standard Grade curricula.

In the NCS curriculum, in contrast, a reasonable degree of guidance is given for achieving stated aims. Guidance is given, for instance, throughout Mathematics Documents 6, 7, and 8. For example, Document 8 (pages 12-13) states "… Mathematical content and processes must, where appropriate, be embedded into contexts that will make it possible for learners to establish an authentic connection between Mathematics as a discipline and the application of mathematics in real-world contexts ..." and "… For Mathematics, in particular, electronic and computational devices are currently at the core of the use of Mathematics in everyday life and in industry and commerce …" and "… The scientific calculator is indispensable …".

In addition, in the NCS documents, guidance is also integrated into the assessment standards and is thus more 'upfront' (it is made more explicit) for users of the curriculum. Statements such as "… investigate number patterns, make conjectures and generalisations, provide explanations and justifications …" and "use simple and compound growth formulae to solve problems including interest, hire-purchase, inflation, population growth and other real-life problems …" (see Mathematics Document 7, Page 18) , are examples of this integrated guidance. These statements clearly indicate how Mathematical content is related to processes within the discipline, problem solving and application.

Teaching mathematical modelling and developing learners' ability to conjecture, generalise and justify as demanded in the NCS curriculum are difficult teaching tasks. Because of this complexity, the team felt that the *Learning Programme Guidelines* (Mathematics Document 8) could provide more examples of teaching tasks that will facilitate development of these skills. However, the team felt strongly that guidance for teachers is more appropriately provided in teacher workshops and through ongoing person-to-person support than through simply being written into curriculum documents.

5.4 (4.3) Suitability of stated curricular aims for social contexts in which the Mathematics curricula are likely to be enacted

The Mathematics team considered the classroom contexts in which the curricula would be implemented. In some of the NCS documents, preamble sections mention "inclusivity", "sensitivity to all" (social groups) and "valuing indigenous knowledge systems" (see, for example, Mathematics Document 7, Page 4). These values are couched in general terms, and in this form, do not provide clear guidance for implementation. In other documents such as the *Learning Programme Guidelines* (Mathematics Document 8), however, some suggestions as to how these values might be achieved are provided. Suggestions include the valuing of indigenous knowledge systems (see Page 9), and the use of contexts relevant to learners (see Page 12). In addition, the issues of inclusivity and diversity are directly addressed (see Pages 17-18): a seven-point bulleted list is given of steps that can be taken to address diversity when planning activities. These steps are sufficiently broadly stated to accommodate all learners and avoid being narrowly prescriptive, as, for example, in "… consider individual past experiences, learning styles and preferences …" (see Page 17).

The NATED 550 Higher and Standard Grade curricula (see, for example, Documents 1 and 2) similarly mention differing contexts, and suggest incorporating a range of teaching approaches (see Mathematics Document 1, Page 2; Document 2, Page 2). While such suggestions could be seen as acknowledging the different contexts in which learning will take place, they do not provide any clear detailed guidance as to how the aims of the curriculum may be achieved in varying contexts.

5.4 (4.4) Articulation of the FET Mathematics curricula with other parts of the educational system

The extent to which articulation between the respective curricula for Grades 10, 11, and 12 and other parts of the education system is specified was considered by the Mathematics team. It was found that none of the documents provide anything beyond cursory descriptions of articulation. However, it is important to note here that the comments provided by the team relate to the extent to which the documents *describe* articulation and *do not address* the issue of whether or not, or how the curricula *actually* do or do not articulate with other levels of the system. This omission is perhaps a weakness in this report. Some descriptions are highlighted here.

In the NATED 550 Higher Grade curriculum, there is an indication that curriculum content is aimed at those intending to study Mathematics at university or to study university subjects for which Mathematics is a prerequisite (see Mathematics Document 2, Page 2). The Standard Grade curriculum in contrast, aims at: "… supplying a sufficiently broad base to provide basic training for study and career purposes …" (see Mathematics Document 1, Page 2). No description is provided of what, if any, prior learning upon which either of these curricula is based is needed.

In the NCS documentation, articulation is more explicit. The intention is that Mathematics needs to be taken by learners interested in pursuing careers in scientific or technological fields, and that the curriculum will provide links to Mathematics in Higher Education institutions (see Mathematics Document 7, Page 11). These ideas are also discussed, together with examples of further learning and careers for which Mathematics is needed, in the *Learning Programme Guidelines* (see Mathematics Document 8, Page 7). Both the *National Curriculum Statement* and the *Learning Programme Guidelines* documents state that Mathematics in the FET band builds on the Mathematical base established in the GET band (see Document 7, Page 11 and Document 8, Pages 9-10). For Learning Outcome 3 (Space, shape and measurement), this incremental approach is explicitly stated as building on the experiences of the GET band to "… make more formal and extended levels of knowledge accessible …" (see Mathematics Document 7, Page 13). This explication is also present for Learning Outcome 4 (Data handling and probability) where learners are expanding on the data handling of the GET band and deepening the understanding of probability gained in this band (ibid., Page 14).

The fact that both NCS and NATED 550 Higher Grade curricula are recommended for learners who will pursue further studies in scientific fields suggests that the new NCS curriculum aims to prepare Mathematics learners for the tertiary study of Mathematics, just as the Higher Grade curriculum used to do.

5.4 (5) Teaching approaches and subject methodologies in the Mathematics curricula

In this section, the pedagogic approaches advocated in the respective curricula are evaluated. There are two subsections, namely, those addressing general and subject-specific teaching/ learning approaches respectively.

5.4 (5.1) General teaching and learning approaches in the Mathematics curricula

The NATED 550 Higher and Standard Grade curricula (see Mathematics Document 1, Page 2; Mathematics Document 2, Page 2) suggest pedagogy that encompasses a range of techniques from direct teaching to activity-based learning, discussion. application, problem solving, open-ended investigation, consolidation and practice. This pedagogy is based on the premise of the learner as an active thinker who constructs meaning. However, the recommendation of the approach is presented in the form of a list of possible approaches, with no further detail for implementation. In Documents 14 and 15, no general teaching/learning approach is discussed.

In the NCS system, the curriculum statement itself (see Mathematics Document 7, Pages 1-5) advocates an *Outcomes-Based Education* (OBE) approach and discusses the kinds of teachers and learners envisaged. The educator is described as a "mediator" of learning (see Mathematics Document 7, Page 5). The learner is outlined as someone who will succeed in lifelong learning, think logically and holistically, and be able to transfer skills learned (ibid., Page 5). The *Learning Programme Guidelines* (Mathematics Document 8) provide extensive guidance around possible methods for implementation of the curriculum. These methods range from a discussion of the relationship between the Mathematics learning outcomes and the desired overarching critical and developmental outcomes (ibid., Page 10), on the one hand, to a detailed description of a three-stage approach for designing a learning programme for Mathematics (see Pages 14-20), on the other. Although teaching techniques are not prescribed in the *Learning Programme Guidelines*, the discussion of lesson plans strongly suggests the importance of active and engaged learners (ibid., p22). This focus on active and engaged learners is in line with current international trends in mathematics education.

Suitability of the general teaching and learning approach advocated for Mathematics

The Mathematics team felt that in the case of the NATED 550 curriculum, the list of possible teaching approaches (see Mathematics Document 1, Page 2 and Mathematics Document 2, Page 2) is broad and fairly generic, and can thus can be used and adapted to achieve almost any set of aims, content topics, and groups of learners.

This situation is similar for the NCS curriculum, in that much of what is in the *Learning Programme Guidelines* (Mathematics Document 8) is also fairly generic and could also be applied to many different sets of aims, content topics, and groups of learners. For example, the description of how to develop a learning programme involves steps like "… identify the content to be taught …" and "… identify possible LTSM resources…" (ibid., Page 19). There is, however, an attempt throughout the document to make links back to the curriculum aims. For example, in the discussion on assessment activities, the document states "… Tasks and activities should be placed within a broad context, ranging from personal, home, school, business, community, local and global …" (ibid., Page 17). It is worth noting that both the NATED 550 and NCS curricula advocate active learners. This approach can open up the creation of Mathematics for learners and can aid the development of understanding of Mathematical concepts.

Suitability of the teaching/ learning approaches described, for school classes in different social contexts

The Umalusi Mathematics evaluators claimed that there is nothing inherent in the teaching approaches described that makes them suitable or unsuitable for different contexts of learning and teaching. However, actively engaging learners in mathematical activities, as advocated by both the NCS and NATED 550 curricula, does require teachers with thorough content knowledge at the correct levels, and skills in terms of pedagogic practice. These requirements are unlikely to be the case in many South African classrooms.

5.4 (5.2) Subject-specific methodologies in the Mathematics curricula

The importance of Mathematical processes (such as investigating, conjecturing, etcetera) is emphasised in the NATED Higher and Standard Grade curricula (see Mathematics Documents 1 and 2, Page 2 respectively). Both of these curriculum documents state that problem solving should be the central focus of teaching and learning Mathematics, as follows: "… Due attention should be accorded, not only to the provision of Mathematical knowledge, skills, and concepts in the planned curriculum, but also to the Mathematical processes by means of which pupils are actively and productively involved in learning …" and "… Problem solving should be the central focus of teaching and learning Mathematics. Not only is the ability to solve problems a major reason for studying Mathematics, but problem solving provides a context for learning and doing Mathematics" (ibid.).

In the NCS curriculum, the teaching-learning focus is similar, if not exactly the same: strong emphasis is placed on Mathematical modelling and making connections between Mathematics and contextual situations (see Mathematics Document 8, Pages 11-12). It is perhaps important to note that while in both the NATED 550 and NCS curricula there is discussion of similar subject-specific methodologies, in the NATED 550 documents they are discussed in the preambles only (see Mathematics Documents 1 and 2). In the NCS curriculum, methodologies are discussed in detail in the *Learning Programme Guidelines* (Mathematics Document 8).

Here clear guidance is given about the mathematical modelling process (see Mathematics Document 8, Page 12). In addition, this guidance is also infused throughout the various NCS documents and in particular in the assessment standards (see, for example, Assessment Standard 12.2.2, which requires that learners "… investigate and generate graphs …" and Assessment Standard 10.1.3, which requires that learners "… make conjectures and generalisations …" – see Mathematics Document 7, Pages 23 and 18 respectively). This infusion throughout the curriculum and within its 'heart' makes the approaches more visible and more accessible in the NCS than in the old NATED 550 curricula. This explicitness could potentially facilitate greater implementation of these approaches in classrooms than was previously the case.

Suitability of the subject-specific methodology advocated for mathematics

As already noted, in the NATED 550 curriculum there is an emphasis on problem solving, and Mathematical processes are clearly linked with the stated aims of developing in learners "… the ability to use a variety of Mathematical processes …" and "… the ability to apply their knowledge … to solve relevant problems …" (see Mathematics Documents 1 and 2, Page 3 respectively). A problem-solving approach and a focus on mathematical processes can be applied to the teaching and learning of almost any Mathematical content. However as mentioned, after the preambles in which these approaches are advocated, the NATED 550 curricula go on to simply list the content to be covered (see Mathematics Document 1, Pages 9-25 and Document 2, Pages 9-27). No guidance whatsoever is given as to how this teaching approach could be enacted using the prescribed content. It should be noted that a focus on problem solving and mathematical processes can be a very effective method of learning Mathematics, but it does require skilled teachers who receive support and guidance to do this effectively.

In the NCS curriculum, the emphasis on modelling is linked to the aim of using Mathematics in the world outside the classroom. Further, the emphasis on Mathematical processes is tied to the

aim of developing understanding of the discipline of Mathematics. As discussed in Section 5.4 (4.2), above, the *Learning Programme Guidelines* (Mathematics Document 8) do provide some guidance on how this linking might be done. In addition, guidance on how to make the focus on modelling and processes work with the content can be gleaned from the discussion of the learning outcomes, and from within the assessment standards themselves. For example, in the discussion of Learning Outcome 1 (Number and number relations), it is stated that learners will "… explore real-life and purely Mathematical number patterns and problems which develop the ability to generalise, justify and prove ..." (see Mathematics Document 7, Page 12). To cite another instance, Assessment Standard 10.3.6 states that learners must "… Solve problems in two dimensions by using the trigonometric functions (sin, cos and tan) in right-angled triangles and by constructing and interpreting geometric and trigonometric models (examples to include scale drawings, maps and building plans) …" (ibid., Page 36). To emphasise again, the issue of suitably skilled teachers is important for these learning approaches.

The skilling of teachers in this approach cannot be achieved through curriculum documents alone, although clear curriculum documents do help. Again, the Umalusi Mathematics team feels that the acquisition of suitable teaching knowledge and skills is more appropriately achieved through teacher workshops and ongoing support.

5.4 (6) Guidance for assessment of Mathematics content and skills in the curricula

The Mathematics team considered the nature and clarity of assessment guidance in the respective curricula. These aspects of the evaluation are reported in this section.

Table 5.4.7 (immediately below), shows the nature and weighting of assessment tasks in the NATED 550 Higher and Standard Grade curricula (see Mathematics Document 12).

Table 5.4.7: Assessment tasks in the NATED 550 curriculum for Grade 12

Assessment item	Weighting (out of 400 marks)
Internal assessment	**100**
1 June exam	10
1 trial exam	10
3 controlled tests	20
3 class work items	10
3 homework items	10
6 short tests	10
1 project	15
1 tutorial	15
External assessment	300
Paper 1	150
Paper 2	150

With respect to internal assessment in the NATED 550 curriculum, the *National Guideline* document for the implementation of continuous assessment in Mathematics provides information on the number, type and weighting of internal assessment items (see Mathematics Document 12, Page 4). Descriptions of the various types of assessment tasks are given (ibid., Page 8) along with exemplar ways of marking them (ibid., see Appendices F and G). That internal assessment makes up 25% of learners' final marks and external assessment 75% was not stated in the text of this document (this information was provided by the subject advisor on the Umalusi Mathematics evaluation team).

Regarding external assessment in this curriculum, the *Examination Guideline* document provides information on the weighting of content areas for external assessment as well as the maximum marks available for "bookwork" (see Mathematics Document 5, Pages ii and iv). This document also

provides a taxonomy of levels of cognitive demand and suggests the weighting of questions in the examination papers according to these levels of cognitive demand (ibid., Pages ii, v, and vi). These suggestions are provided together with further general information about the nature of the paper, such as "… sketches provided are not necessarily drawn to scale …" (ibid.).

There are altogether fewer assessment tasks in the NCS curriculum. Table 5.4.7 (immediately below), shows the nature and weighting of these tasks – Tables 5.4.6 and 5.4.7 can be compared to highlight differences between the NATED 550 and NCS curricula (see Mathematics Document 6, Pages 2 and 11).

Table 5.4.8: Assessment tasks in the NCS curriculum for Grade 12

Assessment item	Weighting out of 400 marks
Internal assessment	**100**
Test 1	10
Investigation or project	20
Assignment 1	10
Assignment 2	10
Examination 1	15
Test 2	10
Examination 2	25
External assessment	**300**
Paper 1	150
Paper 2	150

In the new curriculum, assessment guidance is provided for both internal and external assessment in the *Subject Assessment Guidelines* (Mathematics Document 6). Unlike in the NATED 550 documents, and although these guidelines state clearly that internal assessment will be 25% of the total mark, and external assessment 75% (ibid., Page 2), guidance for internal assessment is scant.

The internal *Progamme of Assessment* for Grade 12 provides information on the types and weighting of tasks to be included (see Mathematics Document 6, Page 11). However, the types of tasks required are simply listed by name (as, for example, "assignment", "project", etcetera). None of the NCS curriculum documents provides clear guidelines as to what exactly is meant by an "investigation", a "project" or an "assignment" (ibid.). This lack of clarity is of concern because, as one of the Mathematics evaluators points out, "… As an Umalusi CASS moderator, I have found widely differing standards for such tasks within the same school, within the same cluster or school district, and within the same province …"

Various tools to accompany the differing forms of assessment are suggested; for example, it is suggested that a marking memorandum accompany a test and a generic rubric be used for assessment of a project (see Mathematics Document 6, Page 9). However, none of these suggested tools are fleshed out in any detail. There is some discussion of different methods of recording and reporting data collected during assessment (see Mathematics Document 7, Pages 67-68) – however, again, no detailed guidance is provided.

Guidance for external assessment is as clear in the NCS as in the NATED 550 documents. The *Subject Assessment Guidelines* (Mathematics Document 6) detail the necessary information on the external examinations. Time allocations as well as the allocation of learning outcomes to each of the two papers are given (ibid., Page14). In addition, a suggested distribution of marks is given for topic areas in the examinations, with the maximum numbers of marks that will be allocated to bookwork (ibid., Page 12). In addition, a weighting of questions according to specific taxonomical differentiation of cognitive complexity is provided (ibid.). The taxonomy is based on the 1999 TIMSS Mathematics survey; its four levels are fleshed out in the document (ibid., Page 13). Examples of the types of questions that can be set at each level are also provided (ibid., Pages 32-33).

5.4 (7) Availability, user-friendliness and use of Mathematics curriculum documents

The NCS documents are readily available to anyone with Internet access, and the Umalusi Mathematics team believes that they have been distributed to all Mathematics teachers at schools.

