# *2008 Maintaining Standards* Report

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

# Part 3: Exam Paper Analysis

**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
- Biology/Life Sciences
- Mathematics
- Mathematical Literacy
- Physical Science

# Part 3: Exam Paper Analysis

May 2009

# ACKNOWLEDGEMENTS

2008

# CONTENTS

# 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, including 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to have a valid understanding of the quality and levels of cognitive demand of the new curricula relative to those just superseded.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; Biology/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 a myriad of 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 Biology/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, Biology/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 of items or marks at specified cognitive type and difficulty levels.

Three teams (Physical Sciences, Biology/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 Paper 1 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 As in the 2008 NSC papers would be equivalent to As 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 As 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 at just-passing-Standard-Grade levels to pass. However, the teams note 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 from the levels of the questions.

Three Umalusi teams (Geography, Biology/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 Biology/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 standardization 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 Biology/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 way 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 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 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; Biology/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 First Additional Language (English FAL), Geography, Biology/Life Sciences, Mathematics, Mathematical Literacy and Physical Science, in the period 2005–2008.

# PART 3

## LIST OF ACRONYMS

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

## LIST OF TABLES

# LIST OF GRAPHS

# 1. INTRODUCTION

Most large-scale examination systems include measures to ensure consistency over periods of time, and it is natural for these measures to be refined to incorporate systemic change from time to time. Umalusi currently manages a statistical moderation process whereby results obtained in final examinations by school, college, and adult learners are adjusted to maintain reasonably consistent standards over time. Prior to 2008, this moderation included several measures, including adjusting raw scores on the basis of *norms* calculated from learner performance over three- or five-year periods. Moderation also took into account the results of *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. Third, moderation took into account comments made by internal and external moderators, on the fairness of the exam papers; language level and percentages of problematic questions; and perceived overall level of cognitive difficulty. Traditionally, these moderators have worked individually or in small groups of two or three.

In 2008, Umalusi urgently needed to review its systems in this area. First, there had been widespread criticism of its usual approach, wherein it was claimed that there was too heavy an emphasis on statistics with insufficient qualitative input, and that the system favoured upward adjustments. The main reason for the urgency however was that the first cohort of learners completing the new outcomes-based curriculum – the *National Curriculum* – adopted as a result of the advent of democracy in South Africa, wrote the first set of exit exams.

What had to be addressed immediately was that 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. It should be drawn to readers' attention that while prior to 2008 learners were able to take up subjects and be examined on these subjects at Higher or Standard Grade levels, in 2008 *all* learners in South Africa enrolled and were examined at the *same levels*. Single 2008 examination papers thus had to incorporate ranges of questions, from those typically at the highest difficulty levels in Higher Grade papers to those at "just passing" levels in Standard Grade exams, as well as questions at all levels in between these extremes, in order to differentiate learners.

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 the *National Senior Certificate* exams in 2008. Part of this overall strategy involved the creation of new norms, and conducting in-depth research into the quality, type and levels of cognitive demand in the respective intended and examined (NATED 550 Higher and Standard Grade, and *National Curriculum Statement*) curricula in order to ascertain their relative levels of difficulty. The intention for 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 the just use of pairs analysis and new norms.

Descriptions 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 the booklet Part 1 (*Overview*) of the current report. This part of the report documents the exam paper analyses in detail.

Ideally, the subjects to be analysed by teams of evaluators would have been all 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. Available budget, time, and capacity meant that only 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 (First Additional language or FAL), Geography, Biology/Life Sciences (previously Biology), Mathematics, Mathematical Literacy and Physical Science.

Three assumptions are worth noting here. The first – explored fully in the curriculum analyses for the subjects (see the booklet Part 2 of the report) – was that a comparison of the three intended curricula (NATED 550 Higher and Standard Grade curricula, and the *National Curriculum Statement*) would provide an indication of whether the demands made by each are 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 analyses of the exam papers together with those of the intended curricula would range beyond the immediate requirements of the Umalusi Statistics and Assessment Committee. It was intended that the findings relating to the exam paper analyses would contribute towards improving future exam papers and examining processes. The aim was similarly, that the reports on the curriculum analyses would provide useful formats for meaningful future comparisons across curricula, and become input for future curriculum refinements.

The research was to be deemed successful if it was able to provide information useful for the Umalusi Statistics and Assessment Committee's task of comparing the levels of difficulty of 2008 NSC subject examinations with those of previous years' examinations, and if it provided findings useful for future evaluations and improvements of both the exam papers and their associated curricula.

### Structure of this part of the report

This report is the third of three for Umalusi's 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 3 of the report consists of an introductory section in which the focus and methods of the analysis are detailed, followed by the in-depth reports for each subject. It then draws together some trends across the 2008 exam papers for different subjects, and closes with some overarching concluding comments.

## 2. QUESTIONS THE EXAM PAPER ANALYSIS HAD TO ANSWER

There were four evaluators per subject. Evaluators knew that they were evaluating each intended and examined curriculum comprehensively in its own right, as well as making judgments regarding the respective levels of difficulty of work covered in these documents and exam papers. They were given 30-page research instruments consisting of sets of questions for which they had to report in highly specified ways, in the tables provided or in paragraphs with specific word counts (see the booklet for Part 1 of this report for more detail regarding the research tool and methodology followed). Evaluators were then asked to draw on their responses to answer the main research questions, as *concluding tasks*.

The specific research questions for the present study thus featured at the end of each part of the Umalusi evaluation instrument – one part of this tool being for the curriculum evaluation, and one for the analysis of exam papers. The reason for this positioning of the main questions was to ensure that the answers to them were based on the visible and comprehensive trails of evidence generated by the other questions. Umalusi insisted that all responses be based on this evidence (aggregated judgments, percentage counts of categories of items, and the like) from the body of

the exam report of each evaluator. Further, the intention was to make sure that the responses of the different *subject* teams were based on comparable types of evidence and systematic reasoning.

The specific research questions (or concluding tasks) for the exam paper analyses were:

1.  Do the 2008 exemplar and final papers allow 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 new A-grades are comparable to the old Higher Grade A's*? (Indication of the exemplar and final NSC items which would reflect this new A-grade achievement needs to be provided. Responses must be based on specific findings from the body of the exam report for this research question and all those that follow).

2.  Do the 2008 exemplar and final papers allow for the average learner passing at the level of the old Standard Grade papers to pass the new NSC exams? (Indication of the exemplar and final NSC items which would allow the Standard Grade–level learners to pass needs to be provided).

3.  From the analysis of the 2005–2007 Senior Certificate examination papers, are the examinations of roughly comparable standards across the three years? Or is there any particular year, or even paper, that seems to be anomalous? (Motivation and evidence need to be provided for the position taken).

4.  What distinguishes most significantly the Higher from the Standard Grade exams? (Responses are again to be based on specific findings in the body of the report).

5.  From the analysis of the Higher and Standard Grade papers, how do the 2008 NSC exemplars compare? And how do the 2008 NSC final papers compare with the exemplars, on one the hand, and the Higher and Standard Grade papers on the other hand? Are there any points of comparison not already covered?

6.  Are the exemplar and final papers good models for future examinations, or should their format be critically re-examined immediately? Suggestions need to be specific.

7.  How appropriate are the language levels in the 2008 exemplar and final exam papers?

## 3. HOW THE EXAM PAPERS WERE ANALYSED

In order to answer the exam paper–related research questions outlined in the previous subsection, it was intended that the teams of four evaluators per subject would judge the difficulty levels of each item (sub-part of question) in each exam paper concerned.

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 subsection 4 below. The research methodology followed is spelled out in more detail in the booklet Part 1: *Overview* of this report (see subsection 4, *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 only briefly here: fuller discussion of these aspects features 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 a 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.

Details of the evaluators selected for each subject team are given in Appendix 1 (below).

Second, the exam papers and memoranda for the respective subjects were required. The following documents were analysed:

- For the NATED 550 curricula, 2005–2007 examination papers, plus marking memoranda. All papers were included. For most subjects, this number of papers included Papers 1 and 2 for Higher and Standard Grade levels respectively. For subjects such as English First Additional Language (English FAL), there were three papers for each exam, Papers 1, 2 and 3. For all subjects barring English FAL, all of the papers were nationally set, and location of the papers was relatively straightforward. In the case of English FAL, Papers 1 and 3 were national, while Paper 2 was provincial. Since this fact had potential to increase the task of the English FAL team five-fold, it was decided to include provincially set versions of Paper 2 from only two provinces, a well-resourced province (Western Cape) and a less well-resourced province (KwaZulu-Natal). The number of papers analysed by the English FAL team was still higher than that of the other teams.
- For the exemplars for the new system, Department of Education NSC exemplar examination papers dated August 2008, with associated marking memoranda. Additional exemplars issued by the Department of Education in September – October 2008 were *not* included in the analysis, as they had not been factored into the original timelines for the project. For most subjects this meant two papers to analyse. For subjects with three papers, Mathematics Paper 3 was not included as it is written by only a small number of learners; for English FAL, national Papers 1 and 3 were analysed, as were provincial Papers 2 from the Western Cape and KwaZulu-Natal.
- For the final 2008 exam paper analysis, 2008 NSC exam papers and memoranda issued by both the Department of Education, and the Independent Examinations Board (IEB). Due to time constraints, only national Papers 1 and 2 were analysed by all subject teams; national Papers 1 and 3 were analysed by the English FAL team.

Between 11 and 28 exam papers were analysed in total per subject team; details of the specific papers analysed feature in the individual subject reports in sections 7 and 8 of this report.

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

## 3.2 OUTPUTS EXPECTED OF THE ANALYSES

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, in the reports evidence for *all* of the many judgment tasks required, as well as arguments supporting their conclusions based on the evidence of their own judgments. The process whereby versions of reports were refined until they included all of this information was followed to this end.

Each Umalusi evaluator was required to work individually. The composite reports constitute the *combined* results of the judgments and reasoning of four very experienced individuals in each instance. It was thought that if the four experts could independently come up with similar judgments, the results would 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 final drafts to Umalusi.

It was expected that judgments would be more varied in the exam than in the curriculum analyses, given that individuals were judging a multitude of very specific and detailed items in the exam papers. Given that the results were to inform standardisation, the reliability of the results was of paramount importance. Since each exam paper item had to be categorised into one of nine possible categories, *if* evaluators did not have common understanding of the categories, the possibility for a potential lessening of reliability was increased. Umalusi took steps to facilitate this joint understanding of categories of evaluation by giving teams time to work together in the initial briefing workshop. How each subject team further increased the reliability of their exam analysis results is described in the individual subject reports below.

## 3.3 EXAM PAPER ANALYSIS INSTRUMENT

The full Umalusi exam paper evaluation instrument is presented in Part 1 of this report, and will not be discussed in detail again here. Briefly, evaluators were asked to note the cognitive type and level of difficulty of each exam item (sub-part of question), and total these judgments to describe the overall level of difficulty of each paper. Different papers for each subject were then considered in relation to each other. Table 3.3.1, below, shows the generic instrument used by the teams.

**Table 3.3.1: Revised Bloom's taxonomy for the analysis of exam questions and items**

| Type of Cognitive Demand | Level of difficulty |
|---|---|
| **Basic conceptual, knowledge**<br>- recall;<br>- literal comprehension,<br>- making simple evaluative judgements in terms of previously acquired facts;<br>- etcetera. | **Easy** |
| | **Moderate** |
| | **Difficult** |
| **Comprehension, Application**<br>- understanding, application, analysis of previously acquired information in a familiar context;<br>- making evaluative judgments that require the use of a range of previously acquired facts/information;<br>- etcetera. | **Easy** |
| | **Moderate** |
| | **Difficult** |
| **Problem-solving**<br>- analysis, interpretation and application of information in a new or unfamiliar context;<br>- synthesis, creation of novel solution or product;<br>- evaluation or making judgement in relation to a mixture of old and new material or information. | **Easy** |
| | **Moderate** |
| | **Difficult** |

Although all teams used this instrument, some customised it for their subjects. The challenges leading to this customisation are dealt with in the booklet Part 1 of this report. How particular teams developed it is shown in the individual subject reports below.

# 4. SCHOOL SUBJECTS CHOSEN FOR ANALYSES

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, etcetera). Given budget and time constraints however, it was feasible to include only six subjects.

The Umalusi Statistics and Assessment Committee requested that 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 on Page 21:

1.  English Second Language        490 909
2.  Biology/Life Sciences          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/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, that it would have enrolment numbers and therefore affect the results of many learners was known.

The full results of the analysis of the exam papers for these subjects are presented in the next section.

# 5. EXAM REPORTS PER SUBJECT

The results of the exam paper analyses are presented in this section, per subject. It must be noted that as for the curriculum analysis, all six Umalusi subject teams reported on all of the aspects required for the exam paper analysis in the Umalusi evaluation instrument. The 24 Umalusi evaluators each completed a full table for each exam paper analysed, in Excel format.

The full table completed by evaluators for each paper recorded the number of each item (the smallest possible independent part of the exam question concerned), its cognitive type and difficulty level; a comment on its usefulness for future NSC exams (*National Senior Certificate* exams linked to the NCS curriculum) for the subject concerned, and the particular exam paper, learning outcome and assessment standard it could be used to examine. Since the tables were in Excel format, it was easy to work out the total numbers of differing item types and difficulty levels. Evaluators drew on this information directly in order to answer the 10 tasks for the exam paper evaluation.

The team leader for each subject put together a single composite report for their subject. The tables and information on reusable items are stored elsewhere and are not reported here, as they are not relevant for the current report.

Teams reported here, on, first, whether the 2008 exemplar and final papers allow for learners who would have achieved A-grades in the old NATED 550 Higher Grade papers to achieve A-grades in the new NSC exams *where the new A-grades are comparable to the old Higher Grade A's*. Second, they reported on whether these 2008 exemplar and final papers allow for average learners passing at the level of the old Standard Grade papers to pass the new NSC exams. These are critically important findings.

The teams also reported on the comparability of the 2005–2007 *Senior Certificate* examination papers across the three years (on the degree of consistency of the standards of these papers); on what one can use to distinguish between the NATED 550 Higher and Standard Grade exam

papers; on how the 2008 NSC exemplars and final papers compare with the NATED 550 Higher and Standard Grade papers for their subjects in general; on whether or not the 2008 exemplar and final papers are good models for future NSC exams, and on the appropriateness of language levels in the 2008 NSC papers.

The reader may choose to read about the *general* trends (Subsection 6) before considering the detailed exam analysis reports that follow.

# 5.1 ENGLISH FIRST ADDITIONAL LANGUAGE (FAL)

*Introductory note to the exam paper analyses for English FAL*

The English FAL team attempted to benchmark the new 2008 NSC English FAL exams by analysing the type of cognitive demand and levels of difficulty of items (questions and sub-questions) in the NATED 550 Higher Grade and Standard Grade examination papers for 2005, 2006 and 2007, and the NSC exemplar and final examination papers for 2008.

In order to conduct the comparative evaluation between these papers, the English FAL team analysed thirty-one papers. This number of papers is far higher than those analysed by any other subject team, as English FAL has three exam papers per examination instead of the two for all other subjects analysed. Further, only Papers 1 and 3 are nationally set: Paper 2, being provincially set, occurs in nine versions, as it were. The English FAL team therefore analysed the two nationally set papers (at Higher and Standard Grade levels where applicable) for each year included in the study, and two of the nine provincially set Paper 2s – those from Kwa-Zulu Natal and the Western Cape – also for each year in the study, and at Higher and Standard Grade levels where applicable. Because of the complexity of the evaluation, findings from the Paper 2 analyses are included only where they do not add unnecessary complexity to this report. Each paper was individually analysed by three evaluators. The papers analysed are listed here:

- 2005 NATED 550 English FAL Papers 1 (Higher and Standard Grade); Papers 2 (Kwa-Zulu Natal and Western Cape, Higher and Standard Grade); Paper 3 (Standard Grade only, as the Higher Grade paper could not be sourced)
- 2006 NATED 550 English FAL Papers 1 (Higher and Standard Grade); Papers 2 (Kwa-Zulu Natal and Western Cape, Higher and Standard Grade); Papers 3 (Higher and Standard Grade)
- 2007 NATED 550 English FAL Papers 1 (Higher and Standard Grade); Papers 2 (Kwa-Zulu Natal and Western Cape, Higher and Standard Grade); Papers 3 (Higher and Standard Grade)
- 2008 NSC exemplar and final Papers 1
- 2008 NSC exemplar Papers 2 (Kwa-Zulu Natal and Western Cape)
- 2008 NSC exemplar and final Papers 3

The method used in this examination paper analysis is presented in Subsection 5.1 (1), below, followed by the results and discussion of this analysis in Subsection 5.1 (2).

## 5.1 (1) Method of analysis used for the English FAL exam papers

The team agreed that the evaluation tool as a generic template for all the subjects being researched was a good foundation, but that the tool needed to be interrogated and elaborated for English FAL. Examples have been added to each category of item, as a result of this process. Individual evaluators initially used the generic version of the instrument, yielding vastly disparate results. Since it was then not possible for the team leader to compile a credible report, the team spent two additional days negotiating their interpretation of the tool, adapting it to suit the English FAL examination questions, and then revising all judgments previously made individually (see the refined instrument in Table 5.1.1, see overpage).

**Table 5.1.1: Customised exam paper analysis tool for English FAL**

| Type of Cognitive Demand | Level of difficulty | Examples of items |
|---|---|---|
| **Basic conceptual, knowledge (level of difficulty changes depending on complexity of question and text)**<br>- recall;<br>- literal comprehension,<br>- making simple evaluative judgements in terms of previously acquired facts | **Easy** | Use punctuation effectively to show grammatical relationships; Spelling |
| | **Moderate** | Use verb forms and auxiliaries to express tense and mood in familiar contexts with increasing accuracy;<br>Use a wide range of figurative language such as idioms appropriately;<br>CLOSE PROCEDURE; WORD CHOICE |
| | **Difficult** | CONCORD; Homophones;<br>ONE WORD FOR A PHRASE |
| **Comprehension, Application – (level of difficulty changes depending on complexity of question and text)**<br>- understanding, application, analysis of previously acquired information in a familiar context;<br>- making evaluative judgments that require the use of a range of previously acquired facts/ information | **Easy** | Describe plot;<br>Interpret character |
| | **Moderate** | Infer meaning using word attack skills and contextual clues; EMOTIVE AND PERSUASIVE LANGUAGE; Use contextual clues to infer meaning; Evaluate style and register to suit purpose; Idiomatic expression; Knowledge of root and suffix; LITERAL AND FIGURATIVE EXPRESSIONS; Identify and explain headings; Dictionary skills; Background and how it relates to theme; Recognise the socio-political and cultural background to texts |
| | **Difficult** | SUMMARY WRITING; Graphic interpretation; SYNONYMS; FIGURES OF SPEECH |
| **Problem-solving**<br>- analysis, interpretation and application of information in a new or unfamiliar context;<br>- synthesis, creation of novel solution or product;<br>- evaluation or making judgement in relation to a mixture of old and new material or information | **Easy** | Graphic interpretation; Invitation; Diary |
| | **Moderate** | Implicit and explicit messages, values and attitudes reflecting the position of the speaker; Narrative /Descriptive essays; Reflective essays; Informal letter; Dialogue; Formal letter; Report |
| | **Difficult** | Constructing acceptable compound sentences; Argumentative essay; Discursive essay; Expository essay |

The team noted at the start of the analysis that learners working at a typical NATED 550 Standard Grade level would likely have been capable of answering the following types of items: *basic conceptual knowledge* items at *easy, moderate,* and *difficult levels*; *comprehension/application* and *problem-solving* items at an *easy* level only. Further, *moderate comprehension/application* items were like a transitional zone, in which only top achievers at Standard Grade level were likely to achieve. Learners working at the NATED 550 Higher Grade level were likely to achieve at all of these levels, as well as being able to answer *difficult comprehension/application* and *problem-solving* items. Table 5.1.2 (overpage) is an example of how data was captured for reflecting the cognitive demands of each paper. These categories were combined in some instances, for clarity. In other instances, the *marks* awarded for particular types of items were the units of analysis. The

reader is asked to note that throughout the English FAL report, percentages may add up to figures very slightly above or below 100 due to rounding of the numbers for cleanness of presentation.

**Table 5.1.2: Percentages of items at each level of cognitive demand, per exam paper**

| EFAL P1 HG 2005 | No of items | BE | | BM | | BD | | CE | | CM | | CD | | PE | | PM | | PD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| TOTAL | 49 (100%) | 5 | 10 | 6 | 12 | 24 | 50 | 0 | 0 | 7 | 14 | 4 | 8 | 0 | 0 | 1 | 2 | 3 | 6 |

**Legend:**
BE = basic conceptual demand (easy); BM = basic conceptual demand (moderate);
BD = basic conceptual demand (difficult); CE = comprehension/ application (easy);
CM = comprehension/ application (moderate); CD = comprehension/ application (difficult); PE=problem-solving (easy); PM=problem-solving (moderate); PD=problem-solving (difficult);
P1 HG=Paper 1, NATED 550 Higher Grade

In terms of percentages, in order to achieve an A-grade in the NATED 550 exams, a candidate would have had to score 80% or more. Similarly, in the NSC exams, an A Grade candidate would need to reach Level 7 (80% or more). To pass the NATED 550 Standard Grade exams, a candidate would have to score 33%. However, for the exemplar and final NSC exam papers, a candidate just passing would have had to achieve 30%. How overall marks were distributed is shown in Table 5.1.3 (below).

**Table 5.1.3: Overall composition of English FAL marks**

| External examination | Covered by papers | NSC | NATED 550 |
|---|---|---|---|
| Paper 1 | Language in context | 80 | 80 |
| Paper 2 | Literature | 70[1] | 80 |
| Paper 3 | Writing | 100 | 80 |
| Paper 4 | Oral tasks | 50 | 60 |
| Total for external assessment | | 300 | 300 |
| Programme of assessment marks | 14 tasks | 100 | – |
| **TOTAL** | | **400 marks** | **300 marks** |

It must be remembered that while Paper 1 (Language) was analysed fully throughout, because of time constraints only two of nine possible versions of Paper 2 (Literature) were considered. Further, in Paper 3, because learners were presented with several questions and only have to answer three, and because learners' choices differed widely, Paper 3 was discussed in some places only.

## 5.1 (2) Results of the English FAL exam paper analyses

The Umalusi English FAL team reported here on the seven research questions required for the Umalusi exam paper analyses for the subject, and made some additional points.

### 5.1 (2.1) Distinguishing English FAL highest level achievers (2008 NSC exemplar and final papers)

In order to determine whether the 2008 exemplar and final NSC English FAL Paper 1 (Language) papers allowed for learners who would have achieved A-Grades at the level of the old NATED 550

---

[1] Paper 2 is examined provincially, and no national exemplars were supplied.

Higher Grade papers to achieve similar results, the team analysed NATED 550 Paper 1 Higher Grade from the years 2005 to 2007, as well as the 2008 NSC exemplar and final papers. Table 5.1.4 shows the results of this analysis: percentages of *marks* (not items) allocated to each category are shown. Marks were chosen in this case, as they show the weighting of items at different cognitive levels. It was decided to combine marks for all *easy*, all *moderate*, and all *difficult* items (regardless of whether they were awarded for *basic, comprehension,* or *problem-solving* items) for this analysis.

**Table 5.1.4: Average percentage of marks allocated to each level of difficulty in NATED 550 Higher Grade papers (2005–2007) and the 2008 NSC exemplar and final papers**

| Exam papers | % Easy items | % Moderate items | % Difficult items |
|---|---|---|---|
| NATED 550 HG Paper 1 (2005) | 59 | 13 | 29 |
| NATED 550 HG Paper 1 (2006) | 53 | 35 | 13 |
| NATED 550 HG Paper 1 (2007) | 59 | 18 | 24 |
| AVERAGE MARKS/ % FOR NATED 550 HG papers | 56 | 22 | 22 |
| 2008 NSC EXEMPLAR MARKS/ % | 45 | 34 | 21 |
| 2008 NSC FINAL MARKS/ % | 54 | 21 | 25 |

Table 5.1.4 shows that the levels of difficulty of questions in the *final* 2008 NSC Paper 1 were closer to the average levels of difficulty in the NATED 550 Higher and Standard Grade Paper 1 papers than were those in the 2008 exemplar papers. The 2008 *exemplar* papers were slightly harder than the final ones. It is clear that since the spread of levels of difficulty, and especially the percentages of *difficult* items in the 2008 exemplar and final papers were similar to those in the NATED 550 Higher Grade papers, that the A-grades in the exams of both systems were likely to be similar. This similarity was especially the case when comparing the *final* 2008 NSC papers with the NATED 550 Higher Grade papers.

The items in the 2008 final NSC Paper 1 that were most likely to differentiate A–grade learners were: Item 1.3, Item 2.8, Item 3, Item 4.2.4, Item 5.3, Item 6.3.1, and Item 6.3.2.

In an attempt to evaluate the types and levels of cognitive difficulty of items in the Paper 3 (Writing) papers, the Umalusi English FAL team could not use marks since there were 10 questions of varying difficulty in each paper, and candidates had to answer only three of these items. Since it was not possible to predict which questions candidates might choose, a decision was made to use the number of items at particular cognitive levels to determine the relative level of difficulty of each Paper 3. All of the questions in these papers required extended writing and were classified as *problem-solving* items. Table 5.1.5 (below), shows the results of this analysis (NATED 550 Paper 3 for 2005 was not obtained).

**Table 5.1.5: Cognitive levels of items in the English FAL Paper 3 (writing) papers**

| EFAL P3 HG | NO. OF ITEMS | BE | BM | BD | CE | CM | CD | PE | | PM | | PD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 28.57% | 7 | 50% | 3 | 21.42% |
| 2007 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 21% | 7 | 50% | 4 | 29% |
| Exemplar | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 19% | 7 | 43% | 6 | 38% |
| NSC | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 17% | 5 | 42% | 5 | 42% |

**Legend:** (See Page 26)

BE = basic conceptual demand (easy); BM = basic conceptual demand (moderate); BD = basic conceptual demand (difficult); CE = comprehension/ application (easy); CM = comprehension/ application (moderate); CD = comprehension/ application (difficult); PE=problem-solving (easy); PM=problem-solving (moderate); PD=problem-solving (difficult); P3 HG=Paper 3, NATED 550 Higher Grade

From Table 5.1.5 it can be seen that the NATED 550 Higher Grade Paper 3 (Writing) papers were similar to their 2008 NSC exemplar and final paper counterparts, with the NSC papers being slightly more difficult. The team noted that these similarities made it highly likely that the A-grades in the two systems would be equivalent. However, this finding was not conclusive, as the learners' choice of questions would have determined the overall levels of difficulty they had selected within the paper in each case.

The slightly higher number of difficult questions in the 2008 NSC papers was balanced out by content and structural differences in these papers, which may have benefitted learners. These features included more creative stimuli such as photographs; shorter transactional pieces than were previously the case; increased mark allocations (100 instead of 80 marks); and decreased word counts (requiring 200–250 rather than 250–300 words), giving candidates more time to plan, draft and edit their work.

On the whole, the team found that NSC Papers 1 and 3 were similar to the NATED 550 Higher Grade equivalents. The papers contained a good spread of genres, and of levels of difficulty.

### 5.1 (2.2) Determining average English FAL learners (2008 NSC exemplar and final papers)

Ideally, comparison would be between questions answerable by learners achieving at *average* levels in relation to the NATED 550 and NCS curricula respectively. Since the idea of *average* in this instance was difficult to define, the English FAL team benchmarked the lower cognitive-level NSC questions against NATED 550 Standard Grade items in relation to which Standard Grade learners achieving at the lower ends of the scale would have scored. Percentages of marks are shown in Table 5.1.6 (below).

**Table 5.1.6: Percentages of marks awarded for the respective Paper 1s in the NATED 550 Standard Grade and 2008 NSC exemplar and final papers**

| Exam papers | %<br>Easy items | %<br>Moderate items | %<br>Difficult items |
| --- | --- | --- | --- |
| NATED 550 SG Paper 1 (2005) | 71% | 29% | 0% |
| NATED 550 SG Paper 1 (2006) | 44% | 34% | 23% |
| NATED 550 SG Paper 1 (2007) | 64% | 29% | 8% |
| **AVERAGE MARKS/ % FOR NATED 550 SG papers** | **60%** | **30%** | **10%** |
| **2008 NSC EXEMPLAR MARKS/ %** | **45%** | **34%** | **21%** |
| **2008 NSC FINAL MARKS/ %** | **54%** | **21%** | **25%** |

**Legend:**
BE = basic conceptual demand (easy); BM = basic conceptual demand (moderate); BD = basic conceptual demand (difficult); CE = comprehension/ application (easy); CM = comprehension/ application (moderate); CD = comprehension/ application (difficult); PE = problem-solving (easy); PM = problem-solving (moderate); PD = problem-solving (difficult); P3 HG = Paper 3, NATED 550 Higher Grade

From Table 5.1.6 it can be seen that the NATED 550 Standard Grade Paper 1 contained more easy, and in some instances more easy and more moderate items, than did both the 2008 exemplar and final NSC papers. The NSC papers were clearly more difficult than the NATED 550 Standard Grade papers. While top-achieving Standard Grade learners would have been able to score 80–90% by answering only *easy-moderate* items in the Paper 1 papers correctly, learners answering the same level of items correctly in the NSC Paper 1 papers would have been likely to score only 70–80%. However, while it was slightly more difficult to score the highest grades in the NSC than in the Standard Grade papers, there were clearly still sufficient *easy* items in the NSC Paper 1 (language) papers to enable learners achieving at low levels, to pass.

The items in the final 2008 NSC Paper 1 paper which were likely to enable learners achieving at the level of just passing at Standard Grade to pass, were Item 1.1, Item 1.11, Item 1.14, Item 3.1.3, Item 4.1.1, Item 4.1.2, Item 4.1.3, Item 4.1.4, Item 4.1.5, Item 4.1.6, item 4.2, Item 4.3, Item 4.4.1, Item 4.4.2, Item 4.5.1, Item 4.6, Item 4.7, Item 4.9.1, Item 4.9.2, and Item 5.2.

To ascertain the relative difficulty levels of the Paper 3 (Writing) papers for learners achieving at the lower ends of the scale, the NATED 550 Standard Grade papers between 2005 and 2007 were compared with the NSC 2008 exemplar and final papers. To reiterate an earlier point, all items in Paper 3 were categorised by the team as being *problem-solving* types of questions. The percentages of items in the respective papers are shown in Table 5.1.7 (below).

**Table 5.1.7: Percentages of *easy*, *moderate*, and *difficult problem-solving* items in the NATED 550 Standard Grade Paper 3 (Writing) papers 2005–2007, and 2008 NSC exemplar and final Paper 3's**

| NATED 550 SG Paper 3/2008 exemplar and final papers | Number of items | PS – Easy | | PS – Moderate | | PS – Difficult | |
|---|---|---|---|---|---|---|---|
| 2005 | 11 | 1 | (9%) | 8 | (73%) | 2 | (3%) |
| 2006 | 14 | 3 | (21%) | 9 | (64%) | 2 | (14%) |
| 2007 | 12 | 3 | (25%) | 8 | (67%) | 1 | (8%) |
| 2008 exemplar | 16 | 3 | (19%) | 7 | (44%) | 6 | (38%) |
| 2008 NSC final | 12 | 2 | (17%) | 5 | (42%) | 5 | (42%) |

**Legend:**
BE = basic conceptual demand (easy); BM = basic conceptual demand (moderate); BD = basic conceptual demand (difficult); CE = comprehension/ application (easy); CM = comprehension/ application (moderate); CD = comprehension/ application (difficult); PE = problem-solving (easy); PM = problem-solving (moderate); PD = problem-solving (difficult); P1 HG = Paper 1, NATED 550 Higher Grade

From Table 5.1.7 it is clear that the NSC Paper 3 (Writing) papers contained more *difficult* items than did their NATED 550 Standard Grade equivalents. However, there were still sufficient *easy* and *moderate* items to enable learners achieving at the lower end of the scale to pass. The reader is reminded that scores are difficult to predict as learners chose any three from the available questions: learners could just as easily have selected three questions categorised by the Umalusi team as *easy*, and they could have chosen three *difficult* questions, or any other items in combination. As noted, the 2008 papers contained a good spread of genres and levels of difficulty.

### 5.1 (2.3) Comparability of the 2005–2007 English FAL papers

NATED 550 Higher and Standard Grade Papers 1, 2 and 3 were compared separately across the three years 2005, 2006, and 2007. The Umalusi team considered structural aspects of the papers, mark weightings, and the cognitive demand of items in the papers.

With respect to the NATED 550 Higher Grade Paper 1 in 2005 and 2007 – the papers were structurally similar in terms of mark allocations, and numbers of questions and items. The Higher Grade Paper 1 in 2006 included additional texts – two passages for *comprehension* and two texts for *summaries*. This amount of text was detrimental in that learners, and especially low-achievers, needed more time to read the texts on which the questions were based in these two sections. Paper 1 was thus anomalous in 2006. Only the spread of *levels* of cognitive demand of items in these papers is captured in Table 5.1.8 (below), as these percentages capture differences between the papers – *types* of cognitive demand are not included in the table.

**Table 5.1.8: Percentages of items at particular difficulty levels in the NATED 550 Higher Grade Papers 1, 2005–2007**

| EFAL NATED 550 Paper 1 HG | % Easy items | | % Moderate items | | % Difficult items | |
|---|---|---|---|---|---|---|
| 2005 (50 items) | 35 | (70%) | 7 | (14%) | 8 | (16%) |
| 2006 (49 items) | 32 | (65%) | 16 | (33%) | 1 | (2%) |
| 2007 (52 items) | 38 | (73%) | 8 | (15%) | 4 | (8%) |

From Table 5.1.8 it can be seen that the NATED 550 Paper 1 (Language) Higher Grade papers between 2005 and 2007 had roughly similar amounts of easy items. The 2005 and 2007 papers also had similar percentages of *moderate* and *difficult* items, where the 2006 paper was anomalous (easier) in 2006.

The NATED 550 Standard Grade Paper 1 (Language) papers differed slightly more across the years 2005–2007 than did their Higher Grade counterparts. This variance is captured in Table 5.1.9 (below). Again, only levels of cognitive demand (and not cognitive type) are shown, as these percentages capture differences between the papers clearly. While the 2005 and 2007 papers in this instance are still roughly similar, they differ more than do the corresponding Higher Grade versions in these years. The 2006 paper is also an outlier.

**Table 5.1.9: Percentages of items at particular difficulty levels in the NATED 550 Standard Grade Papers 1 2005–2007**

| EFAL NATED 550 Paper 1 SG | % Easy items | | % Moderate items | | % Difficult items | |
|---|---|---|---|---|---|---|
| 2005 (49 items) | 36 | (73%) | 13 | (27%) | 0 | (0%) |
| 2006 (43 items) | 24 | (56%) | 10 | (23%) | 9 | (21%) |
| 2007 (52 items) | 41 | (79%) | 8 | (15%) | 3 | (6%) |

Both of the NATED 550 Higher and Standard Grade Paper 3 (Writing) papers were fairly similar over the three years (2005–2007). The figures for the Higher and Standard Grade papers are given in Tables 5.1.10 and 5.1.11 (overpage). Percentages were remarkably similar for the Higher Grade papers considered. Again, only figures for levels of cognitive demand are shown, as these fully capture the differences between papers.

**Table 5.1.10: Percentages of items at particular difficulty levels in the NATED 550 Higher Grade Papers 3, 2006–2007**

| EFAL NATED 550 Paper 3 HG | % Easy items | | % Moderate items | | % Difficult items | |
|---|---|---|---|---|---|---|
| 2006 (14 items) | 4 | (21%) | 7 | (50%) | 3 | (29%) |
| 2007 (14 items) | 3 | (29%) | 7 | (50%) | 4 | (21%) |

**Table 5.1.11: Percentages of items at particular difficulty levels in the NATED 550 Standard Grade Papers 3, 2005–2007**

| EFAL NATED 550 Paper 3 SG | % Easy items | | % Moderate items | | % Difficult items | |
|---|---|---|---|---|---|---|
| 2005 (11 items) | 1 | (9%) | 8 | (73%) | 2 | (18%) |
| 2006 (14 items) | 3 | (21%) | 9 | (64%) | 2 | (14%) |
| 2007 (14 items) | 3 | (25%) | 7 | (67%) | 4 | (8%) |

For good measure, the provincial NATED 550 Higher Grade Paper 2 (Literature) papers were compared across the years 2006–2007.

