GRADE 10-12 MATHS AND SCIENCE LEAD TEACHER TRAINING REPORT: KWA-ZULU NATAL, EASTERN CAPE AND LIMPOPO

FINAL DRAFT

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EDUCATION TRAINING AND DEVELOPMENT PRACTISES SECTOR EDUCATION AND TRAINING AUTHORITY (ETDP SETA)

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Abbreviations

Annual National Assessments	ANA
Assessment standards	AS
Centre for Advancement of Science and Mathematics Education	CASME
Curriculum and Assessment Policy Statements	CAPS
Department of Basic Education	DBE
Foundations for Learning	FFL
Further Education and Training	FET
Learning outcome	LO
Monitoring, Quality Assurance	MQA
Multiple-choice question	MCQ
National Curriculum Statement	NCS
National Department of Education	DoE
National Education Collaboration Trust	NECT
not routine question	NRQ
open-ended questions	OEQ
Physics Education Technology	PhET
Portfolio of Evidence	PoE
short answers	SA
senior phase	SP

EXECUTIVE SUMMARY

The National Education Collaboration Trust (NECT) is a public benefit organization with one of its primary objectives being to improve the quality of schooling as guided by the Education Collaboration Framework, a blueprint partnership between government and other social partners. One of the most critical programmes in improving the quality of schooling is a District Intervention Programme which seeks to build capacity in districts aimed at improving learning outcomes in schools. It is in this context that the teacher training in mathematics and science was mooted that we are reporting here. The NECT's work in maths and science complements a wide range of policies, programmes and strategic initiatives that are being undertaken nationally and in provincial education departments and education districts. In this regard, the NECT has taken cognizance of the work done by the Teacher Development and Curriculum Management Committee of HEDCOM on interventions to improve learner performance in Maths, Science and Technology. In response, NECT submitted a successful proposal to the ETDP SETA aimed improving the quality of classroom practice in a sample of schools.

To achieve the above objective, the NECT appointed as service provider the Centre for Advancement of Science and Mathematics Education (CASME) from KwaZulu-Natal. CASME developed the content of the Train-the- Trainers (ToT) segment, of the materials for mathematics and science, and of pre-test/post-test evaluation instruments. CASME, together with NECT and district officials from uThungulu and Pinetown (KZN) and Libode and Mt Frere (Eastern Cape), arranged and completed three 3-day (weekend) workshops, while Vhembe and Waterberg (Limpopo) arranged and completed two 3-day workshops. CASME also completed one 2-day and two 3-day train-the-trainer sessions.

This ETDP SETA Short Course Program involved 472 teachers, only 28 short of the targeted 500, with 147 teachers from EC, 147 from KZN and 178 from Limpopo.

CASME also completed one 2-day and two 3-day Train-the-Trainer sessions. These sessions were very successful, giving an opportunity for the trainers to share their knowledge and plan for the subsequent training. It was also very encouraging to see that the district officials from EC and Limpopo who attended Train-the-Trainers went back to their districts and assisted with the training.

The NECT Monitoring and Quality Assurance (MQA) team provided support throughout the programme. They attended all the Train-the-Trainer sessions and gave feedback which CASME and the facilitators used to improve their training sessions. The materials were also quality assured and feedback was given to CASME, which used the information for further improvements. The MQA team also attended all the training sessions in all the provinces and was able to give constructive feedback to the facilitators, who appreciated the input.

The training of the teachers went very well. The sessions were well attended – probably due to the residential nature of the course, which was especially helpful for those teachers who had long distances to travel. The evaluations done by the teachers emphasized how much they felt that they had benefited – as can also be seen in the improvements from pre-test to post-test.

Teachers enjoyed the inclusion and use of ICT. Many said that this was completely new to them and that they would use it in their classes. The two ICT software programs used were GeoGebra and ChemSketch, and teachers were shown how they could generate learner tests using these programs. Positive response could also be seen in the Portfolios of Evidence.