The release of the *Subject Assessment Guidelines* (Mathematics Document 6) which demarcated "core" and "optional" sections for the NCS curriculum and thus, in a sense, replaced the designation of learning outcomes and assessment standards in the original *National Curriculum Statement* (Mathematics Document 7) did cause some confusion initially, although it appears that this separation is no longer a problem.

The fact that the NCS documents are clearly dated is useful when trying to establish the latest versions of the documents. The tables of content in the NCS documents aid navigation and the location of particular information within the documents.

It is less clear what documents exactly comprise the NATED 550 curricula. This situation could perhaps be attributed to the fact that this curriculum has been around for longer than that of the NCS, and underwent many revisions in the lead up to the new curriculum.

5.4 (8) Concluding comments for Mathematics

The Umalusi Mathematics team made two concluding comments, each of which is dealt with in a separate subsection here.

5.4 (8.1) Types and levels of content and skills

An attempt was made to ascertain whether not the NATED 550 and NCS curricula require similar types and levels of knowledge and skills of learners. The Mathematics team felt that since a major determinant of passing or failing is the final examination, it was important to look at the two final externally moderated exams. Using Mathematics Document 5 (see Page 2) for the NATED 550 curricula, and Mathematics Document 6 (Page 12) for that of the NCS, the team put together Tables 5.4.9 and 5.4.10 to show the respective cognitive-level requirements for examinations in the three curricula.

Table 5.4.9: Cognitive demand in the NATED 550 curriculum's final examinations

Cognitive ability	Approximate mark allocation	
	HG	SG
Knowledge and skills	40%	50%
Understanding	40%	40%
Application and creative thought	20%	10%

Table 5.4.10: Cognitive demand in the *National Senior Certificate* final examinations

Taxonomical categories	Mark allocation
Knowledge	25%
Performing routine procedures	30%
Performing complex procedures	30%
Problem solving	15%

These categories of cognitive demand are not directly comparable. However, if one looks at the examples provided of complex procedures for the NCS curriculum (see Mathematics Document 8, Page 33), it is clear that some of the procedures would fall into the *application and creative thought* category of the NATED 550 curriculum. *Problem solving* clearly falls within the category of *application and creative thought*. The Mathematics team pointed out that it could be argued

that the *National Senior Certificate* papers (NSC papers associated with the NCS curriculum) are comparable to the NATED 550 Higher Grade papers in terms of the highest cognitive level categories. The NSC examination papers are more heavily weighted in terms of items in the most complex cognitive category than are the NATED 550 Standard Grade papers.

However, percentages of items in the *knowledge* and *routine procedures* categories of the NSC papers were found by the team to be more comparable with percentages of items in the *knowledge and skills* category of the NATED 550 Standard Grade papers. The NSC papers are, therefore, likely to have similar weighting of items in these lower-level categories to the NATED 550 Standard Grade papers.

The team's evaluation of cognitive levels in assessment therefore suggests that the National Curriculum with its NSC examinations will lie somewhere between the cognitive levels of the old NATED 550 Higher and Standard Grade examinations. The cognitive levels required suggest that the NSC potentially provides for sufficient routine questions to enable learners at the level of just passing the previous Standard Grade examinations to pass the NSC examinations. They also suggest that, potentially, sufficient higher order questions will be provided in the NSC examinations to ensure that only learners performing at high levels (learners achieving A-grades) in the previous Higher Grade curriculum will perform at the top achievement levels in the NSC examinations.

In addition, the comparison of the NATED 550 and NCS curricula discussed extensively in Section 5.4 (1), above, suggests that the content and skills intended for examination in NSC *Paper 1* appear to be *roughly equivalent* in terms of cognitive demand to those associated with the Higher Grade curriculum, on the one hand; and *more demanding* than those linked to the Standard Grade curriculum, on the other. However, the content and skills intended for examination in NSC *Paper 2* appear to *roughly equivalent* in terms of cognitive demand to those associated with the old Standard Grade curriculum and *less demanding* than those linked to the Higher Grade curriculum. This finding again suggests that the cognitive demand of the NCS sits somewhere between that of the NATED 550 Higher and Standard Grade curricula.

5.4 (8.2) Usefulness of the curriculum evaluation instrument for mathematics

The Umalusi Mathematics team critiqued the Umalusi curriculum evaluation instrument in terms of its usefulness for the analytical task, and in its own right.

It found that the questions asked in the tool are certainly relevant for an evaluation of the curriculum and its usefulness. It also elaborated some shortcomings, as follows:

a) The attempt to fit the quantification process (amounts of content and skills topics; assigning numerical values to judgments around clarity and complexity, etcetera) into a prescribed format is problematic: these judgments are more accurately captured by words than numbers.

b) The initial requirement for division of the Mathematics curriculum into skills and content did not work well: it yielded tables with information that did not prove useful elsewhere in the report. As a result, the team did not differentiate between content and skills in this report.

c) A number of the reporting categories and concepts requiring discussion were not sufficiently well-defined to prevent multiple interpretations between Mathematics team members. For example, the three team members each had different understandings of what comprises organising principles, and so initially gave completely different (but reasonable) suggestions as to what constitutes these principles for the NATED 550 and NCS curricula.

SUMMARY OF CURRICULUM EVALUATION: MATHEMATICS

The Mathematics documents for the old NATED 550 and the new NCS curricula were compared. The most important differences found were the following:

- The inclusion of *data handling* and *statistics*, and an increased emphasis on *Mathematical modelling* in the NCS suggests a move away from a pure Mathematics to a curriculum more broadly inclusive of the Mathematical Sciences in general.
- There is a decrease in emphasis of complex *algebraic manipulations* for their own sake in the NCS relative to the old Higher Grade curriculum: topics like *absolute value* and *logarithmic equations and inequalities*, which provided for quite complex problems in the old Higher Grade documents, are absent in the NCS. This decrease in emphasis of complex *algebraic manipulations* is, however, balanced by an increased focus on high-level skills such as *modelling, investigating, conjecturing* and *justifying*. Thus, in terms of the content and skills to be examined in the new *National Senior Certificate* Paper 1, the NCS appears to be roughly equivalent in terms of cognitive demand to the Higher Grade and more demanding than the Standard Grade curriculum.
- The high-demand *Euclidean geometry* of the old Higher Grade curriculum has been replaced by *transformation geometry* and *data handling and statistics* in the NCS. These *transformation geometry*, and *data handling and statistics* sections are not likely to be examined at high levels of cognitive demand. The content and skills to be examined in *National Senior Certificate* Paper 2 were found to be roughly equivalent in terms of cognitive demand, to those in the Standard Grade, and less demanding than those in the Higher Grade curriculum.
- Overall, when considering the skills and content required in the NCS for Mathematics on the whole (in other words, the total body of content and skills examined in Papers 1 and 2 combined), the cognitive demand of the NCS sits somewhere between that of the old Higher and Standard Grade curricula.

5.5 MATHEMATICAL LITERACY

In conducting the analyses which would enable the Umalusi Mathematical Literacy team to answer the research question as to the level of difficulty of the NCS Mathematical Literacy curriculum in relation to the NATED 550 Higher and Standard Grade *Mathematics* curricula, this team began - as did the other subject teams - by attempting to create lists of content and skills with which to identify overlapping and differing content and skill topics. The Mathematical Literacy team soon found that, not only were they not able to easily separate content and skills (as with the Umalusi Mathematics team members), but that there *were no overlapping* content and skill topics between the NCS Mathematical Literacy and NATED 550 Mathematics curricula.

The Umalusi Mathematical Literacy team members may have disagreed slightly as to whether one or two sub-elements of the NATED 550 Mathematics Higher and Standard Grade curricula were examinable or not in Grade 12, but all members of the team were in unanimous agreement that no content or skill *topics* identified as examinable in either of the NATED 550 Mathematics curricula, were identified as examinable in the NCS Mathematical Literacy curriculum. They also found the converse to be true: no content or skill areas identified as examinable in the NCS Mathematical Literacy curriculum are examinable in either of the NATED 550 Mathematics curricula.

The Umalusi Mathematical Literacy team thus analysed the NCS Mathematical Literacy curriculum mostly *in its own right*, attempting to report in the same format as that used by the other Umalusi subject teams. Where applicable, it drew comparisons with the Mathematics curricula for benchmarking purposes.

5.5 (1) Content and skills specification and coverage in Mathematical Literacy

The Mathematical Literacy team reported on Mathematical Literacy content and skills in terms of first, their cognitive types and levels; second, their weighting in the curriculum; and third, their focus. Where possible, comparisons were drawn with the old Mathematics curricula.

5.5 (1.1) Content and skills specification in Mathematical Literacy

Since any particular content and skill topic can be taught at varying difficulty levels, the team classified content and skills according to perceived type of cognitive demand and level of difficulty at which they are *examined*.

Content and skills topics were categorised as *basic* when they required basic conceptual understanding (requiring, for example, literal comprehension; little prior disciplinary knowledge and skill, etcetera). They were deemed as *applications in familiar contexts* when learners were required to apply, analyse, and synthesise using specified principles in *familiar* contexts. They were classified as *applications in new contexts* when learners were required to apply, analyse, and synthesise using specified principles in *new* contexts (see Table 5.5.1 below).

Table 5.5.1: Types of cognitive skills in the NATED 550 Mathematics and NCS Mathematical Literacy curricula

	Basic	Application-familiar	Application-new
NATED 550: Mathematics Higher and Standard Grade	20%	52%	28%
NCS 2008: Mathematical Literacy	29%	43%	28%

In summarising the classification of content and skills according to cognitive demand, it is interesting to note that while Mathematical Literacy may have a slightly higher percentage than Mathematics of what are seen as *basic skills* and slightly fewer of what are termed *application-familiar skills*, both subjects appear to have approximately 30% of their skills rated as *application-new*.

Each type of examinable content and skill topic was also categorised by the team as *easy*, *moderate*, or *difficult* according to the level at which it was expected to be examined (see Table 5.5.2, below). This approach was adopted, as both the NATED 550 and NCS curricula are silent with respect to the difficulty levels at which content and skill topics must be taught. Since the team agreed that all of the skills can be examined at each of the different levels (*easy, moderate*, and *difficult*), team members had to draw more on their experience and knowledge than on the guidance provided in any of the documentation

Table 5.5.2: Classification of content and skills according to level of difficulty for the NATED 550 Mathematics and Mathematical Literacy curricula

	Easy	Moderate	Difficult
NATED 550: Mathematics SG	43%	43%	14%
NATED 550: Mathematics HG	40%	37%	23%
NCS 2008: Mathematical Literacy	46%	35%	19%

From Table 5.5.2, it can be seen that Standard Grade Mathematics has a slightly lower percentage of skills examined at the *difficult* level than does Higher Grade Mathematics. Mathematical Literacy, while including more skills at the easy level than either Higher or Standard Grade Mathematics, also has more skills examined at the *difficult* level than does Standard Grade, although this amount is still smaller than that in the HG papers.

The Mathematical Literacy team noted that the classification of content and skills for Mathematical Literacy was much easier to carry out than it was for the NATED 550 Mathematics curricula, primarily because for Mathematical Literacy, the *Subject Assessment Guidelines* (Mathematical Literacy Document 6, Page 13) and *Examination Guidelines* (Mathematical Literacy Document 13, Pages 16-20) provide sufficient descriptors and details of skills in terms of cognitive *types*, in their delineation of learning outcomes.

5.5 (1.2) Content and skills weighting in Mathematical Literacy

When attempting to ascertain content and skills *weighting*, the Mathematical Literacy team relied on and extrapolated from three key sources, namely, the examination guidelines; suggested schemes of work provided in some provinces (KwaZulu-Natal and Western Cape), and personal experience.

For NATED 550 Mathematics, neither the curriculum nor the guideline documents provide any clear guidance on how much time should be allocated to the different content and skill items identified by the research team. Although the suggested schemes of work (Mathematical Literacy Documents 9, 10, and 11) provide a sense of the numbers of weeks to be allocated to certain topics, these provincial schemes are often based on the experiences of small groups of individuals (for example, those in a single school) and the perceived examination value of items (items allocated more marks and receiving more time in examinations, than others). The NATED 550 examination guideline documents provide clear outlines of how many marks are to be allocated to each section of each paper, and team members were able to use this outline to estimate the examination weighting of each item on the list. Thus, the description of content weighting in this report closely links classroom time and examination content, and it is suspected that this link similarly informs classroom practice.

For NCS Mathematical Literacy, the subject statement (Mathematical Literacy Document 7) does not provide explicit guidance on allocation of classroom time, but it does suggest that each of the four learning outcomes should be given the same amount of attention. The associated examination guidelines indicate only that the same number of marks will be allocated to each learning outcome (see Mathematical Literacy Document 13, Page 5). The team therefore allocated both classroom time and examination weighting for each of the content items on a proportional basis.

In summary, the team's expectation is that class time and examination weighting are in direct proportion to each other. The Mathematical Literacy evaluators see this relationship to be the case, because the final examinations are believed to determine classroom practice for Mathematics in the NATED 550 curriculum, and are anticipated to do so for NCS Mathematical Literacy.

5.5 (1.3) Content and skills focus in Mathematical Literacy

In analysing the content and skills focus in terms of the degree to which content and skills are *disciplinary* (relevant only for Mathematics or Mathematical Literacy respectively), *generic* (relevant for several school subjects) or *life-related* (relevant for life outside school), members of the Mathematical Literacy team did not have a common understanding of these terms. It is therefore not possible to aggregate these results into one table, although it could safely be said that overall, it appears that NATED 550 Mathematics was deemed to comprise more *disciplinary* content and skill than does Mathematical Literacy, and NCS Mathematical Literacy is considerably more *generic* and *life-related*.

5.5 (2) Organising principles and coherence in the Mathematical Literacy curriculum

The organising principle in the NATED 550 Mathematics Higher and Standard Grade curricula – in broad terms – is the division of Mathematical knowledge and skills into broad Mathematical topics: Algebra (including: *sequences and series*; and *differential calculus*); Geometry; and Trigonometry (see Mathematical Literacy Documents 1 and 2). The NATED 550 Mathematics documents suggest topics to be taught within these broad divisions, in school Grades 10, 11 and 12.

The NCS Mathematical Literacy curriculum has an explicitly stated organising principle, namely, the learning outcomes and assessment standards. These outcomes are, broadly, WWWWW (Learning Outcome 1); XXXXX (Learning Outcome 2); YYYYY (Learning Outcome 3); and ZZZZZ (Learning

Outcome 4). The organisation around learning outcomes and assessment standards is evident throughout the *Subject Statement* (Mathematical Literacy Document 7). In addition, the notions of high knowledge and skills, a as well as progression is well articulated across the assessment standards (see Mathematical Literacy Document 7, Pages 14-38). The *Subject Statement* (ibid., Pages 38-43) provides guidance on the content and contexts for attainment of the assessment standards.

5.5 (3) Sequence, progression and pacing in Mathematical Literacy

The Mathematical Literacy team commented on within-year progression; progression over the three final years of senior secondary school, and increases in cognitive complexity across these years (Grades 10, 11, and 12).

5.5 (3.1) Within-year progression in Mathematical Literacy

As noted by both the Mathematics and Mathematical Literacy teams, in the NATED 550 Mathematics Higher and Standard Grade curricula, the sections *algebra; geometry; analytical geometry*, and *trigonometry* develop increasingly advanced and complex knowledge and skills sequentially as each year progresses (See Mathematical Literacy Documents 1; 2; 3 and 4). The sequencing per school term is based on the desire to have a mix of *algebra, geometry; analytical geometry* and *trigonometry*, with the aim of ensuring that the necessary prerequisite knowledge and skills upon which new knowledge/ skills requiring the prior knowledge are built, is in place. For example, *reciprocal* and *quotient trigonometric functions* are taught before *square trigonometric identities*, which together are essential to *simplify trigonometric expressions* or to *prove trigonometric identities*.

All these topics precede the *general and specific solutions of elementary trigonometric equations* (see Mathematical Literacy Document 1, Page 9). This sequencing is typical of the process of developing increasingly advanced and complex knowledge and skills in Mathematics. Another example is the teaching of *basic analytical geometry* (distance between *points; midpoint; gradient; equation of a line; perpendicular and parallel lines; intercepts of a line on axes; equations of circles with centre at origin*, etcetera) before proceeding to *loci* (ibid., Page 9). Similarly, in *algebra, average gradient* and *limits* are covered before *differentiation in calculus* in Grade 12 (see Mathematical Literacy Document 2, Page 20), ensuring that prerequisite knowledge is in place and learning can proceed to address the more advanced knowledge and skills pertaining to *rates of change* and *solving maxima and minima problems*.

For the Mathematical Literacy curriculum, the NCS demonstrates progression within Grades 10, 11, and 12, through both the assessment standards and the content and contexts for each learning outcome and grade. The NCS curriculum facilitates progression by organising the sequencing of assessment standards so that learners first encounter familiar content (as applied in context) and then progress to higher-level skills that rely on a thorough understanding of the content. For example, as part of Learning Outcome 4 (LO4) for Grade 10 (see Mathematical literacy Document 7, Pages 30-34), the learners first consider *summaries of data*, then learn how to *organise and display raw data* and thereafter progress to *measures of central tendency* (which requires the ability to organise data sets). Finally, learners are required to apply all of these skills in a number of different contexts.