Structurally, the Western Cape papers were more complex than those from KwaZulu-Natal were. The papers from the Western Cape contained more items than their KwaZulu-Natal counterparts (see Table 5.1.12, below). Candidates in the Western Cape would therefore have needed to read a lot more than learners in KwaZulu-Natal. The KwaZulu-Natal papers, however, contained slightly more *difficult* items.

Interestingly, none of the Higher Grade papers from either province considered contained items that the Umalusi team could categorise as *problem-solving*.

Table 5.1.12 (below) shows percentages of items at various levels of cognitive demand in the Paper 2 (Literature) Higher Grade papers from the two provinces.

**Table 5.1.12: Percentages of levels of the cognitive demand of items in some NATED 550 Higher Grade Papers 2, 2006–2007**

| Year | Province | Easy | | Moderate | | Difficult | |
|---|---|---|---|---|---|---|
| 2006 | KZN (97 items) | 50 | (52%) | 16 | (17%) | 31 | (32%) |
| 2006 | Western Cape (151 items) | 94 | (62%) | 39 | (26%) | 18 | (12%) |
| 2007 | KZN (126 ITEMS) | 87 | (69%) | 32 | (25%) | 7 | (6%) |
| 2007 | Western Cape (136 items) | 106 | (78%) | 28 | (21%) | 2 | (2%) |

From data in Table 5.1.12 it is apparent that the 2006 Higher Grade Paper 2 from KwaZulu-Natal was the most difficult of the four *literature* papers analysed, and that the papers from that province contained fewer *difficult* items than did the corresponding papers from the Western Cape. Further, percentages of items at different cognitive levels were relatively varied across the four papers analysed.

In all, considering the NATED 550 Higher and Standard Grade Papers 1, 2, and 3 analysed for the period 2005–2007, it can be said that papers were generally similar within their categories (paper type, grade level), but that there were sometimes outliers (see for example Higher Grade Paper 1, 2006). There was more variation in the provincial than the nationally set papers.

### 5.1 (2.4) Distinguishing English FAL Higher from Standard Grade papers

Bearing in mind that the NSC exam papers needed to accomplish the differentiation between learners, previously afforded by the Higher and Standard Grade papers, it is important to have an idea as to what distinguished these two levels of papers. In order to answer the question, the weighting of *marks* allocated to items at differing cognitive items were analysed for the NATED 550 papers in the years 2005–2007. Only the findings from the analysis of Paper 1 are presented here. Table 5.1.13, below, shows the weighting of marks in the respective papers (these figures are comparable to the percentages given in Tables 5.1.4 and 5.1.6.

**Table 5.1.13: Percentages of marks at differing cognitive levels in the NATED 550 Higher and Standard Grade Papers 1, 2005–2007**

| NATED 550 Paper 1 | Weighting of marks | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Easy | | Moderate | | Difficult | |
| | HG | SG | HG | SG | HG | SG |
| 2005 | 59% | 71% | 13% | 29% | 29% | 0% |
| 2006 | 53% | 44% | 35% | 34% | 13% | 23% |
| 2007 | 59% | 64% | 18% | 29% | 24% | 8% |

The data in Table 5.1.13 show that, *in general*, the Higher Grade papers included fewer *easy* items and more items categorised as *difficult*. There were however anomalies where the Standard Grade paper had fewer *easy* items and more *difficult* ones (see the 2006 papers).

### 5.1 (2.5) Overall view of 2008 NSC English FAL papers in relation to the 2005–2007 NATED 550 Higher and Standard Grade papers

Only the 2008 NSC exemplar (and not the final) papers were considered in detail in relation to the NATED 550 Higher and Standard Grade papers of 2005–2007. Knowing the relationship between the exemplar and final papers, however (see Tables 5.1.4, 5.1.5, 5.1.6, and 5.1.7) made it possible to consider some of the findings of this part of the analysis in relation to the final papers. The analysis again focused on Papers 1 and 3 for the sake of clarity.

In structure and format, the Higher and Standard Grade Papers 1 were similar to the 2008 NSC exemplar (and therefore the final) paper. Total mark allocations were roughly the same; subdivision of marks in some subsections differed (see, for instance, the reduced marks for the *comprehension* exercise and *language use* section; and the increased weighting of the visual literacy section in the NSC exemplar). Table 5.1.14 (below) shows the weighting of marks allocated to *easy, moderate,* and *difficult* items in the respective papers.

**Table 5.1.14: Percentages of marks at differing cognitive levels in the NATED 550 Higher and Standard Grade Papers 1, 2005–2007, and the 2008 exemplar papers**

| NATED 550 Paper 1 | Weighting of marks | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Easy | | Moderate | | Difficult | |
| | HG | SG | HG | SG | HG | SG |
| 2005 | 59% | 71% | 13% | 29% | 29% | 0% |
| 2006 | 53% | 44% | 35% | 34% | 13% | 23% |
| 2007 | 59% | 64% | 18% | 29% | 24% | 8% |
| 2008 NSC exemplar | 45% | | 34% | | 21% | |
| | (54% in final NSC paper) | | (21% in final NSC paper) | | (25% in final NSC paper) | |

Table 5.1.14 (see Page 30) shows that the number of marks allocated to *easy* items in the NSC exemplar Paper 1 was, with the exception of the 2006 paper, closer to that in the Higher than the Standard Grade papers. The same pattern was evident when the figures for the final NSC Paper 1 were considered.

Percentages of marks allocated for *moderate* and *difficult* items in the Higher and Standard Grade Paper 1 papers fluctuated between 2005 and 2007 – when looking at mark allocations, differences between these papers were sometimes very small. The findings here were not sufficient for comparison with the 2008 NSC exemplar and final papers: looking at trends in the Higher and Standard Grade papers over a longer period of time might have made this comparison more feasible. Similar comment could be made regarding the Paper 3 (Writing) papers.

### 5.1 (2.6) The 2008 NSC English FAL exemplar and final papers as models for future NSC exams

The Umalusi team found that the 2008 exemplar and final NSC papers for Paper 1 were *generally* good models in terms of format and structure, for future examinations. The texts used were interesting and of appropriate length; the language level was accessible and roughly tuned to accommodate learners working at both Higher and Standard Grade levels.

More specific comment on the commendable aspects of the 2008 NSC Paper 1s was as follows. First, the comprehension texts could be interpreted by most candidates. Second, the examiners used a variety of question types, such as multiple choice; questions asking for opinions; literal interpretation; and basic comprehension skills, thus testing a range of cognitive competences. Third, it was important to distinguish between characters in popular cartoons, which the papers did, rather than assuming that learners had a point of reference from which to proceed, as this assumption would not necessarily have been true for additional language learners. Fourth, the use of bracketed explanations of unfamiliar words was a good means of aiding understanding while exposing learners to new words. Fifth, the editing exercise in the exemplar was a good one as the errors were identified and underlined, making the exercise accessible for second-language users.

In some cases instructions needed to be made clearer. In the 2008 exemplar Paper 1, for example, the word count relating to the summary could have been clearer. The count could have applied to point form summary as well as to paragraphs or to the point form summary only.

On the one hand, it was expected that broadly speaking the weighting of items in the 2008 NSC Paper 1s would have given realistic indications of the capabilities of additional language learners. On the other hand, it was found that it would have be relatively easy for top-achieving learners to achieve at Levels 6 (70–79%) by answering less than half of the items categorised by the Umalusi team as *difficult*.

It was also found that the 2008 Paper 3's were good models for future examinations. In the *creative writing* (essay) section, candidates were not confined to one genre in their responses. This choice potentially provided greater chances of good performance, as learners could choose genres in which to show their strengths. In most cases, the essay topics contained were sufficiently broad to permit interpretation as *narrative, discursive* or *reflective*, and it is generally known that former Standard Grade learners usually gave narrative interpretations.

The longer and shorter transactional questions in the 2008 NSC Paper 3's were found to be accessible for learners working at levels typical of both Higher and Standard Grade. In future papers, in the sections with longer transactional texts, a greater challenge for top-achievers could have been provided in the form of a formal letter (such as a letter of application for employment).

### 5.1 (2.7) Language levels in the 2008 NSC exemplar and final English FAL papers

On the whole, the language used in the 2008 NSC exemplar and final papers was found to be suitable for South African learners. The chosen texts did not use elevated language and the phrasing of questions was plain and clear. However, the team found that there is room for improvement in some minor aspects of the papers.

### Regarding NSC Paper 1

While this paper, overall, was found to be accessible, in exemplar Paper 1 some figurative expressions were included that would not have been understood by the majority of learners. Specific examples of these expressions in 2008 NSC Paper 1 included the idiomatic/figurative language in Question 1.3; the use of the terms 'prompted' and 'claims' in Question 1.7 (where simpler alternatives could have been provided in brackets); 'accolades' and 'dignified' in 4.3 and 4.5.1 would have posed challenges. When using such difficult words, the antonyms/synonyms should be found in the text.

Final 2008 NSC Paper 1 was thought to be particularly accessible: the text for the *comprehension* question was appropriately sourced from a magazine with a second-language target market. The addition of a photograph of a hippopotamus was seen as a thoughtful way of ensuring that learners would understand the denotation of the word, "hippo".

There were also, however, small areas for improvement in this paper. Question 4.2.5 for example was found to be problematic in terms of the acceptable answer given in the memorandum. The evaluators believed that learners could have been disadvantaged if they had answered that the statement was a *fact* as, indicated in the memorandum. The second part of the question, which asked for a reason for learners' answers, could also have been used to support an answer that the statement was factual. The Umalusi team also found the *dictionary question* in the exemplar more appropriate than that in the final paper, as the former modelled what an actual dictionary contains.

### Regarding NSC Paper 3

In exemplar Paper 3, although no major challenges were found, the odd term such as "evident" in the second bulleted instruction and "substantiated" in Question 1.6 could have been problematic for additional language users. Such terms could in future be replaced with simpler alternatives such as "clear" or "supported" respectively.

The team was, however, of the opinion that the style in which Paper 3 was presented, was constraining. Examiners were clearly attempting to assist the learners by providing 'guidance' about what could be written, but this potentially constrained, not only a more three-dimensional definition of genre, but also the creative style of learners.

## SUMMARY OF EXAM PAPER ANALYSIS: ENGLISH FAL

Given that the 2008 NSC exam papers needed to accomplish the discrimination of learners previously achieved by both NATED 550 Higher and Standard Grade papers, the English FAL team commented on whether A-grades (Level 7 achievement) in the 2008 NSC final papers would be equivalent to A-grades on the old Higher Grade level. The team also considered whether learners achieving at levels comparable to just passing on Standard Grade level, would be likely to pass the 2008 NSC English FAL exam. Table 20 (immediately below) provides a summary of percentages of marks allocated for items at particular levels of cognitive difficulty in the English FAL exam papers.

**Table 5.1.15: Percentages of marks allocated for items at particular levels of difficulty in selected NATED 550 Higher and Standard Grade, and NSC English FAL exam papers**

| NATED 550 Paper 1 | Weighting of marks | | | | | |
|---|---|---|---|---|---|---|
| Year | Easy | | Moderate | | Difficult | |
| | HG | SG | HG | SG | HG | SG |
| 2005 | 59% | 71% | 13% | 29% | 29% | 0% |
| 2006 | 53% | 44% | 35% | 34% | 13% | 23% |
| 2007 | 59% | 64% | 18% | 29% | 24% | 8% |
| Average 2005-2007 marks | 57% | 60% | 22% | 31% | 22% | 10% |
| 2008 exemplar | | 45% | | 34% | | 21% |
| 2008 final NSC | | 54% | | 21% | | 25% |

It can be seen in Table 5.1.15 (above) that the percentages of marks allocated for items at *easy, moderate,* and *difficult* levels in the 2008 NSC exams, is closer to those in the HG than the SG NATED 550 exams. It could thus be said that for the top achievers the 2008 NSC exams would have been as challenging as the NATED 550 Higher Grade exams.

The data in Table 5.1.15 also suggest that there are sufficient *easy* and *moderate* items to enable learners achieving at levels typical of learners just passing at the old Standard Grade level to pass. The combined percentage of marks for easy and moderate items is slightly lower in the 2008 final NSC Paper 1 than it was on average in the NATED 550 Standard Grade papers, but it is still sufficiently high by a very safe margin.

The Paper 2 (Writing) papers for the subject were not analysed in detail, as unlike Papers 1 and 3 in each instance, they were provincially rather than nationally set.

The spread of *easy, moderate,* and *difficult* items in the respective Papers 3 for English FAL was roughly consistent across the NATED 550 Higher and Standard Grade papers considered (2005–2007) and the 2008 NSC exemplar and final papers. The team found that learners would have similar opportunities to achieve comparable marks across the NATED 550 and NSC examinations. However, it was not possible to make definitive judgments here, as the levels of difficulty of questions attempted by learners depended on the genres they selected, and on their three questions chosen from the range on offer.

## 5.2 GEOGRAPHY

The Umalusi Geography team benchmarked the 2008 NSC Geography exams by categorising the types of cognitive demand and levels of difficulty of items (questions and sub-questions) in the NATED 550 Higher and Standard Grade exam papers for 2005, 2006 and 2007, and the NSC exemplar and final examination papers for 2008.

The following 16 exam papers were analysed:

- 2005 NATED 550 Higher and Standard Grade Geography Papers 1 and 2
- 2006 NATED 550 Higher and Standard Grade Geography Papers 1 and 2
- 2007 NATED 550 Higher and Standard Grade Geography Papers 1 and 2
- 2008 NSC exemplar and final Geography Papers 1 and 2

This Geography exam paper analysis has three sections. The first covers the method used for analysis. The second details the results of this analysis, and the third, the answers to the research questions regarding the respective levels of difficulty of the various exams.

## 5.2 (1) Method of analysis used for the Geography exam papers

The analytical tool focuses on, first, the type of cognitive demand expected in each of the subsections of the questions, and second, the levels of difficulty of these items (see Table 5.2.1, below).

**Table 5.2.1: Framework of types of cognitive demand and levels of difficulty**

| Type of Cognitive Demand | Level of difficulty | Coding |
|---|---|---|
| **Basic conceptual, knowledge**<br>- recall,<br>- literal comprehension,<br>- making simple evaluative judgements in terms of previously acquired facts,<br>- etcetera. | Easy | BE |
| | Moderate | BM |
| | Difficult | BD |
| **Comprehension, Application**<br>- understanding, application, analysis of previously acquired information in a familiar context,<br>- making evaluative judgments that require the use of a range of previously acquired facts/information<br>- etcetera | Easy | CE |
| | Moderate | CM |
| | Difficult | CD |
| **Problem-solving**<br>- analysis, interpretation and application of information in a new or unfamiliar context;<br>- synthesis, creation of novel solution or product;<br>- evaluation or making judgement in relation to a mixture of old and new material or information | Easy | PE |
| | Moderate | PM |
| | Difficult | PD |

**Legend:**
BE = basic conceptual demand (easy); BM = basic conceptual demand (moderate); BD = basic conceptual demand (difficult); CE = comprehension/ application (easy); CM = comprehension/ application (moderate); CD = comprehension/ application (difficult); PE = problem-solving (easy); PM = problem-solving (moderate); PD = problem-solving (difficult); P1 HG = Paper 1, NATED 550 Higher Grade

Individual items were allocated cognitive type and difficulty levels and types and levels of items were totalled for each exam paper, making comparison of papers in these terms possible.


## 5.2 (2) Results of the Geography exam paper analyses

It must be noted that judgments relating to the cognitive types and levels of items are embedded in the professional knowledge and experience of individual team members. That this knowledge and experience varied considerably between Umalusi Geography team members potentially posed a threat to the reliability of the results. To address this difficulty, after initial analysis the findings were subjected to statistical scrutiny, and where significant differences were detected between evaluators the team evaluated the questions again, collaboratively. In these instances re-evaluation led to discussion of the tool, and high degrees of common understanding and overlap in judgements.

In the course of analysis, an additional dimension was acknowledged – that of types of knowledge (factual, procedural, conceptual and meta-cognitive), within which types and levels of cognitive demand are situated. This dimension was not included in the analysis, but could in future contribute to a more nuanced analysis of exam questions.

Further, for the purposes of this analysis, data for the two Geography exam papers (Papers 1 and 2) in instances are presented separately, and are in some instances combined. It is worth noting that the papers assess different competences, as outlined here.

- **Paper 1** was aimed primarily at assessing the Geography learner's *foundational* and *reflexive* competences. These aspects deal with learners' ability to apply acquired geographical knowledge and skills in familiar and unfamiliar situations.
- **Paper 2**, on the other hand, was usually based on topographical and orthophoto maps of areas in South Africa, and was focused primarily on assessing learners' *practical* competence. Coupled with this focus is also the element of *applying* geographical knowledge and skills in the context of the mapped area.

So, although the current analyses are conducted at a higher level of generalisation – around the same variables (types and levels of cognitive demand) for both papers – the reader could bear in mind that the variables are applied with differing foci; approaches; and epistemological bases in the two papers. Table 5.2.2 summarises the composite results of the geography team's analyses.

**Table 5.2.2: Results of the analysis of Geography examination papers, 2005–2008**

| Geography examination paper | | Type of cognitive demand | | | Level of difficulty | | |
|---|---|---|---|---|---|---|---|
| | | Basic, conceptual knowledge | Compre-hension application | Problem-solving | Easy | Moderate | Difficult |
| Paper 1 | HG 2005 | 38,1% | 54,0% | 7,9% | 47,7% | 30,2% | 22,1% |
| | HG 2006 | 29,6% | 62,8% | 7,7% | 31,5% | 55,5% | 13,0% |
| | HG 2007 | 53,3% | 44,0% | 2,7% | 46,0% | 49,3% | 4,7% |
| | **HG Average** | **40,3%** | **53,6%** | **6,1%** | **41,7%** | **45,0%** | **13,3%** |
| | SG 2005 | 56,9% | 35,9% | 7,2% | 39,2% | 54,7% | 6,1% |
| | SG 2006 | 50,9% | 42,0% | 7,1% | 44,2% | 48,7% | 7,1% |
| | SG 2007 | 60,0% | 33,8% | 6,2% | 39,6% | 53,6% | 6,8% |
| | **SG Average** | **55,9%** | **37,2%** | **6,8%** | **41,0%** | **52,3%** | **6,7%** |
| | 2008 Exemplar | 47,0% | 49,5% | 3,5% | 49,5% | 43,5% | 7,0% |
| | 2008 Final | 40,5% | 50,0% | 9,5% | 39,5% | 45,0% | 15,5% |
| Paper 2 | HG 2005 | 38,8% | 61,2% | 0,0% | 47,5% | 32,5% | 20,0% |
| | HG 2006 | 36,0% | 53,0% | 11,0% | 35,0% | 54,0% | 11,0% |
| | HG 2007 | 54,0% | 24,0% | 22,0% | 56,0% | 28,0% | 16,0% |
| | **HG Average** | **42,9%** | **46,1%** | **11,0%** | **46,2%** | **38,2%** | **15,6%** |
| | SG 2005 | 56,7% | 35,0% | 8,3% | 23,3% | 60,0% | 16,7% |
| | SG 2006 | 68,0% | 32,0% | 0,0% | 42,7% | 52,0% | 5,3% |
| | SG 2007 | 64,0% | 30,7% | 5,3% | 64,0% | 24,0% | 12,0% |
| | **SG Average** | **62,9%** | **32,6%** | **4,5%** | **43,3%** | **45,4%** | **11,3%** |
| | 2008 Exemplar | 68,0% | 32,0% | 0,0% | 41,0% | 46,0% | 13,0% |
| | 2008 Final | 32,0% | 64,0% | 4,0% | 36,0% | 41,0% | 23,0% |

The figures in Table 5.2.2 have been used to generate Graphs 1–8 that follow, showing the relationship between items in the NATED 550 Higher and Standard Grade, and NSC exemplar and final papers for Paper 1, on the one hand (see Graphs 5.2.1, 5.2.2, 5.2.5, and 5.2.7), and comparison of items in the NATED 550 Higher and Standard Grade and NSC exemplar and final papers for Paper 2, on the other hand (see Graphs 5.2.3, 5.2.4, 5.2.6, and 5.2.8).

**Graph 5.2.1: Comparing NATED 550 Higher Grade and NSC exemplar Papers 1 for Geography in terms of type of cognitive demand and level of difficulty**



| | Basic, conceptual knowledge | Comprehension, application | Problem-solving | Easy | Moderate | Difficult |
|---|---|---|---|---|---|---|
| 2005 HG P1 | 38.1 | 54.0 | 7.9 | 47.7 | 30.2 | 22.1 |
| 2006 HG P1 | 29.6 | 62.8 | 7.7 | 31.5 | 55.5 | 13.0 |
| 2007 HG P1 | 53.3 | 44.0 | 2.9 | 46.0 | 49.3 | 4.7 |
| 2008 Exemplar | 47.0 | 49.5 | 3.5 | 49.5 | 43.5 | 7.0 |

TYPE OF COGNITIVE DEMAND AND LEVEL OF DIFFICULTY
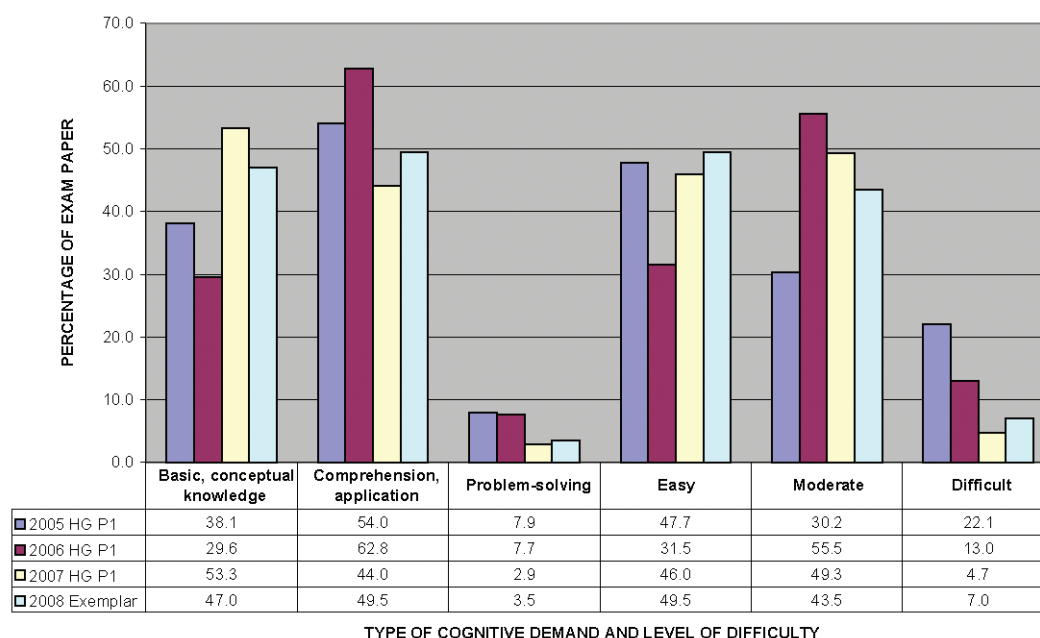
**Graph 5.2.2: Comparing NATED 550 Standard Grade and NSC exemplar Papers 1 for Geography**



| | Basic, conceptual knowledge | Comprehension, application | Problem-solving | Easy | Moderate | Difficult |
|---|---|---|---|---|---|---|
| 2005 SG P1 | 56.9 | 35.9 | 7.2 | 39.2 | 54.7 | 6.1 |
| 2006 SG P1 | 50.9 | 42.0 | 7.1 | 44.2 | 48.7 | 7.1 |
| 2007 SG P1 | 60.0 | 33.8 | 6.2 | 39.6 | 53.6 | 6.8 |
| 2008 Exemplar | 47.0 | 49.5 | 3.5 | 49.5 | 43.5 | 7.0 |

TYPE OF COGNITIVE DEMAND AND LEVEL OF DIFFICULTY

**Graph 5.2.3: Comparing NATED 550 Higher Grade and NSC exemplar Papers 2 for Geography in terms of type of cognitive demand and level of difficulty**



| | Basic, conceptual knowledge | Comprehension, application | Problem-solving | Easy | Moderate | Difficult |
|---|---|---|---|---|---|---|
| 2005 HG P2 | 38.8 | 61.2 | 0.0 | 47.5 | 32.5 | 20.0 |
| 2006 HG P2 | 36.0 | 53.0 | 11.0 | 35.0 | 54.0 | 11.0 |
| 2007 HG P2 | 54.0 | 24.0 | 22.0 | 56.0 | 28.0 | 16.0 |
| 2008 Exemplar | 68.0 | 32.0 | 0.0 | 41.0 | 46.0 | 13.0 |

TYPE OF COGNITIVE DEMAND AND LEVEL OF DIFFICULTY
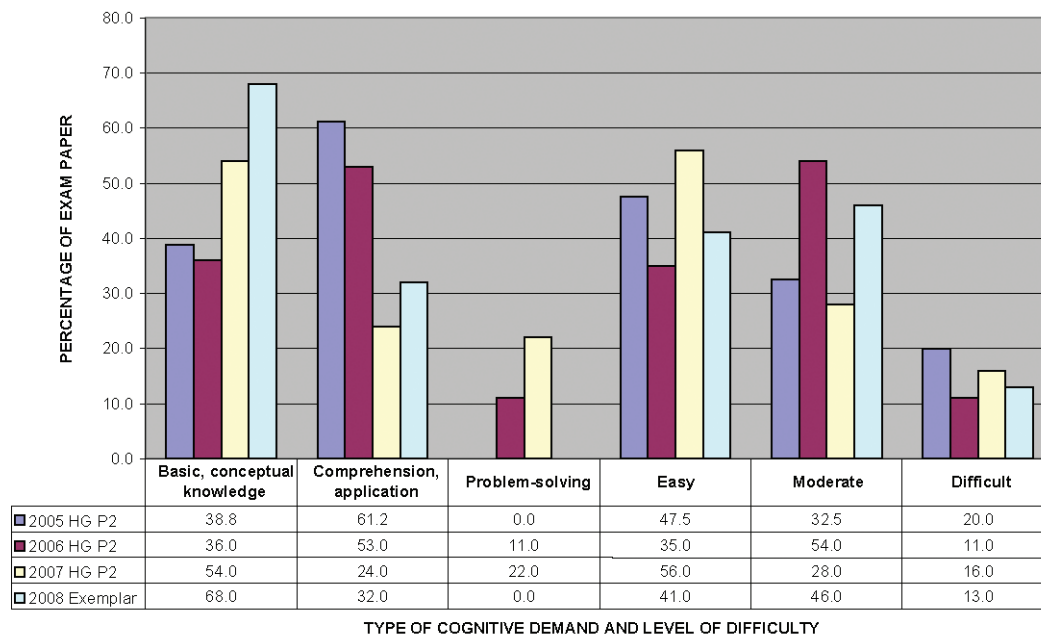
**Graph 5.2.4: Comparing NATED 550 Standard Grade and NSC exemplar Papers 2 for Geography in terms of type of cognitive demand and level of difficulty**



| | Basic, conceptual knowledge | Comprehension, application | Problem-solving | Easy | Moderate | Difficult |
|---|---|---|---|---|---|---|
| 2005 SG P2 | 56.7 | 35.0 | 8.3 | 23.3 | 60.0 | 16.7 |
| 2006 SG P2 | 68.0 | 32.0 | 0.0 | 42.7 | 52.0 | 5.3 |
| 2007 SG P2 | 64.0 | 30.7 | 5.3 | 64.0 | 24.0 | 12.0 |
| 2008 Exemplar | 68.0 | 32.0 | 0.0 | 41.0 | 46.0 | 13.0 |

TYPE OF COGNITIVE DEMAND AND LEVEL OF DIFFICULTY
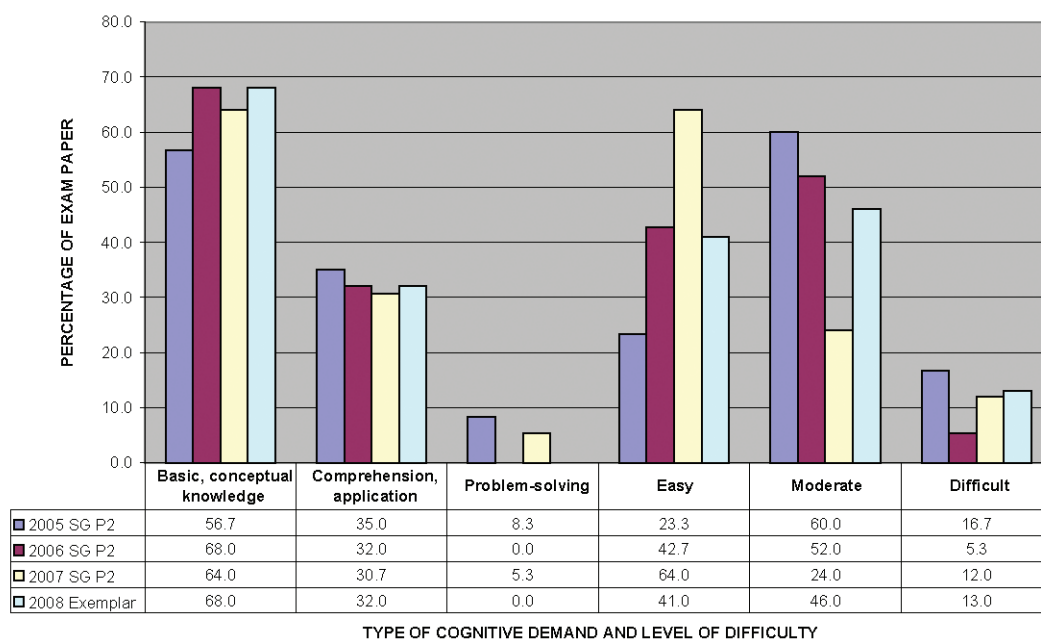
**Graph 5.2.5: Comparing NATED 550 Higher Grade and NSC final Papers 1 for Geography in terms of type of cognitive demand and level of difficulty**



| | Basic, conceptual knowledge | Comprehension, application | Problem-solving | Easy | Moderate | Difficult |
|---|---|---|---|---|---|---|
| NATED 550 HG Paper 1 | 40.3 | 53.6 | 6.1 | 41.7 | 45.0 | 13.3 |
| 2008 FINAL Paper 1 | 40.5 | 50.0 | 9.5 | 39.5 | 45.0 | 15.5 |

TYPE OF COGNITIVE DEMAND AND LEVEL OF DIFFICULTY
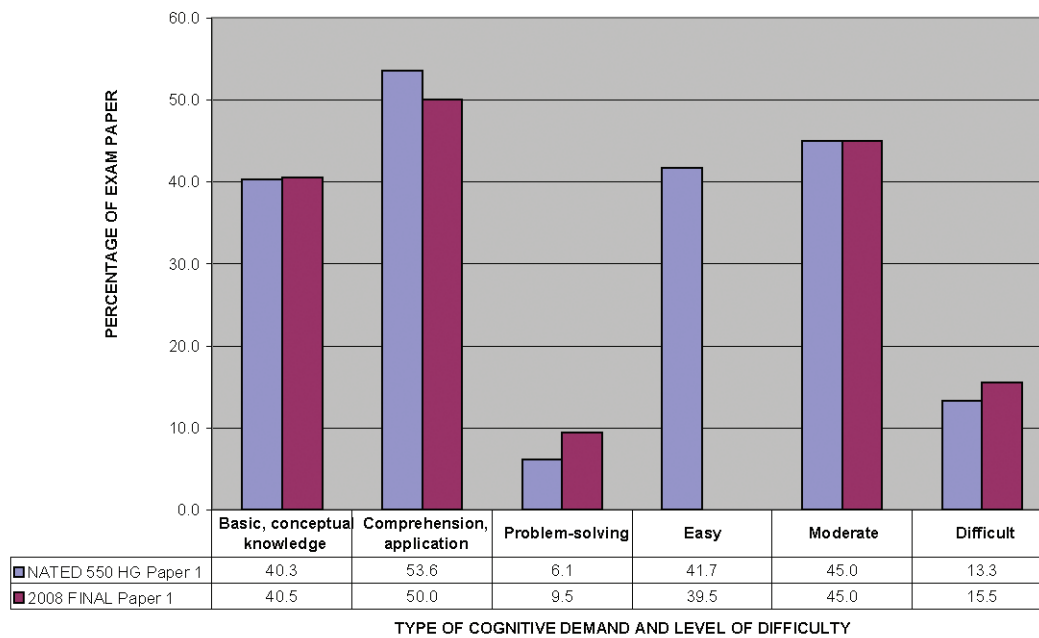
**Graph 5.2.6: Comparing NATED 550 Higher Grade and NSC final Papers 2 for Geography in terms of type of cognitive demand and level of difficulty**



| | Basic, conceptual knowledge | Comprehension, application | Problem-solving | Easy | Moderate | Difficult |
|---|---|---|---|---|---|---|
| NATED 550 HG Paper 2 | 42.9 | 46.1 | 11.0 | 46.2 | 38.2 | 15.6 |
| 2008 FINAL Paper 2 | 32.0 | 64.0 | 4.0 | 36.0 | 41.0 | 23.0 |

TYPE OF COGNITIVE DEMAND AND LEVEL OF DIFFICULTY
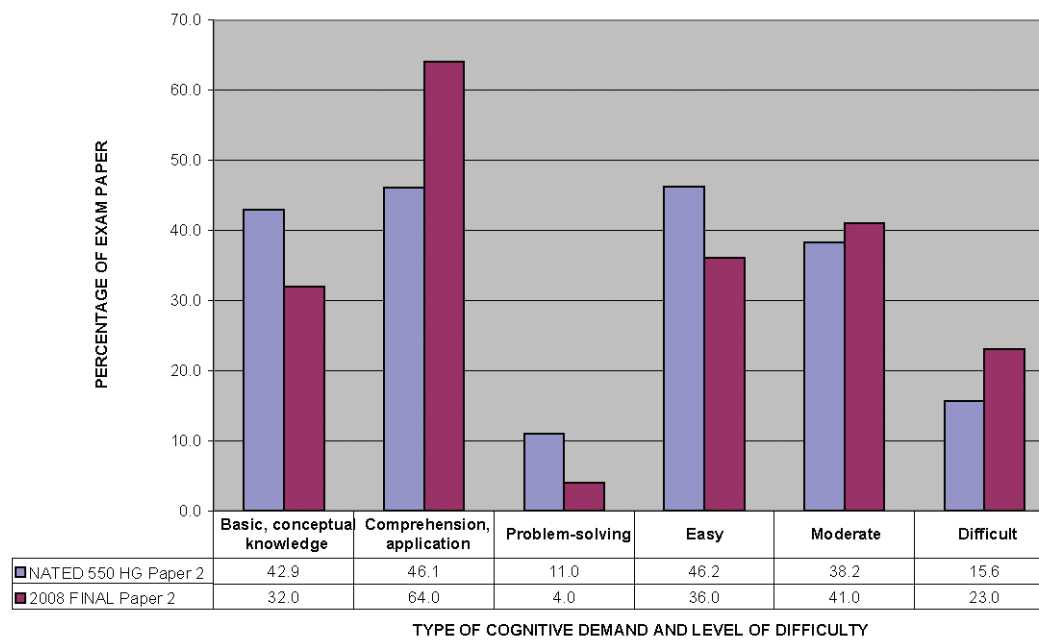
**Graph 5.2.7: Comparing NATED 550 Standard Grade and NSC final Papers 1 for Geography in terms of type of cognitive demand and level of difficulty**



| | Basic, conceptual knowledge | Comprehension, application | Problem-solving | Easy | Moderate | Difficult |
|---|---|---|---|---|---|---|
| NATED 550 SG Paper 1 | 55.9 | 37.2 | 6.8 | 41.0 | 52.3 | 6.7 |
| 2008 FINAL Paper 1 | 40.5 | 50.0 | 9.5 | 39.5 | 45.0 | 15.5 |

TYPE OF COGNITIVE DEMAND AND LEVEL OF DIFFICULTY
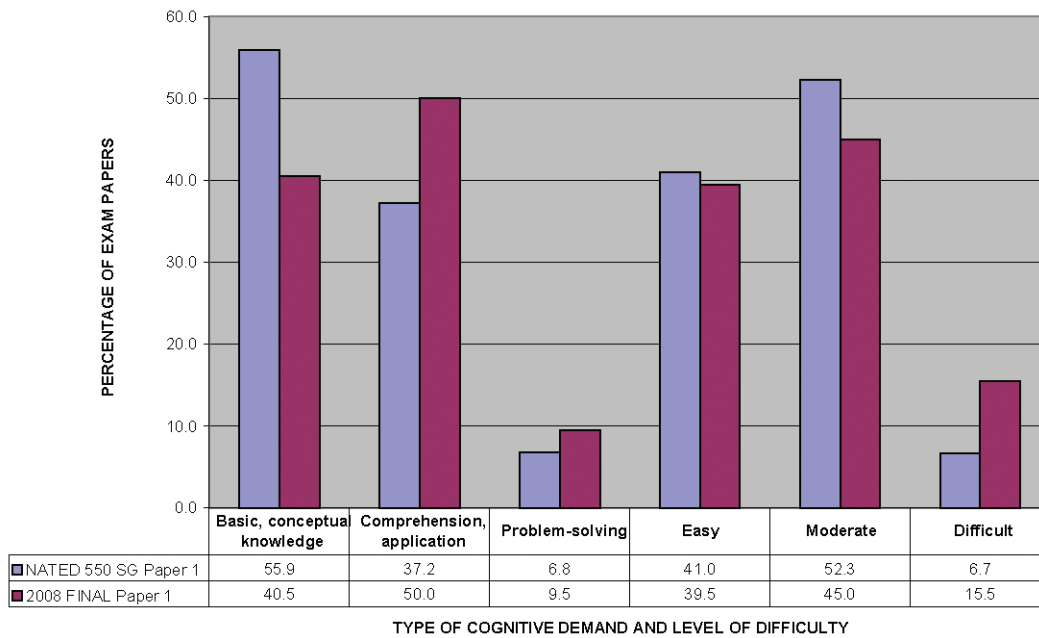
**Graph 5.2.8: Comparing NATED 550 Standard Grade and NSC final Papers 2 for Geography in terms of type of cognitive demand and level of difficulty**



| | Basic, conceptual knowledge | Comprehension, application | Problem-solving | Easy | Moderate | Difficult |
|---|---|---|---|---|---|---|
| NATED 550 SG Paper 2 | 62.9 | 32.6 | 4.5 | 43.3 | 45.4 | 11.3 |
| 2008 FINAL Paper 2 | 32.0 | 64.0 | 9.0 | 36.0 | 41.0 | 23.0 |

TYPE OF COGNITIVE DEMAND AND LEVEL OF DIFFICULTY
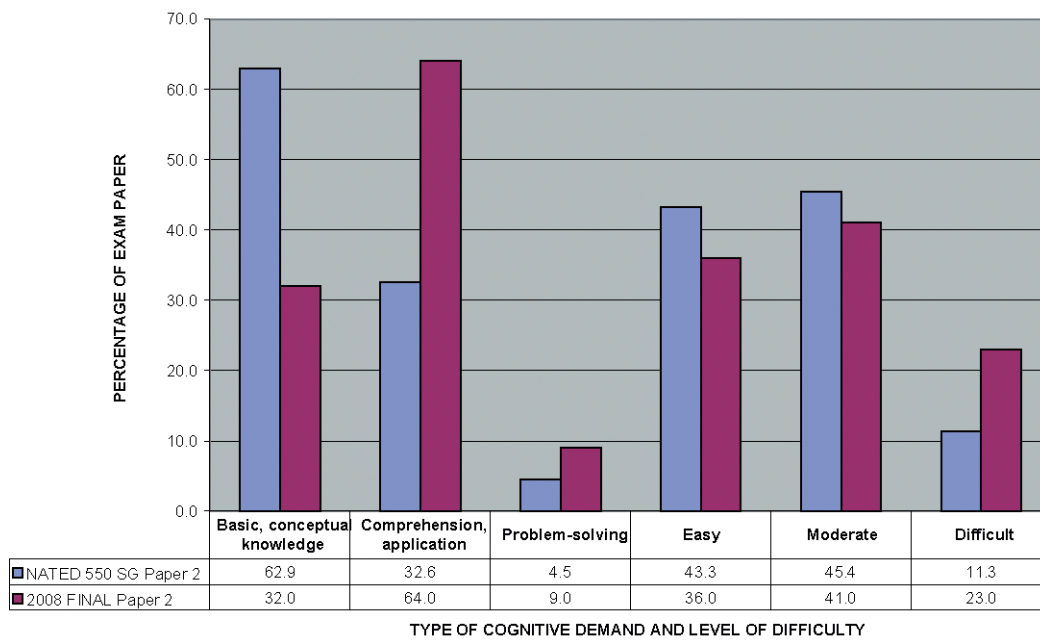
## 5.2 (3) Discussion of Geography exam paper analysis results

In this section the Umalusi Geography team answered the eight research questions asked of the exam paper analysis.