This executive summary attempts to capture the most salient points arising from analysis of the mathematics and science pre-test results and an the post-test result. The primary level of analysis for both mathematics and science was level attained per topic and per subject. The most significant finding in this evaluation was that attainment levels were disturbingly low across all districts.

The pre-test results for both mathematics and science were a concern, as reflected in the quantitative analysis section of this report. Given below is a summary of the pre- and post-test outcomes.

Mathematics

- One hundred and eighty-eight teachers wrote the pre-test evaluation, 193 wrote the post-test evaluation, and 151 wrote both the pre-test and the post-test. The projected number of teachers for the project was 250 for Mathematics, and the registered number of teachers for Mathematics (highest number that attended the workshop) was 232. This means that only 151 of 232 (65%) wrote both tests.
- A 76.6% majority of teachers scored less than 50% in the pre-test, and although this was reduced to to 49.7% of teachers in the post-test, it still indicates a substantial proportion of teachers who are performing well below the expected standard.
- It is encouraging to see the improvement at the top achievement levels, where 20.2% of teachers scored above 70% for the post-test, compared with only 5.8% of teachers scoring at that level in the pre-test.
- The 39 teachers who scored above 70% should be recognised as being on track to become district-appointed Lead Teachers. However, much work must still be done to improve their skills level.
- At the bottom end of the achievement levels more work must be done for teachers who showed very substantial content deficiencies.
- All districts showed significant shifts in the post-test, with an average of 17.3% improvement.
- Pinetown improved by the biggest percentage, while Libode showed the smallest percentage shift.
- F-value statistical analysis (see explanation of F-value in Chapter 6, section 6.1): Since all F-ratio scores in Mathematics for all districts were greater than the F-critical, we can assume that the nine-day ETDP SETA Short Course was effectively beneficial, as evidenced in the improvements from pre-test to post-test scores in Mathematics.

Science:

- Two hundred and sixteen teachers wrote the pre-test, 192 wrote the post-test, and 169 wrote both pre-test and post-test. The projected number of teachers for the project was 250 for Science, and the registered number of teachers for Science was 219. This means that only 169 of 219 (77%) wrote both tests.
- A 63.4% majority of teachers scored less than 50% in the pre-test, and although this was reduced to to 38.1% of teachers in the post-test, it still indicates a substantial proportion of teachers who are performing well below the expected standard.
- It is encouraging to see the improvement at the top achievement levels, where 31.2% of teachers scored above 70% in the post-test, compared with only 15.3% of teachers scoring at this level in the pre-test.

- The 60 teachers who scored above 70% should be recognised as being on track to become district-appointed Lead Teachers. However, much work must still be done to improve their skills level.
- At the bottom end of the achievement levels more work must be done for teachers who displayed very substantial content deficiencies.
- All districts showed significant shifts in the post-test, with an average improvement of 14.5%.
- uThungulu improved by the biggest percentage while Mt Frere showed the smallest percentage shift.
- F-value statistical analysis: Since four of the F-ratio scores for districts are greater than the F-critical we can assume that the nine-day ETDP SETA Short Course was beneficial, as evidenced in the improvements from pre-test scores to post-test scores in uThungulu, Vhembe, Waterberg and Libode.
- Pinetown and Mt Frere each had an F-ratio score that was less than F-critical, suggesting that improvements from pre-test to post-test could be the result of chance.

Poor attainment in the pre-test was a major concern, and facilitators made extra effort to address the content gaps in teacher knowledge. The initial post-test results show substantial improvement in all six districts.