5.5 (3.2) Progression in Mathematical Literacy across years in the FET phase

As elaborated in the Mathematics Section 5.4 (3) above, progression from year to year is generally evident in all of the Mathematics Higher and Standard Grade documents (see Mathematical Literacy Documents: 1; 2; 3 and 4) in that the Mathematical content of the Mathematics curricula increases from year to year, and the additions and/or extensions from one year to the next build clearly on prior content/skills. For example, sequencing and progression are clearly demonstrated in *Euclidean geometry* (see Mathematical Literacy Document 1, Pages 12-13; 17-18, and 24) and in

trigonometry (ibid., Pages 11, 16, and 23), as well as in functions in algebra (ibid., Pages 11, 14-15, and 19). However, there are also topics where progression and sequencing are not followed. For example, sequences and series were only covered in Grade 12 and not in Grade 10 and 11 (ibid., Page 19). Also, *financial Mathematics* was only taught in Grade 12 and not in Grades 10 and 11 (ibid, Page 21).

Progression, which comprises a steady increase towards more advanced and complex knowledge and skills over the final three years of secondary school, is clearly evident in the NCS Mathematical Literacy curriculum. For example, Assessment Standard 10.4.5 (see Mathematical Literacy Document 6, Page 25) explicitly and clearly illustrates this notion of progression over three years (see Table 5.5.3, below).

Table 5.5.3: Progression in assessment standards over three years

Grade 10	Grade 11	Grade 12
10.4.5 Work with simple notions of likelihood/ probability in order to: • Express probability values in terms of fractions, ratios and percentages.	11.4.5 Work with simple notions of likelihood/ probability in order to: • Design simple contingency tables to estimate basic probabilities; • Draw tree diagrams.	12.4.5 Critically engage with the use of probability values in making predictions of outcomes in the context of games and real-life situations.

Further, the Mathematical Literacy curriculum statement provides guidance for this grade-to-grade progression, through an articulation of assessment standards (see, for example, those assessment standards shown in Table 5.5.4, below, taken from Mathematical Literacy Document 7, Pages 26-27). Each learning outcome is followed by an explicit statement of the particular level of performance expected for the outcome (this information is also given in Table 5.5.4, below). Assessment standards are formatted to show increasing levels of expected performance per grade (ibid.). Content and contexts for each grade also show progression from simple to complex.

Table 5.5.4: Example of curriculum guidance for progression in Mathematical Literacy

LO3: Shape and Measurement The learner is able to measure using appropriate instruments, to estimate and calculate physical quantities, and to interpret, describe and represent properties of and relationships between 2-dimensional and 3-dimensional objects in a variety of orientations and positions		
Grade 10	**Grade 11**	**Grade 12**
AS 10.3.3 – Draw and interpret scale drawings of plans to represent and identify views	AS 11.3.3 – Use and interpret scale drawings of plans to represent and identify views, estimate and calculate values according to scale.	AS 12.3.3 – Use and interpret scale drawings of plans to represent and identify views, estimate and calculate values according to scale, and build models.
For example: Draw and interpret top, front and side views or elevations on a plan.	*For example: Study a plan of the school building and identify locations or calculate available real area for extensions.*	*For example: build a scale model of a school building, based on the plan of the building.*

Progression in Mathematical Literacy includes not only an increase in *task complexity*, but also the need for increased confidence in the application of Mathematical skills to everyday contexts, and the increasing *complexity of the contexts* themselves. Although a nuanced reading reveals this progression, these aspects need to be developed even more prominently (explicitly) in the NCS Mathematical Literacy curriculum documents.

5.5 (3.3) Progressive increase in cognitive demand in Mathematical Literacy

The Mathematical Literacy team, like that for Mathematics, found that in the NATED 550 Mathematics Higher and Standard Grade curricula, the cognitive demand of content/ skills clearly increases from year to year (see Mathematical Literacy Documents: 1; 2; 3 and 4). They

cited, for example, the covering of *elementary functions* of the types y = mx +c; y = k/x; and y = ax2 + c in NATED 550 Mathematics for Grade 10; the more complex *functions* of the type y = ax2 + bx + c in Grade 11, and the *log and exponential functions* as well as the *cubic function* in Grade 12. They pointed out that each year the cognitive demand progresses from relatively more basic knowledge and skills to developing a greater degree of understanding in the content area concerned, with the ultimate goal of enhancing levels of application and creative thought.

The team noted that in the NCS Mathematical Literacy curriculum (see Mathematical Literacy Documents 6 and 7) this progression is less clear. The lack of obvious progression is partly due to the nature of the subject. To reiterate a point made in Section 5.5 (3.2) above, an increase in cognitive demand in Mathematical Literacy lies in both task and context complexity, both of which aspects could be described more clearly and thoroughly in the NCS documents.

Another possible reason for the less evident visibility of year-to-year progression in Mathematical Literacy could be that in the subject, the *Mathematics* used as tools for problem solving does not actually change much. In other words, the Mathematics itself does not become increasingly cognitively demanding – it is rather *what is done with* the Mathematics that becomes more demanding. However, the evaluators found that the *Examination Guidelines* for Mathematical Literacy (Mathematical Document 13, Pages 16-20), do provide a useful breakdown of the cognitive types and levels for the subject, in the form of a taxonomy addressing each Learning Outcome. This taxonomy could facilitate the choice of context and task complexity.

5.5 (4) Aims, purposes, visions and outcomes in Mathematical Literacy

The team reported on aims in the Mathematics and Mathematical Literacy curricula; guidance provided for achieving these aims, the suitability of the aims for the contexts of South African classrooms; and articulation between these subjects at FET (school Grade 10, 11, and 12) levels, and other parts of the education system.

5.5 (4.1) Stated aims, purposes, visions, and outcomes

Both of the NATED 550 Mathematics curricula (Mathematical Literacy Documents 1 and 2) provide bulleted lists of different characteristics or attributes to be developed in learners. Some examples of these attributes (from Mathematical Literacy Document 1, Page 2 and Document 2, Page 2) include:

- Understanding of number, measurement and spatial concepts and relationships;
- Ability to use a variety of mathematical processes, such as comparing, classifying, specialising; generalising; inferring, analysing, and validating;
- Ability to apply knowledge of mathematical concepts, methods and processes (through individual or cooperative effort) to solve relevant problems set in purely Mathematical situations, or by recognising real-world situations as being amenable to Mathematical representation, formulating appropriate Mathematical models, determining the Mathematical solutions and interpreting the results in real-world situations;
- Ability to think and reason logically, to express ideas in meaningful ways and to reflect critically on the quality and validity of written work;
- Ability to understand, interpret, read, speak and write Mathematical language;
- Appreciation of the place of Mathematics, and its widespread applications in other subjects and our world;
- Mathematical skills necessary for future employment and further study;
- Love for, and a positive attitude towards, Mathematics.

In addition, the Standard Grade Mathematics curriculum is clearly concerned with the development of *basic* Mathematical skills (see Mathematical Literacy Document 2), skills that are largely (if not completely) *disciplinary* in nature. The Higher Grade curriculum in contrast, focuses more on the *development* of basic mathematical skills *appropriate for further study* of Mathematics or Mathematics-related fields (see Mathematical Literacy Document 3). Mathematics taken at

Higher Grade level was an induction course into the discipline of Mathematics; the knowledge and skills comprising this curriculum are all *disciplinary* in nature.

NCS Mathematical Literacy, in contrast to both of the NATED 550 Mathematics courses, is intended to empower learners to *use* elementary mathematics to make sense of the numerical, spatial and data-based problems characterising the lives of self-managing individuals, contributing workers, and citizens (see Mathematical Literacy Document 7). These aims are further expressed in the learning outcomes and assessment standards for the subject.

5.5 (4.2) Guidance for achieving the stated Mathematical Literacy aims, purposes, visions, and outcomes

Generally, the documentation for all three curricula being evaluated clearly list their aims for the subjects, but in terms of providing guidance for *achieving* these aims, the NCS Mathematical Literacy is more helpful than both of the NATED 550 curricula.

As noted by the Mathematics team in Section 5.4 (4) above, guidance for achieving curricular aims in the NATED 550 Mathematics curricula is integrated in the elaboration of content to be covered. The Umalusi Mathematical Literacy team further illustrated this point by including the following excerpts from the NATED 550 Mathematics documents (See Mathematical Literacy Document 1, Page 2, and Document 2, Page 2):

- … the learner learning Mathematics be conceptualised as an active Mathematical thinker who tries to construct meaning in what he is doing on the basis of personal experience and who is developing his way of thinking as his experience broadens, always building on the knowledge which he has already constructed …
- … due attention should be accorded, not only to the provision of Mathematical knowledge, skills and concepts, but also to the Mathematical processes by means of which pupils are actively and productively involved in learning. These include comparing, classifying; describing, representing, pattern searching, inferring, analysing, validating and problem solving …
- … the calculator should be integrated into the curriculum as an important aid to be used in learning and doing Mathematics ...
- … problem solving should be the central focus on teaching and learning Mathematics. Not only is the ability to solve problems a major reason for studying Mathematics, but problem solving provides a context for learning and doing Mathematics …
- … successful Mathematics teaching should embrace a wide variety of styles and approaches, which should include opportunities for the direct teaching of – individuals groups, whole class; activity-based learning; discussion between teacher and pupils and between pupils themselves; application and problem solving; open-ended investigations; consolidation and practice …

In other words, guidance for achieving curricular aims for NATED 550 Mathematics is couched in general terms. The Umalusi evaluation team felt that, in contrast, for Mathematical Literacy, there is far more guidance for achieving the aims of the NCS (see, for example, Mathematical literacy, Document 7, Pages 2-4). Given that the aims for Mathematical Literacy are expressed in terms of the learning outcomes and assessment standards for the subject, guidance for acquiring skills elaborated in the assessment standards comprises some of the guidance for achieving curricular aims (see Table 5.5.4 in Section 5.5 (4) above). By way of example, the Mathematical Literacy team quoted from the *Subject Statement* (see Mathematical literacy Document 7, Page 3):

> … Teachers should choose meaningful contexts to embed the content gleaned from the assessment standards, in clusters across learning outcomes, where possible. This means assessment standards from different learning outcomes can and should be attained by exploring different problems in the same context whenever possible. For example, in the context of sport, measurement of distances, heights and times (LO3), calculations related to the cost of housing sports events (LO1), calculations to optimise food provision (LO2) and data related to attendance over time (LO4) can be integrated to attain various assessment standards ….

In addition to information supplied in the *Subject Statement* (Mathematical Literacy Document 7), the *Learning Programme Guidelines* (Mathematical Literacy Document 8) also provide detailed guidance of how the aims of the Mathematical Literacy curriculum can be achieved. The *Learning Programme Guidelines* (ibid.) detail issues related to designing *learning programmes*. For example, they tabulate the implications of the main issues at each of the three stages of the development of a *learning programme*, by creating a *subject framework* (Stage 1 of a *learning programme*); a *work schedule* (Stage 2); and a *lesson plan* (Stage 3). Guidance takes the form of detailing policies and principles; content; integration; conceptual progression; time allocation and weighting; LTSM to be used; assessment; inclusivity and diversity; and learning and teaching methodology (ibid., Pages16-19).

The *Learning Programme Guidelines* go so far as to provide *exemplars* of work schedules for Grades 10, 11, and 12. These exemplars are designed in tabular form and contain the following useful types of guidance: amount of time to be used to cover particular content areas in terms of weeks; specific learning outcomes and assessment standards to be covered at particular times; descriptions of contexts and forms of assessment; and actual types of resources to be used (see Mathematical Literacy Document 8, Pages 26-32)

5.5 (4.3) Guidance for use of the Mathematical Literacy curricula in different school contexts

The documents for the two NATED 550 Mathematics curricula make no reference to contexts within which the curricula are to be implemented. In a sense, the *disciplinary* approach within these documents decontextualises the content, but at the same time, there is no guidance as to how to facilitate *disciplinary* knowledge and skills within differing school contexts

The NCS Mathematical Literacy curriculum, in contrast, is inherently contextual in nature and the topics in this curriculum are related to contexts from real life situations in order to attain the required assessment standards. It is intended that the contexts suggested enable embedding of content in situations *meaningful to the particular learners* being taught, and so enhance learning and teaching. Some examples of the embedding of Mathematical Literacy content in contexts, follow.

Learning Outcome 1 (Number and Operations in Context) is applied to the following *life-related* contexts: budgets; bond repayments; profit margins; effects of interest rates; and comparison of different credit options (see Mathematical Literacy Document 6, Page 18). Learning Outcome 2 (Functional Relationships) is operationalised in relation to critiquing information about functional relationships in articles such as telephone costs before and after rate changes; interpreting and critiquing quotations for two similar packages given by cell phone providers or car hire companies; investigating the spread of HIV-AIDS and other epidemics; and population growth in different countries (ibid., Pages 19-20). Learning Outcomes 3 (Space, Shape and Measurement) and 4 (Data Handling) are given similarly *life-related* applications (ibid., Pages 22, and 23-24 respectively).

There is more guidance for the attainment of assessment standards elsewhere (see, for example, Mathematical Literacy Document 7, Pages 38-43). However, teachers are encouraged to select examples relevant to their own teaching and learning contexts wherever possible. The curriculum documents recommend drawing on any local contexts which would link Mathematical Literacy to the experiences of the learners in any particular social settings, in order to make teaching and learning more meaningful for them.

5.5 (4.4) Articulation between FET Mathematical Literacy and other parts of the education system

The *disciplinary* focus of Mathematics comprising the NATED 550 Mathematics curricula promotes access to fields such as natural sciences and engineering.

The NCS Mathematical Literacy curriculum refers, in its introductory remarks, to articulation with the education system in general and the *critical outcomes* cutting across all twelve years of formal schooling in South Africa in particular (see Mathematical Literacy Document 7).

Further, the learning outcomes of Mathematical Literacy are designed to enable learners passing through the Further Education and Training (FET) band to handle with confidence, the Mathematics that affects their lives. It is intended that they be appropriately educated for successful functioning in the modern world. It is intended, for example, that learners will be able to proceed with learnerships in career pathways requiring Mathematical Literacy at various National Qualifications Framework (NQF) levels. Finally, it is intended that learners proceeding to Higher Education Institutions (HEI) will have acquired a mathematical literacy that will enable them to deal effectively with mathematically related requirements in some disciplines, for example, those of the Social Sciences.

5.5 (5) Teaching approaches and subject methodologies for Mathematical Literacy

The Mathematical Literacy team commented only on the general teaching and learning approaches advocated in the NATED 550 Mathematics and NCS Mathematical Literacy curricula, noting that there are no additional subject-specific guidelines for these aspects of the curricula.

5.5 (5.1) General teaching and learning approaches for Mathematics and Mathematical Literacy

The NATED 550 Higher and Standard Grade Mathematics curricula (see Mathematical Literacy Documents 1 and 2, Page 2 respectively) provide generic points relating to teaching and learning approaches to be adopted in the teaching of Mathematics. In addition to these lists of points, the documents refer to an approach that emphasises the use of problems, and typically in the final years of secondary school, the use of Mathematical problems, both as a *purpose* for teaching Mathematics and as a *means* of doing so (ibid.). This reference is the full extent to which the documents elaborate on the approach; and since the reference is in the introductions to the curricula, it is possible that many curriculum users may not have seen it.

In a similar way, the NCS Mathematical Literacy curriculum (Mathematical Literacy Document 7, Pages 18-19) also provides a rather generic bullet list of styles, approaches and activities that could be used in the teaching of the subject. For both the NATED 550 and NCS curricula, these lists are so generic that they could almost apply to any subject.

The general teaching and learning approach advocated for all of the NCS subjects including Mathematical Literacy is that of an *Outcomes-Based* approach (see the introduction to the Mathematical Literacy subject statement, Document 7). Further to this approach, a more specific teaching approach to be adopted for the teaching and learning of Mathematical Literacy, in particular, is one that uses real-world and meaningful problems as vehicles for both the purpose of using the mathematical tools, and as important problems to be resolved in their own right (see Mathematical Literacy Documents 6 and 7).

The Umalusi Mathematical Literacy team noted that none of the documents for the subject give any significant guidance in terms of how these approaches are to be realised in the classroom. This observation can also be made in relation to textbooks for the subject. In the case of Mathematical Literacy, the early editions of the textbooks range from books that purely drill basic Mathematical skills to those that contextualise all learning in real-world problems.

5.5 (5.2) Alignment of teaching and learning approaches with Mathematical Literacy curriculum aims

The NATED 550-endorsed curriculum aims (see Mathematical Literacy Document 2, Page 3) embrace the ability to use a variety of Mathematical processes (such as problem solving; critical reflection; and logical reasoning); development of the ability to understand, interpret, read, speak and write Mathematical language and the ability to use a range of mathematical methods and technological aids sensibly and appropriately; and Mathematical skills necessary for future employment and further study. Further, particular teaching approaches are suggested. Although the approaches suggested are largely implicit, they are explicit in parts, and it could be said

that they are roughly in line with these aims. For example, one of the aims – problem solving – is stipulated for some topics, such as *functions*. The section entitled *Functions* explicitly states "… solve problems by means of a system of equations …" (see Mathematical Literacy Document 2, Page 10; Document 1, P 14). *Trigonometry* also makes provision for problem solving in practical contexts (see Document 1, Page 13; Document 2, Page 13). Other topics such as *calculus* (ibid., Page 20); *absolute value* (ibid., Page 22), and *sequences and series* (ibid., Page 19), make provision for problem solving.