### 5.2 (3.1) Distinguishing Geography highest level achievers

In order to answer the question as to whether the A-grades received by learners in the 2008 NSC exemplar and final papers are equivalent to the A-grades received in relation to typical NATED 550 Higher Grade papers for the subject, the team looked at the characteristics of the old Higher Grade papers. Previously, achievement of A-grades required not only a high command of *basic, conceptual knowledge* but also competence when answering questions demanding comprehension, application, and problem-solving.

Table 5.2.2 and Graph 5.2.1 show that more than half of the questions in the NATED 550 HG Paper 1 papers between 2005 and 2007 fall into these high-level categories (there are an average of 53,6% *comprehension and application-type* items and 6,1% of *problem-solving–type* items). There are fewer of this type of item in the NSC exemplar Paper 1 (49,5% and 3,5% respectively). There are also a greater number of items in the category basic, *con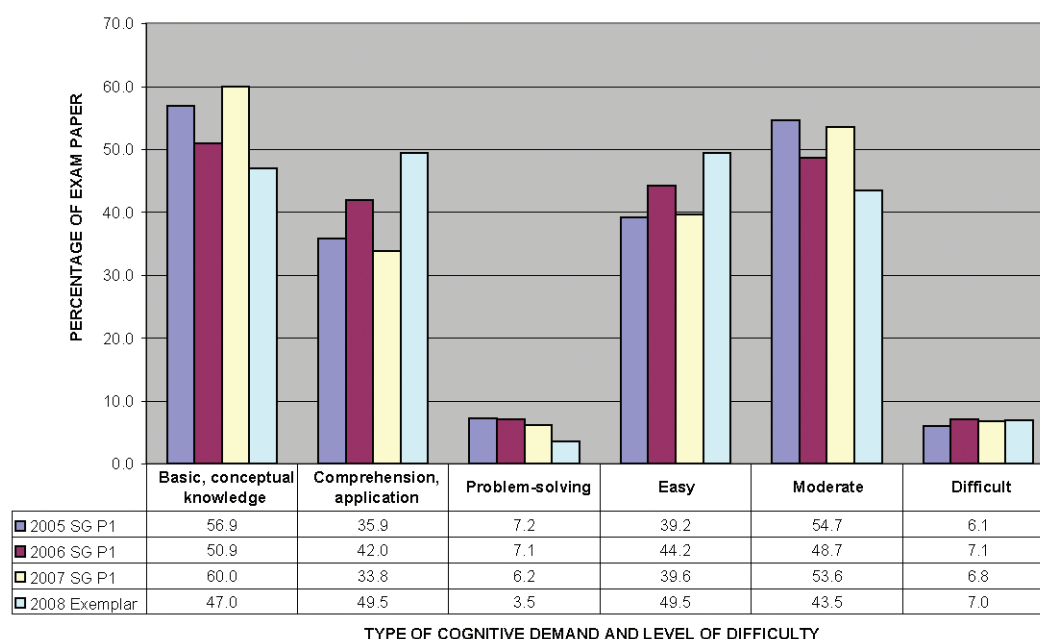ceptual knowledge* in the 2008 exemplar, compared with the Higher Grade average for these items (47% and 40.3% in the respective papers). In short, the exemplar Paper 1 was easier than its Higher Grade counterpart.

NSC exemplar Paper 2 was similarly easier than its Higher Grade counterparts. There are on average 20% more items involving *basic, conceptual knowledge* in the Higher Grade than in the NSC Paper 2 papers. Further, in the 2008 exemplar Paper 2, there were no questions testing learners' ability to problem-solve (see Table 5.2.3).

When comparing the NATED 550 Higher Grade Papers 1 and 2 to the *final* NSC Papers 1 and 2 (Graphs 5.2.5 and 5.2.6), however, a high degree of similarity can be seen. In other words, levels of cognitive complexity in the Higher Grade and NSC final papers were found to be equivalent: the 2008 Geography exemplar papers were easier than the final ones.

In the 2008 final NSC Paper 1 there is a slight increase in the number of questions demanding *problem-solving*. The shift is clearly evident in Graph 6 which shows fewer easy questions involving *basic conceptual knowledge* and more questions demanding moderate and difficult *comprehension, application* and *problem-solving* items in Paper 2. This pattern is to be expected in the context of the learning outcomes that drive assessment in the NCS.

On closer analysis of the final 2008 NSC Paper 1, it was noted that learners' choice of questions could potentially have affected their chances of attaining A-grades (see categorisation of items according to questions in this paper in Table 5.2.3 (overpage).

**Table 5.2.3: Analysis of questions of the NCS Final 2008 Paper 1, showing percentage of items for different cognitive types and levels**

| Item | Q1 | Q2 | Q3 | Q4 |
|---|---|---|---|---|
| **Cognitive demand** | | | | |
| % B | 40 | 52 | 38 | 32 |
| % C | 48 | 38 | 58 | 56 |
| % P | 12 | 10 | 4 | 12 |
| **Level of difficulty** | | | | |
| % E | 46 | 46 | 30 | 36 |
| % M | 28 | 46 | 42 | 64 |
| % D | 26 | 8 | 28 | 0 |

In Table 5.2.3 it can be seen that of the four questions set, learners had to choose one question from Section A (Physical Geography), one from Section B (Human Geography) and a third from any of the questions not yet completed. Since Questions 2 and 4 contained considerably fewer difficult items than Questions 1 and 3, learners selecting these questions would have had greater chances of scoring high grades. Further, in Question 3, new terminology was introduced and examined – examples being Item 3.3.5: "shanty town"; Item 3.5.2: "trans-national co-operation"; and Item 3.5.6: "sweatshop". The fact that these concepts do not feature in the curriculum would have contributed to the difficulty of the question.

The most difficult items in NSC exemplar Paper 1 are Item 1.4, Item 2.4, and Item 4.2; and in Paper 2, Items 2.5.1 and 3.6. Those in the final NSC Geography Paper 1 are Item 1.4.3, Item 1.5.2(c), Item 1.5.3, Item 1.6.4, Item 2.5.2(d), Item 3.3.3, Item 3.3.4, Item 3.3.6, Item 3.5.4, Item 3.5.5, Item 3.5.8; and in Paper 2, Items 2.2, 2.3, 2.5 and 3.4.

### 5.2 (3.2) Determining average achievement in Geography

The average learner just passing at the level of the NATED 550 Standard Grade papers would have been able to recall *basic, conceptual knowledge* and, to a lesser extent, answer questions in the category of *comprehension and application*. Comparing the average Standard Grade Paper 1 and the NSC exemplar in terms of *basic, conceptual knowledge* showed a decrease in this type of item from 55.9% to 47,0% in 2008. While there was an increase in items involving comprehension and application, there was also a decrease in questions requiring *problem-solving* (see Graph 5.2.2). Standard Grade Paper 2 was found to be roughly similar to its corresponding NSC exemplar (see Table 5.2.4).

While the 2008 NSC exemplar papers were roughly similar to - if a little harder in part - than their Standard Grade equivalents, there was a shift towards higher levels of cognitive demand in general, and the inclusion of more *difficult* questions, in particular, in the final 2008 papers (see Graphs 5.2.7 and 5.2.8). In both final NSC Papers 1 and 2, fewer items requiring only *basic conceptual knowledge* and very few easy questions were included. At the other end of the continuum, it is clear from these graphs that considerably more *problem-solving* and *difficult* questions were included in the NSC papers.

The Umalusi Geography team's consensus was that the 2008 final NCS papers were pitched at levels closer to those found in previous Higher Grade papers than in the Standard Grade counterparts. It was expected that average learners would pass the exemplar papers, and struggle with the final papers. Further, the team noted that the exemplar papers might have sent false signals regarding expected difficulty levels in the final Geography exams.

Items potentially enabling learners achieving at levels typical of those just passing Standard Grade in the exemplar papers were, in exemplar Paper 1, Item 1.1, Item 1.2, Item 1.3, Item 2.1, Item 2.2, Item 3.1, Item 3.2, Item 4.1, Item 4.2, and Item 4.4; and in Paper 2, Item 1, Item 3, and Item 4. Such items in the final 2008 papers would have been, in Paper 1.

### 5.2 (3.3) Comparability of the 2005–2007 Geography papers

Again drawing on data in Table 5.2.2, Graphs 5.2.9 and 5.2.10, below have been created to compare the 2005–2007 Higher and Standard grade papers respectively.

**Graph 5.2.9: Comparing NATED 550 Higher Grade papers between 2005 and 2007**



| | Basic, conceptual knowledge | Comprehension, application | Problem-solving | Easy | Moderate | Difficult |
|---|---|---|---|---|---|---|
| 2005 HG P1&2 | 38.5 | 57.6 | 3.9 | 47.6 | 31.4 | 21.1 |
| 2006 HG P1&2 | 32.8 | 57.9 | 9.4 | 33.3 | 54.8 | 12.0 |
| 2007 HG P1&2 | 53.7 | 34.0 | 12.4 | 51.0 | 38.7 | 10.4 |

TYPE OF COGNITIVE DEMAND AND LEVEL OF DIFFICULTY
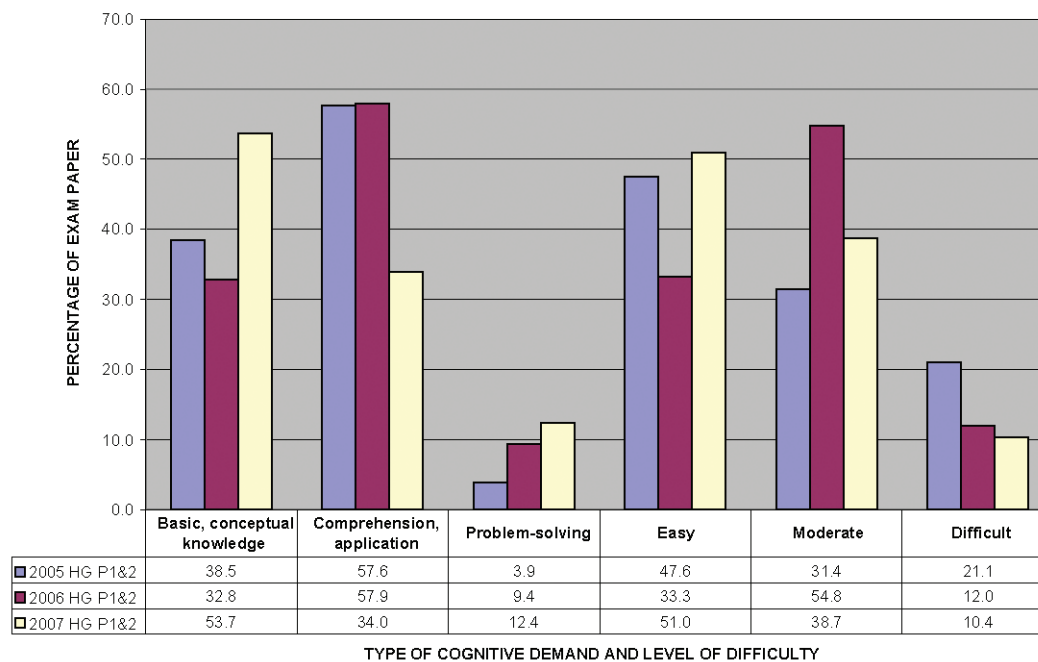
**Graph 5.2.10: Comparing NATED 550 Standard Grade papers between 2005 and 2007**



| | Basic, conceptual knowledge | Comprehension, application | Problem-solving | Easy | Moderate | Difficult |
|---|---|---|---|---|---|---|
| 2005 SG P1&2 | 56.8 | 35.5 | 7.8 | 31.3 | 57.4 | 11.4 |
| 2006 SG P1&2 | 59.5 | 37.0 | 3.6 | 43.5 | 50.4 | 6.2 |
| 2007 SG P1&2 | 62.0 | 32.3 | 5.8 | 51.8 | 38.8 | 9.4 |

TYPE OF COGNITIVE DEMAND AND LEVEL OF DIFFICULTY
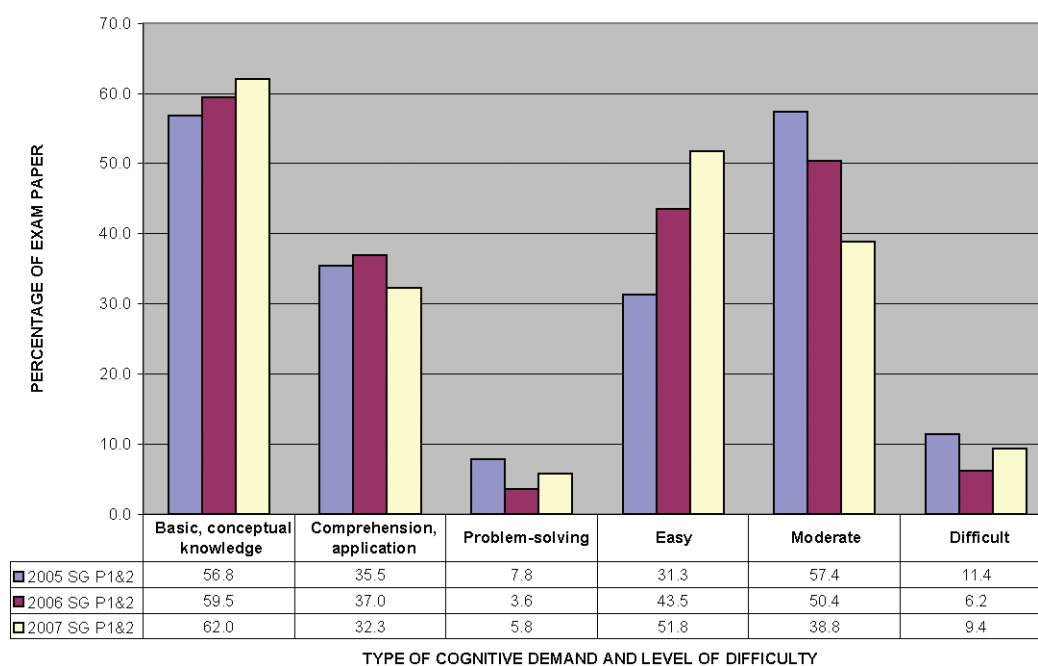
Considering the degree of consistency across NATED 550 Higher Grade papers from 2005 to 2007, (Graph 5.2.10) shows that there were fluctuations in the types and levels of cognitive difficulty of items in these papers. In 2007, the proportions of items decreased with increasing levels of cognitive difficulty. The 2005 and 2006 papers contained considerably higher numbers of items in the category *comprehension and application* than did the 2007 papers. The papers do not move uniformly in any particular cognitive direction.

The Standard Grade papers, on the other hand, are more comparable across the three years, if only roughly so (see Graph 5.2.10). During this period, a general trend towards inclusion of increasing numbers of easier questions requiring *basic conceptual knowledge* was evident. There was a corresponding general decrease in proportions of *moderate* questions and questions that require *comprehension and application*. It appears that amounts of *difficult* items and those involving *problem-solving* were roughly similar across the three years. There was some variation, but these differences still fall within a general pattern.

### 5.2 (3.4) Distinguishing Geography Higher and Standard Grade levels

When trying to distinguish Higher from Standard Grade papers in general, definitive trends emerged (see Table 5.2.2 and Graphs 5.2.1–5.2.8). The following points can be made:

**a)** The Higher and Standard Grade papers differ significantly in the respective proportions of items classified as *comprehension, application* and *problem-solving* included. The Higher Grade papers contain higher proportions of these types of item than do their Standard Grade equivalents.

**b)** The two sets of papers appear to have similar proportions of items at the three difficulty levels, namely *easy : moderate : difficult*. In both sets of papers there tend to be slightly more moderate than easy questions, and fewer *difficult* than *easy* and *moderate* questions. The fact that there are slightly more items at the moderate level in the Standard Grade papers could be ascribed to the fact that considerably fewer *difficult* items were included than in the Higher Grade equivalents.

**c)** An important general difference between the Higher and Standard Grade papers is that more items that can be classified as both *problem-solving* and *difficult* in the HG papers (see Table 5.2.2).

### 5.2 (3.5) Overall view of 2008 NSC Geography exemplar and final papers in relation to their 2005–2007 NATED 550 Higher and Standard Grade counterparts

It was found that while the NSC exemplar Paper 1 was roughly midway between the levels of the previous Higher and Standard Grade papers for the subject, the final NSC Paper 1 was closer to the NATED 550 Higher Grade papers than their Standard Grade counterparts (see Table 5.2.2, above). Like the final NSC Paper 1, the final NSC Paper 2 was also found to be closer in terms of types and levels of cognitive complexity to previous Higher Grade papers. In the case of Paper 2, however, the NSC exemplars were closer to previous Standard Grade than being midway between Higher and Standard Grade.

In short, the 2008 Final NSC Papers 1 and 2 are more difficult than the NATED 550 papers preceding them. They contain higher percentages of items categorised as *comprehension and application* and *problem-solving*. They have correspondingly lower counts of items requiring *basic, conceptual knowledge*.

Interestingly, the proposed ratio of lower to middle to higher order questions in the *Subject Assessment Guidelines* for Geography (see Geography Document 4 in the Reference section below) is 30%:40%:30%. While the spread of types and levels of items in the NATED 550 Higher and Standard Grade papers, and the in the NSC exemplar papers do not match that suggested in the document, those in the final 2008 papers are closer.

### 5.2 (3.6) The 2008 NSC Geography exemplar and final papers as models for future NSC exams

The team found that some aspects of the 2008 exemplar papers could be carried forward in the design of future Geography papers. Learning Outcomes 1 and 2 are thoroughly assessed in the exemplars. Learning Outcome 3, which deals with the application of skills and knowledge in different situations, as well as engaging learners with attitudes and values that may impact on human-environment relations, is not sufficiently assessed. Further, in order to match more closely the proposed ratio of lower, middling, and higher order questions suggested in the *Subject Assessment Guidelines* (Geography Document 4), more items relating to Learning Outcome 3 need to be included. These items need to include questions requiring learners to solve problems in both familiar and unfamiliar contexts.

These limitations in the exemplars are further highlighted by the small number of items requiring learners to *apply* acquired skills and to *solve problems*. In the 2008 NSC exemplar Paper 1, for example, there are fewer *problem-solving* items than the average percentages for both NATED Higher and Standard Grade papers. In 2008 NSC exemplar Paper 2, no *problem-solving* questions were asked (see Table 5.2.2). The team was convinced that the 2008 exemplar papers sent the wrong messages to Geography teachers and learners.

The *2008 final papers* are, in contrast, good models according to which future examinations could be developed. They comprise different types of items allowing examiners, not only to find ways of assessing learners with differing learning styles, but also to cater for learners with differing intellectual abilities. Items range from requiring straightforward *recall* to more complex *problem-solving*. A welcome new trend is created with the many more 'interactive items' for which learners are expected to imagine themselves in different situations (see for example Paper 1, Items 1.3 and 2.4.3; and in Paper 2, Item 4.5).

Also part of this trend, are items where learners are introduced to different scenarios (see for instance Paper 1, Items 2.4 and 3.3), as well as having to explore different types of data (see Paper 1, Items 1.3, 1.5, 2.5, 3.4, 3.5, 3.6, 4.2, 4.3, and 4.5). Using these data-response items allows examiners to structure items so that they cover the full range of levels of cognitive difficulty and types of cognitive demand, as well as geographical conceptual development.

Although closer to the spread of types of items suggested in the *Subject Assessment Guidelines*, there was still disparity between the proposed and actual weighting of cognitive levels in the final 2008 Geography papers. If Table 5 below which illustrates this disparity, is considered, it is evident that there needs to be fewer items in the lower and middle-order categories, and more higher-order items. This distribution of items is especially important in light of the view that high stakes exit examinations such as those for the NSC have a major influence on preparing learners for further work in the field. In addition, it is important that external summative assessment is closely aligned with school-based and exemplar assessment, if learners are to be prepared for their final exams.

**Table 5.2.4: Disparities in weighting of cognitive levels**

|  | Lower Order (easy, basic and conceptual items) | Middle Order (moderate, comprehension and application items) | Higher order (difficult, problem-solving items) |
|---|---|---|---|
| SAG 2008 | 30% | 40% | 30% |
| 2008 Final Papers | 37,1% | 50% | 12,9% |

### 5.2 (3.7) Language levels in the 2008 NSC exemplar and final Geography Sciences papers

The Umalusi Geography team found that language levels in the 2008 NSC exemplar papers was of an appropriate standard for English First Additional Language (English FAL) speakers. It is clear that

the examiners made special efforts to support learners who may experience language barriers by, for example, providing alternatives for certain concepts (see for instance Items 1.4.1 and 2.1.4. in Paper 1).

In contrast, the team felt that language is less user-friendly in the 2008 final than in the exemplar papers. The rather confusing instructions regarding the number of questions that should be answered, as well as the use of what could be described as difficult or new concepts (such as "sweatshop" and "shanty town") contributed to this problem.

### 5.2 (3.8) Comment on the appropriateness of the Umalusi exam paper evaluation tool for Geography

The Umalusi Geography team found the generic exam paper analysis instrument useful, uncomplicated, and generally suitable for the subject. Comments relating to the fact the analysis was at a level of generalisation (abstraction) above different kinds of Geography knowledge (factual, procedural, conceptual and meta-cognitive) have already been made (see the introductory paragraphs to Section 5.2 (2) above). An additional weakness is that it does not cater for the evaluation of general knowledge-type questions classified as *basic/easy* but being *outside the frame of reference* of the learner. Here the team was referring to the different contexts and lived experiences of the rural versus the urban learner.

The team noted that the tool successfully facilitates common understanding of the evaluation of school-based assessments and examinations in the FET band.

## SUMMARY OF EXAM PAPER ANALYSIS: GEOGRAPHY

The 2008 final NSC papers contain on average similar proportions of *comprehension and application* and *problem-solving questions* to, as well as more *difficult* questions than, the NATED 550 Higher Grade papers (when averaged together). Further, and especially since the average percentage of *difficult* items is high, the team found that an A-grade achieved for the 2008 NSC Geography papers would be roughly equivalent to that achieved for previous Higher Grade papers.

Since there were fewer *basic conceptual knowledge* type and easy items, however, passing these exams would be challenging for learners functioning at just-passing-Standard-Grade levels.

## 5.3 BIOLOGY/LIFE SCIENCES

The Umalusi Biology/Life Sciences team noted several changes marking the transition from the NATED 550 *Senior Certificate* exam papers to those linked to the National Curriculum Statement (NCS) and its *National Senior Certificate* (NCS) exam:

**a)** The NATED 550 subject Biology has changed to the NCS subject Biology/Life Sciences, composed of four knowledge areas:

(1) *tissues, cells and molecular studies;*
(2) *structure, control and processes in basic life systems;*
(3) *environmental studies; and*
(4) *diversity, change and continuity.*

This structuring of the subject is very different to its previous structuring, making the corresponding structuring of the associated exams different also. Biology/Life Sciences exam papers are structured around these four knowledge areas, with Paper 1 assessing the first two, and Paper 2 assessing the second two areas.

**b)** The Biology/Life Sciences curriculum has shifted from having a traditional disciplinary-type syllabus with lists of aims, objectives, and content, to an outcomes-based curriculum based on three learning outcomes: Learning Outcome 1 *involving scientific inquiry and problem-solving skills*; Learning Outcome 2 covering the *construction and application of Biology/Life Sciences knowledge*; and Learning Outcome 3 comprising *Biology/Life Sciences, technology, environment and society*. It is intended that the learning outcomes form the focus of the curriculum, with the content being the vehicle to attain these learning outcomes. In the examinations, it is intended that 40% of the marks be assigned to Learning Outcomes 1 and 2 respectively, with the remaining 20% being assigned to Learning Outcome 3.

**c)** The Higher and Standard Grade levels at which learners used to write the Biology/Life Sciences exams have been replaced with single courses and exams for Biology/Life Sciences. It is expected that the Biology/Life Sciences papers will discriminate between all of these learners.

The Umalusi Biology/Life Sciences team attempted to benchmark the new 2008 NSC Biology/Life Sciences exams by analysing the type of cognitive demand and levels of difficulty of items (questions and sub-questions) in the NATED 550 Higher Grade and Standard Grade examination papers for 2005, 2006 and 2007, and the NSC exemplar and final examination papers for 2008.

The following exam papers were analysed (16 papers in all):

- 2005 NATED 550 Higher and Standard Grade Biology/Life Sciences Papers 1 and 2
- 2006 NATED 550 Higher and Standard Grade Biology/Life Sciences Papers 1 and 2
- 2007 NATED 550 Higher and Standard Grade Biology/Life Sciences Papers 1 and 2
- 2008 NSC exemplar and final Biology/Life Sciences Papers 1 and 2

The method used in this examination paper analysis is presented in Section 5.3 (1), below, followed by the results of this analysis, together with discussion of these results in Section 5.3 (2).

## 5.3 (1) Method of analysis used for the Biology/Life Sciences exam papers

Following the Umalusi brief, each sub-part of each question in the respective exam papers was analysed in terms of its type of cognitive demand and level of difficulty, using the supplied criteria in Table 5.3.1 (below).

**Table 5.3.1: Categories for cognitive types of questions (items)**

| Type of cognitive demand | Description |
|---|---|
| Basic conceptual knowledge | Recall; literal comprehension; making simple evaluative judgements in terms of previously acquired facts, etcetera. |
| Comprehension, application | Understanding, application, analysis of previously acquired information in a familiar context. Making evaluative judgements that require the use of a range of previously acquired facts/information, etcetera. |
| Problem-solving | Analysis, interpretation and application of information in a new or unfamiliar context; Synthesis, creation of novel solution or product; Evaluation or making judgement in relation to a mixture of old and new material or information. |

Each question (item) was also assigned to an *easy, moderate* or *difficult* category based on each Umalusi evaluators' experience of learners' performance on different types of questions. The four evaluators worked entirely independently, using only the framework provided in the Umalusi documentation and outlined in the table immediately above, and their own experience. Each

evaluator provided the results of his/her evaluation to the lead evaluator, who combined the results of all four evaluations, and calculated summary statistics. Each evaluator's raw data per paper was entered into a grid in the following format:

**Table 5.3.2: Recording format for types and difficulty levels of questions**

| Levels of difficulty | Cognitive skills | | | Totals |
|---|---|---|---|---|
| | Basic conceptual | Comprehension | Problem-solving | |
| Easy | | | | |
| Moderate | | | | |
| Difficult | | | | |
| Total | | | | |

The total number of marks for each paper differed: for Higher Grade it was 200, whereas for Standard Grade and the *National Senior Certificate* (NSC) papers it was 150. To enable valid comparisons among papers, all totals were converted to percentages. All evaluators did not analyse all of the papers, but each paper was analysed by at least three evaluators. Averages were calculated averaging the scores for Paper 1 and Paper 2 for all evaluators.

Inter-observer reliability was relatively low, and therefore the analysis was restricted to row totals and column totals, where inter-observer reliability was somewhat higher. However, poor inter-observer reliability was noted as a difficulty in this analysis, which had to be dealt with through more rigorous discussion of criteria for each cognitive skill and each level of difficulty *before* observers conducted an independent analysis.

## 5.3 (2) Results of the Biology/Life Sciences exam paper analyses

The Umalusi Biology/Life Sciences team reported here on the eight research questions required for the Umalusi exam paper analyses for the subject, and made some additional points.

### 5.3 (2.1) Distinguishing Biology/Life Sciences highest level achievers

To achieve an A-symbol in the NATED 550 Higher Grade papers, a learner would have had to score at least 80% or 320 marks out of the total of 400. The equivalent level of achievement in the 2008 NSC papers would be 'Level 7' achievement, for which a learner would have to score 80% or 240 marks out of the total of 300. Differentiating the A-candidate from others required making assumptions about what differentiates the performance of A-candidates from that of B and lower achieving candidates.

Based on the average percentages of marks allocated to items at each cognitive type (*basic; comprehension application*; and *problem-solving*) and level (*easy; moderate; difficult*) (see Table 5.3.3 overpage), the Biology/Life Sciences team constructed a tentative model of the performance of a typical NATED 550 Higher Grade learner achieving at the highest levels. The A-candidate would have been expected to:

- Answer all the *easy* questions correctly (33.2% of the questions)
- Answer 80% of the *moderate* questions correctly (34.5%; cumulative total = 67.7%)
- Answer 50% of the *difficult* questions correctly (11.9%; cumulative total = 80%)

**Table 5.3.3: Average percentage of marks allocated to each type and level of cognitive skill in NATED 550 HG papers 2005–2007**

| | Cognitive skills | | | |
|---|---|---|---|---|
| Levels of difficulty | % Basic conceptual | % Comprehension | % Problem-solving | Totals % |
| Easy | 22.4 | 9.4 | 1.4 | 33.2 |
| Moderate | 14.6 | 20.5 | 6.1 | 43.1 |
| Difficult | 1.9 | 12.4 | 9.3 | 23.7 |
| **Total** | **38.9** | **44.3** | **16.8** | **100.0** |

In the absence of supporting evidence from the actual performance of A-candidates, the assumption was made that an NSC A-candidate would potentially have been able to answer all of the easy questions, most of the *moderate* questions, and more of the *difficult* questions than learners who scored lower symbols (see Table 5.3.4, below). The 25% contribution of CASS (Continuous Assessment) to learners' final marks was not considered in this analysis.

**Table 5.3.4: Average percentage of marks allocated to different cognitive skill types and levels in the 2008 NSC final papers (and exemplar papers in brackets).**

| | Cognitive skills | | | | | | |
|---|---|---|---|---|---|---|---|
| Levels of difficulty | Basic conceptual | | Comprehension | | Problem-solving | | Total |
| Easy | 20.9 | (20.8) | 8.9 | (8.0) | 3.4 | (3.8) | 33.3 (32.9) |
| Moderate | 12.4 | (12.5) | 19.3 | (17.3) | 13.7 | (13.3) | 45.4 (43.2) |
| Difficult | 2.7 | (6.3) | 9.8 | (8.6) | 8.8 | (9.1) | 21.3 (23.9) |
| **Total** | **36.0** | **(39.6)** | **38.1** | **(34.3)** | **25.9** | **(26.2)** | **100.0** |

The profile of items for the NATED 550 Higher Grade and NSC final papers in Tables 5.3.3 and 5.3.4, above was remarkably similar. Applying the Higher Grade model of an A-candidate to the 2008 NSC final examination paper using the figures in Table 5.3.4, above, yielded the following calculation: as a minimum, an NSC A-candidate would be expected to:

- Answer all the easy questions correctly (33.3%)
- Answer 80% of the moderate questions correctly (36.3%; cumulative total = 69.6%)
- Answer 50% of the difficult questions correctly (10.7%; cumulative total = 80.3%)

If this model is correct, equivalent opportunities were provided in the 2008 NSC and NATED 550 HG papers for candidates to score A-grades.

Answering the research questions as to whether the A-grades in the NATED 550 and NSC papers were similar required that evaluators predict which questions were the most difficult in each paper. These questions would then serve the function of separating A-grade candidates from other candidates.

The item-by-item analyses of all four evaluators were compared to identify the questions where at least *three* of the four evaluators concurred in evaluating the question as *difficult*. Table 5.3.5 (overpage), shows the final consensus list for the 2008 NSC exemplar paper items that were predicted to differentiate A-grade NSC learners from others.

**Table 5.3.5: Questions most likely to differentiate A-candidates from non-A candidates (2008 NSC exemplar papers)**

| Exemplar paper 1 : 2008 | | Exemplar paper 2 : 2008 | |
|---|---|---|---|
| Questions | Marks | Questions | Marks |
| 2.2.4 | 2 | 1.6.2 | 1 |
| 3.2.3 | 3 | 1.6.3 | 5 |
| 4.1.3 | 11 | 2.1.8 | 2 |
| 4.1.4 | 4 | 2.2.3 | 4 |
| 4.1.5 | 2 | 4.1.4 | 2 |
| 4.2 | 3 | | |
| 4.3.1 | 8 | | |
| | **Total 33 (22%)** | | **Total 14 (9.3%)** |

Table 5.3.5 shows the consensus list for the 2008 NSC final papers that were predicted to differentiate A-grade learners from others.