These are some recommendations that follow from the ETDP SETA Short Course outcomes:

1. Disseminate the findings of the report with all key partners, including ETDP SETA, DBE, provincial departments and district level managers. Subject advisors and NECT implementing teams to receive specific attention.
2. Debrief with the service provider and identify key issues that need attention if the programme is re-offered or extended.
3. Consider two differentiated training offerings to meet the needs of separate groups of trainees: a) those requiring higher-level content (lead teachers), b) those that need strengthening in more basic content in maths and science.
4. Adjust the training content to include other priority areas in maths (e.g. calculus) and areas to be determined in science.
5. Retain and strengthen the training model, based on pre- and post-testing of trainees.
6. Consider an additional component which includes training and supporting talented learners as peer educators in maths and science.
7. Aim to achieve 100% coverage of all Grade 11-12 level maths and science teachers in the target districts.
8. Develop a strategy for reaching teachers who are responsible both maths and science in the same school.
9. Address the lack of critical teaching resources in science (basic science kits for demonstrations).
10. Develop and implement a follow up in-school support strategy for teachers that have already been trained.
11. Improve the evidence base on post-training outcomes in terms of classroom practice.
12. Collaborate with district management to make the upgrading program a mandatory requirement for all FET level maths and science teachers in target districts.

1 TERMS OF REFERENCE

1.1 Introduction

In examining international, national and local teacher training and professional development programs and initiatives, educational achievement tests are used to monitor acceptable levels of performance in mathematics and science. Implementation of these programs varies, depending on funding and educational demands, and often involves only a sample of teachers at a sample of schools in a district, province or country.

Over the past decade, systemic research conducted by the National Department of Education has indicated that learners throughout South Africa are performing well below the acceptable standards in mathematics and science.

1.2 Rationale for ETDP SETA Short Course Program

This project is designed in the context of significant underperformance of learners in mathematics and science in the National Senior Certificate (NSC) examinations, taking into account the introduction and reorganization of content in CAPS for Mathematics Grades 10–12, in which Probability and Euclidean Geometry were examinable sections in the NSC for the first time in November 2014. Although there were no major shifts in other sections of the Mathematics syllabus, the NSC 2014 results show a lack of conceptual understanding of Functions and Graphs. These three sections were the focus topics for the three Mathematics workshops. Similar trends in underperformance were observed in Physical Sciences, especially in the following topics: a) Electrodynamics/Electric circuits, b) Work, Energy and Power, and c) Acids and Bases. These three domains became the focus topics for the three Science workshops.

The project aimed to train teachers in a non-threatening and supportive environment, with emphasis on motivating them to acquire the basic skills they need to teach the above-noted topics with confidence, thus creating renewed interest in these topics for the learners and enhancing appreciation of the role of these concepts in society.

CASME provided the capacity and expertise to deliver on the project goals through its well-established network of contractors at district, provincial and national levels. Additionally, CASME is an accredited SACE provider and an accredited International GeoGebra Institute (IGI) in South Africa. The IGI provides free dynamic mathematics software and shares expertise in training, support and materials development for students and teachers alike, worldwide, to improve mathematics, science and technology education. GeoGebra was the key thread linking mathematics and science, and across all of the content domains in this program.

The overall Project Goal in providing this short course for teachers in mathematics and science in the FET band in three provinces (KZN, Limpopo and EC), and in two districts in each province, is achievement of the NECT goal for 90% of learners to pass mathematics and science at the 50% level by 2030. The following key objectives were listed as project deliverables:

- This project was based on collaboration between DBE, NECT (and its DIP in the districts), ETDP SETA, and CASME as the lead service provider.
- DBE, represented through the districts, would identify teachers according to set criteria agreed upon by stakeholders; this list was presented to CASME.