In the NCS Mathematical Literacy curriculum, *Outcomes-Based-Education* is the explicitly stated aim, and it is intended that teaching and learning focus on attainment of the four learning outcomes through the assessment standards for each grade – there is clear alignment between the aims and approaches advocated. Through the attainment of assessment standards, Mathematical process skills such as investigating, organising, analysing, proving, problem solving, and modelling are developed. Through the use of these skills, knowledge and understanding of Mathematical knowledge and skill are built up progressively from grade to grade (see Mathematical Literacy Document 8, Page 11).

5.5 (5.3) Suitability of advocated teaching and learning approaches for the social contexts in which they are implemented for Mathematical Literacy

As noted by the Mathematics team, specific teaching-learning contexts are not stipulated or suggested in the NATED 550 documents, although the use of practical contexts is suggested (see Mathematical Literacy Documents 1 and 2, Pages 1 and 3 respectively).

The Umalusi Mathematical Literacy team noted that the *Outcomes-Based Education* approach in theory is suited to all classrooms, since it is a learner-centred and activity-based approach, which places learners at the centre of the teaching and learning process and emphasises human rights and inclusivity (see Mathematical Literacy Document 7, Page 4). In this approach, it is intended that appropriate methodologies get utilised in differing contexts to achieve the assessment standards of Mathematical Literacy. For example, for Learning Outcome 2 and Assessment Standard 12.2.3, the following directive is given: "… Critically interpret tables and graphs, inclusive of graphs with negative values on the axes; more than one graph on a system of axes …", with the context further clarified by giving specific examples such as "… interpret graphs of temperature against time of day during winter over a number of years, to investigate claims of global warming; compare graphs of indices such as the consumer price index and business confidence index to graphs of percentage change in those indices over a particular time interval …" (ibid, Page 23). Furthermore, teachers are encouraged to develop their own activities for achieving the learning outcomes and assessment standards (as described in Mathematical Literacy Document 8, Page 18).

The team noted, importantly, that while this approach works in theory, in reality it requires well trained and well resourced teachers, something not universally the case in the South African context.

5.5 (6) Assessment guidance in the Mathematics and Mathematical Literacy curricula

Of all the information in all the documentation associated with all three curricula – the detail provided with respect to assessment is almost certainly the most comprehensive! There are very clear guidelines (see details below) on the nature and weighting of both internal and external assessment provided throughout.

5.5 (6.1) Guidance for internal assessment

The Umalusi Mathematics team described guidance for internal assessment in the NATED 550 curricula as being relatively clear (see Section 5.4 (6), above). The Umalusi Mathematical Literacy team described internal assessment as outlined in the NCS *Subject Assessment Guidelines* for

Mathematical Literacy (see Mathematical Literacy Document 6), similarly. While there are some 19 internal assessment tasks for NATED 550 Mathematics, there are seven for Mathematical Literacy.

The latter are substantial, consisting of: two investigations (20%); two tests (30%); an assignment (10%); an examination (30%); and one project (10%) in Grade 11, and one project (10%); one investigation (10%); one test (15%); two assignment (20%); and two examinations (one counting 20%, and the other 25%) in Grade 12. While the items needed are clearly listed, the team felt that there is a need for more guidance in relation to the specific requirements comprising each of these tasks in the documentation.

With respect to the examination component of the internal assessment for both Mathematics Higher and Standard Grade and Mathematical Literacy, the team noted that the respective curricula (see Mathematical Literacy Documents 5 and 6) provide similarly reasonably detailed analyses of how the marks within the examinations should be distributed in terms of content and skill topics and levels of cognitive demand: in essence, it is assumed in both instances that the internal examinations will mirror their external counterparts in structure.
Internal assessment for both Mathematics Higher and Standard Grade and Mathematical Literacy constitutes 25% of learners' final marks.

5.5 (6.2) Guidance for external assessment

External assessment for both Mathematics Higher and Standard Grades and Mathematical Literacy comprises externally moderated examinations contributing 75% of the weighting of learners' final marks for the subjects (see Mathematical Literacy Documents 5; 6 and 8). For all three subjects, this external examination consists of two three-hour papers. Detailed examination guideline documents for both Mathematics Higher and Standard Grades and Mathematical Literacy (ibid.) describe, in detail, how the marks within the examinations should be distributed across the two papers in terms of content and skill topics and levels of cognitive demand. Since the content and skill topics for Mathematical Literacy differ from those for Mathematics, they are not discussed here; the exam requirements for Mathematical Literacy are described in detail in the book for Part 3 of this report.

The nature of the exam papers for Higher and Standard Grade Mathematics differ from those for Mathematical Literacy in a manner that highlights the difference between the subjects. The two papers for each of Higher and Standard Grade Mathematics examine different topics: Paper 1 examines *algebra* and *differential Calculus*, while Paper 2 examines *analytical geometry; trigonometry; and Euclidean geometry*.

In contrast, it is intended that Paper 1 for Mathematical Literacy assesses 'basic knowing' and 'routine application' type questions, whilst Paper 2 is an''applications' and 'reasoning and reflecting' paper (see Mathematical Literacy Document 6). Both of the Mathematical Literacy papers assess all of the learning outcomes and assessment standards for the subject. In addition, all of the questions in the Mathematical Literacy exam papers are to be focused by a context, and to integrate assessment standards from more than one learning outcome.

In other words, while the Mathematics exam papers are structured according to *disciplinary* topics reflecting the disciplinary structure and emphasis of the subject, those for Mathematical Literacy are structured according to skill levels, where the skills are explicitly integrated with each other and their contexts – emphasising the *applied* nature of Mathematical Literacy.

5.5 (7) Availability, user-friendliness and use of the Mathematical Literacy curriculum documents

The Umalusi Mathematics team noted difficulties concerning obtaining the correct NATED 550 curriculum documents for the subject; the Umalusi Mathematical Literacy evaluators echoed this view and went on to describe the documents as brief and cryptic in nature, where the examinations over the years provided all the guidance and interpretation that teachers have used. The team noted that the impact of the examinations is also evident in the way that textbooks have become significantly more homogeneous for the subject over time.

In contrast, for Mathematical Literacy, the NCS curriculum documents do provide some of the necessary detail: see for instance some elaboration of assessment requirements. The team emphasised that these documents, too, are insufficient in terms of some aspects, such as the guidance needed in relation to teaching and learning approaches.

The Umalusi research team was reasonably confident about the general availability of the various NCS curriculum documents. In terms of NCS Mathematical Literacy the Umalusi team members found a large number of internally consistent documents for this curriculum, referring to Mathematical Literacy Documents 6, 7 and 8 as well as the many provincial documents not referred to in this research but whose existence was well known to the research team.

5.5 (8) Concluding comments for Mathematical Literacy

Since, given the fundamental differences in the intended and examined content and skills in the NATED 550 Mathematics and NCS Mathematical Literacy curricula, the Mathematical Literacy team could not comment on the relationship between the two subjects, it commented briefly here, on the Umalusi curriculum evaluation tool.

There was general consensus among the members of the Mathematical Literacy team that the evaluation tool was appropriate for the task. If nothing else, the team felt that the tool helped to provide a more objective mechanism for comparing curricula in general, than would have been the case using individual analyses and a tool less specified in terms of its constituent tasks. However, it was necessary to customise the tool fairly heavily in order to evaluate the Mathematical Literacy curriculum, as it will be in future, if two very different subjects need evaluation.

SUMMARY OF CURRICULUM EVALUATION: MATHEMATICAL LITERACY

The following findings are reported from the comparative evaluation of the NATED Mathematics and NCS Mathematical Literacy curricula:

- The content and skills identified as examinable in the NATED 550 Mathematics (HG and SG) curricula were not found in the NCS Mathematical Literacy curriculum, and vice versa. The two subjects (NATED 550 Mathematics (HG and SG) and NCS Mathematical Literacy) have entirely differing curricula in which content and skill topics are different in terms of substance and purpose, despite sharing the phrasing of their four learning outcome headings respectively. It was thus not possible to rank the curricula in terms of their relative levels of cognitive complexity.

- It is expected that mastery of the learning outcomes of Mathematical Literacy will enable learners passing examinations at the Further Education and Training level to handle Mathematics that affects their everyday lives with confidence, provided that the suggested teaching and learning approaches are modelled extensively in relation to appropriate contexts, in curriculum documents as well as in exemplar and final exams.

5.6 PHYSICAL SCIENCE

5.6 (1) Content and skills specification and coverage in Physical Science

The NATED 550 Higher and Standard Grade (HG and SG) and *National Curriculum Statement* (NCS) curricula for Physical Science were analysed to compare the content and skills foci within them; the relative weighting of respective content areas and types of skills; and the degree to which these items are specified. Details of the findings of this part of the analysis are given below. Physical Science content and skills have been analysed separately.

5.6 (1.1) Content specification and pacing in the Physical Science curricula

The broad content topics covered during the FET phase (Grades 10 to 12) are listed in Table 5.6.1, below. Where the topic is specified in the relevant curriculum, a Y (signifying yes') is placed in the 'specified' column. Where topics are examinable in final Grade 12 examinations, an E (for 'examinable') features in the 'examinable' column. This listing of topics was created by grouping smaller sub-topics. A few points should be noted about these content topics:

Regarding the *specified curriculum*

a) In many of the cases where topics are common to both the NATED 550 and NCS curricula, the NCS contains additional advanced sub-topics that are not included in Table 5.6.1 for the sake of brevity.

b) In some instances the NATED 550 HG curriculum contains some sub-topics at more advanced levels than those in the NATED SG curriculum. Again, these details are not shown here as Table 5.6.1 shows only the list of broad content topics; no distinction is made between HG and SG levels within it.

c) Table 5.6.1 shows that the NCS covers 42 topics as opposed to the 29 topics covered in the NATED 550 curricula. In other words, the NCS curriculum contains roughly 30% more content topics than does the NATED 550 curriculum.

d) Some 26 of the NCS topics overlap with those in the NATED 550 curriculum, the NATED topics thus making up roughly 62% of the total NCS topics.

e) Only five of the topics covered in the NATED 550 syllabus are not covered in the NCS curriculum: the NCS curriculum contains many new topics *in addition* to covering most of the topics in the old curriculum. This number of topics has serious implications for pacing in the delivery of the new curriculum: in order to cover all the material stipulated, a certain quick pace needs to be maintained and is likely to result in a relatively superficial rushing through items just in order to cover them.

Regarding the *examined curriculum*

a) Many topics that have been included in the specified NCS curriculum are not examinable. From the listing of content areas in Table 5.6.1, only 16 of 42 (38%) of the specified topics are examinable. This percentage is surprisingly low given that it is the intention that topics covered in the FET phase stand as a whole, with topics in the more senior years of the phase building on those covered in previous years within the phase. This curriculum structuring is discussed in more detail in Section 7.2.2 of this report.

b) In the NATED 550 curriculum, 14 out of 29 topics (48%) are examinable. In this case, the low percentage is to be expected, as many of the topics, particularly those covered in Grade 10, are considered to be stand-alone areas which are 'written off' at the end of the year concerned.

Table 5.6.1: Broadly-defined content topics covered in NATED 550 and NCS curricula at FET level

Content topic	NATED 550		NATED 550		NCS	
	SG		HG		2008	
	Specified	Examinable	Specified	Examinable	Specified	Examinable
Vectors	Y	E	Y	E		
Motion in 1-D	Y	E	Y	E	Y	E
Motion in 2-D					Y	
Gravity and mechanical energy	Y	E	Y	E	Y	E

Content topic	NATED 550		NATED 550		NCS	
	SG		HG		2008	
	Specified	Examinable	Specified	Examinable	Specified	Examinable
Force, momentum and impulse	Y	E	Y	E	Y	E
Work, power and energy	Y	E	Y	E	Y	E
Transverse pulses on a string or spring	Y		Y		Y	
Transverse waves	Y		Y		Y	
Longitudinal waves	Y		Y		Y	
Sound	Y		Y		Y	
Geometrical optics	Y		Y		Y	
Doppler effect					Y	E
Colour					Y	E
2D and 3D wavefronts					Y	E
Wave nature of matter					Y	
Electrostatics	Y	E	Y	E	Y	E
Electric circuits	Y	E	Y	E	Y	E
Magnetism					Y	
Electromagnetism	Y	E	Y	E	Y	E
Particles substances are made of	Y		Y		Y	
The atom – basic building block of all matter	Y		Y		Y	
Electronic properties of matter					Y	
Atomic combinations molecular structure	Y		Y		Y	
Atomic nuclei					Y	
Ideal gases and thermal properties	Y	E	Y	E	Y	
Optical phenomena and properties of materials					Y	E
Organic molecules	Y	E	Y	E	Y	E
Mechanical properties					Y	
Organic macromolecules					Y	
Physical and chemical change					Y	
Representing chemical change	Y		Y		Y	
Quantitative aspects of chemical change	Y		Y		Y	
Rate and extent of reaction	Y	E	Y	E	Y	E
Electrochemical reactions	Y	E	Y	E	Y	E
Acids, Bases and Salts	Y	E	Y	E	Y	
Inorganic Chemistry	Y	E	Y	E		
Global cycles					Y	
The hydrosphere					Y	
Exploiting the lithosphere/ earth's crust					Y	
The atmosphere					Y	
Heat	Y		Y			
Reactions of metals	Y		Y			
Reactions of non-metals	Y		Y			

5.6 (1.2) Content weighting in Physical Science

The NATED 550 syllabus documentation for Physical Science gives no indication of the amount of class time that should be spent on each topic. The NCS documents, in contrast, give clear guidance with respect to time, but there are discrepancies between that suggested for each general topic (as outlined in Physical Science Document 1) and the percentage of examination marks allocated to each of these topics (as indicated in Physical Science Document 6).

In the NCS documentation, class and exam time is subdivided between six broad content topics, namely *mechanics; waves, sound, and light; electricity and magnetism; matter and materials; chemical change*; and *chemical systems*. Time allocations needed for each broad area were obtained by estimating the ideal number of 45-minute periods needed for the teaching and learning of each topic. Amounts of time needed for each topic were used to work out how much time will be spent at different levels of cognitive difficulty. Table 5.6.2, below, summarises the findings (it should be noted that rounding the figures may cause percentages not to add up to 100% exactly, but in the interests of readability of the data, no decimal places have been included).

Table 5.6.2: Estimated class time needed to teach and learn Physical Science content in the FET curricula

	Estimated class time (number of 45 minute periods)		% class time (Full curricula)			% class time (Examined curricula)		
Curriculum name	Full curriculum	Examinable curriculum	Difficult	Medium	Easy	Difficult	Medium	Easy
NATED 550 SG	241	119	34	57	9	37	53	10
NATED 550 HG	254	144	37	55	9	47	44	9
NCS	368	162	38	49	13	43	48	9

It is notable that in all three curricula the percentages of class and exam time do not match. It is likely that this discrepancy will confuse users of the documents: clearer guidance is needed for the structuring of the annual Physical Science learning programme. These results are discussed further in the *Concluding comments* section of this Physical Science report.

5.6 (1.3) Content foci in Physical Science

The focus of content stipulated in each of the NATED 550 syllabi and the NCS curriculum was ascertained by the evaluation team. In the case of Physical Science, the content focus is described as *discipline-specific* when the content is specifically applicable to the further study of Physical Science. It is described as *generic* when it is relevant for school subjects other than Physical Science as well as for Physical Science itself. In addition, content is described as *everyday* when it is directly relevant in everyday life. It is described as *everyday* in *addition* to being either *discipline-specific* or *generic*, when it is directly relevant for life outside school. In Physical Science, this *everyday* connection is expected to be high as it is a subject with wide application to everyday life.

The percentages of *discipline-specific* and *generic* content should add up to 100% in Table 5.6.3 below, as the topic in question cannot belong to both of these categories. However, content can be either *discipline-specific* or *generic* and *everyday* at the same time, so the knowledge relevant to everyday life is shown in a separate column in this table. Estimated class time to be spent on content in these different focus areas is shown in Table 5.6.3 (below).

Table 5.6.3: Estimated percentages of class time spent on different content foci in the FET curriculum

Curriculum name	Content focus		Everyday knowledge content
	Discipline specific	Generic	
NATED SG	83.3	16.2	63.1
NATED HG	85.4	14.6	59.8
NCS	75.0	25.0	55.2

A few points can be noted from this table:

a) It can be concluded that the NCS content is somewhat less *discipline-specific* than that in the NATED 550 curricula. This focus is to be expected, as there is an emphasis in the new curriculum on identifying the links between related content areas across disciplines and to the broader South African context, particularly in the content area named *chemical systems*, which links very strongly with South African mining and industry in general.

b) The NCS content has a somewhat lower percentage of *everyday* content than the NATED 550 curricula, because more high-level theoretical content has been included in the NCS than in the NATED 550 curricula. Examples of this theoretical content include the *photoelectric effect* (Document 1, Page 44); *nucleosynthesis* (Document 1, Page 45), and *semiconductors* (ibid.).

c) A consequence of this focus in the NCS content is that it can be considered to be more difficult than the NATED 550 content, since these more theoretical topics do not have any familiar context from learners' everyday life experiences, and their application in everyday life can not be seen or appreciated.