**Table 5.3.6: Questions most likely to differentiate A-candidates from non-A candidates (2008 NSC final papers)**

| Final paper 1 : 2008 | | Final paper 2 : 2008 | |
|---|---|---|---|
| Questions | Marks | Questions | Marks |
| 1.6.2 | 2 | 1.4.3 | 2 |
| 1.6.3 | 2 | 1.4.5 | 2 |
| 1.6.5 | 4 | 1.5.4 | 2 |
| 3.1.4 | 4 | 3.2 | 2 |
| | **Total 12 (8%)** | | **Total 8 (5.3%)** |

This analysis was conducted on a predictive basis, whereas it is more accurate to work from learners' actual performance on questions. For example, the evaluators predicted that Item 4.1.3 in Paper 1 of the exemplar paper would be a useful discriminating question, worth 11 marks, but the actual results of learners must serve as the final test of whether it does so.

### 5.3 (2.2) Determining average Biology/Life Sciences achievers

In order to determine the number of marks needed for a learner achieving at the level of the typical average Standard Grade learner just passing to pass the 2008 NSC exemplar and final exams for the subject, the Biology/Life Sciences team considered the percentages of items categorised at different levels in the Standard Grade papers between 2005 and 2007. These categorisations are shown in Table 5.3.7 (see overpage).

**Table 5.3.7: Average percentage of marks allocated to each cognitive skill and level of difficulty in the NATED 550 Standard Grade papers 2005–2007**

| | Cognitive skills | | | |
|---|---|---|---|---|
| Levels of difficulty | Basic conceptual | Comprehension | Problem-solving | Totals |
| Easy | 31.4 | 12.1 | 1.4 | 44.9 |
| Moderate | 12.1 | 24.3 | 4.5 | 40.7 |
| Difficult | 1.7 | 7.6 | 4.8 | 14.2 |
| **Total** | **45.2** | **44.1** | **10.7** | **100.0** |

A learner had to score 33.33% in the NATED 550 Standard Grade papers to pass. In order to achieve this lower benchmark, it was assumed that learners should answer sufficient questions at the *easy* level of difficulty to pass. Table 5.3.7 shows that an average 44.9% of the marks in NATED 550 Standard Grade papers were at an easy level of difficulty: there was therefore an oversupply of *easy* questions. In fact, since 31.4% of the marks were at the lowest combined type and level of difficulty (*easy basic conceptual* items), a learner could almost pass by answering only those questions. Table 5.3.4 is repeated here for ease of comparison.

**Table 5.3.4: Average percentage of marks allocated to different cognitive skill types and levels in the 2008 NSC final papers (and exemplars in brackets)**

| | Cognitive skills | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Levels of difficulty | Basic conceptual | | Comprehension | | Problem-solving | | Totals | |
| Easy | 20.9 | (20.8) | 8.9 | (8.0) | 3.4 | (3.8) | 33.3 | (32.9) |
| Moderate | 12.4 | (12.5) | 19.3 | (17.3) | 13.7 | (13.3) | 45.4 | (43.2) |
| Difficult | 2.7 | (6.3) | 9.8 | (8.6) | 8.8 | (9.1) | 21.3 | (23.9) |
| **Total** | **36.0** | **(39.6)** | **38.1** | **(34.3)** | **25.9** | **(26.2)** | **100.0** | |

A learner had to score 30% in the 2008 NSC final exam to pass. Achieving this score was just possible in the 2008 exemplar and final NSC papers if learners answer almost all of the easy questions correctly, but there was very little margin for error. Only about 21% of the marks in the exemplar and final papers were for easy *basic conceptual questions*, while learners would have had to obtain a further 8% or 9% for easy *comprehension* questions and 3.8% for easy *problem-solving* questions in order to pass either the exemplar or final papers.

The evidence presented here supports a conclusion that it would be difficult for low-achieving learners to pass the 2008 NSC final exam.

The process of identifying items that would allow low-achieving learners to pass the 2008 NSC exams involved listing all items and their coding by all four evaluators. The lists were then compared to identify items where at least *three* of the four evaluators concurred in evaluating the question as *easy*.

Tables 5.3.8 and 5.3.9 show the final consensus lists for items in the 2008 NSC exemplar and final papers that were predicted to assist low-achieving learners to pass.

**Table 5.3.8: Questions that would allow SG learners to pass the 2008 NSC exemplar papers**

| Final paper 1 : 2008 | | Final paper 2 : 2008 | |
|---|---|---|---|
| Questions | Marks | Questions | Marks |
| 1.1.1 | 2 | 1.1.1 | 2 |
| 1.1.4–1.1.5 | 4 | 1.1.3 | 2 |
| 1.2.3 | 1 | 1.2.2–1.2.4 | 3 |
| 1.2.5–1.2.6 | 2 | 1.2.6 | 1 |
| 1.3.1–1.3.5 | 5 | 1.3.1–1.3.5 | 5 |
| 1.5.3 | 1 | 1.4.1–1.4.2 | 4 |
| 1.6.1–1.6.3 | 4 | 1.4.4–1.4.5 | 6 |
| 2.1.1–2.1.2 | 2 | 1.7.2 | 2 |
| 2.1.4 | 1 | 3.1.1 | 1 |
| 2.3.3 | 1 | 3.3.1–3.3.2 | 4 |
| 3.1.1–3.1.3 | 4 | 3.4.1 | 3 |
|  | Total: 27 (18%) |  | Total: 33 (22%) |

**Table 5.3.9: Questions that would allow SG learners to pass the 2008 NSC final exams**

| Final paper 1 : 2008 | | Final paper 2 : 2008 | |
|---|---|---|---|
| Questions | Marks | Questions | Marks |
| 1.1.1 | 2 | 1.1.1 | 2 |
| 1.1.2 | 2 | 1.2.2 | 1 |
| 1.1.3 | 2 | 1.2.3 | 1 |
| 1.1.5 | 2 | 1.2.4 | 1 |
| 1.1.6 | 2 | 1.2.5 | 1 |
| 1.2.3 | 1 | 1.2.6 | 1 |
| 1.2.4 | 1 | 1.3.1 | 1 |
| 1.2.6 | 1 | 1.3.4 | 1 |
| 1.3.2 | 1 | 1.5.1 | 2 |
| 1.4.1 | 2 | 1.6.2 | 1 |
| 1.5.1 | 1 | 2.4.1 | 3 |
| 1.5.3 | 1 | 2.4.2 | 3 |
| 2.1.2 | 1 | 3.4.1 | 1 |
| 2.3.1 | 2 | 4.1.1 | 1 |
| 3.1.2 | 1 |  |  |
| 4.1.2 | 2 |  |  |
|  | Total: 24 (16%) |  | Total: 20 (13.3%) |

The team reiterated that there were limitations when making predictions relating to learner achievement. Post hoc analysis of learners' actual responses would provide more robust results.

### 5.3 (2.3) Comparability of the 2005–2007 Biology/Life Sciences papers

The Umalusi Biology/Life Sciences team assessed the standards of the NATED 550 Biology/
Life Sciences Higher and Standard Grade papers between 2005 and 2007 by comparing the
proportions of marks allocated to *easy, moderate* and *difficult* questions or items. The results of this
analysis are shown in Table 5.3.10 and Figures 5.3.1–5.3.4.

**Table 5.3.10: Changes in levels of difficulty and balance of cognitive skills in NATED 550 papers for 2005, 2006, and 2007**

| Higher Grade | | | |
|---|---|---|---|
| Level of difficulty | 2005 | 2006 | 2007 |
| Easy | 31.4 | 36.4 | 30.8 |
| Moderate | 39.6 | 42.3 | 47.6 |
| Difficult | 29.0 | 21.3 | 21.5 |
| Cognitive skill | | | |
| Basic conceptual | 43.5 | 35.3 | 39.2 |
| Comprehension | 33.5 | 53.1 | 43.2 |
| Problem-solving | 23.0 | 11.6 | 17.5 |

| Standard Grade | | | |
|---|---|---|---|
| Level of Difficulty | 2005 | 2006 | 2007 |
| Easy | 42.4 | 42.8 | 50.1 |
| Moderate | 39.0 | 42.2 | 40.7 |
| Difficult | 17.7 | 15.0 | 9.2 |
| Cognitive skill | | | |
| Basic conceptual | 49.1 | 29.9 | 56.0 |
| Comprehension | 36.8 | 58.8 | 37.9 |
| Problem-solving | 14.1 | 11.3 | 6.1 |

Graph 5.3.1 (see overpage) and Table 5.3.10 (above) show that Higher Grade papers are
characterised by the fact that over 20% of the allocated marks are awarded for *difficult* questions.
This figure declined from 29% in 2005 to a little over 20% in 2006 and 2007. The proportion of marks
for *moderate* questions increased during this period, and the proportion of marks for easy questions
increased in 2006 and decreased to a similar level in 2007, as it was in 2005 (just over 30%).

**Graph 5.3.1: Percentage of marks allocated to levels of difficulty HG 2005 - 2007**
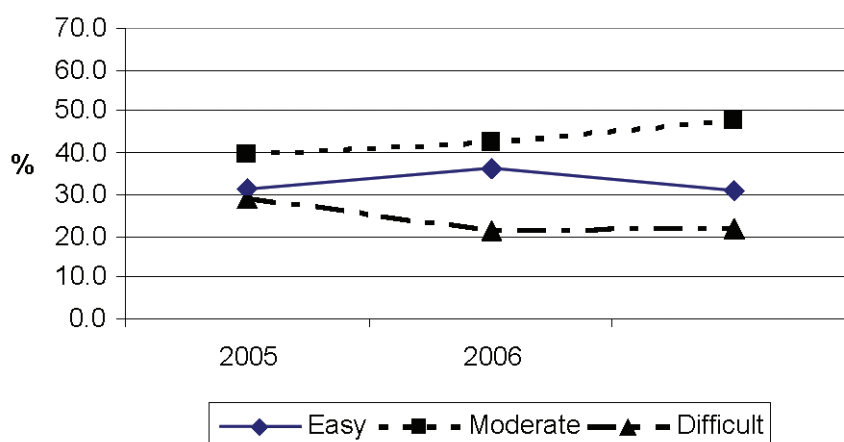


The weighting given to different types of cognitive skills in the NATED 550 Higher Grade papers is shown in Table 5.3.10, and Graph 5.3.2 (below) Proportions of marks allocated to *basic*, *comprehension* and *problem-solving* skills have fluctuated between the three years concerned. The 2005 papers contained more marks for *problem-solving* and fewer for *comprehension* items than papers in subsequent years.

Although there was a slight decrease in the marks awarded for *problem-solving* and a slight increase in those awarded for *comprehension* between 2005 and 2006, the weighting of cognitive skills remained roughly similar between 2006 and 2007. The overall level of difficulty of Higher Grade papers decreased slightly over the period 2005–2007.

**Graph 5.3.2: Percentage of marks allocated to cognitive skill HG 2005 - 2007**
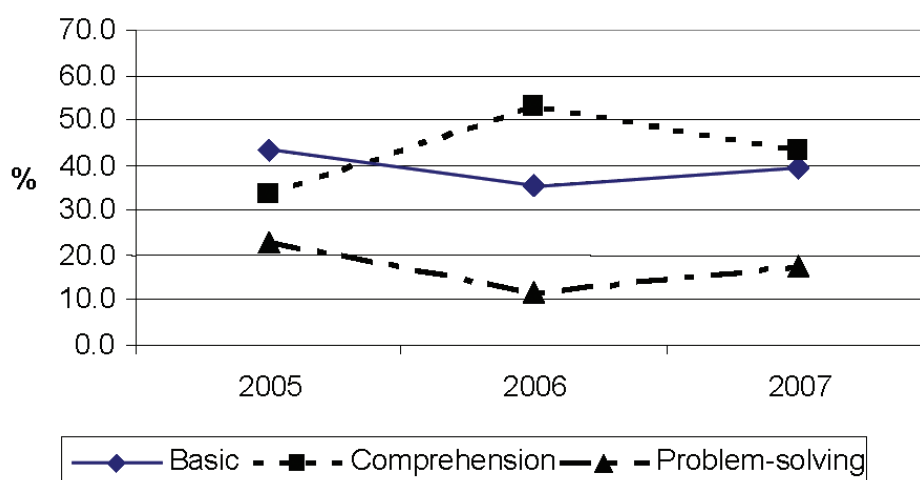


The analysis for Standard Grade question papers is shown in Table 5.3.10 and in Graphs 5.3.3 and 5.3.4 (see overpage). Graph 5.3.3 shows that the papers were characterised by less than 20% of the marks being allocated to *difficult* questions, and over 40% assigned for *easy* questions. The proportion of marks for *moderate* questions remained stable at around 40% in the period concerned. Overall, the Standard Grade papers, like their Higher Grade counterparts, became easier between 2006 and 2007.

**Graph 5.3.3: Percentage of marks allocated to level of difficulty SG 2005 - 2007**
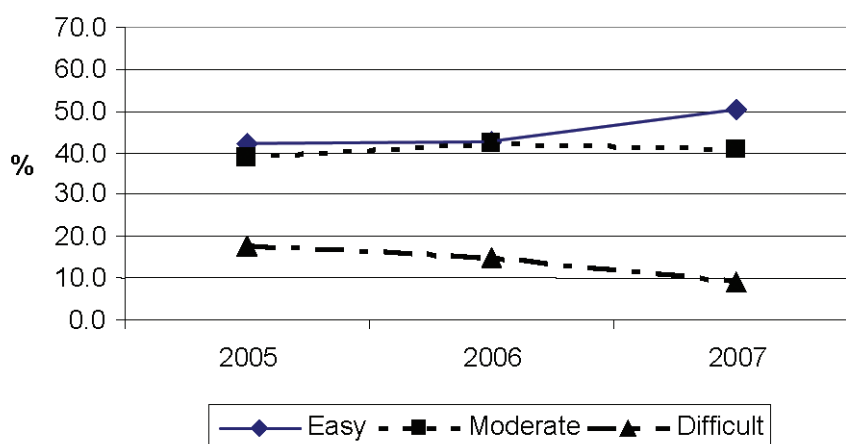


Graph 5.3.4 (below) shows that the proportion of *problem-solving* marks in the Standard Grade papers decreased from 2005 to 2007, while the balance between *basic conceptual* and *comprehension* questions fluctuated. During 2006 the proportions of *basic conceptual* and *comprehension-type* questions were reversed relative to 2005 and 2007.

**Graph 5.3.4: Percentage of marks allocated to cognitive skill SG 2005 - 2007**
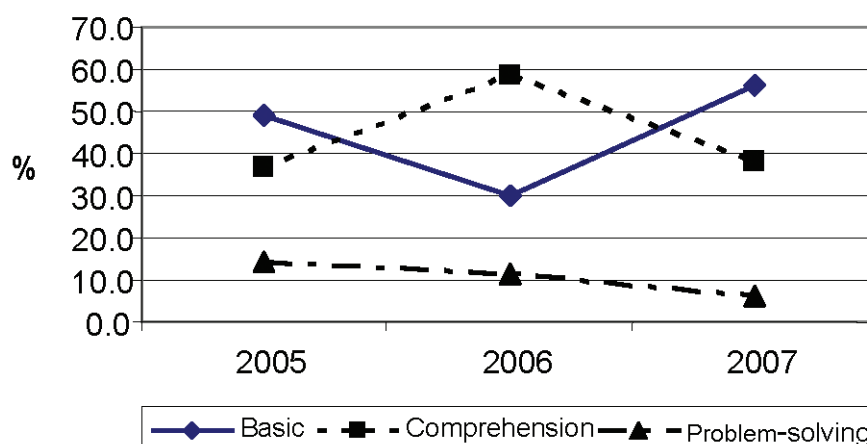


Taken together, Graphs 5.3.3 and 5.3.4 (above) provide evidence of decreasing levels of difficulty in the NATED 550 Standard Grade papers over the period 2005–2007.

### 5.3 (2.4) Distinguishing Biology/Life Sciences Higher from Standard Grade papers

In order to distinguish between the NATED 550 Biology/Life Sciences Higher and Standard Grade exam papers, the Biology/Life Sciences team considered the average percentages of *easy, moderate* and *difficult* questions in the Biology/Life Sciences Higher and Standard Grade papers over the period 2005–2007. Similarities and differences can be seen in Graphs 5.3.5 and 5.3.6 (See overpage).

**Graph 5.3.5: Comparison of HG and SG levels of difficulty**
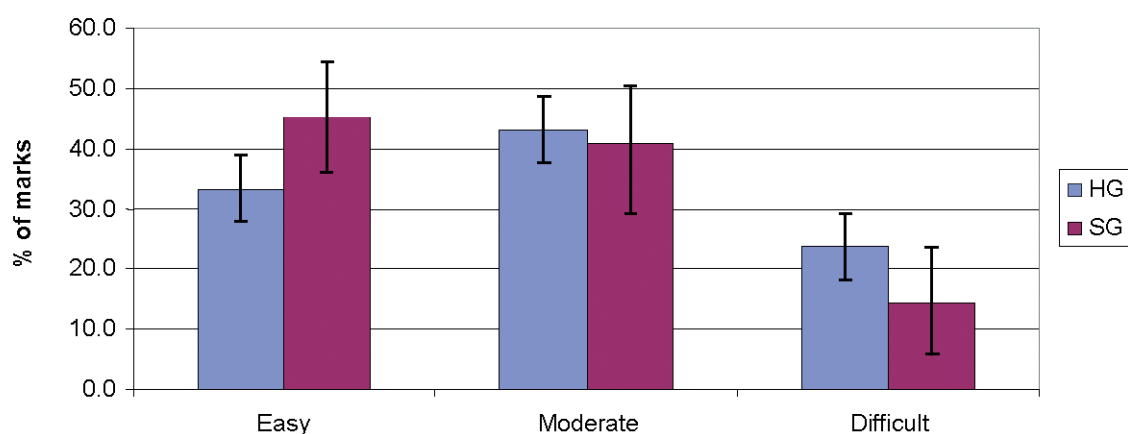


Graph 5.3.5 shows that the Standard Grade papers had higher proportions of easy questions and lower proportions of *difficult* questions than did the corresponding Higher Grade papers.

**Graph 5.3.6: Comparison of HG and SG cognitive skills**
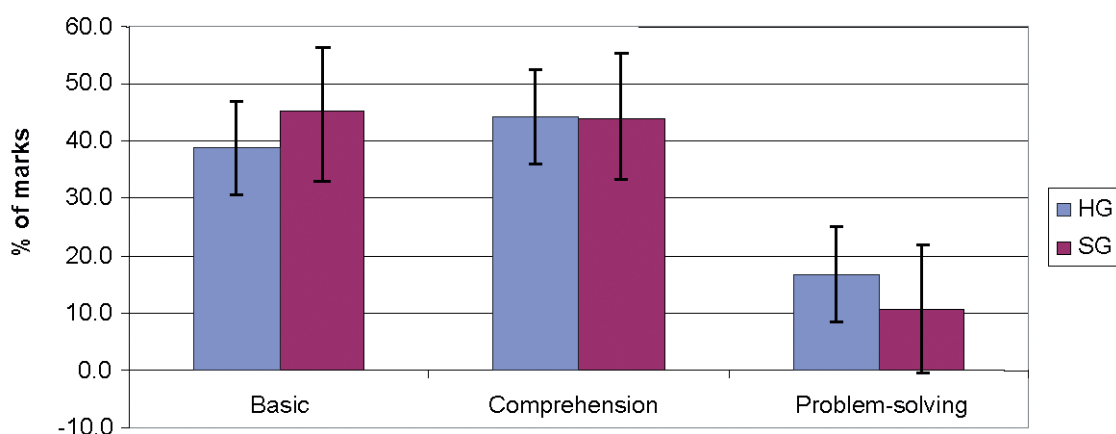


Graph 5.3.6 shows that the Standard Grade papers had higher proportions of marks allocated to *basic conceptual* questions and lower proportions to *problem-solving* questions than did the corresponding Higher Grade papers.

The NATED 550 curriculum documents (See Biology/Life Sciences Documents 1 and 2) specify that Standard Grade papers should contain 80% of *recall* and *comprehension* questions, and 20% higher order *application* questions. The documents stipulate a 60:40 ratio of such questions for the Higher Grade papers. The analysis conducted here supported a distinction between Higher Grade and Standard Grade papers in the direction stipulated in the curriculum.

### 5.3 (2.5) Overall view of 2008 NSC Life Sciences exemplar and final papers in relation to the 2005–2007 NATED 550 Higher and Standard Grade papers for Biology

**Graph 5.3.7: Comparison of HG, NCS and SG levels of difficulty**
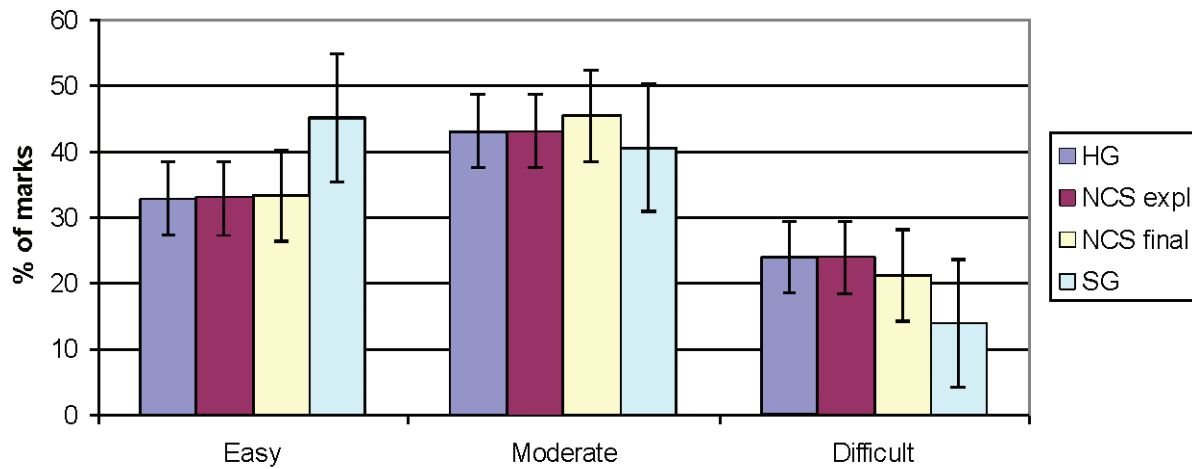


The Umalusi Biology/Life Sciences team considered the overall difficulty levels of the 2008 NSC exemplar and final papers in relation to the NATED 550 Higher and Standard Grade Biology/Life Sciences papers. Graph 5.3.7 shows a comparison of the average percentages of *easy*, *moderate* and *difficult* questions in the NATED 550 Higher and Standard papers and the 2008 NSC exemplar and final papers.

From Graph 5.3.7, it can be seen that the 2008 NSC Biology/Life Sciences exemplar and final papers closely resembled the NATED 550 Biology/Life Sciences Higher Grade papers in terms of levels of difficulty. There were fewer marks for easy questions and more for *moderate* and *difficult* questions in the NSC papers than in the NATED 550 Standard Grade papers for the subject.

On these grounds the Umalusi Biology/Life Sciences team predicted that learners who would previously have written these exams at Standard Grade level would find the 2008 NSC papers difficult.

**Graph 5.3.8: Comparison of HG, NCS and SG cognitive skills**
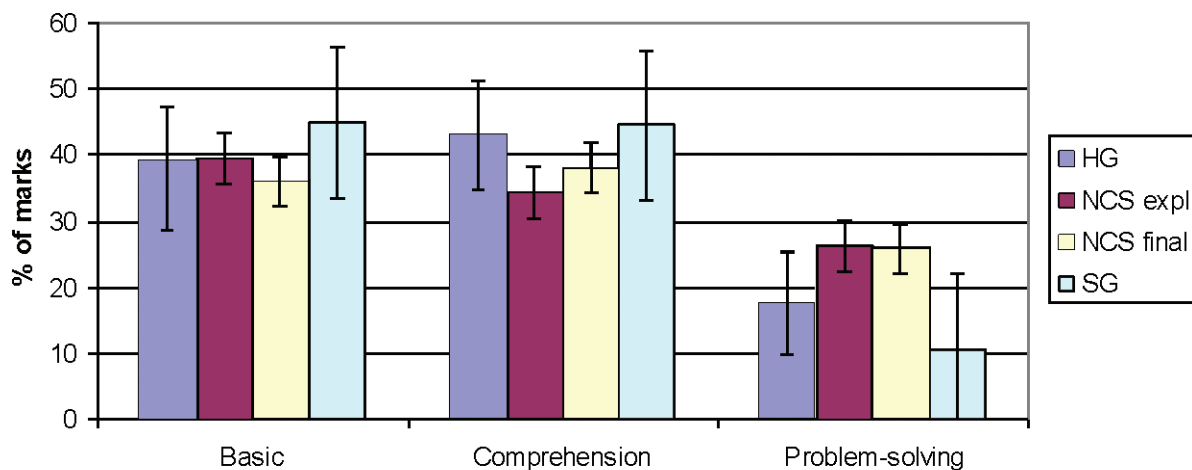


Graph 5.3.8 shows a comparison of the types of cognitive skills in the NATED 550 Higher and Standard Grade papers and 2008 NSC exemplar and final papers.

The 2008 NSC exemplar and final papers had greater proportions of marks allocated to *problem-solving* than did the NATED Higher and Standard grade papers. This allocation was at the expense of *comprehension* item marks, an area given more weight in the NATED 550 papers. Based on this finding and the unfamiliarity of this type of question, the team predicted that the first (2008) NSC examinations would be experienced by learners as being more difficult than the NATED 550 HG and SG exams were. Further, learners who would previously have written on the Standard Grade level might have been disadvantaged by the relatively smaller proportion of *basic* and *comprehension* items in the NSC exams.

It is also worth noting that the 2008 NSC papers contained more questions relying on learners' opinions and on basic numeracy and comprehension of text than was previously the case (see for example Items 1.4, 1.5, 1.6, 2.2.1, 2.2.2, 2.2.3, 3.4.3, 4.1.1, 4.2, 4.1.3, 4.1.4, 4.1.5, and 4.3 from final 2008 NSC Paper 2 – these items made up 64 marks or 43% of the paper). An example of this type of question from 2008 NSC final Paper 2 was the following: "Why should society be concerned about over-exploitation of resources in the sea?" The NATED 550 papers have never included such open-ended questions.

This type of item tests learners' ability to construct arguments or lines of reasoning. If teachers have not prepared learners to answer in this way, learners will be disadvantaged.

The team's conclusions were that the first (2008) NSC papers were likely to be experienced as being more difficult than their NATED 550 predecessors, firstly, because of unpredictability for both learners and teachers, and secondly, because weaker candidates would be disadvantaged by the shift in emphasis from *comprehension-type* to *problem-solving* questions. In addition, learners may have been disadvantaged if they had not been taught or had not mastered, argumentation.

### 5.3 (2.6) The 2008 NSC Biology/Life Sciences exemplar and final papers as models for future NSC exams

Evaluators found that the 2008 NSC exemplar and final papers were, in general, good models for future examinations. Further, the papers met requirements listed in the *Subject Assessment Guidelines* for Biology/Life Sciences (see Biology/Life Sciences Document 4). Nevertheless, several recommendations could be made.

This finding is not to say that there should not be a reduction in the number of questions drawing on learners' general knowledge, rather than requiring specialist Biology/Life Sciences knowledge or skills: proportions of these items should be greatly reduced. The weightings of particular learning outcomes is debatable. Lastly, it would be helpful if the format and structuring of the *essay* question, to ensure argumentation, explicitly required the inclusion of an introduction; a thesis statement; development of the argument with supporting evidence; and a conclusion. Allocating marks for each of these items is likely to ensure that they feature at least in part.

### 5.3 (2.7) Language levels in the 2008 NSC exemplar and final Biology/Life Sciences papers

*Sentence complexity* and *number of long words* have been shown to affect readability of short sections of text, such as examination questions (Dempster and Reddy, 2007). In order to assess language levels in the 2008 NSC exemplar and final papers for Biology/Life Sciences, *sentence complexity* and the amounts of *long words* were assessed for the two papers. *Sentence complexity* is calculated as the number of words per sentence in each question. The number of *long words* is defined as the number of words with more than seven letters. This analysis was carried out by all four evaluators. The results are shown in Table 5.3.11 (below).

**Table 5.3.11: Readability factors for the 2008 NSC final papers (the figures indicate mean ± sd per question)**

| Item | Paper 1 | Paper 2 |
|---|---|---|
| Sentence complexity | 11.8 ± 4.2 | 12.5 ± 4.6 |
| Number of long words | 3.9 ± 4.6 | 4.0 ± 4.2 |

Previous research (Dempster and Reddy 2007) has shown that where questions have a *sentence complexity* of about 12 (12 words per sentence), Grade 8 learners resort to strategies that have little to do with making sense of the questions concerned.

The team did not have information on the reading competence of Grade 12 learners in South Africa. The *sentence complexity* of the 2008 NSC final papers was, however, a cause for concern. In Paper 1, 26 questions out of 68 (38% of questions) had a *sentence complexity* above the average of 12. In Paper 2, 32 questions out of 62 (52% of questions) had a sentence complexity above the average of 12.5.

The number of *long words*, defined as words with more than seven letters, is the second factor identified as contributing to readability of questions in tests and examinations (see Dempster and Reddy, 2007). Biology/Life Sciences has a large specialist vocabulary, requiring familiarity with a number of discipline-specific long words. However, examiners uses non-specialist *long words* in the questions that added to the reading load of question papers. The number of *long words* per question was totalled, and the average calculated for each paper. The results (Table 5.3.11) show that there was an average of four long words per question. The high standard deviation indicates that the number of *long words* per question was very variable.

Dempster and Reddy (2007) show that questions that were easiest to answer by Grade 8 learners had an average of 3.6 *long words* per question. The implication of the present analysis is that the 2008 NSC final papers had a somewhat higher number of *long words* than would be recommended.

In the absence of accurate reading levels for Grade 12 learners in South Africa, the Biology/Life Sciences team made a tentative prediction that the 2008 NSC final papers would have been difficult to read for the majority of candidates. This finding was based on two factors known to affect readability of examination questions: *sentence complexity and long words*.

Table 5.3.12 shows actual items that had the potential to present reading difficulty.

**Table 5.3.12: Examples of items from 2008 final Paper 1 and Paper 2 to illustrate reading challenges**

| Paper 1 | | | Paper 2 : 2008 | | |
|---|---|---|---|---|---|
| Q No | Complexity | Long Words | Q No | Complexity | Long Words |
| 4.1.3 | 28 | 3 | 1.1.2 | 27 | 9 |
| 4.2.1 | 20 | 11 | 3.2 | 22 | 6 |
| 1.1.3 | 15 | 11 | 3.3.2 | 20 | 5 |
| 4.1.1 | 14 | 10 | 4.2.2 | 18 | 6 |
| 4.3 | 16 | 27 | 3.1.1 | 15 | 7 |
| 4.1.4a) | 16 | 8 | 4.3 | 15 | 24 |

### 5.3 (2.8) Match between assessment requirements in the Subject Assessment Guidelines for Biology/ Life Sciences, 2008 NSC final papers for the subject

The *Subject Assessment Guidelines* (Biology/Life Sciences Document 4) for Biology/Life Sciences specify that 50% of the marks in the Biology/Life Sciences final external examinations should be of the lower order cognitive abilities (*knowledge* and *comprehension*) and that 50% should be of the higher order cognitive abilities (*application* and *problem-solving*).

While items in the papers do roughly match these requirements, the Biology/Life Science team's combined judgement was that the distribution of marks in the 2008 NSC final papers was closer to 60% for the lower order items and 40% for higher order items, for both Papers 1 and 2.

### 5.3 (2.9) Comment on the appropriateness of the Umalusi exam paper evaluation tool for Biology/ Life Sciences

The Biology/Life Sciences team noted that the Umalusi exam paper analysis instrument was not entirely appropriate for analysing Biology/Life Sciences questions. More time was needed than was provided for discussion amongst team members to reach a common understanding of the definitions of each category of type of cognitive challenge and level of difficulty.

### 5.3 (2.10) Comment on the relative levels of difficulty of the 2008 NSC exemplar and final papers

The Biology/Life Sciences team noted that the 2008 NSC final examination papers were marginally less difficult than the 2008 NSC exemplar papers for the subject. Judgements informing this statement can be seen in Table 5.3.13 (below).

**Table 5.3.13: Level of difficulty of 2008 NSC exemplar papers compared with 2008 NSC final papers**

|  | NSC Exemplar | NSC Final |
|---|---|---|
| Easy | 32.9 | 33.3 |
| Moderate | 43.2 | 45.4 |
| Difficult | 23.9 | 21.3 |

## SUMMARY OF EXAM PAPER ANALYSIS: BIOLOGY/LIFE SCIENCES

In order to compare A-grades achieved in the NATED 550 Higher Grade exams between 2005 and 2007 with A-grades obtained in the final 2008 NSC papers, the Umalusi Biology/Life Sciences team evaluated the cognitive types and levels of cognitive difficulty of items in the respective papers. Their judgements are summarised in Table 5.3.14 (below).

**Table 5.3.14: Average percentage of marks allocated to types of cognitive skill and level of difficulty in the NATED 550 Higher Grade and final 2008 NSC papers**

| Papers | Level of difficulty | Cognitive skills | | | |
|---|---|---|---|---|---|
|  |  | Basic conceptual | Comprehension | Problem-solving | Total |
| NATED 550 HG 2005–2007 | Easy | 22.4 | 9.4 | 1.4 | 33.2 |
|  | Moderate | 14.6 | 20.5 | 6.1 | 43.1 |
|  | Difficult | 1.9 | 12.4 | 9.3 | 23.7 |
|  | **Total** | **38.9** | **44.3** | **16.8** | **100.0** |

| Papers | Level of difficulty | Cognitive skills | | | |
| | | Basic conceptual | Comprehension | Problem-solving | Total |
|---|---|---|---|---|---|
| NSC final papers | Easy | 20.9 | 8.9 | 3.4 | 33.3 |
| | Moderate | 12.4 | 19.3 | 13.7 | 45.4 |
| | Difficult | 2.7 | 9.8 | 8.8 | 21.3 |
| | **Total** | **36.0** | **38.1** | **25.9** | **100.0** |

A-grade candidates would have had to obtain 80% for their exam papers. To achieve at this level, they would have been expected to answer all the easy questions correctly, about 80% of the moderate questions correctly, and about 50% of the difficult questions correctly.

This achievement applies to NATED 550 Higher Grade candidates as well as to those writing the 2008 NSC final examinations. Since the profiles of *easy*, *moderate* and *difficult*, and basic, *comprehension*, and *problem-solving* categorisations are remarkably similar for the Higher Grade and NSC papers, the team concluded that the final 2008 NSC papers would have afforded equivalent opportunity for A-grade achievement in the two systems.

When attempting to determine whether the 2008 final NSC papers contained enough items to enable learners achieving a the level of just passing at Standard Grade level, to pass, the team again evaluated the cognitive types and levels of difficulty of items in the respective papers. The judgements are summarised in Table 5.3.15 (below).

**Table 5.3.15: Average percentage of marks allocated to types of cognitive skill and level of difficulty in the NATED 550 Standard Grade and final 2008 NSC papers**

| Papers | Level of difficulty | Cognitive skills | | | |
| | | Basic conceptual | Comprehension | Problem-solving | Total |
|---|---|---|---|---|---|
| NATED SG 2005–2007 | Easy | 31.4 | 12.1 | 1.4 | 44.9 |
| | Moderate | 12.1 | 24.3 | 4.5 | 40.7 |
| | Difficult | 1.7 | 7.6 | 4.8 | 14.2 |
| | **Total** | **45.2** | **44.1** | **10.7** | **100.0** |
| NSC final papers | Easy | 20.9 | 8.9 | 3.4 | 33.3 |
| | Moderate | 12.4 | 19.3 | 13.7 | 45.4 |
| | Difficult | 27.0 | 9.8 | 8.8 | 21.3 |
| | **Total** | **36.0** | **38.1** | **25.9** | **100.0** |

For the 2008 NSC final examinations the percentage of easy marks for the low-achieving learner was much lower (33.3%) than in the previous NATED 550 SG exams (45%), a difference of 12%. The new pass mark of 30% leaves very little margin for error.

Overall, the team found that the level of difficulty of the 2008 NSC exemplar and final papers was more closely aligned with the NATED 550 Higher Grade than with the Standard Grade papers. The analysis of cognitive type shows that the NSC papers contained more *problem-solving* and fewer *comprehension* items than did the NATED 550 papers. The unfamiliarity of these questions may have increased the difficulty levels of the NSC papers.

The team also drew attention to the worrying inclusion of a high proportion of items requiring general rather than specialised Biology/Life Sciences knowledge to answer, noting that this pattern was likely to have created the impression that it was not necessary to study for the Biology/Life Sciences exams.