- CASME was responsible for logistics that included registration, accommodation and venues, communication with teachers, supply of notes, organization of refreshments, development, printing and supply of course materials, training and evaluation of the course, supply of facilitators, and monitoring and support of the training roll-out. However, it was jointly decided that NECT and CASME would work together on the logistics planning.
- On completion of the nine-day short course, and following due process, teachers would be able to claim SACE professional development points.
- NECT would provide high-level support for the full duration of the program.
- The beneficiaries were the targeted 500 mathematics and science teachers in the FET phase, listed as follows:
    - KZN: 160 teachers from two districts (Pinetown and uThungulu), with 80 teachers from each district, equally divided between mathematics and science
    - EC: 160 teachers from two districts (Libode and Mt Frere), with 80 teachers from each district, equally divided between mathematics and science
    - Limpopo: 180 teachers from two districts (Vhembe and Waterberg), with 80 teachers from each district, equally divided between mathematics and science
- CASME was responsible for all aspects of the teacher participation logistics. Teachers received a pack of notes and exercises at the start and during every workshop.
- Teachers were expected to write pre-tests and post-tests aimed at measuring educational shifts.
- The training program involved a full three-day block session that ran parallel for mathematics and science. This content training session occupied nine days in total, with 3 x 3 parallel sessions each starting on a Friday and ending on a Sunday (Friday 11h00 – 18h00; Saturday 08h00 – 18h00; Sunday 08h00 – 12h00).
- The project aimed in addition to expose teachers to better assessment practices, well-constructed tests, and marking memorandums, and also to encourage district and provincial officials to review their own suppot initiatives for teachers.

The above-listed points detail the scope of work completed according to the terms of reference, and indicate the context for project implementation by the service provider.

2 MATERIALS DEVELOPMENT

This section provides an overview and rationale for designing and developing the course materials used in mathematics and science.

2.1 Introduction

Developing and finalising of materials kicked off on 4 August 2015 with a broad stakeholder consultation at the CASME offices. Stakeholders included district subject advisors, lead agents and CASME. Submissions were solicited beforehand from district subject advisors and lead agents on topics identified as problematic for teachers. Initial inputs had also been received from the NECT. In addition, the 2014 National Senior Certificate Technical Report and an item-level analysis of learner responses in the Western Cape were reviewed to test the inputs from districts against available performance data.

Based on this consultative process and desktop review the following principles were agreed:

- The materials would focus on a selection of identified topics in each subject area.
- The materials would support a programme to be structured as a nine-day short course offered in three block sessions.
- Accreditation would be through the South African Council of Educators (SACE) Professional Development Points system.
- A Teacher Profile and pre-course assessment would be administered.
- A Portfolio of Evidence would be included as evidence for accreditation and to serve as a resource for teachers.

Following this initial engagement, a draft set of materials for Session 1 was prepared for review at a meeting of the stakeholder grouping (31 August 2015 at NECT offices). The purpose was to approve the format and approach and provide an opportunity for external and district level input.

It was agreed, following input at this meeting from the National Department of Education, that ICT skills be included. The programme and materials would therefore incorporate a particular focus on ICT Integration, Planning and Assessment.

The following were identified as specific topics in each subject area:

Mathematics:

Session 1: Euclidean Geometry; Session 2: Probability; Session 3: Functions

Physical Science:

Session 1: Vertical Projectile Motion and Work, Energy and Power; Session 2: Organic Chemistry and Acids and Bases; Session 3: Electricity and Magnetism and Electrodynamics

2.2 Design and Purpose

The materials were designed to be used in a facilitated teacher-professional development context rather than as a stand-alone content-knowledge text. For each session a Facilitator and Participants Guide was prepared.

Design and purpose were focused on providing a model for teachers on how they might approach the teaching of these topics in their own classrooms rather than focused exclusively on content knowledge. The objective was to incorporate this model into a TPCK (Technological, Pedagogical, Content Knowledge) framework that included critical aspects of assessment and planning.

The materials were structured to include activities that enable teachers to engage in problem solving, group discussions and feedback to or from the larger group.

A typical outline for each three-day block session included the following elements:

- Assessment programme

    - Formal: Tests, exams and practical investigations.

    - Informal: Revision tests, homework assignments and projects.

    - Weighting of topics and levels of difficulty.