5.6 (1.4) Skills specification and pacing in Physical Science

An attempt was made to compare the skills specified in the various curriculum documents. Three comments can be made about this:

a) In selecting the skills specified in the curricula, it was decided to include *only* those skills explicitly stated in the documentation. In Physical Science, many of the content topics have implied skills associated with them, but since these were not specified in the documentation, they have not been included, as there would be no way of ascertaining the class time and examination weighting required for them. Further, it cannot be assumed that all teachers have an understanding of the inherent skills associated with particular content topics, unless these skills are spelled out in the documentation.

b) It is worth noting that skills are underspecified in the NATED 550 documentation. Documents 2 and 3, for example, have no skills listed at all. It was up to individual provinces to spell out the skills required. In the current research, a list of skills was compiled from the Western Cape Education Department's Instructural (sic) Programmes (Physical Science Documents 8 and 9).

c) In capturing the skills for the NCS, the Umalusi Physical Science evaluation team used the associated assessment standards: specific assessment standards were separated into the particular operations required by each assessment standard.

5.6 (1.5) Skills weighting in Physical Science

No indication is given in the NATED 550 documentation regarding the amount of classroom time that should be allocated to the various skills. In contrast, the NCS documentation allocates a clear percentage of examination time to the various Learning Outcomes (see Physical Science Document 5, Page 15) covering a number of assessment standards. In Physical Science, these assessment standards have been designed to incorporate the skills required for the subject.

In this report, a list of assessment standards is used to identify the skills specified in the NCS curriculum. It is noted that Physical Science Document 1 (Page 15) states that the three learning outcomes are of equal importance and must have the same amount of teaching and assessment time. However, this allocation contradicts the examination allocation given in Document 5. Table 5.6.4 (below) shows a summary of the broad skills as specified in the respective curricula.

Table 5.6.4: List of skills specified in NATED and NCS curricula at FET level

Skills specified	NATED 550 SG		NATED 550 HG		NCS 2008	
	Specified	Examinable	Specified	Examinable	Specified	Examinable
Conducting an investigation					Y	E
Interpret data to draw conclusions					Y	E
Solving problems					Y	E
Communicating and presenting information and Scientific arguments					Y	E
Recalling, stating and discussing specified concepts					Y	E
Explaining relationships					Y	E
Applying Scientific knowledge	Y		Y		Y	E
Evaluating knowledge claims					Y	E
Evaluating the impact of Science on human development					Y	E
Evaluating the impact of Science on the environment and sustainable development					Y	E
Practical skills such as handling of apparatus, measuring, observing, information retrieval, etc.	Y		Y			
Apply Science to everyday life and industry						
Scientific explanation of phenomena	Y		Y			

A few points can be made from this weighting of skills, as follows:

a) A comparison of the three curricula shows that the NCS contains many more specified skills than the NATED 550 curricula.

b) Many skills that are understood to be part of any Physical Science course are unspecified in the NATED 550 curricula. One such example is *problem solving*. However, it cannot be assumed that all of the implied skills are understood by all teachers: a more detailed description or list of skills is required for a complete curriculum outline.

c) The NATED 550 documentation contains no indication of which of the skills are examinable. All skills in the NCS are examinable: the assessment standards comprise the skills pertaining to a particular course.

d) It is impossible to determine the difficulty of any of the NCS skills, as each one may be implemented at various difficulty levels determined by the teacher concerned.

5.6 (1.6) Skills foci in Physical Science

An attempt was made to estimate the focus of the skills specified in the curricula. Skills, like content areas, were identified as either *discipline-specific* or *generic*, as well as *everyday* when directly relevant for life outside school. The results are shown in Table 5.6.5 (below):

Table 5.6.5: Estimated percentages of class time spent on different types of skill in the FET curricula

Curriculum name	Content focus		Everyday knowledge content
	Discipline-specific	Generic	
NATED SG	0	100	100
NATED HG	0	100	100
NCS	0	100	57

A few points can be noted about these skills foci:

a) For all of the curricula considered, the skills are very generically described and could apply to any science subject. It is at the level of classroom practice that the extent to which these skills take on a *discipline-specific* nature is determined. Hence the totals in Table 5.6.5 indicate the generic nature of the skills as they are specified in the documentation, and do not actually describe what would take place in the context of a Physical Science classroom (which would vary from classroom to classroom).

b) It could therefore be argued that a more specific and subject-defined list of skills should accompany the curriculum documentation, since although well-qualified teachers may know what these skills should be, not every educator is able to know and implement these in their classrooms.

c) The high percentage of *everyday* skills in the NATED 550 curricula is purely due to the very general and unspecific way in which they have been described, and therefore does not have much meaning. This percentage is lower in the NCS because some of the skills are clearly only relevant in a science classroom context and would not be used in everyday life.

5.6 (2) Organising principles and coherence in the Physical Science curricula

For Physical Science, the Umalusi Physical Science team felt that a clear organising principle is important for the structuring of a curriculum as it enables learners to construct knowledge meaningfully. In addition, the team thought that the absence of an organising principle could contribute to the level of difficulty of a curriculum as knowledge could then potentially be encountered in discrete ways unconnected to overall understanding. In the Physical Science analysis, the NATED 550 and NCS curricula have been considered in this light, and the following observations were made the evaluators:

a) In the NATED 550 documentation, no explicit organising principle is evident or stated. The only observable coherence in these curricula is in the consistent division of content into Physics and Chemistry across the three grades (Grades 10, 11, and 12).

b) In contrast, the NCS curriculum has a very explicitly described organising principle, which is followed cohesively in the design of the curriculum. This principle is explicitly stated in Physical Science Document 1 (see the fifth line from the bottom of Page 10): "… Knowledge in the Physical Sciences is organised around six core knowledge areas …". These knowledge areas are given on Page 11 of the document, as (1) *Mechanics*; (2) *Waves, Sound and Light*; (3) *Electricity and Magnetism*; (4) *Matter and Materials*; (5) *Chemical Systems*, and (6) *Chemical Change*. This principle was deemed by the team to be coherent as content in each of the three grades is organised into the same six knowledge areas. Further, content within each knowledge area

is appropriately positioned for each of the three years of study. In other words, the content allocated to each area shows conceptual cohesion and contributes to the accessibility of the curriculum as a whole.

It can be concluded that, with regard to organising principles, the NATED 550 curricula are more difficult in terms of integrating new knowledge within the subject, than is the NCS curriculum, since it is more difficult for learners to construct their knowledge meaningfully within the former.

5.6 (3) Sequencing and progression in the Physical Science curricula

The three curricula were considered by the Physical Science team in light of sequencing, progression and pacing. Four points are noted here, upon which a conclusion is drawn.

a) There is some evidence of sequencing and progression *within years*, in each topic in the NATED 550 curriculum. For example, Grade 10 starts with *vibrations*, continues with *pulses, transverse waves, longitudinal waves* and then *light*, showing progression in terms of concepts building upon prior concepts (see Physical Science Document 9, Page 4). The general progression within each topic is from concrete to abstract concepts and representations; sequencing within each topic is with respect to continually increasing levels of conceptual demand. In the NCS, there is a certain amount of guidance given to progression within each year, in the Learning Programme Guidelines (Physical Science Document 4), where suggested work schedules are provided per grade. This information, however, contradicts the sequencing in another NCS document, the curriculum statement itself (Physical Science Document 1). This variance suggests that there is no clear intention with regard to the progression of topics in the NCS curriculum design.

b) In all three of the curricula, Physics topics tend to precede Chemistry ones, implying that Physics is conceptually easier than Chemistry. This is a false assumption, however, as some topics in Physics are more conceptually demanding than those covered in Chemistry.

c) There is some evidence of progression in content *across the three years* (Grades 10, 11, and 12) in the NATED 550 curriculum, where the simpler topics (such as *waves* and *atomic structure*) are dealt with in Grade 10, and the more demanding items (such as *graphs of motion* and *electrochemistry*) are covered at later stages (see Physical Science Documents 8 and 9). In the NCS, there is very clear evidence of progression in content over the three years, with each of the same knowledge themes being covered in greater complexity in subsequent years (see Physical Science Document 1, Pages 38-49). There is also clear evidence of progression in terms of skills, with the description of the assessment standards gaining in complexity over the three years (see Physical Science Document 1, Pages 18-33). One example can be seen where in Grade 10, learners are expected to *plan and conduct an investigation controlling one variable*; in Grade 11, learners *plan and conduct investigations controlling numerous variables*; and in Grade 12, they *design, plan and conduct scientific inquiries controlling numerous variables*.

d) All three curricula contain some description of what content should have been covered by the end of each year. These topics, together with the year in which they should be covered, are fully described in Appendix 7.2.1 (1.1.1)/A. There are a number of points to be made, from which it can be suggested that the guidance regarding progression given in the documentation is not sufficient:

- In both the NATED 550 SG and HG curricula, the depth of knowledge required is not always clear. One such example is the section on *reactions of metals with water* (see Physical Science Document 9, Page 13). No mention is made here of the solubility of products formed in water and the alkalinity of resulting solutions, although both of these observations would have been examined in the past years.
- The Department of Education (DoE) has published additional documentation for the NCS in which an attempt is made to spell out the depth and breadth of both content and

skills in the curriculum (see Physical Science Document 10). However, this document is not available from the DoE website, and not all teachers have access to it. Some content and skills are described in much greater depth and breadth in this document than in any other, creating confusion about what is examinable.

It is intended that the NCS assessment standards provide guidance on the depth of work to be covered in each grade (see Physical Science Document 1, Pages 18-33). However, this guidance is broad and open to interpretation, as the extremely wide variation in detail and cognitive depth of the Physical Science textbooks in South Africa shows. It is recommended that a single and much more explicit document be written with the purpose of minimising ambiguity and spelling out with clarity the depth of content to be assessed.

Regarding sequencing and progression in Physical Science, the point is made that the NCS curriculum shows much clearer evidence of sequencing and progression of content and skills *across* the three years of study in the FET phase than does the NATED 550 curriculum. This clarity allows current learners to build on foundations laid in earlier years, and to recognise the progression and increasing conceptual demands being placed upon them in subsequent years. It could be suggested that the lack of explicit sequencing and progression in the NATED 550 curricula makes them more difficult in that they are more fragmented and without clear indication of the levels of conceptual understanding required of learners. The sequencing and progression *within each year*, however, is sufficiently clear in neither the NCS nor the NATED 550 curricula.

5.6 (4) Aims; purpose; vision; general outcomes, and articulation in the Physical Science curricula

The three curricula were scrutinised with regard to the specified aims, purpose, vision and general outcomes within them. It was found that:

a) The national syllabus documents for the NATED 550 curriculum (Physical Science Documents 2 and 3) mention no aims. It was left up to individual provinces to spell out the aims and objectives of the Physical Science curricula. The list of aims from the Western Cape Education Department's Instructural (*sic*) Programmes (Physical Science Document 9) include the following: (1) providing learners with necessary subject knowledge and comprehension, as well as the necessary skills, techniques and methods of science; (2) the development of desirable scientific attitudes and responsibilities; and (3) the introduction of learners to the scientific explanation of phenomena, the use of scientific language, and the application of science to everyday life and industry. Interestingly, the imposed Christian National Education values are also expressed through these aims, in the phrase "reverence for the Creator" (Physical Science Documents 8 and 9, Page 1).

b) The NCS contains a list of principles rather than aims; values in line with the current South African constitution are embedded in these principles. They are listed as "… social transformation; *Outcomes-Based Education*; high knowledge and skills; integration and applied competence; progression; articulation and portability; human rights, inclusivity, environmental and social justice; valuing indigenous knowledge systems; and credibility, quality and efficiency …" (Physical Science Document 1, Page 1). In addition, the Learning Programme Guidelines contain a description of the purpose of Physical Science, which is to "… equip learners with investigating skills …", and to "… promote knowledge and skills in Scientific enquiry and problem solving; the construction and application of Scientific and technological knowledge; an understanding of the nature of Science and its relationships to technology, society and the environment. .." (see Physical Science Document 4, Page 7). The aims of each of the individual learning outcomes are also given (see Physical Science Document 1, Pages 18-33); scientific enquiry and problem solving skills, for example, are described as "… the tools that learners need in order to understand the working of the world …" (ibid. 10). The development of these skills and processes "… allows learners to solve problems, think critically, make decisions, find answers and satisfy their curiosity …" (ibid.: 13). The objectives in the NCS are clearly more closely tied to the world of science beyond the classroom than are those in the NATED 550 curriculum.

Regarding guidance provided in the curricula for achieving these aims, it was found that:

a) In the NATED 550 curriculum, some guidance is given towards achieving the stipulated aims (see Physical Science Documents 8 and 9, Pages 2-49, and Pages 2-55 in the HG and SG curricula respectively); namely, SI units and IUPAC nomenclature are designated as compulsory throughout the documents; compulsory core content to be studied is indicated; compulsory practical work to be completed is spelled out, together with further elaboration of core content; and some information is given for assessment per grade. This guidance helps only with the achievement of some of the syllabus aims; the necessary links to others are not very clearly made.

In terms of realising these aims in classrooms in differing social contexts, there is extremely thin evidence that varying contexts have been considered. There is only the briefest of mentions of contextual features in the phrasing "… to develop in learners the desirable scientific attitudes and responsibilities, such as interest in natural phenomena, relationship to society and its environment …" and "… the application of Science in everyday life and in industry …" (see Physical Science Document 8, Page 1).

b) In the NCS documentation, in contradistinction, both the curriculum principles and how these can be achieved are spelled out in detail (see Physical Science Document 1, Pages 2-4). Further, the Learning Programme Guidelines contain a description of how Physical Science links with the underlying principles of the NCS (see Physical Science Document 4, Pages 8-10). In addition, the focus of each learning outcome is given (see Physical Science Document 1, Pages 10 and 11). An example of one of the foci given to the learning outcome relating to *Science, society and the environment is* "… to understand the scientific enterprise and, in particular, how scientific knowledge develops …" (ibid.). Additional guidance is provided throughout Document 1: this guidance is too vast to reproduce here (see guidance interspersed throughout Physical Science Document 1).

Since the goal of social transformation is addressed throughout the NCS, this curriculum contains explicit references to the specific and varied social contexts of learners in South Africa (Physical Science Document 1, Pages 2 and 4). Examples of such references include the valuing of indigenous knowledge systems; the acknowledgement of human rights; and the emphasis on inclusivity and socio-economic justice throughout the curriculum. While detailed instances regarding *how* these principles can be implemented are not always spelled out, the principles themselves are emphasised.

In parts, more detailed guidelines are provided. For example, Learning Outcome 3, *the nature of science and its relationship to technology, society and the environment*, aims at developing relationships between society, the environment, Science, and technology. Teachers are given guidance as to the contexts they can use in their own classroom environments to develop this skill and knowledge (Physical Science Document 1, Page 50-53). In one instance – in the knowledge area of mechanics – some of the recommended contexts are "… transportation; planets and their movement; astronomy, cosmology; machines and mechanics; structures, including architecture; and weather systems …" (ibid, Page 50). Other named contexts take into account education and career links: "… Science teachers, nurses, medical doctors …" etcetera, are referred to (ibid, Page 12). Yet others such as "… applies understanding of electrolysis to the production of chlorine in swimming pool chlorinators …" (ibid, Page 27), address the application of science in everyday life and industry.

While this guidance is sufficiently detailed to be of assistance to teachers, it does not always span the full range of South African learning contexts. It is sometimes left to textbook writers and publishers to include examples suitable for classrooms at the lower end of the socio-economic range.

Regarding connections made between the FET curricula under investigation and other parts of the education system, it emerged that there is no explicit links are articulated between the NATED 550 curricula studied and those preceding or following it.

In contrast, in the NCS documentation, numerous references are made to articulation and portability, although these references are not backed up with guidance as to the mechanics of the connections. References include integration across subjects within the same learning field and across learning fields, for example, emphasising "… the relationships between qualifications … that promote access from one qualification to another …" (see Physical Science Document, 1 Page 3), and articulation between FET institutions, such as in "… learners who have studied Physical Science will have access to academic courses at institutions such as universities and technikons (sic) …" (ibid, Page 12). Linking comments also include reference to articulation with and portability between the General Education and Training (GET) phase of schooling: "… The nature of Science forms the basis from which learning outcomes have been developed. This allows for smooth progression for learners. The Physical Science curriculum will not only deepen the knowledge base laid in the General Education and Training band; it will also provide learners with a deeper general knowledge, specialised knowledge and skills ..." (ibid, Page 12). Reference is made to the relevance of FET Physical Science for professional careers in the applied sciences and engineering such as those of "… veterinarians, radiographers, dentists …", etcetera (ibid, Page 12), and to vocational career paths such as those of "… technicians, technologists and beauty therapists …" (ibid.).

All of these linking ideas, however, appear to be statements of intent rather than providing clear mechanisms to facilitate actual articulation. The experience of the Umalusi Physical Science team suggested that articulation between the GET and FET bands is not as smooth as the documentation may lead users to believe: the breadth and depth of content required at FET level is far greater than that covered at the end of the Senior Phase in the GET band, resulting in considerable discontinuity between what is required of learners in the two bands.

5.6 (5) Teaching approaches and subject methodologies for Physical Science

The Physical Science team reported separately on general and subject-specific teaching approaches advocated for Physical Science in the curricula.