# 5.4 MATHEMATICS

### Introductory note to the exam paper analyses for Mathematics

In order to make an attempt at benchmarking the new NSC Mathematics examinations for 2008, the exam papers from the previous three years (2005–2007) were analysed by the Umalusi Mathematics team to assess and compare the level of cognitive demand in these papers with that in the 2008 NSC exemplar and final Mathematics papers for 2008. The Mathematics exam papers (16 in all) analysed are as follows:

- 2005 NATED 550 Higher and Standard Grade Mathematics Papers 1 and 2
- 2006 NATED 550 Higher and Standard Grade Mathematics Papers 1 and 2
- 2007 NATED 550 Higher and Standard Grade Mathematics Papers 1 and 2
- 2008 NSC exemplar and final Mathematics Papers 1 and 2

The method used in this examination paper analysis is presented in Section 5.4.(1), below, followed by the results of this analysis in Section 5.4.(2). The Mathematics part of this report ends with a discussion of these results in answer to the eight exam paper research questions in Section 5.4.(3).

## 5.4 (1) Method of analysis used for the Mathematics exam papers

In analysing the type of cognitive demand in the Mathematics exam papers, the Umalusi Mathematics team used the taxonomy of categories of Mathematical demand set out on Page 13 of the *Subject Assessment Guidelines* for Mathematics (see Mathematics Document 6). The team chose to use this taxonomy because, like the customised instrument used by the Biology/Life Sciences team, it made a comparison of items for this subject easier, and also allowed for comparison of the team's evaluation with the stated weighting of items in the *Subject Assessment Guidelines*. The description of the categories as given in the *Subject Assessment Guidelines* is shown in Table 5.4.1 (overpage).

**Table 5.4.1: Categories of items in Mathematics**

| | Explanation of skills to be demonstrated |
|---|---|
| **Cognitive levels knowledge (K)** | - Algorithms<br>- Estimation; appropriate rounding of numbers<br>- Theorems<br>- Straight recall<br>- Identifying from data sheet<br>- Simple mathematical facts<br>- Knowledge and use of appropriate vocabulary<br>- Knowledge and use of formulae<br>All of the above will be based on known knowledge. |
| **Routine procedures (R)** | - Problems are not necessarily unfamiliar and can involve the integration of different LOs<br>- Perform well-known procedures<br>- Simple applications and calculations which must have many steps and may require interpretation from given information<br>- Identifying and manipulating of formulae<br>All of the above will be based on known procedures. |
| **Complex procedures (C)** | - Problems are mainly unfamiliar and learners are expected to solve byintegrating different LOs<br>- Problems do not have a direct route to the solution but involve:<br>* using higher level calculation skills and reasoning to solve problems<br>* Mathematical reasoning processes<br>- These problems are not necessarily based on real-world contexts and may be abstract requiring fairly complex procedures in finding the solutions. |
| **Solving problems (P)** | - Solving non-routine, unseen problems by demonstrating higher level understanding and cognitive processes<br>- Interpreting and extrapolating from solutions obtained by solving problems based in unfamiliar contexts<br>- Using higher level cognitive skills and reasoning to solve non-routine problems<br>- Being able to break down a problem into its constituent parts – identifying what is required to be solved and then using appropriate methods in solving the problem<br>- Non-routine problems based on real contexts |

Team members also used examples of the types of questions that can be set for each of the four categories of cognitive demand provided on Pages 32-34 of the *Subject Assessment Guidelines* (Mathematics Document 6), to help guide their analysis.

In addition to using these categories the team designated a level of difficulty (*E = easy, M = moderate, D = difficult*) to each task. These levels of difficulty are useful for making fine distinctions within categories. For this reason, they are considered in conjunction with the category designations. The team looked, for example, at the number of questions involving routine procedures (*R*) at differing levels of difficulty, to get an idea of how many were *easy (RE), moderate (RM)* or *difficult (RD)*.

In a number of cases, the team found it useful to combine the lower two levels of cognitive demand (i.e. *knowledge (K)* and performing *routine procedures (R)*) and compare their combined weighting with a combination of the higher two levels of cognitive demand (i.e. performing *complex procedures (C)* and *solving problems (P)*). This usefulness is based on the fact that it was often easier to see differences and commonalities between the various examination papers when they were compared using fewer dimensions. In addition *knowledge* and *performing routine procedures* questions are similar in that they mostly require fairly straightforward recall of facts

or procedures. Similarly, *performing complex procedures* and *solving problems* both tend to be unfamiliar and less straightforward.

Clearly the categorisation of questions into the various levels of cognitive demand relies on the judgment and experience of each of the individual evaluators. It is thus unsurprising that there were differences between the individual evaluators in their evaluation of the various questions on the examinations. However, each paper was evaluated by at least three (and sometimes four) evaluators, and so - in combining three or four evaluations - the team felt that the picture of the cognitive demand of the examinations derived was reasonable. The team chose to average the judgments of the evaluators and use this average evaluation to make the comparison between papers.

## 5.4 (2) Results of the Mathematics exam paper analyses

In this section, the Umalusi Mathematics team provided an overview of the results of the Mathematics exam paper analyses. Table 5.4.1 shows a comparison of the percentages of marks at each level of cognitive demand in each of the NATED 550 Higher Grade papers from 2005, 2006, and 2007, as well as an average for the Higher Grade papers between 2005 and 2007. It also shows percentages of marks at each level of cognitive demand for the 2008 NSC exemplar and final papers for Mathematics.

Table 5.4.2 shows the corresponding figures for the NATED 550 Standard Grade papers and the 2008 NSC exemplar and final Mathematics papers. In both of these tables the team considered Papers 1 and 2 separately as well as in combination. Paper 1 covered *algebra, functions* and *calculus* in each case; whereas Paper 2 covered *geometry* and *trigonometry* (and *data handling* in the case of the NCS, but not in the case of the NATED Higher or Standard Grade curricula).

**Table 5.4.2: Comparison of Higher Grade and 2008 NSC exemplar and final papers by percentage of marks at each level of cognitive demand**

| HG 2005–2007 and NSC exemplar and final paper comparison | | | | | | |
|---|---|---|---|---|---|---|
| Paper 1 | 2005 | 2006 | 2007 | 2005–7 average | NSC Exemplar | NSC Nov Final |
| Knowledge | 8 | 8 | 14 | 10 | 16 | 6 |
| Performing routine procedures | 51 | 57 | 36 | 48 | 61 | 66 |
| Performing complex procedures | 34 | 30 | 38 | 34 | 18 | 23 |
| Problem-solving | 6 | 5 | 11 | 7 | 6 | 5 |

| HG 2005–2007 and NSC exemplar and final paper comparison | | | | | | |
|---|---|---|---|---|---|---|
| Paper 2 | 2005 | 2006 | 2007 | 2005–7 average | NSC Exemplar | NSC Nov Final |
| Knowledge | 9 | 6 | 16 | 10 | 15 | 13 |
| Performing routine procedures | 41 | 39 | 26 | 35 | 57 | 59 |
| Performing complex procedures | 48 | 50 | 42 | 47 | 22 | 26 |
| Problem-solving | 2 | 5 | 17 | 8 | 6 | 3 |

| HG 2005–2007 and NSC exemplar and final paper comparison | | | | | | |
|---|---|---|---|---|---|---|
| **Paper 2** | 2005 | 2006 | 2007 | 2005–7 average | NSC Exemplar | NSC Nov Final |
| **Papers 1 & 2** | 2005 | 2006 | 2007 | 2005–7 average | NSC Exemplar | NSC Nov Final |
| Knowledge | 9 | 7 | 15 | 10 | 16 | 9 |
| Performing routine procedures | 46 | 48 | 31 | 42 | 59 | 62 |
| Performing complex procedures | 41 | 40 | 40 | 40 | 20 | 24 |
| Problem-solving | 4 | 5 | 14 | 8 | 6 | 4 |

From Table 5.4.2 it appears that the distribution of marks across the various categories of cognitive demand in the NSC exemplar and final papers of 2008 does not resemble that of any of the HG papers between 2005 and 2007. This finding is true for Paper 1, Paper 2 and the combination of Papers 1 and 2. It is also apparent that the cognitive demand of HG Paper 2 is higher than that of HG Paper 1. This difference between Papers 1 and 2 does not appear to be the case for the NSC exemplar and final papers nor, if we look at Table 5.4.3, for the SG papers.

**Table 5.4.3: Comparison of Standard Grade and 2008 NSC exemplar and final papers by percentages of marks at each level of cognitive demand**

| HG 2005–2007 and NSC exemplar and final paper comparison | | | | | | |
|---|---|---|---|---|---|---|
| **Paper 1** | 2005 | 2006 | 2007 | 2005–7 average | NSC Exemplar | NSC Nov Final |
| Knowledge | 15 | 8 | 18 | 14 | 16 | 6 |
| Performing routine procedures | 66 | 66 | 55 | 62 | 61 | 66 |
| Performing complex procedures | 14 | 22 | 22 | 19 | 18 | 23 |
| Problem-solving | 5 | 4 | 4 | 5 | 6 | 5 |
| **Paper 2** | 2005 | 2006 | 2007 | 2005–7 average | NSC Exemplar | NSC Nov Final |
| Knowledge | 20 | 29 | 33 | 27 | 15 | 13 |
| Performing routine procedures | 52 | 41 | 34 | 43 | 57 | 59 |
| Performing complex procedures | 19 | 18 | 22 | 20 | 22 | 26 |
| Problem-solving | 9 | 12 | 10 | 10 | 6 | 3 |
| **Papers 1 & 2** | 2005 | 2006 | 2007 | 2005–7 average | NSC Exemplar | NSC Nov Final |
| Knowledge | 18 | 19 | 26 | 21 | 16 | 9 |
| Performing routine procedures | 59 | 54 | 45 | 53 | 59 | 62 |
| Performing complex procedures | 16 | 20 | 22 | 20 | 20 | 24 |
| Problem-solving | 7 | 8 | 7 | 7 | 6 | 4 |

From Table 5.4.3 it appears that the distribution of marks across the various categories of cognitive demand on Paper 1 of the NSC exemplar and final 2008 papers bears a reasonable resemblance to those of the SG Paper 1 between 2005 and 2007. For Paper 2, the sum of the weightings for problem-*solving* and *performing complex procedures* in the NSC exemplar and final papers is similar to that in the SG papers from 2005 to 2007. The sum of the weighting for *knowledge* and *performing routine procedures* is similar in the exemplar Paper 2 and the SG papers from 2005 to 2007.

For Paper 2 the weighting of marks in the various categories for the NSC exemplar and final papers are similar. For Paper 1 the NSC final paper seems to have been slightly more challenging than the exemplar paper.

In Table 5.4.4 (below) the team provided percentages of marks at each level of cognitive demand as well as combining each type of cognitive demand with the difficulty levels (i.e. easy, moderate or difficult) for the NSC exemplar and final papers, and averages of 2005–2007 SG and HG papers respectively. In all cases, the figures are for a combination of Papers 1 and 2.

**Table 5.4.4: Comparison of Higher and Standard Grade and 2008 NSC exemplar and final papers by percentages of marks for each type of cognitive demand combined with difficulty levels**

|  | NSC Final | NSC Exemplar | 2005–7 SG | 2005–7 HG |
|---|---|---|---|---|
| Knowledge | 9 | 16 | 21 | 10 |
| Routine procedures | 62 | 59 | 53 | 42 |
| Complex procedures | 24 | 20 | 20 | 40 |
| Problem-solving | 4 | 6 | 7 | 8 |
| Knowledge: Easy | 4 | 7 | 8 | 4 |
| Knowledge: Moderate | 5 | 8 | 10 | 4 |
| Knowledge: Difficult | 1 | 0 | 2 | 1 |
| Routine procedures: Easy | 14 | 16 | 12 | 7 |
| Routine procedures: Moderate | 39 | 39 | 34 | 28 |
| Routine procedures: Difficult | 8 | 4 | 7 | 6 |
| Complex procedures: Easy | 5 | 5 | 4 | 2 |
| Complex procedures: Moderate | 12 | 12 | 12 | 23 |
| Complex procedures: Difficult | 8 | 3 | 3 | 16 |
| Problem-solving: Easy | 0 | 1 | 1 | 1 |
| Problem-solving: Moderate | 3 | 4 | 5 | 5 |
| Problem-solving: Difficult | 2 | 1 | 1 | 2 |

By looking at Table 5.4.4 and focusing on the combination of the type of cognitive demand and difficulty level, we can see that the biggest difference between the HG papers and the NSC exemplar and final papers seems to be that the NSC exemplar and final papers were more heavily weighted towards easy and moderate *routine procedures*, whereas the HG papers were more heavily weighted towards the moderate and difficult *complex procedures*. The SG papers and the NSC exemplar and to a lesser extent the final papers again showed a reasonable degree of similarity across the categories.

This initial comparison thus suggests that there was a far greater degree of similarity between the 2008 NCS exemplar and to a lesser extent final papers, on the one hand, and the SG papers of

2005–2007, on the other hand, than there was between the 2008 NSC exemplar and final papers, on the one hand, and the HG papers of 2005–2007, on the other hand.

## 5.4 (3) Interpretation of the results of the Mathematics exam paper analyses

In this section, the Umalusi Mathematics team answered the eight research questions for the exam paper analysis.

### 5.4 (3.1) Distinguishing Mathematics highest level achievers

In order to ascertain whether learners who would have achieved A-grades in the old Higher Grade papers would achieve A-grades in the NSC exemplar and final papers, the team made the assumption that questions at the higher level of cognitive demand (i.e. *performing complex procedures* and *solving problems*) would be the type of questions that would distinguish high achievers.

**Table 5.4.5: Percentage of marks in Higher Grade and 2008 exemplar and final papers, at lower and upper levels of cognitive demand**

| HG and 2008 exemplar and final papers | Knowledge & Routine procedures (%) | Complex procedures & Problem-solving (%) |
|---|---|---|
| Average of 2005–7 HG Papers 1 & 2 | 52 | 48 |
| NCS 2008 Exemplar Papers 1 & 2 | 74.5 | 25.5 |
| NCS 2008 Nov Papers 1 & 2 | 72 | 28 |

By looking at the average of 2005–7 HG Papers 1 and 2 in Table 5.4.5 (above) we see that a learner writing the old HG examinations would have needed to attain more than half of the available marks (at least 28 out of 48) correctly on the questions at higher levels of cognitive demand (namely, *complex procedures and problem-solving*) in order to score an A-symbol. By looking at the distribution of marks in the 2008 NSC exemplar and final Papers 1 and 2 in Table 5.4.5, above, we see that a learner could have achieved an A-grade by doing well on the questions at lower levels of cognitive demand and by attaining a smaller number of marks from questions at a higher level of cognitive demand.

It is thus clear that a candidate who would have got an 'A' symbol in the old HG exams was more likely to get an 'A' symbol in the 2008 exemplar and final papers.

Making the assumption that an 'A' candidate was likely to get about 90% of the marks for questions at lower levels of cognitive demand, we got the picture in Table 5.4.6 (see Page 66).

2. Marks are given out of 100

**Table 5.4.6: Numbers of marks needed to score A-grades**

| HG, and 2008 exemplar and final marks (marks given out of 100) | Assume HG 'A' candidates would achieve 90% of marks for knowledge and routine procedures = number of marks | Number of marks needed to get to an A (i.e. to get 80%) |
|---|---|---|
| Average of 2005–7 HG Paper 1 & 2 | 90% of 52 = 47 | 33 |
| NSC 2008 Exemplar Paper 1 & 2 | 90% of 74.5 = 67 | 13 |
| NSC 2008 Nov Final Paper 1 & 2 | 90% of 72 = 65 | 15 |

Table 5.4.6 shows that a candidate in the old HG exams would have needed to score about 20 more marks[2] for questions at the higher levels of cognitive demand to get an A symbol than a candidate in the NSC exemplar and final papers would have.

### 5.4 (3.2) Determining pass levels for Mathematics learners

In order to ascertain whether learners who would have passed the old SG papers (learners who would have scored a mark of 33.33% in these papers) would pass the 2008 NSC exemplar and final papers (by scoring a mark of 30%), the Umalusi Mathematics team made the assumption that it would have been on questions at the lower levels of cognitive demand (*knowledge* and *performing routine procedures*) that these learners would have needed to score.

**Table 5.4.7: Percentage of marks in Standard Grade and 2008 NSC exemplar and final papers at lower and upper levels of cognitive demand**

| SG and 2008 exemplar and final papers | Knowledge & Routine procedures(%) | Complex procedures & Problem-solving (%) |
|---|---|---|
| Average of 2005–7 SG Papers 1 & 2 | 73 | 27 |
| NCS 2008 Exemplar Papers 1 & 2 | 74.5 | 25.5 |
| NCS 2008 final Papers 1 & 2 | 72 | 28 |

From Table 5.4.7 it is clear that in order to pass either the NATED 550 Standard Grade or NSC exemplar and final papers, a learner would have needed to get fewer than half of the available marks for questions at the lower levels of cognitive demand.

**Table 5.4.8: Percentage of marks in NATED 550 Standard Grade and 2008 NSC exemplar and final papers in subcategories of the lower levels of cognitive demand**

| PAPER 1&2 | NCS 2008 Final | NCS 2008 Exemplar | 2005 SG | 2006 SG | 2007 SG | AVE SG |
|---|---|---|---|---|---|---|
| Easy knowledge and routine procedures (%) | 18 | 23 | 24 | 19 | 17 | 20 |
| Moderate knowledge and routine procedures (%) | 44 | 47 | 44 | 43 | 43 | 44 |

From Table 5.4.8 it appears that it would be possible to get the 30% required to pass the 2008 NSC exemplar and final papers by correctly answering the easy *knowledge* and *routine procedure*

questions and then getting just a few of the moderate *knowledge* and *routine procedures* items (12 out of 44 for the 2008 NSC final paper, and 7 out of 47 in the exemplar) correct. Similarly, it seems that it would have been possible to pass the average Standard Grade paper by getting the easy *knowledge* and *routine procedures* items correct, and answering only a small number of the moderate *knowledge* and *routine procedures* items (9 out of 44 for 2005 SG; 14 out of 43 for 2006 SG; and 16 out of 43 for 2007 SG) correctly.

Tables 5.4.7 and 5.4.8 taken together strongly suggest that learners who had previously passed the Standard Grade papers would have passed the 2008 NSC exemplar and final papers. In other words the demands a learner would have had to have met in order to pass the 2008 NSC exemplar and final papers, would have been roughly equivalent to those in previous Standard Grade papers.

However the team noted that a number of less cognitively demanding questions were based on topics new to the curriculum (for example transformation geometry, statistics). This could mean that learners who had teachers who were unfamiliar with these topics might not have experienced these questions as straightforward.

### 5.4 (3.3) Comparability of the NATED 550 Mathematics papers, 2005–2007

The comparison of the cognitive demand of the Higher Grade papers between 2005 and 2007 needs to be treated with more caution than the comparison between the HG papers, on average, and the 2008 exemplar and final papers. This caution is necessary because seven evaluators (individuals from the Umalusi Mathematics and Umaluis Mathematical Literacy teams) were used to evaluate the HG papers in teams of 3 or 4. Thus in some cases there was little or no overlap between the members of a team who evaluated one HG paper and the members of the team who evaluated another.

For example, no-one who evaluated the 2006 NATED 550 Higher Grade Paper 2 also evaluated the 2007 HG Paper 2. The average results across evaluators were thus combined with an analysis at the results of individual evaluators across the years.

**Table 5.4.9: Percentage of marks at lower and higher levels of cognitive demand in NATED 550 Higher Grade papers between 2005 and 2007**

| HG Papers | Knowledge& Routine procedures % | Complex procedures& Problem-solving % |
|---|---|---|
| **2005 HG Paper 1** | 60 | 40 |
| **2006 HG Paper 1** | 65 | 35 |
| **2007 HG Paper 1** | 50 | 49 |
| **2005 HG Paper 2** | 50 | 50 |
| **2006 HG Paper 2** | 45 | 55 |
| **2007 HG Paper 2** | 42 | 58 |
| **2005 HG Paper 1 & 2** | 55 | 45 |
| **2006 HG Paper 1& 2** | 55 | 45 |
| **2007 HG Paper 1& 2** | 46 | 53.5 |

From Table 5.4.9 it appears as if the 2007 Higher Grade examinations might have been more demanding than the corresponding 2005 and 2006 examinations. This finding is consistent with the results of individual evaluators across the years.

The comparison of the cognitive demand of the Standard Grade papers between 2005 and 2007 also generated results that need to be treated with caution for reasons explained above.

**Table 5.4.10: Percentages of marks at lower and higher levels of cognitive demand in Standard Grade papers between 2005 and 2007**

| SG Papers | Knowledge& Routine procedures % | Complex procedures& Problem-solving % |
|---|---|---|
| **2005 SG Paper 1** | 81 | 19 |
| **2006 SG Paper 1** | 74 | 26 |
| **2007 SG Paper 1** | 74 | 26 |
| **2005 SG Paper 2** | 73 | 27 |
| **2006 SG Paper 2** | 70 | 30 |
| **2007 SG Paper 2** | 67 | 33 |
| **2005 SG Paper 1 & 2** | 77 | 23 |
| **2006 SG Paper 1 & 2** | 72 | 28 |
| **2007 SG Paper 1 & 2** | 70.5 | 29.5 |

From Table 5.4.10 it appears as if the NATED 550 Standard Grade Paper 1 of 2005 was easier than those of 2006 and 2007. However, this finding was not borne out by the ratings of individual evaluators across the years. The pattern suggests that this difference was not significant and that the Standard Grade papers between 2005 and 2007 were of roughly similar standards.

### 5.4 (3.4) Distinguishing Mathematics Higher from Standard Grade papers

The Umalusi Mathematics team attempted to distinguish between the NATED 550 Higher and Standard Grade papers by considering the average percentages of marks allocated for different types and levels of cognitive demand at each (Higher Grade and Standard Grade) level. The results of this comparison are shown in Table 5.4.12, (below).

**Table 5.4.11: Percentage of marks for each type of cognitive demand in the NATED 550 Higher and Standard Grade papers**

| Types of cognitive demand | 2005–7 SG | 2005–7 HG |
|---|---|---|
| **Knowledge %** | 21 | 10 |
| **Routine Procedures %** | 53 | 42 |
| **Complex Procedures %** | 20 | 40 |
| **Problem-solving %** | 7 | 8 |

From Table 54.11 it is clear that the NATED 550 Standard Grade papers were weighted more heavily towards questions at the lower levels of cognitive demand (*knowledge* and *routine procedures*) than their Higher Grade equivalents were, and that they had fewer marks available for questions at the higher levels of cognitive demand, particularly *solving complex procedures*, than did the Higher Grade papers. The team noted that the Higher Grade curriculum contained more topics suitable to questions of the *complex procedures* type, than did that for the Standard Grade. These topics included *the general solution of trigonometric equations*; *absolute value; inequalities; exponential and logarithmic equations*, and *linear programming*. In addition, *Euclidian Geometry* rider-type (difficult) problems in NATED 550 Standard Grade Paper 2 papers tended to be more scaffolded and straightforward than those in the Higher Grade papers.

### 5.4 (3.5) Overall view of 2008 NSC Mathematics exemplar and final papers in relation to the 2005–2007 NATED 550 Higher and Standard Grade papers

The 2008 NSC exemplar and final papers differed from the NATED 550 Higher and Standard Grade papers in terms of the weightings of various content areas.

In Paper 1, the Higher and Standard Grade papers had a heavier weighting of *algebra* and *equations* than did the NSC papers. *Annuities* and *finance* questions were included in the NSC papers, but only featured in the Standard Grade papers in a very limited way, and did not feature in the Higher Grade papers at all. *Linear programming* was in both the Higher Grade and NSC Paper 1, but not in that for Standard Grade.

Many of these shifts could be described in terms of a shift away from the manipulation of algebraic expressions towards applications of mathematics in contextual situations. However, the team was interested to note the shift in the NCS curriculum towards more modelling, problem-solving and a focus on mathematical processes (like *conjecturing, justifying, generalising*, etcetera.) was not reflected in either the exemplar or final papers to the extent that the team had imagined it would be, judging by the contents of the NCS curriculum.

In the 2008 NSC Paper 2 there was no *Euclidean geometry*, which made up about 17% of both Higher and Standard Grade Papers 2. This omission meant that the need to provide proofs was significantly diminished in the NSC exemplar and final papers.

The *Euclidean geometry* sections of the Higher and Standard Grade papers were often cognitively demanding. The new topics in the NSC papers that replaced the topics, and hence, marks previously assigned to *Euclidean geometry*, were *basic statistics* and *transformation geometry*. The team found that almost all of the items dealing with *transformation geometry* as well as most of the statistics items in the 2008 NSC exemplar and final papers were relatively easy in terms of cognitive demand. These levels comprise a possible reason as to why the NSC exemplar and final Paper 2 papers were significantly easier than previous Higher Grade papers. However, as *transformation geometry* and *statistics* were new topics in the curriculum, teachers and learners might have struggled with them initially and the 2008 results might not necessarily have reflected the relatively low cognitive demand.

Overall, the data in Tables 5.4.4, 5.4.5, and 5.5.6 strongly suggest that the 2008 NSC exemplar and final papers were similar to the NATED 550 Standard Grade papers in terms of cognitive demand.

### 5.4 (3.6) The 2008 NSC Mathematics exemplar and final papers as models for future NSC exams, including comparison with recommendations in the Subject Assessment Guidelines

While recognising that the examiners were faced with a difficult task in setting the first round of 'new' mathematics examinations, the team did express concern about some aspects of the 2008 NSC exemplar and final papers as models for future mathematics examinations. The most apparent issue was the lack of sufficient challenging questions to distinguish between achievement levels of the top candidates. In addition, the strong weighting towards skills at the lower end of the cognitive demand type, was of concern. The analysis of the exam papers suggested that the nature of cognitive demand in the 2008 exemplar and final papers was similar to that of the NATED 550 Standard Grade papers. This circumstance clearly mitigated against the intention of providing Mathematics exams that discriminated between the range of learners previously writing Higher and Standard Grade papers. In addition, this analysis showed that both 2008 NSC papers were weighted more heavily towards the lower levels of cognitive demand than the *Subject Assessment Guidelines* (Mathematics Document 6, Page 12) suggested should be the case (see Table 5.4.12, overpage).

**Table 5.4.12: Comparision of percentages of marks in the 2008 NSC exemplar and final Mathematics papers, with percentages of marks suggested in the *Subject Assessment Guidelines* (SAG)(Mathematics Document 6)**

| Expected % as per SAG | Exemplar Paper 1 | Exemplar Paper 2 | Exemplar Papers 1&2 | Final Paper 1 | Final Paper 2 | Final Papers 1&2 |
|---|---|---|---|---|---|---|
| Knowledge(%) | 25 | 16 | 15 | 16 | 6 | 13 | 9 |
| Performing routine procedures (%) | 30 | 61 | 57 | 59 | 66 | 59 | 62 |
| Performing complex procedures (%) | 30 | 18 | 22 | 20 | 23 | 26 | 24 |
| Problem-solving (%) | 15 | 6 | 6 | 6 | 5 | 3 | 4 |

The team pointed out that examinations have a strong wash-back effect on teaching in schools: a focus on recall and routine procedures in the examinations could easily lead to a similar focus in classrooms. However, it is also important that the kind of learner who would previously have taken Mathematics on Standard Grade level is catered for. The imperative is thus to provide for sufficient challenge and differentiation at the upper end of the spectrum, while still retaining sufficient straightforward 'core' work achievable by the average learner. The analysed exemplars and final papers did not achieve these goals adequately.

In addition, the team felt that, given the emphasis in the NCS curriculum documents, the 2008 exemplar and final papers did not give sufficient attention to the following aspects:

- *Applications and modelling*
- *Mathematical processes (e.g. investigating, generalising, conjecturing, justifying)*
- *Problem-solving*
- *Communication (expressing arguments, demonstrating reasoning ability)*

The team suggested that the inclusion of content related to *increasing and decreasing functions, interpretation of functions, rates of change and exponential growth and decay* (beyond the financial context) might provide more modelling opportunities. The questions on *data handling* and *statistics* were regarded as being very basic and the team felt that attention should be paid to including *statistical reasoning* in the examination.

The team was concerned about the absence of *proof*.

The team was also concerned that, given the similarity between the exemplar papers, prelimanary examinations, additional exemplars and the final papers, teachers might already have assumed that future examinations will continue to be of this style and standard. The team thus felt that particular care needs to be taken when setting the 2009 exemplars and examinations, to not entrench these qualities.

### 5.4 (3.7) Language levels in the 2008 NSC exemplar and final Mathematics papers

The Umalusi Mathematics evaluators felt that the language levels in the 2008 NSC exemplar and final Mathematics papers was reasonable. However, the potential for increased language demands on learners who are not first language English speakers created by more contextualised questions needs to be monitored in terms of the impact it could have on their performance.

### 5.4 (3.8) Comment on the appropriateness of the Umalusi exam paper evaluation tool for Mathematics

The Mathematics team found the Umalusi exam paper evaluation tool to be useful, but adapted the categories of cognitive demand in this tool to match those provided in the *Subject Assessment Guidelines* (see Mathematics Document 6), as this adaptation was felt to be more useful for the comparisons made.

## SUMMARY OF EXAM PAPER ANALYSIS: MATHEMATICS

A summary of results from the Mathematics exam paper analysis is captured in Table 5.4.13 (below).

**Table 5.4.13: Results of analysis of examination papers for Mathematics**

| Levels of cognitive demand | Types of items at particular levels of cognitive demand | % of items in final NSC papers, 2008 | % of items in August exemplar NSC papers, 2008 | % of items on average in SG papers, 2005–2007 | % of items on average in HG papers, 2005–2007 |
|---|---|---|---|---|---|
| **Lower level cognitive demand** | Knowledge | 9 | 16 | 21 | 10 |
| | Performing routine procedures | 62 | 59 | 53 | 42 |
| **Higher level cognitive demand** | Performing complex procedures | 24 | 20 | 20 | 40 |
| | Problem-solving | 4 | 6 | 7 | 8 |

In addition to using these categories, the team designated level of difficulty (*easy, moderate, difficult*) to each item (all items making up examination questions). These levels of difficulty were used to make fine distinctions within categories only.

Regarding whether A-grades were similar in the NATED 550 Higher Grade and 2008 final NSC papers, the team noted that the average percentage of marks allocated to the higher level cognitive demand questions in Higher Grade papers was 48%. In contrast, that in the 2008 final NSC papers was 28%. Candidates in previous Higher Grade examinations would have had to get more higher cognitive level items correct in order to score A-grades than would have been needed to score equivalent marks in the 2008 final NSC papers. Assuming that Higher Grade A-grade candidates would achieve around 90% for items involving *knowledge and routine procedures*, the percentage of marks such learners would need to score in oder to achieve their A-grades can be calculated (see Table 5.4.14, overpage).

**Table 5.4.14: Comparing requirements for A-grades in the NATED 550 Higher Grade papers 2005–2007 and 2008 NSC final papers**

| Exam papers (out of 100%) | Marks that A-grade candidates would achieve if scoring 90% for items based on *knowledge* and *routine procedures* | Additional percentage marks needed to score an overall A-grade |
|---|---|---|
| 2005–7 Higher Grade Papers 1 & 2 | 90% of 52 = 47 | 33 |
| 2008 NSC final Papers 1 & 2 | 90% of 72 = 65 | 15 |

Table 5.4.14 shows that an A-grade candidate in previous Higher Grade exams would have needed to score 18 percent more marks for questions at the higher levels of cognitive demand to achieve an 'A' symbol than would a candidate doing the 2008 NSC exemplar and final papers.

In order to ascertain whether learners working at the level of just passing previous Standard Grade papers (i.e. achieving 33.3%) would have passed the 2008 NSC final papers (by achieving a mark of 30%), the team assumed that these learners would have scored marks for answering items at the lower levels of cognitive demand (knowledge and performing routine procedures), correctly. Table 5.4.15 (below) shows the spread of such marks in the NATED 550 Standard Grade (2005–2007) and 2008 NSC final papers.

**Table 5.4.15: Percentages of marks in the NATED 550 Standard Grade (2005–2007) and 2008 NSC final papers for items with higher and lower levels of cognitive demand**

| Exam papers (out of 100%) | Knowledge & Routine procedures (%) | Complex procedures & Problem-solving (%) |
|---|---|---|
| 2005–7 Standard Grade Papers 1 & 2 | 73 | 27 |
| 2008 NSC final Papers 1 & 2 | 72 | 28 |

Table 5.4.15 shows that in order to pass either previous Standard Grade or the 2008 NSC final papers, a learner would have needed to correctly answer fewer than half of the available marks for questions at the lower levels of cognitive demand. Table 5.4.16 (below) shows the types of lower level questions learners achieving at this evel would need to answer correctly.

**Table 5.4.16: Percentages of marks in the NATED 550 Standard Grade (2005–2007) and 2008 NSC final papers for differing types of items at lower levels of cognitive demand**

| Papers 1&2 | NCS 2008 Final | AVE 2005–7 SG |
|---|---|---|
| Easy knowledge and routine procedures % | 18 | 20 |
| Moderate knowledge and routine procedures % | 44 | 44 |

Table 5.4.16 shows that it would have been possible to score the 30% required to pass the 2008 NSC final papers by correctly answering items categorised as *easy knowledge* and *routine procedures* and then scoring some (12 out of 44) of the items classified as *moderate knowledge* and *routine procedures* correctly. Similarly it would have been possible that learners could have passed the Standsard Grade papers analysed by correctly scoring on the easy *knowledge* and *routine procedures* items and some (13 out of 44) of the moderate *knowledge* and *routine procedures* items.

Tables 5.4.15 and 5.4.16 taken together strongly suggest that learners achieving at the level of just passing Standard Grade papers would have passed the 2008 NCS final papers. However we reiterate that the fact that a number of the less cognitively demanding questions were in topics new to the curriculum might mean that many learners might not have performed as well as expected on these questions.

Overall, the standard of the 2008 NSC final papers was closer to that of the NATED 550 Standard Grade than that of the Higher Grade papers.

## 5.5 MATHEMATICAL LITERACY

### *Introductory note to the exam paper analyses for Mathematical Literacy*

Benchmarking of the final matriculation exams is usually achieved in relation to previous examinations in the same subject, as well as in relation to various quality checks, outlined in Section 1 of this report. Benchmarking the 2008 Mathematical Literacy examinations was a considerable challenge, as it was a new subject. In order to start this benchmarking process, the 2008 NSC final Mathematical Literacy examination papers were analysed by a team of Umalusi evaluators, for types and levels of cognitive demand in their own right, and were compared with the exemplars for 2008. The initial intention was to benchmark these final papers against their NATED 550 Mathematics Higher and Standard Grade counterparts for the years 2005 to 2007, but despite several committed attempts, this process proved impossible to carry out, for reasons outlined here.

The reason it was originally intended that the team would analyse the 2008 NSC Mathematical Literacy exemplar and final examination papers in relation to the NATED 550 Mathematics Higher and Standard Grade papers was to determine whether or not it was possible to predict the performance of Mathematical Literacy learners who would historically have had only the options of Mathematics Higher and Standard Grade. The idea was to try to get a sense of the level of Mathematical Literacy papers in relation to what were thought would be its Higher and Standard Grade equivalents. In particular, the Umalusi Mathematical Literacy team attempted to set out to determine whether the 2008 NCS Mathematical Literacy papers allowed for:

**a)** Learners who had achieved A-grades in the NATED 550 Mathematics (Higher Grade) papers to achieve A-grades for the 2008 NSC final Mathematical Literacy papers, *where the two A-grades were comparable;* and

**b)** Average learners who were just able to pass the NATED 550 Mathematics examinations at Standard Grade level to pass the 2008 NCS Mathematical Literacy papers.

It was not possible to answer these questions, however, because they were based on two key assumptions. Firstly, they assumed that it was possible to compare the NSC Mathematical Literacy curricula and examinations with those of the NATED 550 Mathematics Higher and Standard grade courses. The curriculum analysis has already shown that there are no contents and skills common to the curricula of the two subjects (see Section 7.2.4 of this report). There were also no common questions in the examination papers for the two subjects.

Second, the original research questions were based on the assumption that learners participating in the two subjects are similar or comparable. This assumption was not necessarily true, as what were probably the majority of learners enrolled for Mathematical Literacy would not necessarily have taken up Mathematics at all. Historically, approximately 60% of Senior Certificate learners enrolled for Mathematics; approximately 9% of the Senior Certificate candidates registered for Mathematics Higher Grade and 51% at Standard Grade level. The remaining 40% of the Senior Certificate candidates did not register for Mathematics at any level (see Department of Education annual reports on the *Senior Certificate* exams, for example, Department of Education 2006 and 2007).