- Alterative teaching methods
- Teacher resources
- Lesson planning
- Errors and misconceptions (reference to diagnostic report analysis)
- Content and methods of teaching
- Problem solving
- ICT integration
- Group presentations
- Consolidation

2.3 Mathematics: Design and Purpose

Each set of materials had the following objectives:

- To promote mathematical knowledge, skills and problem solving
- To construct and apply mathematical and technological knowledge
- To acquaint the teachers with broad outlines of the content in each topic

The specific subject content covered in each topic included:

Session 1: Euclidean Geometry

- Logical reasoning and proof
- Van Hiele theory
- Burton's model of mathematical thinking
- Examinable theorems, axioms and corollaries
- Theory of quadrilaterals
- Circle geometry

Session 2: Probability

- Experimental outcome versus theoretical probability
- Venn diagrams, contingency tables and tree diagrams
- Mutually exclusive and complimentary events

- Dependent and independent events
- Fundamental Counting Principle

Session 3: Functions

- Functions in everyday life
- Graphs of functions
- Graphs of linear functions
- Logarithmic functions
- Trigonometric functions

2.4 Science: Design and Purpose

Each set of materials had the following objectives:

- To promote knowledge and skills in scientific inquiry and problem solving
- To construct and apply scientific and technological knowledge
- To understand the nature of science and its relationships to technology, society and the environment
- To acquaint the teachers with broad outlines of scientific principles and the way they are exemplified in familiar phenomena, and also with the application of these principles to new situations

Included in the design and purpose was exposition of the following as they related to topic specific content:

- Assessment guidelines
- Misconceptions and errors
- Modelling and teaching using GeoGebra, ChemSketch, PhET

Session 1: Vertical Projectile Motion and Work, Energy and Power

Session 2: Organic Chemistry and Acids and Bases

Session 3: Electricity and Magnetism and Electrodynamics

2.5 ICT: Purpose and Design for Mathematics

In designing the materials for the programme it had been agreed that a particular focus on ICT skills for integration in mathematics teaching and learning would be beneficial. In their responses in the Orientation sessions and in their completed Teacher Profiles teachers identified ICT skills development as a specific need. Our experience also showed that teachers often need a combination of basic ICT literacy, and, in the case of mathematics teachers, a unique set of skills relating to drawing of mathematical diagrams and use of ICTs to generate mathematical symbols, formulas and notation. This improves their productivity and proficiency in preparing learning and teaching resources.

Taking these points into account, separate sets of training materials were developed. In Mathematics these materials included user manuals for selected open source software (i.e. GeoGebra). In addition, recognizing that teachers need practical skills to improve their day-to-day application of ICT, a manual was developed on using the drawing and mathematical tools built into standard Microsoft Office Word.

Finally, to promote alternative ICT-integrated approaches to class-based formative assessment, a manual was developed on the Plickers learner-response system.

Incorporated in these materials were skills and procedures specifically designed for the subject content sections that were covered during the course.

2.6 ICT: Purpose and Design for Science

As with Mathematics, a separate set of resource materials was developed for Physical Sciences, focusing on ICT skills. The materials included Word, GeoGebra and Plickers, as outlined above, but were extended to include ChemSketch, which has particular value in the teaching and learning of Organic Chemistry, and PhET Simulations, for Vertical Projectile Motion and Work, and Energy and Power.

2.7 Critique and Recommendations

After each session, the Monitoring and Quality Assurance (MQA) team provided a report and made recommendations to help improve future teacher development interventions.

2.7.1 Mathematics

Feedback on the Mathematics booklet noted the following defects for CASME to rectify: The booklet presented only a generic objective without indicated objectives for each section; there were many irregularities in layout, structure, font and typesetting , and frequent replication of information on structure, time table and delivery session by session; content was not course specific; there were discontinuities in numbering for the manual and the memo on probability ; page numbers for each topic did not run concurrently; what was termed the facilitator's manual was a test memo; where an activity was answering a question, the content material lacked relevance and failed to provide guidance on teaching strategies and methodologies; most of the material consisted of previous exam question papers.