5.6 (5.1) General pedagogic approaches in Physical Science

The Physical Science team considered *general* overarching and *subject-specific* teaching methodologies for the subject separately, as information could be distinguished in the various curriculum documents for both of these aspects of teaching and learning. Regarding the *general* teaching and learning approaches for Physical Science, the following claims were made, based on the evidence of the Umalusi Physical Science team's combined judgments:

a) There is no description of any general teaching and learning approaches in the NATED 550 documentation. The NCS, on the other hand, explicitly states that its approach is *outcomes-based*. Here, the emphasis is on learners' achievement of their maximum potential and development of skills and knowledge, not only relevant in the classroom, but also in everyday life. Education is an integrated part of individuals' holistic development (see Physical Science Document 1, Page 2 and the entire document with its learning outcomes, assessment standards and guidelines for achieving these outcomes in classroom settings. The guidance given is very clear, for example, in the statement "… The assessment standards are arranged from left to right (Grades 10 to 12), in increasing levels of complexity. Examples of how the assessment standards can be attained are also included, preceded by the phrase '*Attainment is evident when the learners, for example, …*' " (ibid, Page 17)

b) Clearly, since no general teaching and learning approaches are outlined in the NATED 550 documentation, there can be no further discussion of the alignment between general methods

and curriculum aims or suitability for particular contexts: the selection of general pedagogic approaches for the implementation depends on individual teachers.

In the NCS, however, there is close alignment between the teaching and learning approaches advocated, and curricular aims: *Outcomes-Based Education* principles explicitly underpin this curriculum (see Physical Science Document 1, Pages 1-2); teaching and learning is directly framed by learning outcomes designed within generic *critical* and *developmental* outcomes such as "identify and solve problems and make decisions using critical and creative thinking" and "work effectively with others as members of a team…" on the one hand, and "reflect on and explore a variety of strategies to learn more effectively" and "participate as responsible citizens …" on the other, for example. (ibid.).

c) The Umalusi Physical Science team found that the *Outcomes-Based Education* approach is suitable in its own right for the teaching of Physical Science. It is a learner-centred approach that places responsibility on learners for their own learning, an approach suitable for the investigative nature of Physical Science (see Point (d), below). It also emphasises the laudable qualities of promoting human rights and inclusivity (see Physical Science Document 1, Page 4) and at first glance, appears very suitable for South Africa. On the other hand, *Outcomes-Based Education* relies on cohorts of resourceful, well-trained teachers, who are not universally spread throughout the range of South African classroom contexts. In this sense, the *Outcomes-Based* approach is not suited in principle to the present South African social context in general. In addition, although the curriculum documents refer to the social contexts of learners, as well as to the necessity for inclusivity and embracing diversity in classrooms (ibid: Pages 2-4), very little guidance is given regarding the implementation of these ideals in differing classrooms.

d) The approach of *Outcomes-Based Education* is suited to the content and skills of Physical Science in general: being a learner-centred discovery-based approach, it presents a powerful way of learning for this experimental and hands-on subject. It is particularly suitable for acquiring skills, which are well developed through the assessment standards. However, some of the content included in the NCS is too theoretical and esoteric for this kind of approach (see, for example, the *nature of an electromagnetic wave as a particle; photoelectric effects* and the *de Broglie wavelength* (in Physical Science Document 1, Pages 41-45). In addition, far too much content has been included in the Physical Science curriculum to allow for the time needed for a discovery-based approach with its active approach to learning (see the findings in Section 5.6 (1) of this report). The extent of the content and skills included mean that it can only be covered by a more rapid and superficial rote-style learning, which is in contrast to the approach of *Outcomes-Based Education*.

e) The approach of *Outcomes-Based Education* is particularly suited to the interests and capacities of learners at this level, because learners at this age have naturally enquiring and questioning minds, and tend to challenge knowledge that is not validated and integrated. An approach in which learners are encouraged to *begin* with questions and hypotheses, followed by hands-on discovery would satisfy their need for authenticity and involvement in the generation and validation of knowledge. The approach is also suitable for South African learners at this level because they are diverse: in theory, methods can be context-sensitive and learner-paced. Third, the approach advocates team-work, and as such, is likely to appeal to a natural need for community amongst learners in this age group. Last, the focus on the inclusion of indigenous knowledge and approaches is likely to foster interest in the learning process.

5.6 (5.2) Subject-specific methodologies in Physical Science

Regarding *subject-specific* teaching and learning approaches in the Physical Science curricula:

a) There are brief and sketchy references to *subject-specific* teaching and learning approaches in the NATED 550 curricula. These directives refer to the importance of practical work in Physical Science: "… the practical work forms an integral part of the syllabus and plays an important

role in the understanding of Scientific principles and phenomena ..."); and to the use of simplifications: "… In teaching the syllabus it will be necessary to make use of simplifications …" and conceptual models, "… Where conceptual models are used to simplify the explanation of certain phenomena it must be made clear that these are models and, as such, are not intended to serve as fully acceptable Scientific theories …". These references feature in both the HG and SG curriculum documents (Physical Science Document 8, Page 2; Document 9, Page 2). The brevity of these guidelines leaves the many other aspects of teaching Physical Science up to the individual teacher.

b) *Subject-specific* guidelines in the NCS are a little more specified than in the NATED 550 documents, but are still reasonably vague. They are captured in the learning outcomes and assessment standards (see Physical Science Document 1, Pages 17-35). These approaches emphasise *practical Scientific enquiry and problem-solving skills* (Learning Outcome 1); *constructing and applying Scientific knowledge* (Learning Outcome 2), and *the nature of Science and its relationship to technology, society and the environment* (Learning Outcome 3). They are further elaborated in two ways; firstly, in the descriptions of each learning outcome, for example, "… the learner is able to use process skills, critical thinking, Scientific reasoning and strategies to investigate and solve problems in a variety of Scientific, technological, environmental and everyday contexts ..." (part of Learning Outcome 1, Physical Science Document 1, Page 18). They are also elaborated when the evidence for attainment of each assessment standard is described, such as "… Attainment is evident when the learner, for example, plans and conducts an experiment to determine the speed of sound waves in the medium …" (ibid.). These guidelines leave room for interpretation: it is up to individual teachers to decide how to implement these approaches in classrooms in South Africa's widely varying social contexts. Different approaches will clearly need to be adopted in small well-equipped classes and in sparsely-equipped classrooms with large numbers of learners.

c) The additional NCS Physical Science document introduced to provide guidance regarding content and how it should be taught, over and above that in the main (initial) documents for the subject, does further elaborate on teaching and learning approaches (see Physical Science Document 10), but some of this information is in conflict with a general *Outcomes-Based* approach, as it is very content-focused. As in the NATED 550 curriculum, there is an emphasis on practical work: "… Practicals are central to the teaching of concepts …" (ibid.: Page 3). There are also suggestions that a spiral approach to teaching be followed: "… In a spiral approach, concepts are first introduced in a simple way. Later in the year, or in later years, the concepts are revisited and studied in greater depth …" (ibid., Page 4). The document features a column in which specific teaching information is given for each individual topic, for example, "… Energy is another big idea. In the past, the syllabus referred to many kinds of energy. Fundamentally, there are only two kinds of energy – potential and kinetic …" (ibid.: Page 20). This column includes a discussion on possible misconceptions, such as "… It is very important to distinguish between voltage and current, as learners often confuse these two concepts ..." (ibid. Page 30). This document is not available on the DoE website, however, and it cannot be assumed that it is accessible for all teachers.

Regarding the alignment of *subject-specific* pedagogic approaches with general curricular aims:

a) In the NATED 550 curriculum the *subject-specific* approaches are not very clearly aligned with the curriculum aims (as they are described in Physical Science Documents 8 and 9).

b) As for the general pedagogic approach towards Physical Science teaching for the NCS, there is a strong alignment between these aspects on the *subject-specific* level in the main curriculum document. The principles of *Outcomes-Based Education* are followed through in the statements of subject-specific learning outcomes and assessment standards (see, for example, Physical Science Document 1, Pages 17-35, and Page 18 in particular: "… the learner is able to use process skills, critical thinking, Scientific reasoning and strategies to investigate and solve problems in a variety of Scientific, technological, environmental and everyday contexts ...").

It should be noted, however, that there is no explicit mention of how to align teaching and learning strategies to specific learning outcomes.

Regarding the suitability of the *subject-specific* approaches for the social contexts of schools in South Africa:

a) The *subject-specific* approaches of NATED 550 are not clearly suited to the context of most South African classrooms, as the practical sessions recommended (see Physical Science Document 8, Pages 4-55; Document 9, Pages 4-49) require very specific equipment and fairly sophisticated laboratories. An example of work to be covered in one such practical session: "… Electrolysis of a melt, e.g. PbBr2 or PbI2, and a concentrated solution of CuCl2, with carbon electrodes …" (Physical Science Document 8, Page 19): the equipment and chemicals to be used here are not available in most South African schools.

b) In the NCS a similar problem could be encountered with the investigations and practical enquiries recommended, although the *Learning Programme Guidelines* encourage the use of "… relevant equipment from the home ..." (see Physical Science Document 4, Pages 19-31). In addition, teachers are encouraged to develop their own activities for achieving the stipulated learning outcomes and assessment standards, for instance: "… Decide how to teach the LO and AS indicated in Step 1, and develop the activity or activities that will facilitate the development of the skills, knowledge, attitudes and values in the particular [learner] grouping …" (ibid., Page 18). Carrying out this process requires well-trained and well-resourced teachers, a feature not generally the case in the South African context. Importantly, ideally in a learner-centred environment, the pace of the learners concerned should influence the pace of teaching and learning in the classroom. The NCS requires a great deal of content to be covered, however – more than that required by the already pressured NATED 550 curricula – and it is therefore likely that the pace will be largely teacher-driven. All aspects considered, while there is provision in the NCS for learners in the differing South African contexts, the fact that teachers are not always equipped to do what is required, and for the heavy volume of work to be covered works against efforts to take context into account.

Regarding suitability of the *subject-specific* pedagogic approaches for Physical Science as a subject, and for the learners concerned:

a) Since there is very little elucidation of *subject-specific* methodology in the NATED 550 curriculum, there is no evidence that the approaches are congruent with the selected content. In the NCS, there is a general description of the link between selected content and subject-specific assessment standards (skills): "… The content indicated needs to be dealt with in such a way as to assist the learner to progress towards the achievement of the Learning Outcomes …" (see Physical Science Document 1, Page 34). However, the *Learning Programme Guidelines* (Physical Science Document 4, Page 18) states that in the design of their lesson plans, teachers should *select* the teaching and learning approaches to be followed. This directive provides insufficient guidance, particularly for the majority of South African teachers who are not well-enough resourced or trained to be able to carry out the directive. Again, in practice, the teaching and learning approach is likely to be determined by the amount of content to be covered for the year, and since the amount of content is very large, the approach is likely to be superficial and content-driven, favouring rote-learning.

b) In both the NATED 550 and the NCS curricula a practical approach is encouraged, which is beneficial for learners at this level, as they are then encouraged to engage actively in the construction of their own knowledge. This active participation lends authenticity and validity to the learning experience. In addition, the NCS encourages the evaluation of knowledge claims and of the impact of science on society and the environment (incorporated in Learning Outcome 3), which is suited to the questioning and challenging nature of the minds of learners at this level. Further, the open-ended nature of the tasks associated with Learning Outcome 3 is likely to motivate learners, as they are required to extend themselves and to interact with

various real-world contexts, such as workplace and home communities. However, as has been discussed in the above points, the under-resourced context of most South African classrooms, together with the extent of the content to be covered for the year, means that this hands-on discovery-based approach will not be practised in most classrooms.

5.6 (6) Assessment guidance in the Physical Science curricula

The Umalusi Physical Science team reported separately on guidance given in the curricula, for internal and external assessment.

5.6 (6.1) Guidance for internal assessment

The following comments can be made about the guidance given for internal assessment within the various curricula for Physical Science:

a) In the official NATED 550 documentation, there are very brief and sketchy guidelines for internal assessment. These directives comprise only a list of suggested tasks for an accumulated mark and include "… tests, examinations, workbooks, tasks, practicals, projects, practical examinations, etc …" (see Physical Science Document 9, Page 3; Physical Science Document 8, Page 3). No guidance is given regarding the nature or weighting of these tasks, or how to undertake them.

There is an additional *Continuous Assessment Guidelines* document for the NATED 550 curriculum (see Physical Science Document 11) with more guidance for internal assessment, but it is not clear how freely available this document is for all teachers. Further, the document lacks clarity in a number of areas. The percentages for summative and formative assessment are not fixed; the number of 'other' activities is not prescribed; there is no guidance for designing practical tasks from described skills; there are no taxonomies to assess CASS tasks; and none of the examples given cater for the top end of the categories in Bloom's taxonomy.

b) For the NCS, in contrast, there is a very clear document, the *Subject Assessment Guidelines* (see Physical Science Document 5) which spells out in detail how internal assessment should be conducted. There are, for instance, instructions for designing a programme of assessment for the year (ibid., Page 9), for conducting daily assessment (ibid., Page 8), and for recording assessment (ibid., Page 5).

The following internal assessment tasks are recommended in this document: two *practical investigations*; one *research project*; two *control tests*; one *midyear examination*; and one *trial examination*. Each of these tasks is clearly described (see Physical Science Document 5, Pages 10-11); for example, "… A research project involves the collection of data and/or information to solve a problem or to understand a particular set of circumstances and/or phenomena. While the problem that focuses the research task is well defined, the nature of the data collected will determine the solution to the problem ..." (ibid.)

This document does, however, lack clarity in various areas: there is no guidance for the design of assessment tasks; there are no examples of assessment tools (such as rubrics and checklists); and complex tasks such as research projects and practical investigations could be described more clearly, in more detail.

5.6 (6.2) Guidance for external assessment

With respect to guidelines for external assessment in the Physical Science curricula, the Umalusi Physical Science team found the following information:

a) In the NATED 550 curricula, a little more guidance is provided for external than for internal assessment. There are two external examinations, one in Physics, and one in Chemistry.

Descriptions of content to be examined in each of the two exam papers are included (see Physical Science Document 9, Page 3; Physical Science Document 8, Page 3). These guidelines are still brief and sketchy, however, giving only lists of broad topics to be covered, rather than any detail regarding the required depth.

b) For the NCS external, as for internal assessment, considerable detail is given in the *Subject Assessment Guidelines* (see Physical Science Document 5, Pages 15-16). An example of the level of detail is "… Multiple-choice questions could be set in examination papers. However, such questions should have a maximum weighting of 10%. The final end-of-year examination is nationally set, marked and moderated ..." (ibid., Page 15). Additional detail is given in the *Examination Guidelines* (see Document 6), for example, "… Questions will, as far as possible, be arranged in the same order as the knowledge areas described under 'Interpretation of the core syllabus'… " (ibid.). This document also spells out, in detail, the depth and breadth of content to be included in the examinations.

The NCS external assessment for Physical Science, like that in the NATED 550 curriculum, consists of two external examinations, one in Physics and one in Chemistry. For the NCS, there is clear and explicit description of the structure and content weighting in these examinations (see Physical Science Document 6). Despite the overall clarity of these guidelines, however, there are a few areas in which elaboration could be clearer. First, it is not clear exactly which prior knowledge from Grades 10 and 11 is examinable. Second, in some areas of Grade 12, examinable content lacks clarity, such as the concept "a variety of motions" (ibid., Page 4), where these motions have not been sufficiently spelled out. Third, in some instances which include Grade 12 content, information is not clearly described. It is not clear, for example, which graphs are to be examined: the graphs for the *discharge of a capacitor*, and for *chemical equilibrium* are not mentioned in Document 6 but are understood to be part of the examinable content.

5.6 (7) Availability, user-friendliness and use of the Physical Science curriculum documents

The Umalusi Physical Science team evaluated the NATED 550 and NCS documents in terms of their user-friendliness and availability. The following points were made:

a) The Physical Science team knew from experience that the NATED 550 HG and SG curriculum documents were readily available. The documents were generally obtainable from principals' or the district offices. Suitable textbooks were also available, so that teachers did not have to continually consult the syllabus to teach Physical Science. Many teachers did not, in fact, consult the syllabus documents - and some followed textbooks slavishly. Some were not aware of the existence of the curriculum documents. The documents themselves (Physical Science Documents 8 and 9) are very bulky and not user friendly. The layout of these documents – information is in point form in tables - does not make for easy reading.

Regarding the NCS, a number of versions of the various documents associated with the new curriculum have been released over the past five years, to the extent that individuals are not always certain that they are working with the most up-to-date version. The Department of Education website does not always provide the latest versions of the documents. This pace of change is the most significant disadvantage in the NCS curriculum: the sector is not keeping up.

The curriculum for each NCS subject consists of three or four documents, some of which have contained conflicting information at any given time. It appears that teachers have difficulty reading the documents and working with them as tools. They sometimes struggle to understand the language and frequent use of acronyms in the documents. They have to consult different documents for different aspects of their teaching. Many teachers rely heavily on textbooks and curriculum advisors to make sense of the documents. Using textbooks in this way is problematic

since there has always been a lag between currently available textbooks and the latest version of the curriculum. Current NCS textbooks generally are not fully curriculum compliant as they are usually written and distributed before the most recent versions of the curriculum are circulated.

All of these aspects diminish the user-friendliness of the NCS documents.