The NSC requires learners to enrol for either Mathematics or Mathematical Literacy as one of their seven subjects. Based on figures supplied by the Department of Education (Vinjevold, *personal communication*, September 2008), it was anticipated that approximately 53% of the 2008 NSC Candidates would be writing Mathematics, and 47%, Mathematical Literacy. Rather than learners who had historically registered for Mathematics Standard Grade subsequently registering for Mathematical Literacy, it appeared that the vast majority of these learners had registered for Mathematics. It was estimated that only roughly 14% of the learners registered for Mathematical Literacy would historically have attempted some form of Mathematics (Higher or Standard Grade) at all. In other words, over 85% of the current NSC Mathematical Literacy learners would historically probably not have attempted any form of Mathematics as part of their *Senior Certificates*.

Thus, instead of responding to the questions originally posed, this Mathematical Literacy exam paper analysis section of the report will now focus on the following:

- An image of the ideal Mathematical Literacy learner.
- The nature and weighting of items that would need to be included in the NSC Mathematical Literacy examinations in order to ensure that it is possible for learners at the lower end of the achievement scale to pass the examinations; and that it is possible to discriminate between learners at both the lower and upper ends of the achievement scale.
- Analysis of the *final* 2008 NSC Mathematical Literacy papers in terms of whether they met the criteria regarding the nature and weighting of items stipulated in the *Subject Assessment Guidelines* for Mathematical Literacy (see Mathematical Literacy Document 6).
- Analysis of the *exemplar* 2008 NSC Mathematical Literacy papers in terms of whether they met the criteria regarding the nature and weighting of items stipulated in the *Subject Assessment Guidelines* for Mathematical Literacy (ibid.), and whether these exemplars were fair predictors of the final 2008 NSC papers for the subject.
- The suitability of the 2008 exemplar and final NSC Mathematical Literacy papers, for future NSC exams.
- Language level and the phrasing of questions in the 2008 NSC Mathematical Literacy examination papers.

The Umalusi Biology/Life Sciences team attempted to benchmark the new 2008 NSC Biology/ Life Sciences exams by analysing the type of cognitive demand and levels of difficulty of items (questions and sub-questions) in the NATED 550 Higher Grade and Standard Grade examination papers for 2005, 2006 and 2007, and the NSC exemplar and final examination papers for 2008.

The following exam papers were analysed (four papers in all):

- 2008 NSC exemplar and final Mathematical Literacy Papers 1 and 2

## 5.5 (1) The ideal-type Mathematical Literacy learner

The ideal Mathematical Literacy learners are those who can use elementary mathematics (often learned as part of the GET curriculum) *to make sense of the world* in which they live, and solve typical problems associated with self-managing individuals (such as making financial decisions – choosing between options and understanding the implications of their decisions; reading and following instructions especially instructions involving simple calculations; reading log tables; and estimating quantities and values) (see Mathematical Literacy Documents 6, 7, and 8). These learners are potentially contributing workers, able to perform simple calculations; use black-box calculators; read information from tables; and understand cause and effect, and the role of related variables (ibid.). They are critical citizens, able to interpret information presented in tables and graphs with an awareness of how these items can be manipulated to create certain impressions; interrogate the choices of models used by government to allocate scarce resources; and monitor the appropriate use of resources by officials and others (ibid.).

For Mathematical Literacy learners, the Mathematics covered and used is elementary in nature, but the problems solved are complex. These problems are grounded in day-to-day experience and reality, which brings with it the challenge of dealing with ambiguity and uncertainty or knowing what strategy to adopt when one does not know what to do.

This notion of Mathematically literate learners being self-managing individuals, contributing workers and critical citizens, is spelled out in detail in the section entitled *Purpose of Mathematical Literacy* (see Mathematical Literacy *Subject Statement*, Mathematical Literacy Document 7, Pages 9-10).

## 5.5 (2) Evaluation tool for Mathematical Literacy exam papers

Given that the exam papers for Mathematical Literacy need to discriminate between high-achieving learners, on the one hand, and to allow all those who are sufficiently mathematically literate, but who did not achieve above minimal pass marks in Mathematics, on the other hand, to pass, the inclusion and spread of items with specific characteristics in the papers is important for achieving this discrimination. This report describes the nature and weighting of the items that facilitate this discrimination. Both the description and analysis of items in the report are informed by the *Assessment Taxonomy* for Mathematical Literacy detailed in the Mathematical Literacy Subject *Assessment Guidelines* (Mathematical Literacy Document 6, Pages 27-28). This taxonomy is summarised in Table 5.5.1 (see overpage).

**Table 5.5.1: Assessment Taxonomy for Mathematical Literacy**

| Level of Cognitive Demand | Percentage of the papers allocated to the level |
|---|---|
| **Knowing (k)**<br>Tasks at the *knowing* level of the Mathematical Literacy taxonomy require learners to:<br>- Calculate using the basic operations including:<br>- algorithms for +, -, ×, and ÷;<br>- appropriate rounding of numbers;<br>- estimation;<br>- calculating a percentage of a given amount; and measurement.<br>- Know and use appropriate vocabulary such as equation, formula, bar graph, pie chart, Cartesian plane, table of values, mean, median and mode.<br>- Know and use formulae such as the area of a rectangle, a triangle and a circle where each of the required dimensions is readily available.<br>- Read information directly from a table (e.g. the time that bus number 1234 departs from the terminal). | 30% |
| **Applying routine procedures in familiar contexts (rp)**<br>Tasks at the *applying routine procedures in familiar contexts* level of the Mathematical Literacy taxonomy require learners to:<br>- Perform well-known procedures in familiar contexts. Learners know what procedure is required from the way the problem is posed. All of the information required to solve the problem is immediately available to the student.<br>- Solve equations by means of trial and improvement or algebraic processes.<br>- Draw data graphs for provided data.<br>- Draw algebraic graphs for given equations.<br>- Measure dimensions such as length, weight and time using appropriate measuring instruments sensitive to levels of accuracy. | 30% |
| **Applying multi-step procedures in a variety of contexts (mp)**<br>Tasks at the *applying multi-step procedures in a variety of contexts* level of the Mathematical Literacy taxonomy require learners to:<br>- Solve problems using well-known procedures. The required procedure is, however, not immediately obvious from the way the problem is posed. Learners will have to decide on the most appropriate procedure to arrive at the solution to the question and may have to perform one or more preliminary calculations before determining a solution.<br>- Select the most appropriate data from options in a table of values to solve a problem.<br>- Decide on the best way to represent data to create a particular impression. | 20% |
| **Reasoning and reflecting (rr)**<br>Tasks at the *reasoning and reflecting* level of the Mathematical Literacy taxonomy require learners to:<br>- Pose and answer questions about what Mathematics they require to solve a problem and then to select and use that Mathematical content.<br>- Interpret the solution they determine to a problem in the context of the problem and, where necessary, to adjust the Mathematical solution to make sense in the context.<br>- Critique solutions to problems and statements about situations made by others.<br>- Generalise patterns observed in situations, make predictions based on these patterns and/or other evidence and determine conditions that will lead to desired outcomes. | 20% |

## 5.5 (3) Determining average achievement in Mathematical Literacy

In order to make it possible for Mathematical Literacy learners at the lower end of the achievement scale to pass, the NSC Mathematical Literacy papers need to include questions which require:

- Performing simple calculations (with a basic four-function calculator)
- Reading information from tables (including log tables for sport, distance tables on maps, time tables for busses and trains, and dosage amounts for medicines in terms of age/weight)
- Reading information from graphs (graphs used in support of newspaper articles [data graphs], and graphs used to show the relationship between two variables in a functional relationship)
- Substituting values into formula (supplied) and calculating values (with a basic four-function calculator)
- Reading maps and diagrams
- Using scale
- Working with simple mixing and other ratios
- Reading and interpreting information from financial documents such as statements

In the *Assessment Taxonomy* for Mathematical Literacy these questions are referred to as knowing questions. At least 30% of the questions in NSC Mathematical Literacy Papers 1 and 2 need to be posed at this level of cognitive demand (see Mathematical Literacy Document 6, Page 15, and the summary in Table 5.5.1, see Page 76).

## 5.5 (4) Discriminating fairly between ranges of high, low, and moderately achieving Mathematical Literacy learners

Items that potentially identify high-achieving learners in Mathematical Literacy are *difficult* items – items requiring *analysis* of numerical and other information *reasoning* and *reflecting*. For these items, learners need to be able to investigate complex situations, determine ranges of options, and evaluate these options in terms of the contexts in which they will be applied. These questions require learners to consider the impact of more than one variable, and to consider different cases. The questions have a "…if (a), then what, and if (b), then what…" type of structure. In order to answer these questions, learners need to be able to articulate their reasoning and justify their choices of solution, method or approach. In addition, the questions are characterised by numbers, numerical relationships, and data presented in a variety of different ways.

In terms of the *Assessment Taxonomy* for Mathematical Literacy, these questions are referred to as *reasoning and reflecting questions*. It is stipulated that at least 20% of the questions in NSC Mathematical Literacy Papers 1 and 2 should be posed at this level of cognitive demand (see Mathematical Literacy Document 6, Page 15, and the summary in Table 5.5.1, on Page 76).

## 5.5 (5) Final 2008 NSC Mathematical Literacy papers and requirements in the Subject Assessment Guidelines

The Umalusi Mathematical Literacy evaluation team's detailed analysis of the final NCS Mathematical Literacy Papers 1 and 2, in terms of *learning outcomes* and *taxonomy levels*, is summarised in Table 5.5.2 (overpage). Learning outcomes are provided here for the reader:

- Learning Outcome 1: Numbers and Number Relationships
- Learning Outcome 2: Functions and Algebra
- Learning Outcome 3: Shape and Measurement
- Learning Outcome 4: Data-handing and Probability

## Table 5.5.2: Analysis of DoE final 2008 Mathematical Literacy Papers 1 and 2 in terms of learning outcomes and taxonomy levels

| | DoE papers (All values are in %) | Paper1 | | | | | Paper 2 | | | | | Combined | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Learning Outcome | | | | | Learning Outcome | | | | | Learning Outcome | | | | |
| | | 1 | 2 | 3 | 4 | Total | 1 | 2 | 3 | 4 | Total | 1 | 2 | 3 | 4 | Total |
| **Cognitive Demand** | Knowing | 28.0 | 5.3 | 10.0 | 12.7 | 56.0 | 10.7 | | | 4.7 | 15.3 | 19.3 | 2.7 | 5.0 | 8.7 | 35.7 |
| | Applying routine procedures in familiar contexts | 14.0 | 2.0 | 7.3 | 12.7 | 36.0 | 22.7 | 6.0 | 8.0 | 11.3 | 48.0 | 18.3 | 4.0 | 7.7 | 12.0 | 42.0 |
| | Applying multi-step prcedures in a variety of contexts | 1.3 | 5.3 | 1.3 | | 8.0 | 20.7 | 5.3 | | | 26.0 | 11.0 | 5.3 | 0.7 | | 17.0 |
| | Reasoning and reflecting | | | | | 0.0 | 4.7 | 2.0 | | 4.0 | 10.7 | 2.3 | 1.0 | | 2.0 | 5.3 |
| | Total | 43.3 | 12.7 | 18.7 | 25.3 | | 58.7 | 13.3 | 8.2 | 20.0 | | 51.0 | 13.0 | 13.3 | 22.7 | |

In Table 5.5.3 (below) the team compared the combined distribution of questions with specific types of cognitive demand in the NSC final Mathematical Literacy Papers 1 and 2, on the one hand, and the stipulated distribution of questions according to cognitive demand set out in the *Subject Assessment Guidelines* (Mathematical Literacy Document 6).

## Table 5.5.3: Comparison of Subject Assessment Guidelines and 2008 NSC Mathematical Literacy Papers 1 and 2 combined in terms of learning outcomes and taxonomy levels

| | Both papers combined (All values are in %) | SAG | | | | | DoE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Learning Outcome | | | | | Combined Learning Outcome | | | | |
| | | 1 | 2 | 3 | 4 | Total | 1 | 2 | 3 | 4 | Total |
| **Cognitive Demand** | Knowing | | | | | 30 | 19.3 | 2.7 | 5.0 | 8.7 | 35.7 |
| | Applying routine procedures in familiar contexts | | | | | 30 | 18.3 | 4.0 | 7.7 | 12.0 | 42.0 |
| | Applying multi-step prcedures in a variety of contexts | | | | | 20 | 11.0 | 5.3 | 0.7 | | 17.0 |
| | Reasoning and reflecting | | | | | 20 | 2.3 | 1.0 | | 2.0 | 5.3 |
| | Total | 25 | 25 | 25 | 25 | | 51.0 | 13.0 | 13.3 | 22.7 | |

In Table 5.5.4 (below) the team compared the distribution of questions with particular levels of cognitive demand set out in the *Subject Assessment Guidelines* (Mathematical Literacy Document 6), with those actually featuring in the final 2008 NSC Mathematical Literacy Papers 1 and 2.

## Table 5.5.4: Comparison of Subject Assessment Guidelines and 2008 NSC Mathematical Literacy Papers 1 and 2, in terms of the taxonomy levels of questions in the papers overall

| | (All values are in %) | SAG Paper | | | DoE Paper | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | Total | 1 | 2 | Total |
| **Cognitive Demand** | Knowing | 60 ± 5 | 30 ± 5 | | 56.0 | 15.3 | 35.7 |
| | Applying routine procedures in familiar contexts | 40 ± 5 | 20 ± 5 | 30 ± 5 | 36.0 | 48.0 | 42.0 |
| | Applying multi-step procedures in a variety of contexts | | 40 ± 5 | 20 ± 5 | 8.0 | 26.0 | 17.0 |
| | Reasoning and reflecting | | 40 ± 5 | 20 ± 5 | 0.0 | 10.7 | 5.3 |

The Mathematical Literacy team made several observations based on Tables 5.5.1–5.5.4 (above). First, regarding the nature and weighting of items to be included in the NSC Mathematical Literacy Papers 1 and 2, the team found that in order to ensure that it was possible for students at the

lower end of the achievement scale to pass the examination, roughly 36% of the items were at the *knowing* level (see Tables 5.5.1 and 5.5.4), providing sufficient opportunity for all learners to achieve the minimum passing requirement of 30%.

In addition, a further average of 42% of the items were found to be at the *applying routine procedures in familiar contexts* level. The team noted that this figure was in excess of recommended percentages in the *Subject Assessment Guidelines* (see Mathematical Literacy Document 6), which are 30% ± 5%. When these items were taken together with those on the *knowing* level, it was observed that the papers were possibly disproportionately weighted in favour of items at the lower end of the cognitive scale.

Further, the team observed that there were several items among those classified as being at the *knowing* (lowest) cognitive level that were closer to items expected at the General Education and Training (GET) than at the FET level. These items include the following questions and sub-questions in Paper 1: 1.4.1, 1.4.2, 1.4.3, 1.4.4, 2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.3.1, 2.3.2, 2.3.3.a, 3.1, 3.2, 3.3, 5.2.1, 5.2.2, 5.2.3, 5.2.4, 5.2.5, 6.1, 6.2.1, and 6.2.2, accounting for 59 out of 150 marks (39% of the marks) making up the paper. Questions in Paper 2 include Item 1.3.1, Item 1.3.2, Item 1.3.3, Item 4.2.1.b, Item 4.2.1.c, and Item 4.2.1.d, accounting for 23 out of 150 marks (15% of the marks) making up the paper.

Despite the inclusion of questions that were pitched at levels too low for Grade 12 learners, there were also a number of questions for which the language demands and/ or ambiguities in phrasing may have increase the difficulty levels of the questions for English First Additional and Second Additional Language (FAL and SAL) speakers.

The language in these questions was likely to contribute to levels of performance below what the *cognitive demand* of the questions would predict. Items with problematic language included, in Paper 1: Items 1.1.4, 1.3.3, 2.1.1, 2.1.2, 2.1.5, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 3.3, 3.6, 5.1, and 6.2.4, accounting for 28 out of 150 marks (over 18% of marks) in the paper. Items in Paper 2 included 1.2, 1.3.1, 1.3.2, 1.3.3, 1.4, 2.2, 2.3.2, 2.4.1.a, 2.4.2, 3.1.1, 3.1.2, 3.3, 3.5.2, 4.1.3, and 6.4.2.c, accounting for 52 out of 150 marks (34% of marks) in the paper.

In all, the team predicted that the influence of the disproportionately high allocation of marks to items at low cognitive levels in the final NSC papers would be balanced to a certain extent by the phasing of some questions in complex and ambiguous ways. The final 2008 marks that the final 2008 papers might have produced were not likely to be as inflated as the lack of items at the more cognitively demanding levels might have led one to expect. Discrimination that the papers may have produced may be more the result of language comprehension and learners' ability to interpret questions than of the actual cognitive demand of the questions.

At the upper end of the scale, approximately 17% of the items were at the *applying multi-step procedures* in a variety of contexts level, and a further 5% of the items were at the *reasoning and reflecting* level (see Tables 5.5.1 and 5.5.4). These figures were also not in line with recommendations in the *Subject Assessment Guidelines*, which suggest the inclusion of 20–25% of this type of item. A possible implication was that the papers might not discriminate between learners at the upper end of the achievement scale, as intended.

## 5.5 (6) The 2008 NSC Mathematical Literacy exemplar and final papers as models for future NSC exams

In as much as the exemplar and final 2008 NSC Mathematical Literacy papers were a first set of examination papers for the new subject Mathematical Literacy, the Umalusi Mathematical Literacy team acknowledged that they had provided an interpretation of the curriculum and as such had set initial standards. While the team acknowledged this achievement, it was also concerned that if the (low) standards created by this first set of papers are not challenged, then they may

well become the standard or benchmark. In light of this concern, the team wished to make four observations which relate to the contexts of questions in the papers; formulae; high-level questions, and the coverage of learning outcomes.

### *Regarding the role of context*

Mathematical Literacy is a context-based subject, and as such, it is to be expected that exam questions will be framed within verbal (textually-created) contexts. The team found, however, that there were too many instances in the 2008 NSC papers, in which contexts were either gratuitous or confusing.

In instances where contexts were said to be used gratuitously, the questions had an unnecessary number of words and it was expected that they would take considerable time to read, and could create confusion. Further, learners could decide to 'read past' them, ignoring them, when in fact, it was intended that they engage with these features. Examples of these items in final 2008 Mathematical Literacy Paper 1 include: Questions 2.2 and 3, in which the introductions and photographs had little to do with the questions. In these examples, the questions involved only the reading of a diagram and the performing of extremely low-level calculations. In Question 7 (Paper 1), the introduction did not clearly relate to the questions that followed.

In the cases where contexts were deemed confusing, these contexts were found to be used in unrealistic ways, or could simply be interpreted in a variety of ways, and learners would then have needed to spend time working out what they were aiming to convey. The usefulness of Mathematical Literacy for everyday life was not immediately apparent in these cases, and again, it is the very intention of the subject, that Mathematical Literacy learners experience the value of the subject in their lives. The way in which the subject is examined needs to demonstrate this utility.

Examples of questions in which the introductions were confusing include, among others, Question 2.3.1 (Paper 1), in which skills relating to inverse proportions were tested, and where relationships between numbers of builders and numbers of days needed for building, were suggested. In reality, there is no inverse relationship between the number of people used to build a wall and the number of days taken to complete the job. Also, in reality one person may not be able to complete the task alone, but there may not be enough space on the building site for 10 people to work at once. This question was an example of the need for more realistic applications of inverse proportion.

Further examples included Questions 3.3 and 3.4 (Paper 1), where Question 3.3 used a value that was different from the value calculated in 3.2 and as such, broke the flow of the question and context. And then, Question 3.4 had no relationship to the 'story' (context) being developed in the items immediately preceding it, and of which it was part.

Some examples, such as Question 5 (Paper 1), included incorrect information: the paces listed in the introduction were incorrect. In Question 5.2.6 (Paper 1), there was an inappropriate use of probability/ likelihood. Probability/likelihood deals with random events. 'Sipho's' performances were not random – we could expect his next time to be his best ever because he had been training, or, we could have expected it to be his worst because of the route and weather conditions on the day.

Other examples of confusing items were those for which it was not, strictly speaking, possible to find a correct answer. It is not possible to answer Question 2.3.2 (Paper 2) correctly, as answers would require learners to rely on speculation: no information was given on which learners could draw in order to make decisions. Further, Question 2.3.1 (Paper 2) could also not be answered unless learners assumed that the claim within it was correct. In such instances it would have been useful if questions started with something along the lines of "…Assuming that XYZ is correct …". Neither was it possible to answer Item 4.1.3 (Paper 2) using the information given. For the discerning reader, again, the principle behind the question was fairly clear to see, but the information given was neither realistic nor necessarily correct.

At times details were unrealistic. In Question 3.1.2 (Paper 2), for instance, details relating to duvet manufacturing were included. In actuality, these details would never have been considered at all. If learners were able to imagine their way into this 'story' (context), they might have been able to approach answering the question. On the other hand, if they spotted the principles informing this 'trick' context, they were likely to find the question very routine.

In some instances, key pieces of information were 'hidden' in the introductions. In 2008 final Paper 2, for example, Questions 2.2 and 3.3 relied on learners' noticing of words 'hidden' in introductory comments.

### Regarding the role and place of formulae

While it is fair to provide learners with the formulae they need to answer questions (in other words, not expecting students to remember formulae which in day-to-day life they could simply 'look up' anyway), the team found that the way formulae were sometimes provided created confusion.

One example of the confusing use of formulae was found in Question 3.6 (Paper 1), where learners needed to work out what was meant by the "…number of children and pensioners…" in the formula provided. Phrasing of this question would have been easier to follow if, had a table of information already been provided, it had included an extra column for the number of people visiting the aquarium.

In another instance – Question 7.2.1 (Paper 1) – the formula was confusing, in part because the units had been omitted. In a third example, Question 2.4.2 (Paper 2), the formula relied on use of a scientific calculator, where Mathematical Literacy questions should be answerable using a basic four-function calculator.

### Regarding reasoning and reflecting (high level) questions

In terms of questions at the *reasoning* and *reflecting* level of the taxonomy, the team found that simply using words such as "…give reasons…" and "…explain…" did not render items reasoning and reflecting ones. In Item 2.3.3 (in Paper 2), for example, explanation could not be given because insufficient information was provided. Further, providing this answer involved merely deciding if one value was greater than or less than another. In a second instance, Item 2.4.3 (Paper 2) also involved just choosing the smallest value of two values. Item 4.1.3 (Paper 2) similarly involved no analysis or reasoning.

### Regarding under-examined topics

Patterns in Table 5.5.2, on Page 78, show that the learning outcomes for Mathematical Literacy have been examined in the following proportions: LO1: 51%; LO2: 13%; LO3: 13%; and LO4: 23%, and not evenly, as is recommended in the *Subject Assessment Guidelines* (Mathematical Literacy Document 6).

To elaborate a little, very few marks were allocated to realistic and/ or meaningful items dealing with probability/likelihood. In general, there was a need to reflect on what it means to "…make sense of statements involving notions…" of *likelihood* (Assessment Standard 12.4.6, Mathematical Literacy Document 7). For Mathematical Literacy learners, the issue is not so much about being able to calculate estimations of *probability*, but rather about being able to *interpret expressions* involving the concept.

The topic of *taxation/inflation* appeared for the first time in the Grade 12 curriculum, and it was surprising that not a single question in the 2008 papers dealt with the "effects of taxation, inflation…" (Assessment Standard 12.1.3, Mathematical Literacy Document 7)

## 5.5 (7) Language levels in the 2008 NSC exemplar and final Mathematical Literacy papers

It was reasonable to expect that a Mathematical Literacy paper, being contextually based, would involve a great deal of text. What is important is that the text must not obscure the questions or be ambiguous in any way. The text in the exam papers needed to be used economically, but very carefully and clearly.

There were a number of items in the 2008 final Mathematical Literacy papers in which the language used or where ambiguities in the questions asked may have contributed to a poorer performance than the cognitive demand of the items in question would have predicted. These items included, in Paper 1: Items 1.1.4, 1.3.3, 2.1.1, 2.1.2, 2.1.5, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 3.3, 3.6, 5.1, and 6.2.4, accounting for 28 marks (18%) of the paper. In Paper 2, Items 1.2, 1.3.1, 1.3.2, 1.3.3, 1.4, 2.2, 2.3.2, 2.4.1.a, 2.4.2, 3.1.1, 3.1.2, 3.3, 3.5.2, 4.1.3, and 6.4.2.c, accounting for 52 marks (34%) of the paper, were similarly problematic.

## SUMMARY OF EXAM PAPER ANALYSIS: MATHEMATICAL LITERACY

A summary of the Mathematical Literacy exam paper analysis is given in Table 5.5.5 (below)

**Table 5.5.5: Percentages of items for particular cognitive activities in the *Subject Assessment Guidelines* (SAGS) and 2008 final papers for Mathematical Literacy**

| | Type of cognitive activity | Subject Assesment Guidelines | | | 2008 final NSC papers | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | Total | 1 | 2 | Total |
| Cognitive Demand | Knowing | 60 ± 5 | 30 ± 5 | | 56.0 | 15.3 | 35.7 |
| | Applying routine procedures in familiar contexts | 40 ± 5 | 20 ± 5 | 30 ± 5 | 36.0 | 48.0 | 42.0 |
| | Applying multi-step procedures in a variety of contexts | | 40 ± 5 | 20 ± 5 | 8.0 | 26.0 | 17.0 |
| | Reasoning and reflecting | | 40 ± 5 | 20 ± 5 | 0.0 | 10.7 | 5.3 |

Regarding whether learners achieving at the lower end of the spectrum, would have been likely to pass the 2008 final Mathematical Literacy papers, it was found that a disproportionately high number of marks were allocated to items at the lower end of the taxonomy in both Papers 1 and 2. This pattern suggested that it should be possible for students at the lower end of the achievement scale to pass the exams. However, the analysis of language levels in the papers revealed that a relatively high percentage (26%) of items in the two papers were ambiguous or complex in ways likely to render the papers more difficult than the cognitive levels of the items themselves would have suggested.

Regarding discrimination of learners at the upper ends of the spectrum: the team found that only 22% of the examination paper was set at the higher levels of the assessment taxonomy (although 40% was recommended in the *Subject Assessment Guideline* document). It was expected that the final 2008 papers would not discriminate well between learners at the upper end of the achievement scale. The papers might well have discriminated between learners, but these differences were more likely to be along the lines of language comprehension than along the lines of ability in Mathematical Literacy.

## 5.6 PHYSICAL SCIENCE

*Introductory note to the exam paper analyses for Physical Science*

In order to benchmark the new NSC examinations for 2008, the following exam papers were analysed in terms of the types and levels of cognitive demand of their constituent items, and were

compared with the exemplar and final 2008 NSC papers developed by the national Department of Education (16 papers in all):

- 2005 NATED 550 Higher and Standard Grade Physical Science Papers 1 and 2
- 2006 NATED 550 Higher and Standard Grade Physical Science Papers 1 and 2
- 2007 NATED 550 Higher and Standard Grade Physical Science Papers 1 and 2
- 2008 NSC exemplar and final Physical Science Papers 1 and 2

The method used in this examination paper analysis is presented in Section 5.6(1), followed by the results of this analysis in Section 5.6 (2) and interpretation of the results for answers to the Umalusi research questions in Section 5.6 (3).

## 5.6 (1) Method of analysis used for the Physical Science exam papers

To provide a guide for decisions made about type of cognitive demand and level of difficulty, the Umalusi Physical Science team used a conceptual tool that had been developed and used in previous Umalusi benchmarking research projects (Umalusi, 2008) (see Table 5.6.1, Page 84). This tool was adopted by the team instead of the current Umalusi evaluation instrument, as it had proved to be appropriate and useful in the analysis of Physical Science examinations papers in the past, would provide meaningful data in exactly the form required in the current project, and could be said to be a version of the current tool, customised for Physical Science.

**Table 5.6.1: Types and levels of cognitive demand for Physical Science**

| Category | Level | Descriptions | Examples |
|---|---|---|---|
| Remember Factual knowledge (F) | F1 | Very simple recall, State a simple law or equation; recognise content in MCQ; | State term / simple definition e.g. velocity is rate of change of position; naming homologous series; structural formula for simple (1 or 2 carbon) organic compounds. e.g. ethane, methane, etcetera. |
| | F2 | Medium content, learnt diagrams | State Newton's laws, Boyle's law, draw electric field patterns, etcetera. |
| | F3 | Recall complex content | Process for lab preparation of chemical compounds; testing for presence of chemicals; inorganic chemical interactions |
| Understand Conceptual knowledge (C) | C1 | Simple relationships; simple explanations; 1-step answers; derivation of units | Relationship between resultant and equilibrant; explain what is meant by … |
| | C2 | Counter-intuitive relationships; qualitative proportional reasoning; more complex relationships or explanations; 2 steps to arrive at answer, simple applications; interpretation of realistic diagrams | Direction of acceleration for free-fall; effects of changes in circuits; identifying acid-base conjugates, redox pairs, etcetera.; simple influences on dynamic equilibrium; diagrams of AC/DC generators; naming type of reaction, etcetera. |
| | C3 | Identify principles which apply in a novel context; explaining complex reasoning involving synthesis, critical argument; novel or abstract contexts, etcetera. | Identify all influences on realistic motion; identify isomers of organic compounds; complex influences on dynamic equilibrium |
| Problem-solving (P) | P1 | Simple procedure; plug into formula with only one unknown; no extraneous information; known or practiced context; simple chemical equation | Given current and resistance, calculate voltage; simple conservation of momentum; reading values off a given graph; |
| | P2 | Sketch graphs; construction or interpretation of schematic diagrams; problems with 2 or more steps; basic logic leaps; proportional reasoning; interpretation of table of data; acid-base or redox equation | Sketch graph of motion or get information from given graph; force or vector diagrams; diagrams of drip patterns; circuits diagrams; concentration or molar calculations; naming of organic compounds; writing and balancing equations for reactions; using redox table |
| | P3 | Complex abstract representation; combination of concepts across sub-fields; complex problems involving insight and logic-leaps; formulating new equations (using all unknowns); problem-solving in novel context | Interpret complex graphs; translate between various graphs of motion; combine equations for mechanical energy and motion; combine gravitational and electrostatic forces; complex circuit calculations; combination of various factors influencing equilibrium |

It needs to be acknowledged at the outset that the application of these cognitive demand categories to particular examination questions is inexact, as this relied on the personal opinion and experience of the evaluators. There was also some cross-over between the categories of *conceptual* and *problem-solving skills*, and it was unknown whether learners were coached in a particular concept or procedure, in which case, questions which, in principle, were *problem-solving* or *conceptual*, became, in practice, *factual* questions. Slight differences between the analyses for the examination papers should therefore not be regarded too seriously.

Where there were considerable discrepancies between evaluators' assessments of examination questions, these questions were reassessed after discussion. The percentages found by the evaluators for the various categories of conceptual demand were averaged to give a final percentage figure.

In spite of potential differences in evaluators' opinions, the categorisation was a useful tool to reveal trends in the examination papers and to give a sense of the relative standards of the examinations, particularly if one looked at the trends within the range of examinations evaluated by a particular evaluator (in which case the application of the cognitive demand categories would be consistent across these examinations).

## 5.6 (2) Results of the Physical Science exam paper analyses

The number of marks associated with the various types of cognitive demand and levels of difficulty of items were combined for each exam paper analysed. These percentages of categorised marks are presented in Table 5.6.2 (below).

**Table 5.6.2: Results of analysis of examination papers for Physical Science**

| Paper description | Type of cognitive demand | | | Level of Difficulty | | |
|---|---|---|---|---|---|---|
| | Factual | Conceptual | Problem-solving | Level 1 (Easy) | Level 2 (Moderate) | Level 3 (Difficult) |
| 2005 SG Paper 1 & 2 | 23% | 29% | 48% | 29% | 68% | 3% |
| 2005 HG Paper 1 & 2 | 13% | 31% | 56% | 15% | 67% | 19% |
| 2006 SG Paper 1 & 2 | 21% | 27% | 51% | 33% | 59% | 8% |
| 2006 HG Paper 1 & 2 | 8% | 35% | 57% | 13% | 70% | 17% |
| 2007 SG Paper 1 & 2 | 19% | 31% | 50% | 20% | 75% | 6% |
| 2007 HG Paper 1 & 2 | 15% | 24% | 61% | 21% | 57% | 22% |
| 2005 Papers 1 & 2 HG & SG | 18% | 30% | 52% | 22% | 67% | 11% |
| 2006 Papers 1 & 2 HG & SG | 15% | 31% | 54% | 23% | 64% | 12% |
| 2007 Papers 1 & 2 HG & SG | 17% | 28% | 56% | 20% | 66% | 14% |
| Average all SG (2005 to 2007) | 21% | 29% | 50% | 28% | 67% | 5% |
| Average all HG (2005 to 2007) | 12% | 30% | 58% | 16% | 65% | 19% |
| Average all HG & SG (2005 to 2007) | 16% | 30% | 54% | 22% | 66% | 12% |
| 2008 Exemplar Paper 1 & 2 | 25% | 28% | 47% | 21% | 65% | 14% |
| 2008 Final DoE Paper 1 & 2 | 12% | 37% | 50% | 16% | 63% | 20% |

## *Graphs showing exam paper comparisons relating to levels of difficulty*

A set of graphs is shown here to illustrate the comparison between the papers, in terms of their respective levels of difficulty. The results for the difficulty levels of the NATED 550 Higher Grade examinations for the years 2005, 2006 and 2007 were compared with those for the exemplar 2008 exam papers. A graph of these results is shown (see Graph 5.6.1 below).

A similar analysis was conducted for the NATED 550 Standard Grade papers and the 2008 NSC exemplar papers. The results of this analysis are shown in Graph 5.6.1 (below).