2.7.2 Science

Feedback given to CASME at the end of the Train-the-Trainer Session 2, for rectification before the training of teachers, noted the following defects: In Session 2, Training of Trainers, the notes for the three sections were compiled into a single booklet but without renumbering, so each section started with page 1. Each section had a different style, font and typesetting. The introductory section and the course outline were repeated in every section of the booklet, failing to correspond with the content of the particular. The activities for each section were all at the end of the booklet, rather than at the end of each section, making it more difficult to locate the activities for a particular section that was being dealt with. No agenda or specified time was indicated for the various activities. There was no facilitator's manual or participant's manual. In the Organic Chemistry section, the module and unit objectives were missing. Another issue was poor quality of printing, particularly for the ChemSketch section. The graphics in the Mathematics section were also poor.

2.7.3 Recommendations

- The layout, structure and quality of materials need to be consistent and professionally presented.
- There should be a facilitator's manual and a participant's manual. The agenda should specify relevant activities for the day, the timeframe for each activity, materials needed and who is responsible.

- The facilitator's manual should include a pre-workshop checklist. This would list all the materials that the facilitator would need for the training, helping facilitators in the organisation of the workshops they would be running. It is advisable that content should be followed directly in the booklet by related activities.
- The activities in the booklets should from a variety of sources rather than just covering exam questions.

3 METHODOLOGY 1: Training of Trainers

3.1 Introduction

The purpose of the Train-the-Trainer workshops was to prepare the trainers for training the teachers. Two different models were employed in the workshops: a) In KZN, CASME facilitators were fully employed, while district involvement was limited; b) In Limpopo and Eastern Cape, both NECT Curriculum Coaches and the district counterparts participated fully.

These training workshops provided ample opportunity for trainers to engage with the materials and improve the quality of delivery.

The strategy employed by CASME as appointed service provider for the training of the trainers was to train district officials and NECT Curriculum Coaches, who in turn trained the teachers. In KZN, however, CASME facilitated all the training in both mathematics and science and only limited use was made of the district officials.

The purpose of the training was

- to prepare facilitators to present information effectively
- to respond to participants' questions and lead activities that reinforce learning
- to direct participants to supplementary resources and reference materials
- to solicit inputs from facilitators as to how best material and delivery can be structured for maximum impact
- to lead discussions, listen effectively, make accurate observations and help participants to link training to their every teaching

On the first day of the first training workshop there was a plenary session for all participants and stakeholders in the program to set the context for implementation. Inputs included the following focal points:

- From NECT: introduction of all the stakeholder and their role in the project
- From CASME: an outline and the purpose of the project
- From CASME: an overview about the ICT integration component embedded in the project for both mathematics and science
- From PILO: involvement of PILO in KZN, emphasizing the use of curriculum trackers.

The role of the NECT MQA team was to monitor the training and provide feedback to CASME to ensure quality and standardization.

3.2 Attendance

The table indicates the number of people that attended the three training sessions, together with their designated role in the project. Attendance and participation was excellent throughout the training program. The NECT MQA team attended Sessions 2 and 3 of the Training of Trainers.

Table 1: Attendance at Train-the-Trainer sessions

District	NECT subject specialists						District subject advisors					
	Maths			P Science			Maths			P Science		
	ToT 1	ToT 2	Tot 3	ToT 1	ToT 2	Tot 3	ToT 1	ToT 2	Tot 3	ToT 1	ToT 2	Tot 3
CASME							3	3	2	3	3	3
Pinetown	0	0	2	0	0	0	1	3	0	1	2	0
uThungulu	0	0	0	0	0	0	0	1	0	0	1	0
Mt Frere	1	1	2	2	2	1	1	1	0	1	1	0
Libode	1	2	2	1	2	2	1	0	0	1	0	0
Vhembe	1	1	2	1	1	2	1	1	0	1	1	0
Waterberg	1	1	0	1	1	1	1	1	1	1	1	0