5.6 (8) Concluding comments for Physical Science

The Umalusi Physical Sciences team made two sets comments in conclusion, one on the relative difficulty of the three curricula evaluated, and one critiquing the Umalusi evaluation instrument.

5.6 (8.1) Concluding comments on the relative levels of difficulty of the three Physical Science curricula

Attempts were made to ascertain whether the NATED 550 and NSC curricula required similar levels of knowledge and skill of learners. Arguments put forward here are based on the evidence gathered in Sections 5.6 (1-7), above.

a) Regarding skills in the two curricula: due to the lack of explication of skills in all the curricula, but particularly in the NATED 550 documentation, it is not possible to draw conclusions about the equivalence of the skills involved. Comparing the skills as they are outlined in the documents would be misleading, as these are not representative of what takes place in classrooms. Learners in well-resourced contexts with well-equipped teachers are likely to develop wide ranges of skills, while it is possible that those in less advantaged contexts may not develop many skills at all. The strong focus on learning outcomes and Assessment Standards in the NCS does ensure attainment of a certain set of skills, but since the outcomes are generic, not all of the skills required for Physical Science are stated clearly enough to ensure comparability in what takes place across different classrooms. Some examples of the generic phrasing of skills include *unit conversions, proportional reasoning, derivation and manipulation of formulae, graph drawing and analysis,* and *physical interpretation of mathematical formulae* (see Physical Science Documents 1, 4, and 5).

b) Regarding the comparison of content, Table 5.6.2 (above) shows the numbers of 45-minute classroom periods needed for each curriculum. The following points are worth noting

First, to cover the *full* FET-phase curriculum, the NCS requires approximately 35% more class time than does the NATED 550 SG curriculum and 31% more than does the NATED 550 HG. To cover the *examinable* curriculum, 27% more class time is required for the NCS than for the NATED 550 SG curriculum, and 11% more class time is required for the NCS than for the NATED 550 HG curriculum. In other words, it cannot therefore be concluded that the new curriculum falls somewhere between the old HG and SG curricula with regard to breadth of content. The breadth of content in the NCS far exceeds that for either of the previous NATED 550 curricula. What is more alarming is that the estimation of the Umalusi Physical Science team was only for the time spent on content, and did not include time for learning and practising the required skills; neither did it take into account the multiple opportunities needed for learners to achieve principles underpinning the NCS. Estimations did not include the time needed for assessment. And since in the NCS there is a large emphasis on various types of assessment, this activity would considerably increase the amount of class time needed, compounding the already noted lack of class time for covering content. It can be concluded that the NCS is *far more difficult in terms of breadth* of content than the NATED 550 SG and HG curricula, and that this circumstance needs to be addressed urgently.

Second, regarding the *difficulty levels of content*, evidence in Table 5.6.2, above, indicates that it can be concluded from the estimates that the new NCS curriculum falls *somewhere between* the Higher and Standard Grade curricula of the NATED 550 system. In particular, for the examinable content, the percentage of time spent on difficult topics is 43% for the NCS,

which lies between that for the old SG (37%) and HG (47%). The percentage of time spent on topics at a medium level of difficulty is 48% for the NCS, which lies between that for the old SG (53%) and HG (44%). The percentage of time spent on easy topics is 9% for the NCS, which is very similar to that for the old SG (10%) and HG (9%). Since the question of standards relates to the *examinable* curricula, it can be concluded from these figures that the level of difficulty of content in the examinable part of the NCS is roughly equivalent to 50:50 Higher Grade: Standard Grade content.

In summary, it can be concluded that the NCS is far more difficult in terms of breadth of content than is the NATED 550 curriculum, but is midway between the higher and standard grade levels of the NATED 550 curriculum in terms of the levels of difficulty of the content topics.

5.6 (8.2) The usefulness of the Umalusi curriculum evaluation instrument for Physical Science

The Physical Science team considered the usefulness of the Umalusi evaluation instrument as an indicator of the usefulness of the curriculum documents as tools to guide teachers, examiners, moderators and materials developers. The team made four observations here. First, all of the members in the team felt that the tool was useful for *assessing* curricula, for the following reasons:

a) Questions in the instrument cover the key areas of curriculum design and structure and provide stakeholders with meaningful tools for analysis and critique of the curricula.

b) The tool could give teachers a very good base of information from which to do their classroom planning and pacing; it provides the space for reflexivity in specific areas.

c) Where teachers and officials have been raising the issue of curriculum overload in the NCS, this report provides the data to support this argument.

Second, however, the team felt that although the NCS appears to perform very well according to criteria in the instrument, the extent and complexity of the curriculum documentation makes it likely to be inaccessible for the average South African teacher. So, although on paper the curriculum may appear sound, in practice it may be falling far short of the ideal, and the instrument does not allow sufficiently for the capturing of these shortcomings. The experiences of the Umalusi Physical Science team members were discussed: the collective experience of the group is considerable, and individuals' experiences differ. The following key points not captured comprehensively elsewhere in the instrument came out of this discussion:

a) There is a problem with regard to the availability of the NCS documentation for teachers. The *Exam Guideline* document (Physical Science Document 6), for example, was only made available to teachers in late February 2008, which was not early enough to plan learning programmes for the year.

b) Contradictions between the documents, such as those between the *Subject Assessment Guidelines* (Physical Science Document 5) and the *Exam Guideline* document (Physical Science Document 6) regarding examinable content and the weighting of particular learning outcomes was emphasised as being a real problem for teachers, as they are unsure as to which is the authoritative document.

c) Because teachers cannot trust that they have the correct versions of curriculum documents, they tend not to read them. Further, documents are not necessarily filtered through principals' offices; subject advisors are not always kept informed about the distribution of documents, and are often unable to follow up with teachers as to whether they have received the correct documents.

d) There is insufficient training for teachers with respect to implementation of the new curriculum. It appears that there is no official strategy in terms of mediating the implementation of the

curriculum. The subject advisors in the Umalusi Physical Science team commented that the expectation is that they themselves should train teachers, but that this practice is not in line with their official roles.

e) Use of language and the accessibility of explanations in the curriculum documentation may be problematic, especially for second-language users. The Umalusi instrument does not encourage reporting in this area, in detail.

Third, the Umalusi Physical Science evaluators considered the fairness of criteria in the Umalusi evaluation instrument, for expression of the Physical Science teams' views on the curriculum documents. Notwithstanding the points emerging from the discussion of personal experience noted immediately above, all of the team members agreed that the elements in the instrument are fair and neither advantage nor disadvantage particular expressions of the curricula. It was felt that the elements of the instrument are important, in that a cohesive, well-structured and appropriately paced curriculum is necessary for learners to develop sound and integrated bodies of knowledge and skills in senior secondary school.

The elements of the instrument make for a report that will be very helpful to curriculum implementers, materials developers; examiners and moderators. The subject specification required by the tool helps to 'unpack' the curriculum, providing useful overviews and insights into the depth and breadth of content. However, in the same breath, it should be noted that these elements may slightly advantage a curriculum that is complex and possibly inaccessible to teachers, since covering all of the elements satisfactorily requires extensive documentation and reasonably advanced language skills, which may be too theoretical for the average South African teacher.

Last, the evaluators considered whether or not, or the degree to which the Umalusi evaluation instrument enabled *thorough* analysis of the curriculum documents. The Umalusi Physical Science team felt that it was useful to have a set format in which to report. Some of the sub-tasks within the instrument were difficult for the team to address, due to the nature of Physical Science; the difficulties are elaborated here.

a) It was difficult to build a comprehensive list of the skills for the Physical Science courses, as the skills are not listed as such in the documentation. The NATED 550 curriculum comes with a very brief and unsatisfactory list of skills, which is more a suggestion than a list of required skills. The NCS documentation includes lists of assessment standards that are fairly generally worded and do not include the specific skills needed for Physical Science.

b) It was also difficult to allocate types of cognitive demand to each skill, since the categories of cognitive demand provided by Umalusi (namely, *basic conceptual understanding; application, analysis, and synthesis of knowledge, skills, experience, and practice in FAMILIAR contexts*; and *application, analysis, and synthesis of knowledge, skills, experience, and practice in NEW contexts*) do not include some areas key for the Physical Sciences, such as *procedural skills* (for example, applying certain algorithms and problem-solving strategies) and *practical skills* (including the manipulation and reading of apparatus, observation, graph drawing, and translation into theoretical models).

The Umalusi Physical Science team had further difficulties in rating skills in terms of their difficulty levels, as each individual skill can potentially be applied at a range of difficulty levels.

SUMMARY OF CURRICULUM EVALUATION: PHYSICAL SCIENCE

Documents for the old NATED 550 and the new NCS curricula for Physical Science were compared. The most important points arising from this comparison are the following:

- With regard to *breadth* of content, it can not be concluded that the new curriculum falls somewhere between the old Higher and Standard Grade curricula. The breadth of content in the NCS far exceeds that for either of the previous curricula (requiring roughly 30% more class

time than they do). Hence, it can be concluded that the NCS curriculum for Physical Science is far more difficult in terms of breadth of content than the NATED curriculum.

- With regard to the *difficulty* of content, however, it can be concluded from the detailed analyses, that the cognitive complexity of the new curriculum falls somewhere between that of the old Higher and Standard Grade Physical Science curricula.

6. TRENDS ACROSS NSC CURRICULA

While the individual subject reports are unique – both in the subtle details of their findings and in how they combine their different data sets – in differentiating aspects of their evidence in order to pronounce judgments on the respective levels of difficulty of the curricula and on the adequacy and fairness of the Umalusi evaluation instrument, some overarching trends emerge if the reports are considered as a cluster. These trends are discussed briefly in this section.

Regarding curriculum content and skills

It must be said that each of the Umalusi teams engaged with content and skills in the curricula for their subjects in depth, and in original ways, and reported extremely insightfully on their findings, as a result. While each team worked rigorously and systematically, resulting in the highly comparable subject reports making up the booklet for **Part 2** of this report, each crafted a unique, three-dimensional and internally coherent view. When considering commonalities and variances in the comments on content and skills, six aspects emerge.

First, while some subject teams - such as those for Physical Sciences, Life Sciences, and English FAL - were able to report separately on content and skills, other teams found distinguishing between these aspects difficult, if not impossible. The Geography team expressed difficulty in some instances but ultimately distinguish between content and skills in their report. The Mathematics and Mathematical Literacy teams did not distinguish between the two. These differences between the teams speak to the structuring of knowledge in their subjects, and do not affect the substance of this report. It is worth noting for future research, however, that sometimes separating the two aspects yields fine-grained results, while on other occasions similar results may be obtained when the distinction between content and skills is blurred.

Second, the teams compared content and skills (or content skills) across the NATED 550 and NCS curricula for their subjects. While they were asked to consider the relative specification, weighting, and focus of content and skills, many teams also assessed the relative *amounts* of what will here be termed content and skill topics (distinguishable content and skill areas), the *nature* of these content topics and skills, and the *levels of difficulty* of these items. Three teams – those for Mathematics, Geography, and English FAL – reported respectively that while there are some significant changes (in the Mathematics curriculum), some small content additions and new skills (in the Geography curriculum) and far more comprehensive specification of content and skills (in the English FAL curriculum), the NCS documents for these subjects cover largely similar content and skills to their NATED 550 counterparts.

The Physical Science team reported significant increases in the *amounts* of content and skills covered. The evaluation team estimated that 35% and 31% more classroom time is needed to cover all the required content topics than that needed for the topics comprising the NATED 550 Standard and Higher Grade courses respectively.

A third common trend relates to the degree to which the content and skill topics are seen by the teams to be more highly explicated in the NCS than in the NATED 550 curricula for their subjects. Four Umalusi teams – those for Physical Science, Life Sciences, Mathematical Literacy, and English FAL – commented on the fact that their NCS curricula made content and/ or skill topics to be covered extremely clear. The Life Sciences team noted that this comment applies more to content than skill topics, a comment illustrating the advantages for future curriculum revision of distinguishing between content and skills. The other teams noted this degree of clarity in relation to both content and skills in their curricula.

The English FAL team pointed out not only that the comprehensiveness of descriptions of content and skills to be covered in their NCS curriculum made it *appear* broader when it in fact covered roughly the same work as that comprising the NATED 550 Higher and Standard Grade curricula, but that it increased the likelihood of desired implementation. In other words, an effect of the detailed descriptions of content and skills to be covered may present teachers with subject specific knowledge and processes that they may be missing, and so assist them with the associated classroom delivery.

A fourth commonality was the extent to which the NATED 550 curricula were reported to have more 'pure' *disciplinary* foci than their NCS equivalents. The Physical Science, Life Sciences, and Mathematics teams noted that their NATED 550 curricula – especially the Higher Grade versions – began to induct learners into the disciplines of Physics and Chemistry, Biology and pure Mathematics, respectively. The Standard Grade versions of these curricula began to induct learners in similar *directions* but not to similar *extents*, as knowledge in the Standard Grade curricula was more basic. The NCS curricula for these subjects in contrast, are more wide-ranging. In the Physical Science NCS curriculum, there is an emphasis on identifying links across disciplines and in the broader South African context (see **Subsection (1.3)** of the Physical Sciences chapter in the curriculum booklet (**Part 2** of the report)). The NCS for Life Sciences is closer to science-for everyday-living contexts than to the *disciplinary* route, including healthy living, environmental, and current medical topics (see **Subsection (2)** of the Life Sciences (Biology) chapter in the curriculum booklet). The Mathematics team commented on the broad shift from a pure Mathematics focus in the NATED 550 curricula towards that of the 'region of Mathematical Sciences' in the NCS by including broader topics such as those relating to Statistics and Finance (see **Subsection (3.2)** of the Mathematics chapter in the booklet). The subject Mathematical Literacy takes this 'applied' focus to the extreme: by definition, this subject emphasises the *use* of relatively basic Mathematical principles in other disciplines and everyday life. For this subject, it was the *contexts of application* that showed marked increases in cognitive complexity (see **Subsection 3** of the Mathematical Literacy chapter in the curriculum booklet).

Interestingly, the two Umalusi subject teams – those for Geography and English FAL – who reported that the content and skills foci in their respective NATED 550 and NCS curricula are relatively similar could be seen to have already included both *disciplinary* and 'applied' aspects in the NATED 550 versions of their curricula.

A fifth content-skills-related trend comprises the difficulties experienced by all of the subject teams when attempting to describe the weighting of content and skills in their curricula. It appears that the weighting of, and time to be spent on, particular content and skills topics was not fully clear in any of the curricula considered. The Mathematics team outlined rather neatly the advantages and disadvantages of using curriculum topic weightings, curriculum time specifications, and exam weightings respectively (see the introductory section of the Mathematics chapter in the curriculum booklet). To determine content and skill weighting, for example, the Mathematics team used examination weightings. The Physical Science team noted paucity of information in their NATED 550 documents and discrepancies in the NCS curriculum and, ultimately, using estimations of the numbers of 45-minute lessons, needed to cover topics. The Umalusi Life Sciences, Mathematical Literacy, Geography, and English FAL teams used combinations of class time, exam-weighting allocations, and combined personal experience to determine the weighing of content and skills for their subjects.

Lastly, all of the subject teams used one or more aspects of their content and skills analyses when judging the relative levels of cognitive complexity of their NATED 550 and NCS curricula.

Regarding curriculum aims and organising principles

When considering the aims, visions and outcomes of the curricula on the one hand, and the underlying organising principles lending coherence to these sets of documents on the other, the subject teams again commented in unique ways appropriate to their subjects. Some common threads can again be teased out of the responses. Overlapping comments made by the subject

teams can be categorised into the nature of the aims or organising principles and the degree to which these items were made explicit in the documents. There are also similarities in the ways in which teams commented on the guidance given for these aims and organising principles.

All of the subject teams, barring that for Mathematical Literacy which, it emerged, did not have a direct NATED 550 precursor, described the underlying organizing principles in their NATED 550 curricula as *disciplinary*: these NATED 550 subjects were organised along the lines of their parent disciplines. Taken on the Higher Grade, the subjects began inductions into their parent disciplines. Taken at Standard Grade level, the subjects were conceived along disciplinary lines, although concepts were addressed at far more basic levels than they were in the Higher Grade courses. School Physical Science thus began to induct learners into concepts needed for tertiary-level Physics and Chemistry. School Biology began induction into the discipline of Biology, although it failed to include the highest integrating principle, that of evolution by natural selection (see the Life Sciences chapter, curriculum booklet). School Mathematics and Geography began induction into the disciplines of pure Mathematics (algebra, geometry, trigonometry) and Geography (physical, human, and regional Geography) respectively.

The NCS curriculum's organising principles, in contrast, are all broader. There are six broad knowledge areas in NCS Physical Science; disciplinary Biology has become the 'humanistic' Life Sciences, with emphasis on its current human and environmental applications. Mathematics has moved from having a 'pure' to a 'regional' organising principle, where topics from Statistics and Finance and an emphasis on Mathematical modelling are integrated into the disciplinary topics. In Geography, *transmission* of disciplinary knowledge and skills is replaced by an emphasis on the *application* of Geographic knowledge and skills in real-life contexts. The Mathematical Literacy team identified the learning outcomes and assessment standards, defined in terms of Mathematical Literacy skills, as the fundamental principles underlying the subject. The English FAL team noted that the teaching and learning of language in the NCS curriculum was underpinned by social principles such as socio-political transformation; inclusivity and human rights; applied competence, articulation, and portability; environmental and social justice, and others.