**Graph 5.6.1: Comparison of HG exams with 2008 exemplar and final exams**
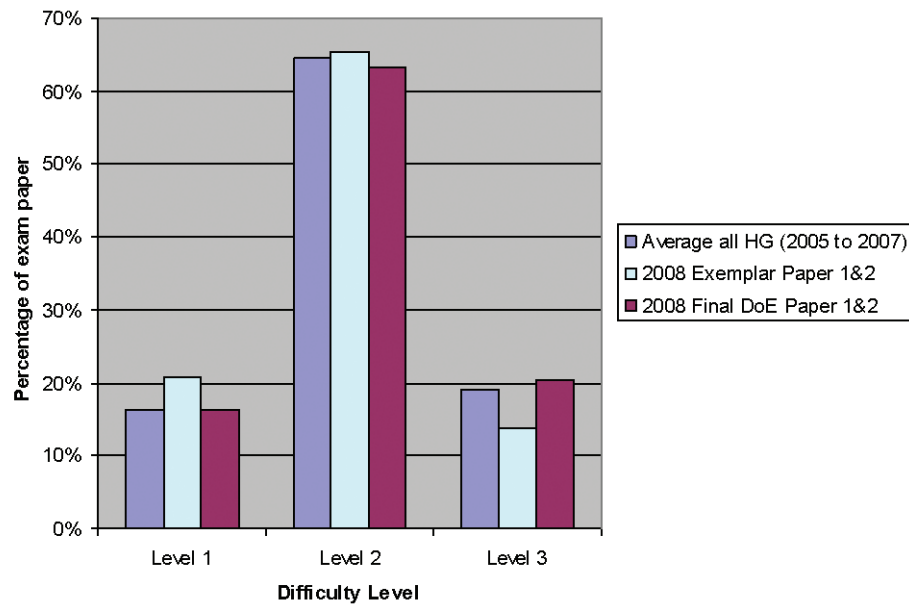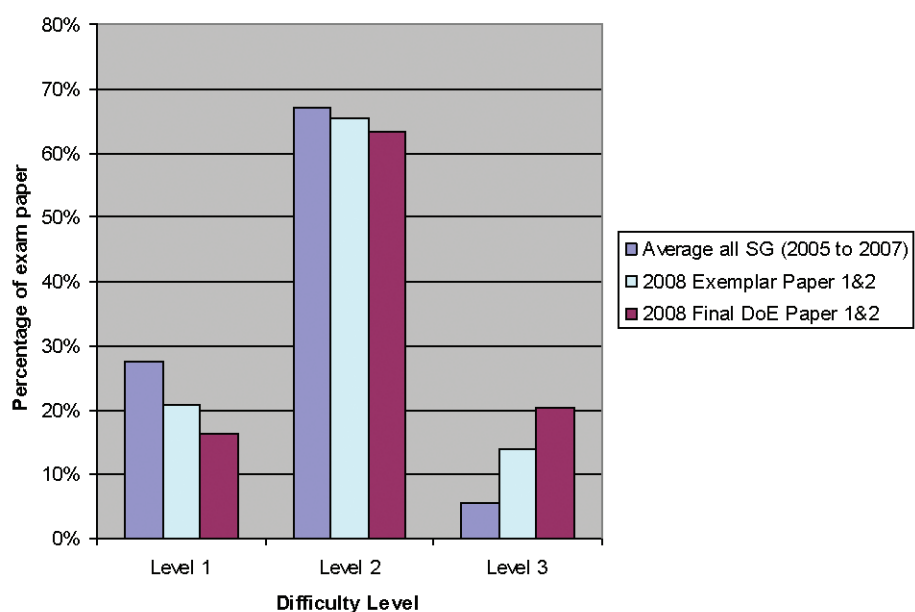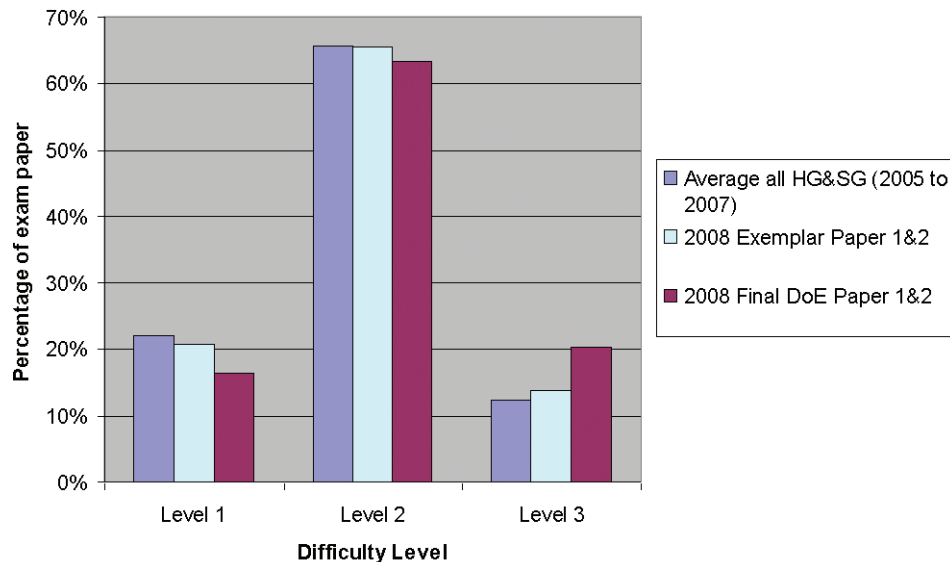


A similar analysis was conducted for the NATED 550 Standard Grade papers and the 2008 NSC exemplar papers. The results of this analysis are shown in Graph 5.6.2, below.

**Graph 5.6.2: Comparison of SG exams with 2008 exemplar and final exams**

A more accurate assessment of the comparative difficulty levels of the respective exam papers would need to combine the NATED 550 Higher and Standard Grade results, since the exemplar papers were aimed at achieving what these papers *together* achieved in differentiating between learners. These results are shown in Graph 5.6.3, below.

**Graph 5.6.3: Comparison of combined HG & SG exams with 2008 exemplar and final exams**



## Graphs showing exam paper comparisons in terms of types of cognitive demand

The results of comparisons of the exam papers in terms of types of cognitive demand, between the NATED 550 Higher Grade papers for 2005, 2006 and 2007, on the one hand, and the 2008 NSC exemplar papers, on the other, are shown in Graph 5.6.4 (below).

**Graph 5.6.4: Comparison of HG exams with 2008 exemplar and final exams**
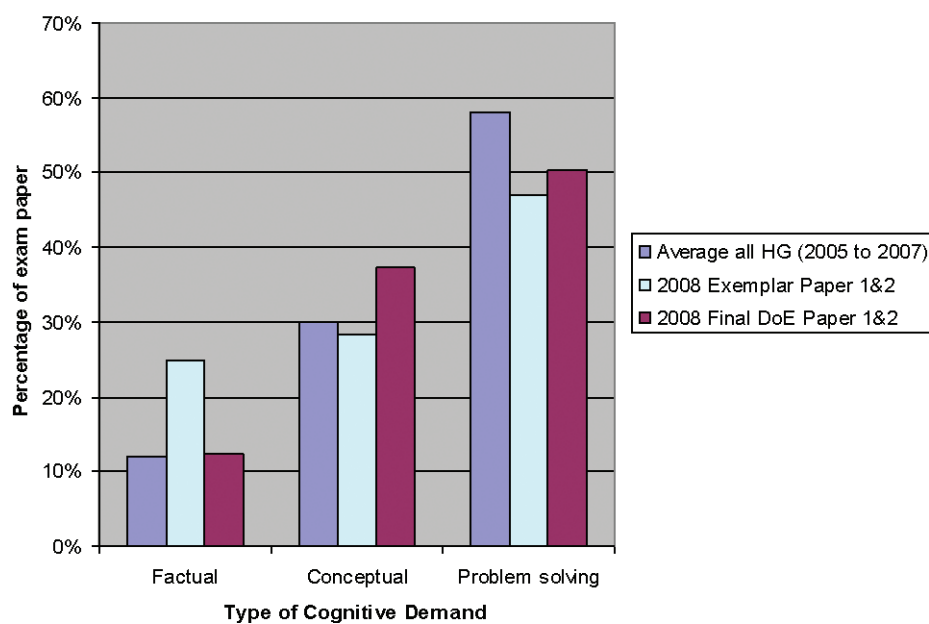


A similar analysis was conducted for the NATED 550 Standard Grade exam papers, on the one hand, and the 2008 NSC exemplar papers, on the other. The results of this analysis are shown in Graph 5.6.5 (overpage).

**Graph 5.6.5: Comparison of SG exams with 2008 exemplar and final exams**
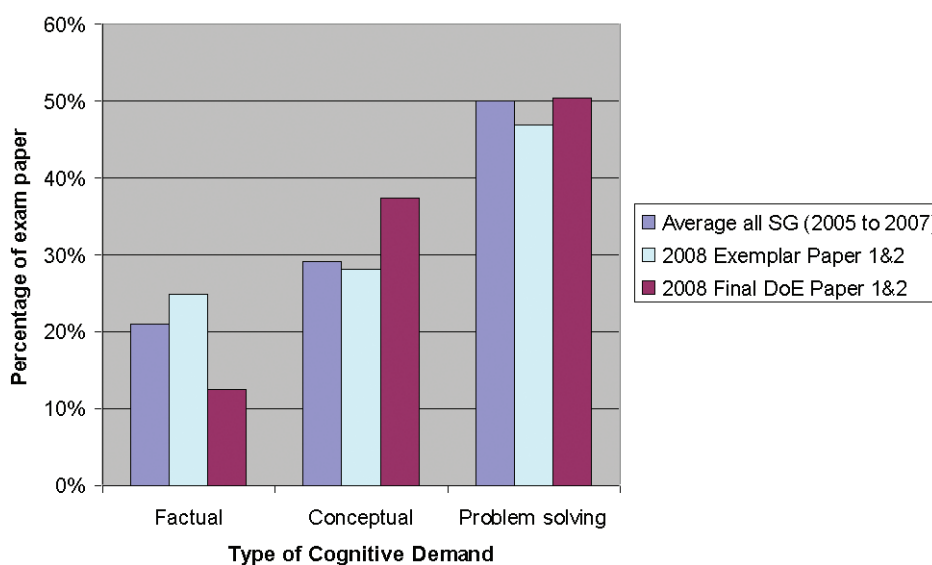


As for the difficulty-level comparisons, the types of cognitive-demand comparisons for the NATED Higher and Standard Grade exams were combined for the 2005, 2006 and 2007 papers and compared with those for the 2008 NSC exemplar papers. These results are plotted on Graph 5.6.6 (below).

**Graph 5.6.6: Comparison of combined HG & SG exams with 2008 exemplar and final exams**
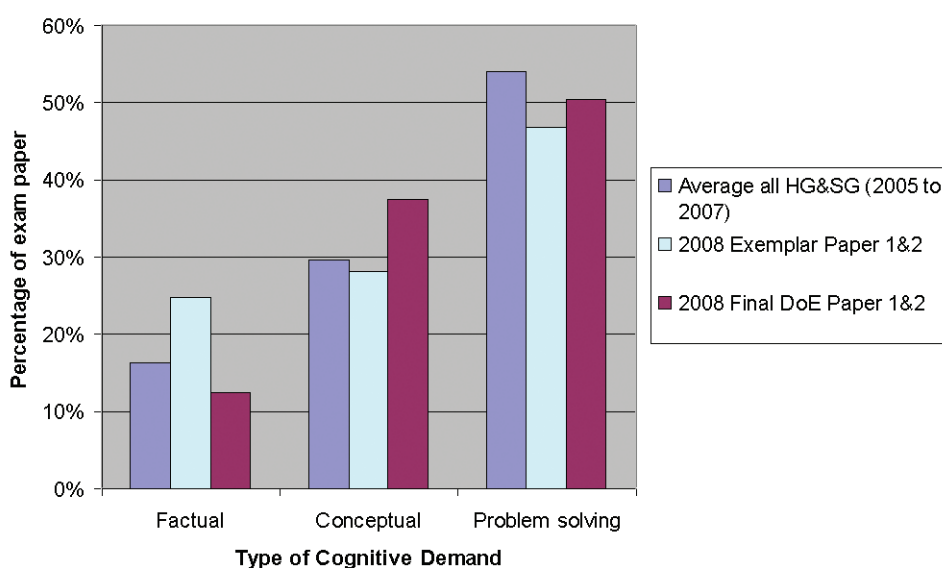


## 5.6 (3) Interpretation of the results of the Physical Science exam paper analyses

In this section, the Physical Science team reported on the eight exam paper analysis tasks.

### 5.6 (3.1) Distinguishing Physical Science highest level achievers (exemplar papers)

To determine whether the 2008 NSC exemplar paper for Physical Science reflected a similar distinction of highest level of achievement as the old NATED 550 Higher Grade exams, the Physical Science team looked at the comparison of the percentage of marks allocated at Level 3 difficulty,

since it would have been those questions that differentiated highest achievement-level learners. When comparing the exemplar paper with the Higher Grade exams alone, there was clearly a higher percentage of Level 3 questions in the old curriculum exam papers than in the exemplar paper: an average of 19% for the 2005 to 2007 Higher Grade exams, compared with 14% for the 2008 NSC exemplar papers.

Thus, if one had been looking at the old Higher Grade results alone one could not have concluded that there would be a comparable differentiation of A-grade achievement in the 2008 NSC exemplar papers. Learners who achieved in the region of 81% in the old Higher Grade exam could have achieved around 86% in the 2008 exemplar exam.

However, since the 2008 exemplar papers were aimed at achieving what the combined Higher and Standard Grade examination papers together achieved in differentiating learners, the comparison in terms of level of difficulty should perhaps have been made across a combination of the Higher and Standard Grade papers. From Table 5.6.2, it can be seen that there was a similar percentage of questions at this difficulty level – 12% for the combined 2005 to 2007 Higher and Standard Grade exams and 14% for the 2008 NSC exemplar papers.

More specifically, Graph 5.6.3 shows that there was good comparability of the standards of the 2008 exemplar exams and the combined old Higher and Standard Grade exams across all three difficulty levels. It could, therefore, be concluded that the standard of the exemplar papers was at the desired level.

However, these findings suggest that the allocation of the highest grade (Level 7 in the new system) should have been changed for the exemplar examination papers – it would have been more fair if learners achieved higher marks (around 86%) in order to be awarded the highest grades for the 2008 exemplar papers.

The exemplar items which would have reflected the new A-grade achievement are as follows: Paper 1 – Questions 7.1, 7.2, 8.3, 9.3, 12.2 and 12.3; and Paper 2 – Questions 4.3, 4.4, 11.2.1, 12.1 and 12.4.


### 5.6 (3.2) Distinguishing Physical Science highest level achievers (final papers)

The percentage of marks allocated to Level 3 difficulty for the final 2008 NSC Physical Science papers was 20%. This figure shows that there was a comparable differentiation of A-grade learners with the old NATED 550 Higher Grade exam papers (where this percentage of marks was 19%) and, hence, that Umalusi's recommended allocation of the highest grade (Level 7 on the new system) was accurate.

Comparison of the final 2008 NCS Physical Science papers with their combined Higher and Standard Grade counterparts showed that there was a large difference in the percentage of questions at difficulty Level 3 – 12% for the combined 2005 to 2007 Higher and Standard Grade exams, and 20% for the 2008 NSC final papers.

More specifically, Graph 5.6.3 shows that the final 2008 papers were more difficult than the combined old Higher and Standard Grade examinations, with more questions at difficulty Level 3 and fewer questions at Level 1. It was therefore concluded that the standard of the final papers was not at the desired levels, in that they did not achieve what the old Higher and Standard Grade examinations together achieved in terms of discrimination between the whole range of learners.

The final exam paper items which reflected the new A-grade achievement were as follows: in Paper 1 – Questions 3.3, 3.4, 4.5, 5.2, 6.1, 6.3, 6.4, 6.5, 7.2, 11.2, 12.1, 12.3, 13.2; and in Paper 2 – Questions 4.2, 5.7.1, 6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.2, 6.3.

### 5.6 (3.3) Determining average Physical Science achievers (exemplar papers)

The average learner at the old Standard Grade level would have needed to achieve 33% in order to pass. The appropriate questions to look at for this level of achievement are questions at difficulty Level 1, together with additional *factual-type* questions, since this is a lower-order cognitive skill and could therefore have enabled the average learner to achieve additional marks beyond those offered by Level 1 questions. The total percentage of Level 1 questions together with the additional percentage of factual questions was ascertained from the examination analysis tables, the results of which are shown in Table 5.6.3, immediately below.

**Table 5.6.3: Total achievable percentage by average SG learner in Physical Science exam papers**

| Paper description | Level 1 questions | Additional factual (beyond Level 1 difficulty) | Total achievable percentage by average learner* |
|---|---|---|---|
| 2005 HG Paper 1 & 2 | 15% | 6% | 21% |
| 2006 HG Paper 1 & 2 | 14% | 5% | 19% |
| 2007 HG Paper 1 & 2 | 19% | 5% | 25% |
| 2005 SG Paper 1 & 2 | 30% | 11% | 41% |
| 2006 SG Paper 1 & 2 | 33% | 9% | 42% |
| 2007 SG Paper 1 & 2 | 22% | 12% | 33% |
| 2005 Papers 1 & 2 HG & SG | 22% | 8% | 31% |
| 2006 Papers 1 & 2 HG & SG | 24% | 7% | 30% |
| 2007 Papers 1 & 2 HG & SG | 21% | 8% | 29% |
| Average all HG (2005 to 2007) | 16% | 5% | 21% |
| Average all SG (2005 to 2007) | 28% | 10% | 39% |
| Average all HG & SG (2005 to 2007) | 22% | 8% | 30% |
| 2008 Exemplar Paper 1 & 2 | 21% | 14% | 34% |
| 2008 DoE Final Paper 1 & 2 | 16% | 7% | 23% |

(* Note: Slight discrepancies in the total are due to decimal places, which are not shown for the sake of readability.)

Although there were slight anomalies in the scores for the previous years' percentages of total achievable marks by the average learner, *in general*, this data suggests that the total achievable marks were slightly lower for the 2008 NSC exemplar papers than for the old Standard Grade papers (34% for the 2008 exemplars, compared with an average of 39% for the 2005 to 2007 Standard Grade exams).

These findings suggest that the minimum achievement required for passing the 2008 NSC exemplar exams should have been somewhat lower for the exemplar papers than for its old Standard Grade counterparts. The decision to set the pass mark at 30% in 2008, as opposed to the previous level of 33.3% addressed this issue.

The exemplar items which would have allowed the Standard Grade–level learners to pass were: in Paper 1,– Questions 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 3.3, 3.4, 4.1, 4.3, 8.1, 8.2, 8.4, 9.1, 10.4, 10.5, 11.1.1, 11.1.2, 11.2.1, 12.1, 12.4, 12.5, 12.6, 13.1, 13.2, 13.3, 13.4, 14.1, 14.2 and 14.4; and in Paper 2 – Questions 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.3, 3.5, 4.4, 5.1, 6.1, 8.4, 10.1, 10.2, 13.1, 13.2, 14.2, 14.3, 14.4 and 14.5.

### 5.6 (3.4) Determining average Physical Science achievers (final papers)

For the final 2008 NSC papers, the total achievable marks for learners achieving at the average level of a typical Standard Grade learner were much lower (23%) than in the old Standard Grade exams (39%), and in the combined old Higher ad Standard Grade exams (30%).

These findings suggested that the minimum achievement required for passing should have been lower for the final 2008 NSC Physical Science papers than for the typical old Standard Grade papers. The decision to set the pass mark at 30% did not adequately address this issue.

The Physical Science team recommended that the pass mark be lowered by a comparable relative percentage, and hence, that the new pass mark should be between 20% and 25%. (The lower bound of 20% allowed for a 40% relative drop from the old pass mark of 33%, which was in line with the relative difference in achievable questions between the old SG (39%) and the final exam (23%)). This may have seemed very low, but considering that the final 2008 NSC exams were of a standard comparable to the previous Higher Grade exam papers considered, this percentage was comparable to the total achievable marks by the average learners in the old Higher Grade exams (an average of 21% for 2005 to 2007, as Table 5.6.3 shows).

The exemplar items which would have allowed the Standard Grade level learners to pass are: in Paper 1 – Questions 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 3.2, 6.2, 7.1, 7.3, 7.5, 8.1, 9.1, 9.3, 9.5, 10.1, 10.2, 10.3, 11.1, 14.1, 15.1; and in Paper 2 – Questions 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 5.1, 5.2, 5.3, 7.3, 8.1.1, 9.1, 9.2, 10.2.3, 10.2.5, 10.2.6, 11.1, and 11.5.

### 5.6 (3.5) Comparability of the 2005–2007 Physical Science papers

Graph 5.6.7, below, shows the relative standards of the Standard Grade exam papers from the years 2005 to 2007.

**Graph 5.6.7: Comparison of 2005 – 2007 SG exam papers**
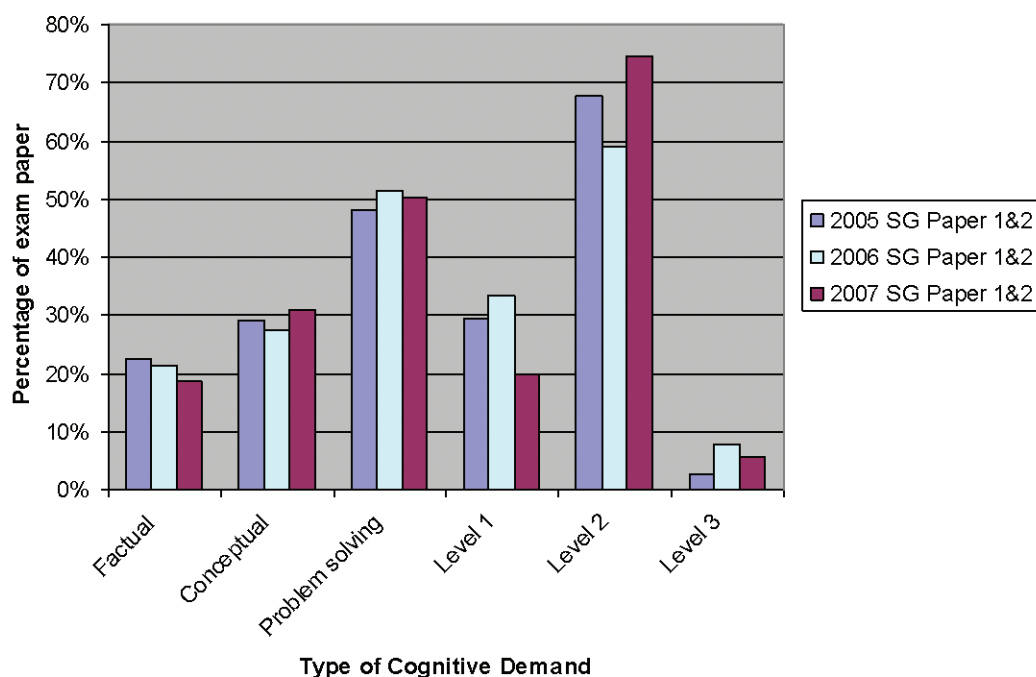


In Graph 5.6.7 general trends and anomalies can be seen. The 2006 papers consisted of more Level 1 questions and the 2007 papers consisted of more Level 2 questions than the trends suggested. However, considering the possible variations in the use of the evaluation tool by

different evaluators, these differences were sufficiently small to enable one to conclude that these examinations were comparable, both in terms of difficulty level, and in terms of the types of cognitive demand tested in the examinations.

Graph 5.6.8, below, shows the relative standards of the Higher Grade exam papers for the years 2005 to 2007.

**Graph 5.6.8: Comparison of 2005 – 2007 HG exam papers**
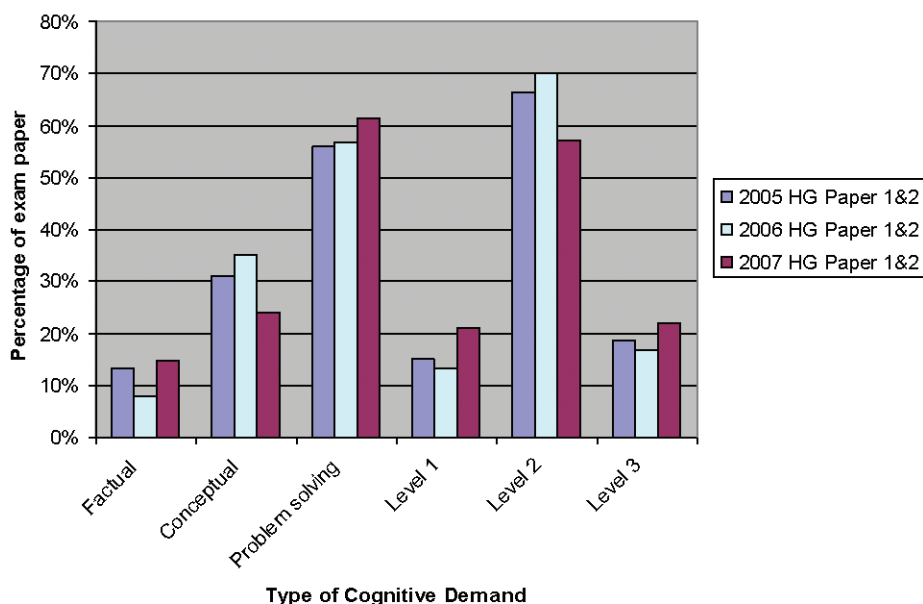


Graph 5.6.8 again shows that the examinations are comparable, both in terms of difficulty level and in terms of the type of cognitive demand assessed in the examinations. It can be argued that the 2007 examination was slightly more difficult, since it contained more problem-solving questions and Level 3 questions than the 2005 and 2006 examinations. These distinctions were not, however, very marked, particularly given the inexact nature of the tool used for categorising questions.

It was therefore concluded that, overall, the 2005–2007 *Senior Certificate* examination papers were of comparable standards across the three years.

### 5.6 (3.6) Distinguishing Physical Science Higher from Standard Grade papers

The main areas in which the NATED 550 Higher and Standard Grade papers differed are outlined here:

**a)** The Higher Grade papers contained a higher proportion of Level 3 questions (an average of 19% for the 2005 to 2007 Higher Grade exams), whereas the Standard Grade papers contained very few of these (an average of 5% for the 2005 to 2007 Standard Grade exams).

**b)** The Standard Grade papers contained more Level 1 questions (an average of 28% for the 2005 to 2007 Standard Grade exams), compared with the Higher Grade papers (an average of 16% for the 2005 to 2007 Higher Grade exams).

**c)** In addition, Table 5.6.3 indicates that the total achievable marks by an average learner was lower for Higher Grade (an average of 21% for the 2005 to 2007 Higher Grade exams) than for Standard Grade (an average of 39% for the 2005 to 2007 Standard Grade exams). This was

because the Standard Grade paper contained a greater percentage of Level 1 and *factual-type* questions than the Higher Grade paper did.

To illustrate the difference between the standards of the old Higher and Standard Grade papers, the Physical Science team calculated the average percentages of the various cognitive levels and skills over the three years for Higher and Standard Grade, and plotted these percentages in Graph 5.6.9 (below).

**Graph 5.6.9: Comparison of 2005 – 2007 HG and SG exams**
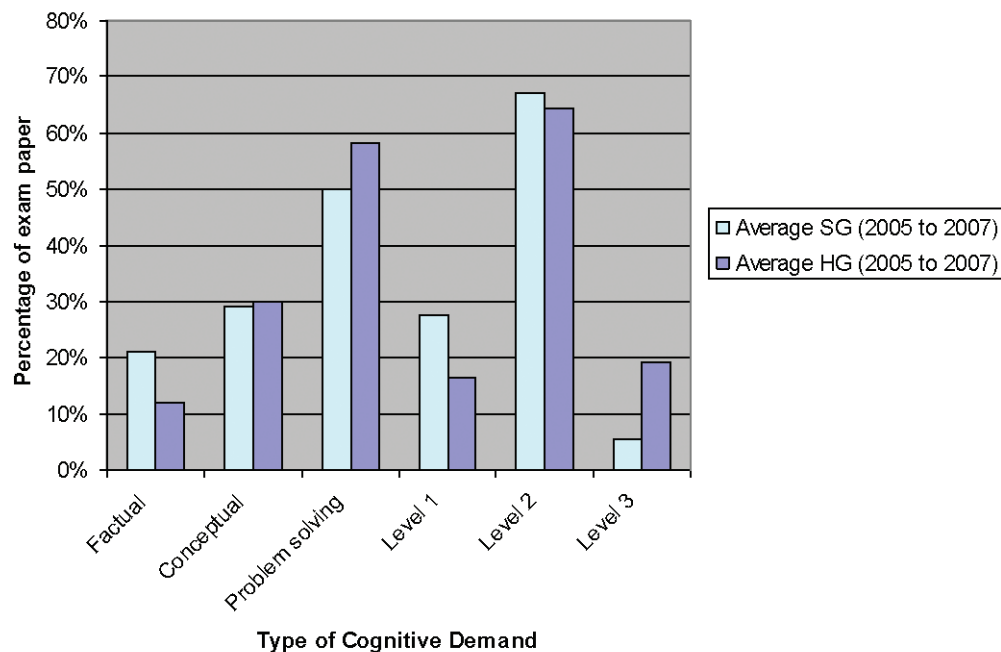


## 5.6 (3.7) Overall view of 2008 NSC exemplar papers in relation to the 2005–2007 NATED 550 Higher and Standard Grade papers for Physical Science

The overall standard of the 2008 NSC exemplar papers for Physical Science compared very favourably with the combined Higher and Standard Grade papers preceding them, in that these examinations tested equivalent levels of cognitive ability. This equivalence can be seen in Graph 5.6.3, which shows that the standards of the exams were comparable for all three difficulty levels. The main distinction between the NSC and NATED 550 papers was that the 2008 NSC exemplar paper contained more *factual recall*–type questions than did the previous examinations, as can be seen in Graph 5.6.6. This inclusion may be for a number of reasons:

a) The new curriculum aims to be not only a course that prepares learners for tertiary studies in the Physical Sciences, but also a course that broadens the scientific literacy of learners. A greater percentage of factual questions was appropriate for the latter aim.

b) The new NCS curriculum contains more advanced content topics than does the previous NATED 550 curriculum (for example *AC electricity*, the *photoelectric effect* and *electrodynamics*). Deep conceptual assessment of these topics was not possible at FET level (this usually takes place at university level), so questions for these topics tended to rely on factual recall instead.

### 5.6 (3.8) Comparison of the exemplar and final 2008 NSC Physics and Chemistry examination papers

The Umalusi Physical Science team compared the papers making up the final 2008 NSC Physical Science exam, since it was observed that the two papers were not of comparable standards. This exam consisted of the two papers, Paper 1 (Physics) and Paper 2 (Chemistry). The standards of these two papers were compared; the results are shown in Table 5.6.4, below:

**Table 5.6.4: Comparison of Paper 1 and Paper 2 of Exemplar and Final examination papers**

| Paper | Type of cognitive demand | | | Level of Difficulty | | |
|---|---|---|---|---|---|---|
| | Factual | Conceptual | Problem-solving | Level 1 (easy) | Level 2 (moderate) | Level 3 (difficult) |
| Exemplar Paper 1 | 28% | 21% | 51% | 27% | 60% | 12% |
| Exemplar Paper 2 | 22% | 36% | 43% | 14% | 70% | 15% |
| DoE Paper 1 | 12% | 31% | 57% | 20% | 52% | 28% |
| DoE Paper 2 | 13% | 43% | 44% | 13% | 75% | 13% |

The Physical Science team did not find vast discrepancies between the standards of the 2008 NSC exemplar exam Papers 1 and 2 for Physical Science. They did find, however, that the final 2008 NSC Paper 1 (for Physics) was considerably more difficult than Paper 2 (the Chemistry paper). Table 5.6.4 shows that 28% of Paper 1 was at difficulty Level 3, which is a very high percentage for marks that are only achievable by A-grade learners. A low percentage of this paper (12%) involved factual recall-type questions, and a large percentage of this paper (57%) involved problem-solving skills, allowing little opportunity for learners with other skills to perform.

This final 2008 Paper 1 was also far more difficult than the NSC exemplar Paper 1, which was problematic, since teachers and learners were led to believe that the standards of the exemplar papers gave accurate indication of the expected standards of the final papers. The discrepancy between the two Physics papers was therefore misleading in light of the actual standard of the final Paper 1.

The standard of the final Paper 2, in contrast, did compare favourably with its corresponding exemplar Paper 2 and did not pose as much of a problem. The main distinction between the two Chemistry papers was that there was a lower percentage of *factual* type questions in the final Paper 2 (13%) than in the exemplar (22%), giving less opportunity for average learners to perform.

### 5.6 (3.9) The 2008 NSC Physical Science exemplar papers as models for future NSC exams

The Physical Science team noted that in general, the 2008 NSC exemplar papers were good models for future NSC examinations. They questioned a variety of skills specific to Physical Science and posed a good variety of different types of questions. Section A of both Papers 1 and 2 showed a variety of question types that relied on different types of answering skills. Many of these questions were recall questions and were less intimidating for learners to answer than were more conceptually complex questions. Such opening sections served to put learners at ease at the start of papers, and allowed opportunities to gain some marks.

In Section B, the questions were well structured and also tested a variety of skills and cognitive abilities. Diagrams were used extensively to explain questions, making explanations clear.

The old Higher and Standard Grade exams contained 15 multiple choice questions which required more language comprehension abilities and awarded "all-or-nothing" marks; not allowing for part-understanding, as compared with the questions in the opening sections of the 2008 exemplar papers. The Physical Science team supported the idea that this type of question be excluded

from the NSC papers. One of the Physical Science evaluators, however, felt that since this type of question had a global track record of appeal and good performance, some could therefore be retained and perhaps be modified so that each such question be awarded a lower mark than was the case in the past, such as say, two marks instead of the three and four marks previously awarded in the Standard and Higher Grade papers respectively.

The Physical Science team noted, in addition, that the 2008 NSC exemplar papers were good models because they allowed for sufficient distinction between differing learner achievement levels. The team recommended, however, that for convenience the new achievement levels (Levels 1–7) be aligned more closely with previous achievement levels (Grades A to H).

Within this overall view, the team identified a number of specific issues emerging from the 2008 exemplar and final NSC papers which they felt needed to be addressed:

**a)** In certain instances, the exam paper developers had made assumptions about the concepts that should be covered, and hence assessed for these concepts, where the curriculum documentation had not specified the concepts. These inclusions severely disadvantage learners in any contexts where teachers had not made similar assumptions. Examiners need to pay close attention to content specified in the curriculum documents. In this instance, the following questions from the 2008 NSC exemplar papers covered content not specified in the curriculum documentation: Question 10.5 in Paper 1; Question 11.2.1 in Paper 2 (here the content was covered qualitatively in the curriculum documents, but the exam paper contained a complex quantitative question on the topic).

**b)** In other instances the questions contained information irrelevant to the question itself. This information was misleading. The following questions were problematic in this regard: Questions 5.1, 5.4 and 14.1 in Paper 2.

**c)** Some questions were scientifically incorrect, such as: Questions 6.6, 8.1, 8.2, 9, 11.1 and 12.1 in Paper 2.

**d)** The 2008 NSC exemplar Paper 2 had too little emphasis on numeric calculations which were important foundational skills in the context of the subject of Chemistry (two University-level lecturers were consulted in this regard).

**e)** Although the curriculum documentation (Physical Science Document 1) indicates that approximately 20% of the examination will assess Learning Outcome 3, only 10 marks (7%) of Paper 2 assessed this learning outcome (no questions in Paper 1 assessed this learning outcome. The *Subject Examination Guidelines* document of 2008 (Physical Science Document 5) stipulated 10% to 20% for Paper 1 and 20% to 30% for Paper 2 for this learning outcome.

### 5.6 (3.10) Language levels in the 2008 NSC exemplar and final papers for Physical Science

The Physical Science team pointed out that the 2008 NSC exemplar and final examination papers for the subject were too wordy, with many long paragraphs and complex use of language, and unnecessary explanations. It is essential that these language levels be addressed immediately, as the papers will not truly have examined Physical Science skills if the level was inappropriate.

Overall, the exemplar and final papers contained a lot of unnecessary wording in both questions and instructions. The papers were perhaps appropriate for first language (home language) English speakers and required excellent reading and understanding abilities of the learners. This language style advantages first language learners to the detriment of all learners for whom English is a second, third or fourth language.

### 5.6 (3.11) Match between assessment requirements in the Subject Assessment Guidelines for Physical Science, and the 2008 NSC exemplar and final papers

Given some of the discrepancies noted between the weighting of topics in the exemplar papers and that in the *Subject Assessment Guidelines* for Physical Science (Physical Science Document 5), the Physical Science team compared the intended weightings for learning outcomes with actual weightings of these items in the final 2008 NSC exam papers. Table 5.6.5 (below) shows the results of this comparison.

**Table 5.6.5: Comparison of the weighting of learning outcomes in the Subject Assessment Guidelines for Physical Science and in the 2008 NSC final exam papers**

|  | Guidelines given in SAG document | | DoE Final exam | |
|---|---|---|---|---|
|  | SAG Paper 1 | SAG Paper 2 | Paper 1 | Paper 2 |
| LO1 | 40% | 30% | 58% | 38% |
| LO2 | 45% | 45% | 42% | 45% |
| LO3 | 15% | 25% | 0% | 17% |

It was an oversight that in the final 2008 NSC Physics paper (Paper 1), there were no questions for Learning Outcome 3. The high proportion of questions for Learning Outcome 1 was a result of the large number of *problem-solving* questions in this paper.

The team pointed out that the 2008 NSC final Paper 1 was notably a problematic paper in terms of its high standards and its uneven addressing of learning outcomes.

## SUMMARY OF EXAM PAPER ANALYSIS: PHYSICAL SCIENCE

### Regarding an overall summary

A summary of the examination Paper analysis for Physical Science can be seen in Table 5.6.6, below.

**Table 5.6.6: Results and analysis of examination papers for Physical Science**

| Paper Description | Type of cognitive demand | | | Level of Difficulty | | |
|---|---|---|---|---|---|---|
|  | Factual | Conceptual | Problem-solving | Level 1 (easy) | Level 2 (moderate) | Level 3 (difficult) |
| Average of all SG exams (2005 to 2007) | 21% | 29% | 50% | 28% | 67% | 5% |
| Average of all HG exams (2005 to 2007) | 12% | 30% | 58% | 16% | 65% | 19% |
| 2008 Exemplar Paper 1 & 2 | 25% | 28% | 47% | 21% | 65% | 14% |
| 2008 Final DoE Paper 1 & 2 | 12% | 37% | 50% | 16% | 63% | 20% |

### Regarding differentiation of top-achievers in the 2008 NSC Physical Science exams

Regarding differentiation of top-level achievers and whether or not the Level 7 (80–100% achievement) in the 2008 NSC papers was equivalent to NATED 550 Higher Grade level A-grades, the percentage of marks allocated to Level 3 difficulty for the final DoE examination was 20%. This figure shows that there was a comparable differentiation of A-grade (top-achieving) learners in the two systems.