3.3 Design for Maths

3.3.1 Training of Trainers Workshop 1

In preparation for the workshop the following materials were designed for Mathematics in consultation with the subject advisors and NECT facilitators:

- FET Mathematics Session 1: Euclidean Geometry Manual – Introduction to GeoGebra
- FET Mathematics: Pre-test
- Mathematics Technology Lab: Introduction to GeoGebra
- Typing Mathematics and Chemical Formulas productively
- FET Physical Sciences and Mathematics – Plickers in a nutshell
- FET Mathematics Trainer's Guide

The workshop focused on teaching and learning of Euclidean geometry with particular emphasis on the Grades 10–12 syllabus. GeoGebra open source software was incorporated in teaching and learning of Euclidean geometry. The aim of Workshop 1 was to orient all trainers on understanding and implementation of ICT and its integration across content domains – in this case, Euclidean Geometry.

3.3.1.1 Integration of ICT

3.3.1.1.1 GeoGebra software

The trainers' responses and activities over the three days gave a clear indication of the advantages of the TPCK framework as a basis for good teaching with technology, requiring content and pedagogical knowledge combined with an understanding of how technologies can be used to represent concepts. Issues dealt with were how to teach Euclidean geometry using technology, knowing the challenges the learners will face when presented with this new pedagogy, and how technology can be used to build on existing knowledge and develop new knowledge.

Availability of dynamic mathematics software such as GeoGebra enabled trainers to create graphical representations of theorems, axioms and corollaries in Euclidean geometry. Building on the graphically presented concepts, trainers could then make connections between the diagrams, the

mathematical concepts and the symbolic representation. When presented with a new concept, learners need to think, visualize and explore relationships and patterns. This is consistent with the CRA (Concrete, Representational, and Abstract) model for teaching mathematics that offers a better way to reach learners as they learn and understand mathematical concepts. Technology makes all of this possible in a short amount of time.

Participation in the NECT-ETDP SETA project activities and using GeoGebra gave the maths trainers experience both in using the different tools of the software and in the way GeoGebra could be a tool to enhance their own practice. This experience positively influenced trainers' perspectives about the use of technology in the teaching and learning of mathematics and increased their confidence in making practical use of technology.

On the last day, trainers worked in groups to showcase the knowledge and skills they had acquired over the first two days. They were impressed by the quality of presentations that the groups come up with.

3.3.1.1.2 Plickers

Trainers were also introduced to Plickers, which is a simple but powerful tool that enables teachers to collect real-time formative assessment data without the need for learners' devices. Teachers can use Plickers for a quick check to see, according to correctness of responses to multiple-choice questions, whether their learners have understood concepts and mastered key skills. Trainers were very excited about this tool and keen to try it out with the teachers. (See the "Plickers in a nutshell" manual in the appendices for more details.)

3.3.1.1.3 Typing mathematics equation productively using Microsoft Word

Trainers had an opportunity to learn productive tricks about typing mathematics. This was an eye-opener for all the participants, and at the end of the workshop, one trainer boldly declared that there would be no more cut and glue technique for him: from now on he would draw his own diagrams with GeoGebra and type his maths equations in MS Word.

3.3.1.2 In general

- Attendance was very good.
- Facilitators/trainers participated actively during the sessions and worked with full concentration. They were alert at all the times and completed all the activities assigned to them.
- The venue was convenient for engaging in activities and seeing them through to completion.
- The trainers enjoyed the content dealt with and the way it was presented to them.
- Unfortunately, not all the trainers had laptops.
- Some trainers lacked basic computer skills but were willing to learn.
- The motivation level varied and participants who lacked basic computer skills were less confident and not overly keen to incorporate ICT in the first session of training with the teachers.

3.3.2 Training of Trainers Workshop 2

Workshop 2 for Mathematics Train-the-Trainer was a great success in all aspects. All provinces were represented, together with the MQA team, whose role was spelt out for session participants.