While in some of the NATED 550 curricula (those for Biology; Mathematics, and English FAL), these organising principles are explicit, in other documents – such as those for Physical Science and Geography – they are implied only, and can be read in the structuring and sequencing of content and skills. In the NCS curriculum documents, in contrast, these underpinning principles are made relatively explicit for all subjects.

These *disciplinary* and broader 'applied' foci in the organising principles for the subjects are mirrored in the respective curriculum aims. The aims in the NATED 550 curricula appear to be fairly clear for all the subjects, and could be said to emphasise proficiency and knowledge in the subjects concerned. Aims in the NCS curricula – as specifically pointed out by the Physical Sciences, Geography, and English FAL teams in particular – are nested in the social principles of transformation, human rights and inclusivity, the applications of specialised knowledge in the world beyond the classroom, and others. Like their NATED 550 counterparts, aims in these curricula are also clear.

Importantly, all six Umalusi subject teams reported that their NCS curricula provided more guidance for achieving these aims than did the NATED 550 documents. Three teams – those for Physical Science, Geography, and English FAL – noted, however, that even although this guidance is considerable in the NCS documentation, it is not sufficient to ensure achievement of the aims in all South African school contexts.

Regarding sequencing, progression, pacing, and articulation in the curricula

With respect to sequencing, progression, and pacing, four subject teams (those for Physical Science, Life Sciences, Mathematical Literacy and English FAL) reported that these aspects of the curriculum are relatively implicit in the NATED 550 curricula, as they are embedded in the structuring of content and skills and the way in which these items are presented in the documents. For three

of the Umalusi subject teams, sequence, progression, and pacing are made far more explicit in the NCS curricula, through their constituent learning outcomes and assessment standards.

This contrast between sequencing that is so implicit that it almost seemed absent in the NATED 550 documents, and explication of a steady increase in cognitive complexity over time in the NCS curricula was especially stark in the case of English FAL. In the NATED 550 curricula for this subject, there was neither distinction between the cognitive complexities required for the Higher and Standard Grade levels of the course, nor were differences between the three FET years apparent. The English FAL team showed how progression in the NCS curricula was spelled out at differing levels in the assessment standards for each of Grades 10, 11, and 12; using appropriate adjectives and verbs (see **Subsection (3)** in the curriculum booklet for **Part 2** of this report).

For Life Sciences, while sequencing in the NATED 550 Biology curricula occurs via content topics that mirror topics key in the discipline of Biology, the documents fail to achieve the highest integrating principle; namely, evolution by natural selection. While this principle is covered in the NCS Life Sciences curriculum, sub-topics taught and learned in Grades 10, 11, and 12 do not mirror the sequence usually followed in the discipline of Biology. Further, while there was clear progression in the NATED 550 Biology curricula, in terms of steadily increasing percentages of *difficult* topics and questions over the three FET years (Grades 10, 11, and 12), there is an increase in *moderate* topics and questions in assessment associated with the NCS curriculum, and decreases in the percentages of both *easy* and *difficult* topics and questions over the same years. In addition and contrary to logical expectation, there is progressively less content covered in NCS Life Sciences between Grades 10 and 12.

For the Mathematics and Geography teams, sequencing was similarly clear in the NATED 550 Higher and Standard Grade curricula as well as in the NCS documents. For the Mathematics evaluators, this sequencing was apparent by virtue of the content itself: it is necessary to cover certain Mathematical principles before progressing to others – prior knowledge and skills are necessary before it is possible to proceed to the subsequent knowledge and skill concerned. It could be said that this sequencing is created by virtue of the knowledge structure of Mathematics: the discipline is a vertical knowledge structure where concepts are progressively integrated into increasingly generalised principles (see Bernstein 1996). Mathematics has been regarded as comprising a number of separate vertical knowledge structures (see O'Hollaran in Christie & Martin (2007)).

Four of the subject teams (all of the teams except that for Mathematics, for which sequencing was said to be clear anyway, and Life Sciences) reported that there was more *guidance* with respect to sequencing and progression in the NCS curricula than in the NATED 550 documents, and that this guidance was more explicit. This guidance was in all of the instances, however, still not sufficient. The Physical Sciences team reported that while the desired sequencing of content and skills was clear, the mechanics for achieving this progression are not. The Mathematical Literacy and English FAL teams noted that more explicit guidance and detailed suggestions are needed to assist teachers. The Geography team pointed out that the depth at which content and skill topics should be covered was not at all clear.

Lastly, articulation or, in other words, progression into, through, and beyond the FET phase (Grades10, 11, and 12) was not made explicit in any of the NATED 550 curricula. In the NCS curricula it is addressed, sometimes clearly and in relative detail (such as in the Physical Sciences and English FAL curricula), and at other times merely as unelaborated statements of intent (as in the NCS Geography curriculum).

Regarding guidance in relation to teaching approaches and subject methodologies

Some of the subject teams reported separately on *general* and *subject-specific* teaching and learning approaches and methodologies, while others reported generally. These patterns reflect distinctions made or blurred in the curricula themselves.

It appears that general pedagogic approaches, if at all advocated, are indicated only briefly in the NATED 550 curricula. There are brief suggestions in the Physical Science and Mathematics curricula; the overarching pedagogic approach is implicit in the Biology curricula. There is no mention at all of pedagogic approach in the national Geography documents; suggestions are made in some of the provincial documents, but these were reported by the team to be neither clear nor aligned to the NATED 550 curriculum aims, and guidance for implementing them is scant.

All of the Umaluis subject teams, in contrast, mentioned *Outcomes-Based Education* (OBE) as the general approach advocated in the NCS curricula. The teams noted that this *outcomes based* approach is aligned to curriculum aims, and that there is guidance in the documents for implementing it. The approach is integrated throughout the curricula through the learning outcomes and assessment standards comprising it. Several teams (see the Geography and Mathematics curriculum reports, for example) pointed out, however, that the guidance provided was not sufficient. Importantly, they all also pointed out the dangers of the approach in the South African context, given that it requires highly skilled and resourceful teachers of which there is a scarcity in South Africa classrooms.

Most of the teams noted the lack of context-sensitivity in the NATED 550 documents: as the Life Sciences team pointed out, these curricula adopted a positivist approach, where context was not taken into account at all. The NCS curricula, in contrast, continually address contextual issues, emphasising the need for inclusivity, local environmental awareness, for valuing indigenous knowledge, and other contextual factors. To reiterate, implementing high-quality context-specific teaching requires a workforce of highly skilled teachers, something lacking for the majority of schools in South Africa.

The Umalusi Physical Science, Life Sciences, and Geography teams reported more detail with respect to subject-specific teaching approaches and methodologies in the NCS than in the NATED550 curricula. At the same time, all of these teams noted partial but lack of sufficient guidance for implementing these approaches fully. The Mathematics team made the same point in relation to *both* Mathematics curricula: problem-solving methods are advocated in both, but there is little guidance as to the mechanics by means of which this technique can be followed.

Only the English FAL team detailed subject-specific approaches in both curricula: *Communicative Language Teaching* and *Language Across the Curriculum* approaches were encouraged in the NATED 550 curricula, and the *Text-based Approach* and *Communicative Language Teaching* are advocated in their NCS counterpart. Further, the team described the guidance for these methodologies in the NCS as 'comprehensive': suggestions and strategies are combined with examples, useful competency descriptors, assessment rubrics, and other tools necessary for following guidelines in the classroom.

Regarding assessment guidance

It appears that guidance for internal assessment is fairly clear for all three curricula for most subjects. Whether this guidance on the nature, number, and weighting of tasks was presented in the national or provincial documents for the NATED 550 curricula, and across several documents in those for the NCS, it was reported to be clear by the Umalusi Mathematics, Mathematical Literacy, Geography and English FAL teams. The Geography team nevertheless pointed to shortcomings in relation to both sets of curricula: in the NATED 550 Geography documents there were examples of tasks learners needed to produce; in the NCS equivalents there are detailed descriptions of tasks required, but no suggestions as to what counts as quality, or evidence for differing levels of achievement. The English FAL team's findings are at the other end of the spectrum: for this subject the NCS documents include detailed recommendations, examples, and assessment tools – in short, comprehensive guidelines.

Two subject teams noted a lack of adequate guidance for internal assessment: for NATED 550 Biology there was clear guidance for Grade 12 assessment tasks, but scant information for those needed in Grades 10 and 11. The team reported that the NCS Life Sciences curriculum made up for this lack. NATED 550 internal assessment guidelines for Physical Science were in list form only; the

NCS equivalents are extensive in relation to planning and outlining of tasks required, but do not include the rather essential descriptions of the tasks themselves.

Most Umalusi subject teams reported a decrease in the number of internal assessment tasks required: in many cases those stipulated in the NATED 550 documents were more than double the number of tasks required in the NCS curricula.

Regarding the requirements for external assessment, all of the subject teams reported that guidance was clear in both sets of curricula, most noting that information was briefer and in more list-like form in the NATED 550 than in the NCS documents, where descriptions are fuller. Despite this greater comprehensiveness, some shortcomings are reported in relation to guidance for external assessment in the NCS. The Physical Science team pointed to 'small pockets' in which more clarity is needed (see **Subsection (6)** of the Physical Sciences chapter in the curriculum report). The Umalusi Life Sciences team found that the NCS exam papers are likely to be a lot less predictable than their NATED 550 counterparts.

Regarding the user-friendliness and use of the curricula

Regarding the use and user-friendliness of the curricula, one Umalusi team (Life Sciences) found the NATED 550 documents sufficient and straightforward, and preferable to the NCS curriculum. Two teams (those of Mathematics and Mathematical Literacy) found the NATED 550 documents too brief and cryptic, with many confusing provincial versions in use, noting that the NCS documents are clearer and contain much of the necessary detail.

Two teams pointed to strengths and weaknesses in both sets of curricula. The Geography team found that the NATED 550 documents for the subject provide the clearest guidance for external assessment, while the NCS curricula are clearer with respect to the competences, knowledge, and skills required of learners. This team found the contradictory information relating to assessment in the NCS documents, problematic. The Physical Sciences team found that the NATED 550 documents for the subject provide insufficient guidance, but that the associated textbooks made up for this lack. This team and that for English FAL found the fact that various documents had to be used together, and that different versions of the documents contain different aspects of the most up-to-date information was confusing.

According to the combined experience of the English FAL team, neither the NATED 550 nor the NCS curricula for this subject are as extensively used as they could be.

Regarding the relative levels of difficulty of the NATED 550 and NCS curricula

In the process of making judgments on the relative levels of difficulty of the NATED 550 and NCS curricula, the subject teams drew on various aspects of their analyses. All the teams drew, for example, on their findings relating to the specification, weighting, and foci of content and skill topics. The Physical Sciences, Mathematics and Geography teams found that information on amounts and levels of difficulty of content and skill topics yielded solid evidence of the respective overall levels of difficulty of the curricula. The Mathematical Literacy team focused on cognitive types and levels of skills in order to make their decisions. The English FAL team compared degrees of specification of content and progressive increases in complexity of skills in their comparisons.

The Life Sciences team drew on a wide range of aspects, including specifications for external assessment, when making their judgments. The Geography team included the nature of the organising principles, finding that the *transmission* of disciplinary knowledge and skills required in the NATED 550 curriculum was easier than the *application* of this knowledge and these skills in the NCS system. In all, three teams (Physical Science, Life Sciences, and Mathematics) found their NCS curricula to be midway between the NATED 550 Higher and Standard Grade equivalents, in 50:50 proportions. It must be noted that the Mathematics curriculum analysed does not include the content and skill assessed in Mathematics Paper 3. The Geography team found the NCS Geography curriculum between the NATED 550 Higher and Standard Grade levels, but closer to that of the Higher Grade, in a 60:40 Higher: Standard Grade relation. The English FAL team found

the NCS curriculum for their subject to be more difficult than both of the NATED 550 Higher and Standard Grade courses are.

Regarding the adequacy and fairness of the Umalusi curriculum evaluation instrument

The Umalusi curriculum evaluation instrument, on the whole, was found to be extremely useful, leading to rigorous and systematic analyses and the desired clear, well-reasoned and evidence based findings. Several evaluators claimed that it helped to deepen their understanding of, and ability to engage with and verbalise ideas around, the curriculum.

Evaluators experienced some challenges in relation to specific conceptual categorisations in the tool, such as the separation of content and skills; the quantification of qualitative judgments; and a clear understanding of categories such as *generic, life-related, application of skills in familiar contexts and application of skills in new contexts*.

Further, some evaluators noted that certain aspects such as the contexts in which curricula are implemented, textbooks, use of language in the curriculum documents and the numbers and versions of documents making up curricula were not addressed sufficiently by the tool.

These shortcomings are summarised here, but are dealt with in more detail in **Subsection 4.4** above.

Recommendations for future curriculum review

Recommendations are made on the basis of the findings of each Umalusi subject team for future curriculum reviews. These recommendations are elaborated in **Subsection 8.2** below, and are summarised in the concluding comments (**Section 9** below).

7. USING THE FINDINGS FROM THE CURICULUM EVALUATION

The findings of this curriculum evaluation were fed, along with the results of the exam paper analyses, into the standardisation processes for the 2008 matriculation results (see Part 1: *Overview* for a description of this usage of the research).

The curriculum evaluations and exam paper analyses are however, also useful in their own right, over and above having provided necessary measures for the standardisation of the 2008 *National Senior Certificate* results. The fact that the research teams were required to comment comprehensively on the curricula and exams for their subjects, and in given formats, meant that reporting included wide ranges of comparable information for each subject. In addition, the fact that the evaluators were only allowed to comment on the relative levels of difficulty of the old and new curricula and exams once they had made *separate* judgments on a considerable number of aspects of curriculum, and on each and every item (sub-part of exam questions) in exam papers, meant that there was solid recorded evidence for each judgment made. The validity of the findings was increased by there being four rather than fewer-than-four consultants per subject group.

The results of the curriculum evaluations and exam paper analyses include detailed recommendations for improvement of the curricula and their associated exams. Almost all of the teams note that the NCS curriculum documents for their subjects (*National Curriculum Statement; Learning Programme Guidelines; Subject Assessment Guidelines*) contradict each other, and call for single (or two) comprehensive and coherent documents per subject. All teams also recommend clearer and more comprehensive guidance regarding what constitutes particular types of assessment tasks; how to assess these tasks in subject-appropriate ways; and how to develop suitable assessment tools. The teams make subject-specific recommendations beyond these general suggestions (these recommendations have been passed on to the assessment bodies concerned).

8. CONCLUDING COMMENTS

Despite the inclusion of only six subjects, rather than the full range of national subjects in the current research, the project has provided meaningful results for the short-, medium- and long-term. With respect to the standardisation of the 2008 matric results, it was possible to extend the reach of the findings by comparing learner performance in similar subjects, with their performance in the researched subjects for which there were clear descriptions of difficulty levels.

The usefulness of the Umalusi evaluation instruments was confirmed in the curriculum and exam analyses. Some teams customised or elaborated on the instruments for use in relation to their subjects; future teams will be encouraged to do the same. Importantly, the instruments are customisable, and at the time of publication of this report, will already have been customised for use at different levels in the education system.

Regarding the overall findings of the curriculum evaluation, an overarching comment can be made. In terms of the levels of difficulty of the six new NCS curricula evaluated, three of these curricula (those for Life Sciences, Mathematics and Physical Science) are judged to be midway between the NATED 550 Higher Grade and Standard Grade curricula *overall*; but at the same time have pockets of difficulty that way exceed difficulty levels in the previous Higher Grade curricula. The new Physical Science curriculum has a far greater volume of content than do both NATED 550 curricula for the subject – there is more *difficult*, as well as more *moderate* and more *easy* content than previously. In the new Life Sciences curriculum, the applications of some principles are found to be beyond the reach of most South African learners.

A fourth curriculum (the NCS curriculum for Geography) was found to be closer to the old Higher- than Standard Grade level. A fifth curriculum (that for English FAL) was found, because of its greater degrees of specification, to be *effectively* more difficult than the NATED 550 curricula, but it was simultaneously found to be a very commendable set of documents, for which more mediation in the form of teacher training is recommended. The sixth curriculum (that for Mathematical Literacy) was found to be so different to the NATED 550 Higher and Standard Grade Mathematics curricula that comparison was not possible.

The main recommendations regarding curriculum are that the current set of NCS documents per subject are rationalised into single, or at most two, coherent documents per subject – and that these new documents be made universally available to *all* schools, in soft or hard copy form, as suits the contexts of the schools. There is also a need, in all subjects, for more guidance regarding teaching in differing social contexts; clarity regarding what comprises different kinds of assessment tasks and how to assess them; and teacher-development of subject-appropriate assessment tools. This guidance needs to feature in the curriculum documents themselves, as well as in teacher-development workshops. Beyond these over-arching curriculum recommendations, the subject teams have also made important subject-specific suggestions (see Part 1: *Overview* of this report).

9. REFERENCES

(INCLUDING REFERENCES FOR PARTS 1, 2, AND 3 OF THIS REPORT)

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NOTES

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37 General Van Ryneveld Street, Persequor Technopark, Pretoria
Telephone: +27 12 349 1510 • Fax: +27 12 349 1511
E-mail: Info@umalusi.org.za • Web: www.umalusi.org.za

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Council for Quality Assurance in
General and Further Education and Training