*Regarding whether low-level achievers are likely to pass the 2008 Physical Science exams*

With respect to the question as to whether learners just passing at Standard Grade level would be able to pass the NSC exams: the total percentage of Level 1 items with the additional percentage of factual questions gave the total percentage achievable by the learner working at the level of the average Standard Grade learner. These figures are shown in Table 5.6.7, below.

**Table 5.6.7: Total achievable percentage by average SG learner in Physical Science exam papers**

| Paper description | Level 1 questions | Additional factual questions (beyond Level 1 difficulty) | Total achievable percentage by average learner |
|---|---|---|---|
| Average all HG (2005 to 2007) | 16% | 5% | 21% |
| Average all SG (2005 to 2007) | 28% | 10% | 39% |
| Average all HG & SG (2005 to 2007) | 22% | 8% | 30% |
| 2008 Exemplar Paper 1 & 2 | 21% | 14% | 34% |
| 2008 DoE Final Paper 1 & 2 | 16% | 7% | 23% |

For the final NSC 2008 examinations, the total achievable marks for the average SG learner was much lower (23%) than in the old SG exams (39%). The recommendation that the pass mark should be lowered from 33.3% in the old system to 30% in the new system did not adequately address this issue. The teams' recommendation was that the new pass mark should be between 20% and 25% in order to be comparable with previous years. (The lower bound of 20% allowed for a 40% relative drop from the old pass mark of 33%, which was in line with the relative difference in achievable questions between the old SG [39%] and the 2008 final NSC exam [23%]). This mark may have *seemed* very low, but considering that the final NSC examination was of a similar standard to the previous *Higher Grade* examinations, this percentage was comparable to the total achievable marks by the learners in the old Higher Grade examination (an average of 21% for 2005 to 2007).

*Regarding comparison of the overall standard of final 2008 NSC papers with the combination of Higher and Standard Grade papers and the 2008 exemplar paper for Physical Science*

The overall standard of the 2008 final NSC papers did not compare favourably with the combination of the NATED 550 Higher and Standard Grade papers. The final NSC exam contained fewer Level 1 (*easy*) questions, and more Level 3 (*difficult*) questions than the combination of the Higher and Standard Grade papers. The final NSC exam did, however, compare favourably with the previous Higher Grade papers. There were similar percentages of questions at all levels of difficulty between these exams.

In all, over and above individual differences between the curricula evaluated, general trends emerged across these documents. These patterns are discussed in the next section.

# 6. TRENDS ACROSS THE 2008 NSC EXAM PAPERS

as for the curriculum reports, individual exam paper analysis reports vary. The Umalusi teams also used the Umalusi analysis tool differently. One Umalusi team (the Geography group) used the Umalusi instrument for evaluating the exam papers as it was given to the teams (and as it is presented in Section of Part 1 of this report). Two teams (those for English FAL and Biology/Life Sciences) customised and clarified this instrument by adding examples to each theoretical category. Having these examples served to increase the consistency of judgments relating to exam paper items across all team members: the examples kept individual members' judgments 'in line'. Another team (the Physical Science team) renamed theoretical categories in the tool, to match types of cognitive skill in the discipline. Both the Mathematics and Mathematical Literacy

teams replaced the tool with the typologies of cognitive skills and levels in their respective *Subject Assessment Guidelines*, as these categorisations enabled finer grained analysis than that afforded by the Umalusi instrument. All of these tools can be seen in the various subject reports.

While the individual exam paper analysis reports are presented in Section 5 above, *trends* in the teams' responses to the exam paper questions are discussed here. That the difficulty levels of exam papers varies from year to year for any given subject, and differs between papers for single subjects in single exams, and that *parts* of papers can be at desired levels while *other parts* of the same papers can be pitched at the wrong levels, emerges clearly in these trends.

### *General comments on the difficulty levels of the 2008 final NSC papers*

The Umalusi 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 of items at specified cognitive type and difficulty levels.

Three teams (Physical Sciences, Biology/Life Sciences, and English FAL) gave differing fine-grained results for the respective final 2008 papers for their subjects, but on the whole, the results show that the papers are closer to the old NATED 550 *Higher Grade* than the Standard Grade papers for these subjects. A fourth team (Geography) found that their 2008 final papers contain *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.

The two remaining Umalusi teams found their papers, on the whole, too easy. Since Mathematical Literacy is a new subject and there were 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 Paper 1 roughly matched that 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 the old NATED 550 *Standard Grade* than the Higher Grade papers. Mathematics Paper 3 was not investigated in this research. However, the team note that some of the questions regarded as reasonably straightforward was 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.

Regarding the relationship between the August 2008 exemplar and final papers, most teams found that the exemplars were similar to the final papers for their subjects, and noted that the exemplars would have given teachers and learners a fair idea of the types and levels of questions to expect in the final papers. The Umalusi Physical Science team noted, however, that one of the final papers (Paper 1: Physics) contains an unexpectedly high proportion of items at the highest difficulty level and too small a number of recall questions, making the paper a hard one for learners at both ends of the achievement spectrum. The Geography team found the Geography final papers considerably more difficult than the exemplars for the subject, with higher numbers of *difficult comprehension* and *problem-solving* items than featured in the exemplars: these exemplars could have lead teachers and learners into a false sense of security.

### Regarding the comparability of A-grades in NATED 550 Higher Grade and 2008 NSC papers

The Umalusi subject teams commented, again based on accurate counts of the types and difficulty levels of items 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 *are comparable to the old Higher Grade A's*.

Four Umalusi teams (English FAL; Geography; Biology/Life Sciences; and Physical Science) found that because the spread of types and levels of questions in the respective papers was similar, the As in the 2008 NSC papers would be equivalent to the As in the NATED 550 Higher Grade papers.

The 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 As in the final 2008 NSC Mathematics papers. It was expected that Mathematics Paper 3 would contain difficult questions, but these difficulty levels were not investigated in this analysis .

The Mathematical Literacy team, again not having previous Higher and Standard Grade papers, considered the value of potential A-grades achieved in relation to the proportions of items at stipulated difficulty levels in the *Subject Assessment Guidelines* for the subject. The team 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*.

### Regarding whether the 2008 NSC papers allow for learners just passing at Standard Grade type level, to pass

For this item, the Umalusi teams commented on whether the August 2008 exemplar and final NSC papers allowed for average learners achieving at the level of 33.3% in the old Standard Grade papers to pass the new NSC exams.

Notwithstanding the overall difficulty levels of the papers, two teams (English FAL and Mathematics) found that 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 at just-passing-Standard-Grade levels to pass. The 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 from the levels of the questions.

Three teams (Geography, Biology/Life Sciences, and Physical Sciences) found the proportions of easy items in the 2008 NSC final papers to be *lower* than those in the average Standard Grade papers for the subjects. The Geography team noted, for example, that the amounts of *basic conceptual* questions in the NSC papers were closer to percentages in the old Higher than in the Standard Grade papers. The Umalusi Biology/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 Physical Science team 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.

### The standards of Senior Certificate papers in the period 2005–2007

The five teams whose papers had NATED 550 predecessors looked at the comparability of the Higher Grade papers between 2005 and 2007, and similarly at the Standard Grade papers, the idea being to check the degree of variance between the papers as a kind of *post hoc* assessment of the comparability of standards across years in general. These teams also considered differences between the Higher and Standard Grade papers, given that these distinguishing features, if any, would now need to be contained in single NSC papers, and would serve to distinguish between differing parts of the same papers.

Three of the Umalusi teams (Biology/Life Sciences; Mathematics; and Physical Sciences) found the fluctuations between years for all papers very small. The Biology/Life Sciences team, for example, found that although the Biology/Life Sciences Standard Grade papers became easier from 2006 to 2007, the percentages of *moderate* items remained stable throughout, and those of the *difficult* and *easy* items fluctuated slightly. The Higher Grade papers for the subject were similarly stable, with the percentages of *moderate* items increasing slowly between 2005 and 2007, with corresponding decreases in *difficult* items in these papers. In the Mathematics Higher Grade papers between 2005 and 2007, the split between items at lower and higher cognitive levels respectively was roughly 50:50, with a 10% variation across the years. The Standard Grade papers for Mathematics showed a similar degree of variation, within a low to high cognitive level split of 80:20. The Umalusi Physical Sciences team found the 2005 Standard Grade paper slightly easier than those for the other two years were; and the 2007 Higher Grade paper slightly harder than those in 2005 and 2006 were.

However, the three teams emphasised that these differences were insignificant – suggesting that the papers were comparable for these subjects across the years.

The other two teams (Geography and English FAL) found greater degrees of fluctuation. The English FAL group had three papers to evaluate for each year (where other subjects had two), where Papers 1 and 3 were nationally set in each case, and Paper 2 was provincial. The team found the 2005 and 2007 national papers to be comparable and the 2006 national papers to be anomalous (more difficult). They also noted that the provincial papers varied, with some containing more items than others did. The Umalusi Geography team found their Standard Grade papers comparable over the years 2005–2007, with a small increase in the percentages of *easy* items in this period, a corresponding small decrease in the number of *moderate* items, and similar proportions of *difficult* items. It was in the Geography Higher Grade papers that a fluctuation in terms of levels of difficulty was higher, with the 2007 papers including a considerably higher number of *difficult* items.

This part of the exam paper analysis lends weight to the importance of the analyses themselves: while exam-setters and moderators aim for specific levels of difficulty per paper, achieving those levels accurately is not an easy task. The fluctuations found in the analysis stress the need for the analysis – for putting *teams of expert minds* to the task of judging the difficulty levels of items – and point to the need for post hoc analysis of learners' results (to verify difficulty levels in relation to actual learner performance) and standardisation per paper rather than per subject.

Regarding fundamental differences between the Standard and Higher Grade papers, all teams found that all of the papers contained ranges of questions spanning *easy, moderate*, and *difficult, basic recall, comprehension, application, and problem-solving questions* and that the Higher Grade papers were distinguished, not surprisingly, by their greater proportions of *difficult comprehension, application,* and *problem-solving questions*.

The Biology/Life Sciences team, for example, found that over 20% of items in the Biology/Life Sciences Higher Grade papers were *difficult*, while there was under 20% of this level of item in the corresponding Standard Grade papers. The Mathematics team found that over the 2005–2007 period there were 35–58% *difficult complex problem-solving* items in the Higher Grade papers, and 19–23% of such items in the Standard Grade papers. The Physical Science group found that,

on average, in the Higher Grade papers around 20% of items are *difficult*, while 5% of items in the Standard Grade papers can be classified as such. Clearly, if the *National Senior Certificate* papers are to cater for learners achieving at levels spanning those found in the Higher and Standard Grade papers, the correct amounts of *difficult*, *moderate* and *easy* items need to be included.

### The 2008 NSC papers as models for future NSC exams

All the Umalusi teams commented on the suitability of the 2008 *National Senior Certificate* exemplar and final papers as models for future NSC exams. In the process, the evaluators compared percentages of different types of items in the papers to those recommended in the *Subject Assessment Guidelines* for their subjects.

Four of the teams (English FAL; Physical Science; Biology/Life Sciences, and Geography) suggested that the 2008 papers were good models for future use. The English FAL team commended its papers most strongly, pointing out the suitability of many aspects such as formatting; instructions to learners and general accessibility; the variety of question types and additional explanations provided in brackets; careful editing so that errors are minimised; and choice of genres on which questions are based.

The Umalusi Physical Science team also commended its papers, supporting the variety of types of questions included, as well as the sequencing in the papers, whereby learners were led from easily manageable questions to more challenging ones further into the papers. Additionally, it commended the proportions of items, which the team asserted, would clearly discriminate between learners. This team also voiced concern that some items were examined when they were not in the curriculum; that some questions contained irrelevant and potentially confusing information; that a small number of questions were incorrect; that there was too little emphasis on numerical calculations, and that proportions of differing types of questions did not match those suggested in the *Subject Assessment Guidelines* for the subject.

The Umalusi Geography and Biology/Life Sciences teams, while finding the papers good models in general, also voice serious shortcomings. Both groups pointed to over-coverage of some learning outcomes and failure to cover others: proportions of questions for particular learning outcomes did not match those in the respective *National Curriculum Statements, Learning Programme Guidelines,* and *Subject Assessment Guidelines.* In addition, the Biology/Life Sciences team recommended fewer questions requiring only general knowledge, pointing out that Biology/ Life Sciences papers traditionally include small percentages of questions requiring general, non-biology-specific knowledge, but that the 2008 NSC papers contained far too many of these items. The team noted that learners could have passed the 2008 Biology/Life Sciences exams without any specialised Biology/Life Sciences knowledge. Further, it suggested that mark allocations and accompanying memoranda should encourage argumentation.

The Mathematics and Mathematical Literacy teams did not commend their 2008 papers as future models. The Mathematics team noted a lack of sufficiently challenging questions – there were too few questions to discriminate between learners at the upper end of the achievement range. There were also too few questions requiring the application of Mathematical principles and Mathematical *modelling*. The team was concerned about the absence of *proof*; and the too few really easy questions allowing those passing at levels comparable to just passing Standard Grade, to pass.

Noting that questions in the Mathematical Literacy papers are always context-based, the Mathematical Literacy team expressed serious concerned about many of the contexts in the 2008 papers. In roughly a fifth of items in final Paper 1, contexts were gratuitous; just over a third of questions in final Paper 2 were found to be ambiguous and confusing. Where formulae were given, they were also sometimes presented in confusing ways. The spread of levels of cognitive difficulty varied greatly from proportions of questions given in the *Subject Assessment Guidelines*.

In summary, while some of the Umalusi teams recommended modelling future NSC papers on the 2008 ones, none of the 2008 papers in fact fully matched the proportions of question types and levels of cognitive difficulty stipulated in the respective *Subject Assessment Guidelines* and *Learning Programme Guidelines*.

### Language levels in the 2008 NSC papers

Two of the Umalusi teams (English FAL and Mathematics) found language levels in the 2008 final NSC papers for their subjects suitable for the average South African learner. The English FAL team, in particular, although noting small ambiguities and obscurities in some questions, and isolated instances of inaccessible language in the memoranda, found the phrasing of exam questions extremely clear. The Mathematics team similarly found accessible language throughout. This team noted the importance of never ceasing to monitor language levels in these papers, as Mathematics questions are often context-based (language-based), opening the possibility of complex language.

The four remaining Umalusi teams – Geography, Biology/Life Sciences, Mathematical Literacy, and Physical Science – found language levels in the 2008 final papers too high. While noting that language levels in the exemplar Geography papers would have been accessible for the majority of South African learners, the team pointed to confusing instructions and new and difficult terminology (not covered in the curriculum) in the final papers. The Biology/Life Sciences, Mathematical Literacy, and Physical Science teams found the papers too wordy: there was too much text and too many difficult words for the average South African learner.

The findings of the exam paper analysis are useful in ways outlined in the following section.

# 7. USING THE FINDINGS FROM THE EXAM PAPER ANALYSES

The findings of these exam paper analyses were fed, along with the results of the curriculum evaluation, into the standardisation processes for the 2008 matriculation results (see Part 1: *Overview* for a description of this usage of the research). They provided strong and much needed qualitative input into standardisation decisions.

The 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 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 exams once they had made *separate* judgements on a considerable number of aspects of the 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.

# 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 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 were confirmed in both the exam and curriculum 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 exam paper analysis, three overarching comments can be made. A major finding of the research is that exam papers are *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 is considerable variation in the *overall* difficulty levels of the papers.

The fact that exam papers are *not necessarily uniformly difficult or easy* comprises a second significant finding. The relative proportions of questions at particular difficulty levels are especially important in the *National Senior Certificate* papers, where single papers are expected to discriminate between extremely high-achieving learners and those performing at low levels, and all grades of performance in between. Where in the previous system the Higher Grade *papers* discriminated between learners achieving at the highest levels, for example, the high-level questions in the *National Senior Certificate*, papers are now required to accomplish the same task. The present research shows that some of the difficulty levels of the *difficult, moderate* and *easy* parts of the 2008 NSC papers were at the desired levels, and some were too low or too high.

The third important aspect highlighted by the exam paper analysis and feeding of the attendant results into the 2008 NSC standardisation processes is the integrity of these processes. While the mechanisms by means of which the research findings were fed into standardisation processes are dealt with in detail elsewhere (see Part 1: *Overview* of this report), the usefulness of the exam paper analysis is noted briefly here. 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. In all, a minimum of seven individuals have independently, and some as teams, evaluated the difficulty levels of the exam papers in question, *before* the Umalusi Statistics and Assessment Committees carried out standardisation. In 2008, robust qualitative and quantitative findings underscored decisions made for the standardisation of NSC results. It is Umalusi's intention that these practices be continued and enhanced in future.

# REFERENCES

(INCLUDING REFERENCES FOR PARTS 1, 2, AND 3 OF THIS REPORT)

## GENERAL REFERENCES

Aikenhead, G.S. (2006). *Science Education for Everyday Life: Evidence-Based Practice*. New York: Teachers College Press.

Bernstein, B. (1971). On the classification and framing of educational knowledge. In M. Young (Ed.),*Knowledge and Control* (pp. 47-69). London: Collier-Macmillan.

Bernstein, B. (1975a). *Class, Codes and Control, Volume 3: Towards a Theory of Educational Transmissions.* London and New York: Routledge and Kegan Paul.

Bernstein, B. (1975b). *Class and Pedagogies: Visible and Invisible*. Paper for the Centre for Educational Research and Innovation.

Bernstein, B. (1981). On the Classification and Framing of Educational Knowledge. In Young, M.F.D.(Ed.), *Knowledge and Control* (pp. 47-69). London: MacMillan.

Bernstein, B. (1990). *Class, Codes and Control, Volume 4: the Structuring of Pedagogic Discourse.* London: Routledge.

Bernstein, B. (1995). Code Theory and its Positioning: a Case Study in Misrecognition. *British Journal of Sociology of Education,* 16(1): 3-19.

Bernstein, B. (1996). *Pedagogy, Symbolic Control, and Identity*. London: Taylor and Francis.

Bernstein, B. (1999). Vertical and Horizontal Discourse: an Essay. *British Journal of Sociology of Education,* 20(2).

Bernstein, B. (2000a). From Pedagogies to Knowledges, Mimeo.
Bernstein, B. (2000b). *Pedagogy, Symbolic Control, and Identity*. Revised Edition. Oxford, New York:

Rowman and Littlefield Publishers, Inc.

Bolton, H. (2005). *Social class, pedagogy, and achievement in art*. Doctoral dissertation. Cape Town: University of Cape Town.

Daniels, H. (1988). *An Enquiry into the Different Forms of Special School Organisation, Pedagogic Practise, and Pupil Discrimination.* Doctoral thesis, CORE (Collected Resources in Education): 12(2).

Daniels, H. (1989). Visual Displays as Tacit Relays of the Structure of Pedagogic Practise. *British Journal of Sociology of Education,* 10(2): 123-140.

Dempster, E.R. and Hugo, W. (2006). Introducing the concept of evolution into South African schools. *South African Journal of Science*, 102: 106-112.

Dempster, E.R. In press. 'Relevant content' in the Senior Secondary Biology curriculum in four African countries. *International Journal of Science Education*.

Dempster, E.R. and Reddy, V. (2007). Item readability and science achievement in the TIMSS 2003 study in South Africa. *Science Education*, 91: 906-925.

Donnelly, J. (2006). The intellectual positioning of science in the curriculum, and its relationship to reform. *Journal of Curriculum Studies*, 38: 623-640.

Ferreira, S. and Morais, A. (2008). Science curricula design: analysis of authors' ideological and pedagogical principles. Paper presented at the *Fifth Basil Bernstein Symposium*, Cardiff School of Social Sciences, Cardiff University, Cardiff, Wales, 9-12 July 2008.

Hoadley, U. (2005). *Social Class, Pedagogy, and the Specialisation of Voice in Four South African Primary Schools.* University of Cape Town: Unpublished Doctoral Dissertation.

Jansen, J. (2008). How to undo the damage. *The Teacher,* September 2008.

Morais, A. M. (1998). To Succeed in the Classroom Context: Acquisition of Recognition and Realisation Rules. *Seminar given at the Instituto de Educacion y Pedagogica, Universidad del Valla, Cali, Colombia.* Also published as Morais, A.M. (1999). Desenvolvimento Cientifico e Aquisicao do Texto Legitimo: Alguns Aspectos da Sociologica da Aprendizagem. Revista Portuguesa daEducacao, (12)2: 197-225.

Morais, A.M. (2002a). Basil Bernstein at the Micro-Level of the Classroom. *British Journal of Sociology of Education*, (23)4: 559-569.

Morais, A.M. (2002b). Instrument for the Characterisation of Pedagogy. Unpublished mimeo.

Morais, A.M. and Camara, M.J. (1997). Science in Kindergarten: the Sociology of Learning in the Classroom. Mimeo. Also published as Camara, M. J. (1998). O Desenvolvimento Cientifico No Jardim de Infancia: Influencia de Praticas Pedagogicas. *Revista de Educacao*, (7)2: 179-199.

Morais, A.M., Fontinhas, F., and Neves, I. (1992). Recognition and Realisation Rules in Acquiring School Science – the Contribution of Pedagogy and Social Background of Students. *British Journal of Sociology of Education,* (13)2: 247-270.

Morais, A.M. and Miranda, C. (1996). Understanding Teachers' Evaluation Criteria: a Condition for Success in Science Classes. *Journal of Research in Science Teaching,* (33)6: 601-624.

Morais, A.M., Neves, I.P., Antunes, H., Fontinhas, F., Medeiros, A., and Peneda, D. (1995). Pedagogic Practises for Equality: a Study of the Relation between Learning Contexts and Students' Learning. *Paper given at the European Conference on Educational Research 1995, University of Bath, United Kingdom.* Also published as Morais, A.M., Neves, I.P., Antunes, H., Fontinhas, F., Medeiros, A., and Peneda, D. (1996). Practicas Pedagogicas e Aprendizagem Cientifica: um Estudo Sociologico. *Revista de Educacao*, (5)2: 69-93.

Morais, A.M, and Pires, D. (2002). The What and the How of Teaching and Learning: going Deeper into Sociological Analysis and Intervention. *Paper given at the Second International Basil Bernstein Symposium 'Knowledges, Pedagogy, and Society', Cape Town, South Africa.* Also published as Morais, A.M., Neves, I.P. and Pires, D. (2004). The What and the How of Teaching and Learning: Going Deeper into Sociological Analysis and Intervention. In Muller, J., Davies, B., and Morais, A.M. (Eds.) *Reading Bernstein, Researching Bernstein* (Chapter 6). London: Routledge and Falmer.

Morais, A.M. and Rocha, C. (1997). Development of Social Competences in the Primary School – a Study of Specific Pedagogic Practises. *Paper given at the Seventh Conference of EARLI – European Association for Research in Learning and Instruction, University of Athens, Greece.* Also published as Morais, A.M. and Rocha, C. (2000). Development of Social Competences in the Primary School – a Study of Specific Pedagogic Practises. *British Educational Research Journal,* (6)1: 93-120.

Muller, J. (2007). On splitting hairs: hierarchy, knowledge and the school curriculum. In F. Christie and J.R. Martin (Eds.), *Language, Knowledge and Pedagogy* (pp. 65-86). London: Continuum.

Neves, I. and Morais, A. (2001). Texts and contexts in educational systems: studies of recontextualising spaces. In A. Morais, I. Neves, B. Davies, & H. Daniels (Eds.), *Towards a Sociology of Pedagogy* (pp. 223-249). New York: Peter Lang.

O'Halloran, Kay L. (2007). 'Mathematical and Scientific Forms of Knowledge: A Systematic Functional Multimodal Grammatical Approach', in Christie, F. and Martin, J.R. (eds), *Language, Knowledge and Pedagogy: Functional Linguistic and Sciological Perspectives* (pp. 205-236). London & New York: Continuum.

Reeves, C. (2005). *The Effect of Opportunity-to-Learn and Classroom Pedagogy on Mathematics Achievement in Schools Serving Low Socio-Economic Status Communities in the Cape Peninsula.* University of Cape Town: Unpublished Doctoral Dissertation.

Umalusi. (2004). *Investigation into the Senior Certificate examination.* Pretoria: Umalusi.

Umalusi. (2006). *Apples and Oranges? A comparison of school and college subjects.* Pretoria: Umalusi.

Umalusi. (2007). *Making educational judgments.* A sketch of the evolution of Umalusi evaluation instruments based on research conducted by Umalusi in the periods 2004–2007. Pretoria: Umalusi.

Umalusi. (2007b). *The 'f' word.* Pretoria: Umalusi.

Umalusi. (2008). *Learning from Africa: A report of Umalusi's research comparing syllabuses and examinations in South Africa with those in Ghana, Kenya and Zambia.* Pretoria: Umalusi.

Umalusi. (2008b, forthcoming). *Linking assessment results. Umalusi website: www.umalusi.org.za*

Umalusi. (2009, forthcoming). Report on the *Schools Performance Analysis*. Pretoria: Umalusi.

## REFERENCES USED BY SPECIFIC SUBJECT TEAMS
### (LISTED IN THE SEQUENCE IN WHICH THE DOCUMENTS WERE USED BY EACH TEAM)

*For English First Additional Language*

Department of Education. (undated). *NATED Interim Core Syllabus for English Second Language(HG, SG, LG) Stds 8, 9, 10.* (referred to as Document 1).

Department of Education. (2002). *National Senior Certificate Examinations Guideline Document. English 2nd Language HG and SG .Papers 1 & 3, from 2002.* (referred to as Document 2).

Department of Education. (2002). *National Curriculum Statement (G10-12) English First Additional Language.* (referred to as Document 3).

Department of Education. (January 2008). *Learning Programme Guidelines: Languages (English First Additional Language).* (referred to as Document 4).

Department of Education. (January 2008). *Subject Assessment Guidelines: Languages.* (referred to as Document 5).

Department of Education. (2006/2007). *Guideline Document for Continuous Assessment (CASS) Portfolio. English First Additional Language. Grade 12. (referred to as Document 6).*

Department of Education. (May 2008). *Guidelines for the Assessment and Moderation of Oral communication for all official languages offered in the National Senior Certificate Examinations.* (referred to as Document 7).

Department of Education. (2008). *National Curriculum Statement Portfolio Guideline document for languages. English Home Language, First Additional Language, and Second Additional Language. Grade 12.* (referred to as Document 8).

Department of Education. (2008). National Curriculum Statement Portfolio Guideline document for languages. English Home Language, First Additional Language, and Second Additional Language. Grade 12. (Amendments) (referred to as Document 9).

Department of Education. (2008). *National Senior Certificate Examination: Prescribed literature texts for study in Grade 12 for all official languages at Home and First Additional Language levels in public schools in 2009-2011.* (Circular 24 of 2008) (referred to as Document 10).

Gauteng Department of Education. (2008). *Provincial Circular 6/2008: Guidelines for Oral Assessment for all Official languages offered in the National Senior Certificate examination at Home, First and Second Additional Language level.* (referred to as Document 11).

Department of Education. (2008). *National circular 3/2008.* (referred to as Document 12).

### For Geography

(Author and date not listed on document) The syllabus document for NATED 550 called *Work Programme for Geography Standard 10 Higher and Standard Grade* (referred to as Document 1).

(Author and date not listed on document) *The National Assessment Guidelines for the National Senior Certificate Examination for Geography.* This document, which was implemented on January 2006, still focused on NATED 550 Geography Higher and Standard Grade (referred to as Document2).

Department of Education. (2003). *National Curriculum Statement for Grades 10-12: Geography* (2003) (referred to as Document 3).

Department of Education. (2008). *Subject Assessment Guidelines* (referred to as Document 4).

Department of Education. *Geography Examination Guidelines Grade 12* (2008) (referred to as Document 5).

Department of Education. (2008). *Learning Programme Guidelines (LPG): Geography* (referred to as Document 6).

Department of Education. (1994). *Geography Syllabus for Standards 8 to 10: Western Cape Education Department* – this curriculum revision involved exorcising of racial content as well as outdated and inaccurate subject matter from school syllabuses – however, these syllabus alterations of this early period in South Africa's democracy had symbolic rather than substantive significance (referred to as Document 7).

### For Mathematics

Department of Education and Culture: House of Assembly. (Date not given). *Draft Core Syllabus for Mathematics, Standards 8, 9 and 10, SG.* Dates of Implementation Std 8: 1993, Std 9: 1994, Std 10:1995 (Official document from old House of Assembly, Provided to us by an experienced teacher as a copy of the 'old syllabus' (referred to as Document 1).

Department of Education and Culture: House of Assembly. (Date not given). *Draft Core Syllabus for Mathematics, Standards 8, 9 and 10, HG.* Dates of Implementation Std 8: 1993, Std 9: 1994, Std 10:1995 (Official document from old House of Assembly, Provided to us by an experienced teacher as a copy of the 'old syllabus' (referred to as Document 2).

(Author and date not listed on document) *Mathematics SG, Code 162209010, Std. 10, Code 610, Syllabus* (Provided by Umalusi. Contains Standard 10 only, lists topics only so does not provide full documentation of curriculum (referred to as Document 3).

(Author and date not listed on document) *Mathematics HG, Code 162108710, Std. 10, Code 610, Syllabus* (Provided by Umalusi. Contains Standard 10 only, lists topics only so does not provide full documentation of curriculum (referred to as Document 4).

(Author and date not listed on document) *National Senior Certificate Examinations, Guideline document, Mathematics HG & SG, Papers 1 & 2, From 2002* (Official document from national Department of Education, provided by Umalusi (referred to as Document 5).

KZN Dept of Education. (2004). *Mathematics SG and HG, Grade 10 Scheme of Work and Suggested Syllabus Coverage: Appendix 1* (KZN provincial document provided by Ms Raju; it provides a suggested syllabus coverage and so is not prescriptive. However, we have used this to help us approximate percentage class time spent on each area of work (referred to as Document 9).

KZN Dept of Education. (2004) *Mathematics HG, Grade 11 and 12 Scheme of Work and Suggested Syllabus Coverage: Appendix 2* (KZN provincial document provided by Ms Raju; it provides a suggested syllabus coverage and so is not prescriptive. However, we have used this to help us approximate percentage class time spent on each area of work (referred to as Document 10).

KZN Dept of Education document. (2004). *Mathematics SG, Grade 11 and 12 Scheme of Work and Suggested Syllabus Coverage: Appendix 3* (KZN provincial document provided by Ms Raju; it provides a suggested syllabus coverage and so is not prescriptive. However, we have used this to help us approximate percentage class time spent on each area of work (referred to as Document 11).

(Author and date not listed on document) *Eastern Cape Provincial Guideline Document for the implementation of continuous assessment in Mathematics.* Document provided by Ms Raju(referred to as Document 12).

Department of Education and Culture, Province of the Eastern Cape. (1996). *Mathematics syllabus, Higher Grade, Standards 8, 9 and 10.* Implementation dates Stds 8–10: 1996. Document provided by Ms Raju (referred to as Document 13).

Department of Education and Culture, Province of the Eastern Cape.(1996) *Mathematics syllabus, Standard Grade, Standards 8, 9 and 10.* Implementation dates Stds 8–10: 1996. Document provided by Ms Raju (referred to as Document 14).

Department of Education. (2003). *National Curriculum Statement for Grades 10–12.* 2003. Official document (referred to as Document 7).

Department of Education. (January 2008). *Subject Assessment Guidelines.* Jan 2008. Official document (referred to as Document 6).

Department of Education. (January 2008). *Learning Programme Guideline.* Jan 2008. Official document (referred to as Document 8).

(Author and date not listed on document) *Term planning 2008, Mathematics grades 10–12* (document provided by Umalusi; status and source of document unknown).

### For Mathematical Literacy

Department of Education and Culture: House of Assembly. (Date not given). *Draft Core Syllabus for Mathematics, Standards 8, 9 and 10, SG.,* Dates of Implementation Std 8: 1993, Std 9: 1994, Std 10:1995 (referred to as Document 1).

Department of Education and Culture: House of Assembly. (Date not given). *Draft Core Syllabus for Mathematics, Standards 8, 9 and 10, HG.* Dates of Implementation Std 8: 1993, Std 9: 1994, Std 10:1995 (referred to as Document 2).

(Author and date not listed on document) *Mathematics SG, Code 162209010, Std 10, Code 610. Syllabus* (referred to as Document 3).

(Author and date not listed on document) *Mathematics HG, Code 162108710, Std 10, Code 610. Syllabus* (referred to as Document 4).

(Author and date not listed on document) *National Senior Certificate Examinations, Guideline document, Mathematics HG & SG. Papers 1 & 2, from 2002* (referred to as Document 5).

KZN Department of Education. (2004). *Mathematics SG and HG, Grade 10 Scheme of Work and Suggested Syllabus Coverage: 2004. Appendix 1* (referred to as Document 9).

KZN Department of Education. (2004). *Mathematics HG, Grade 11 and 12 Scheme of Work and Suggested Syllabus Coverage: Appendix 2* (referred to as Document 10).

KZN Department of Education document. (2004). *Mathematics SG, Grade 11 and 12 Scheme of Work and Suggested Syllabus Coverage: Appendix 3* (referred to as Document 11).

(Author and date not listed on document) CASS Policy document (referred to as Document 12).

Department of Education. (January 2008). *National Curriculum Statement, Grades 10–12 (General) Subject Assessment Guidelines, Mathematical Literacy.* (referred to as Document 6).

Department of Education. (2003). *National Curriculum Statement, Grades 10–12 (General) Mathematical Literacy.* (referred to as Document 7).

Department of Education. (2003). *National Curriculum Statement, Grades 10–12 (General) Learning Programme Guidelines, Mathematical Literacy.* (referred to as Document 8).

Department of Education. (January 2008). *National Curriculum Statement, Mathematical Literacy Examination Guidelines, Grade 12.* (referred to as Document 13).

### For Biology/Life Sciences

Department of Education, (2002). *National Senior Certificate Examinations Guideline document for Biology (Higher and Standard Grade), for Papers 1and 2 (Grade 12)* (referred to as Document 1).

Department of Education and Culture: KwaZulu-Natal. (1996). *Interim Core Syllabus & Provincialised Guide for Biology (Higher and Standard Grade) (Grades 10–11)* (referred to as Document 2).

Department of Education: Gauteng. (undated). *Continuous Assessment Portfolio Guidelines (Higher and Standard Grade) (Grades 10–12)* (referred to as Document 9).

Department of Education. (2001). *National Guideline document for Continuous Assessment* (referred to as Document 10).

Department of Education. (2003). *National Curriculum Statement: Life Sciences (Grades 10–12)* (referred to as Document 8).

Department of Education. (2008). *Learning Programme Guidelines: Life Sciences (Grades 10–12)* (referred to as Document 3).

Department of Education. (2008). *Subject Assessment Guidelines: Life Sciences (Grades 10–12)* (referred to as Document 4).

Department of Education. (2008). *Examination Guideline: Life Sciences (Grade 12)* (referred to as Document 5).

Department of Education. (2007). *Assessment syllabus: Life Sciences (Grade 11),* draft (referred to as Document 6).

Department of Education. (2008). *Assessment syllabus: Life Sciences (Grade 10)* (referred to as Document 7).

### For Physical Science

Department of Education. (undated, c.1990's). *Syllabus: Physical Science (Higher Grade)* (NATED550) (referred to as Document 2); together with the *Western Cape Instructural Offering [sic] for Physical Science Higher Grade* (1995) (referred to as Document 8).

Department of Education. (undated, c.1990's). *Syllabus: Physical Science (Standard Grade)* (NATED550) (referred to as Document 3); together with the *Western Cape Instructural Offering [sic] for Physical Science Standard Grade* (1995) (referred to as Document 9).

Department of Education. (2002). *National Senior Certificate Exam Guidelines* (NATED 550) (referred to as Document 7).

Department of Education. (March 2001). *Continuous Assessment (CASS) Guidelines* (NATED 550) (referred to as Document 11).

Department of Education. (2003). *National Curriculum Statement: Physical Science (Grades 10–12)* (referred to as Document 1).

Department of Education. (2008). *Learning Programme Guidelines: Physical Science (Grades 10–12)* (referred to as Document 4).

Department of Education. (2008). *Subject Assessment Guidelines: Physical Science (Grades 10–12)* (referred to as Document 5).

Department of Education. (2008). *Examination Guideline: Physical Science* (referred to as Document 6).

Department of Education. (June 2006). *National Curriculum Statement: Grades 10–12 Physical Sciences Content* (referred to as Document 10).

# NOTES

**UMALUSI**

Council for Quality Assurance in
General and Further Education and Training