We were also fortunate to have been visited by the official from DBE (Mr Dikgomo), who motivated the team and shared DBE's short-, medium- and long-term strategies for improving learning outcomes. He attended all the sessions and made valuable contributions to the discussions and activities.

The CASME team outlined the purpose of the course with a PowerPoint presentation on NECT long-term goals (see appendices). The programme kicked off with a plenary session bringing together maths and science facilitators, along with all the other stakeholders, to outline objectives for the three days, challenges from previous train-the-teacher sessions, suggested solutions to these challenges, successes of the training sessions, and the way forward.

The training focused on teaching and learning of probability and functions, with particular emphasis on the Grades 10–12 syllabus. GeoGebra open source software was incorporated in teaching and learning of probability and functions.

There was an opportunity to solicit input from various stakeholders about the administration of the pre-test. To get a sense of teacher's misconceptions it was necessary to mark all the scripts targeting questions on probability and functions. The overall process was a success and enabled facilitators to structure the training according to the teacher's needs.

On day 3 of the training the CASME team had a brief meeting with the MQA team and the following recommendations and suggestions were put forward to CASME:

3.3.2.1 Materials:

- Consider overall edit to improve layout, structure and quality.
- Include the objectives and outcomes relevant for each training activity.
- Address replication: section labelled STRUCTURE, TIMETABLE and DELIVERY is replicated from Session 1 and requires editing.
- Content of course needs to be specific to the content of the day/session.
- Numbering in materials needs to be corrected.
- Page numbering must flow and be continuous in a handout (can't have multiple page 1's).
- The current pre-test MEMO needs to be edited into a Facilitator's Manual with the programme for the session.
- Include a proposed structure of an AGENDA.
- Ensure that content and relevant activities were kept together, rather than having all activities at the back of the handout.
- Refer to and include some other content, not limited solely to exam questions (this could be misinterpreted as teaching only for exam purposes).

3.3.2.2 Program

Items to be included in the programme:

- Registration
- Welcome and introductions
- Programme of the day
- Participants expectations
- State and present objectives and outcomes
- Distribution of materials, etc.

3.3.2.3 Pre-workshop checklist

There needs to be a pre-workshop checklist for the Facilitator which should be included in the Facilitator's manual. The checklist should include some or all of the following:

Description; facilitator's manual; participants' manuals; register; data projector; laptop; extension cords; laser pointer; flipchart; markers; Prestik; apparatus for demonstrations; software; name tags; paper for activities.

All these recommendations were implemented

3.3.2.4 Integration of ICT

The facilitators' responses in relation to ICT, and in particular GeoGebra software, confirmed the impressions gained from trainer responses in ToT Workshop 1.

3.3.2.5 General

- Attendance was very good.
- Facilitators participated actively during the sessions and worked with full concentration. They were alert at all the times and completed all the activities.
- The venue was convenient for the exercise.
- The facilitators enjoyed the content dealt with and the way it was presented to them.
- All the recommendations and suggestions by the evaluators and facilitators were put into effect and revised material was circulated to all concerned.
- Given the timeframes for production and distribution to the various district centres, the Session 2 Participants' Guides shared in Train-the-Trainer were already printed. CASME was keen to go ahead and duplicate the updated versions of the Facilitators' Guides and to ensure that these were available, but due to increased costing and time it was decided against re-printing. As a compromise, soft copies of the updated Participants' Guides were made available for distribution on flash drives where applicable and through the Q&A forums. Fortunately, the final workshop 3 materials had not been not printed, so updates were made before going to print.

3.3.3 Training of Trainers Workshop 3

The workshop was very well attended, although the district curriculum coaches from KwaZulu-Natal were not present as they were busy with the Second Chance Program, which is the MEC's intervention programme for Grade 12. Mr Dikgomo from DBE was also present for the workshop. The CASME trainers unfortunately had to leave early as they had other commitments.

3.3.3.1 Facilitation skills

The workshop focused on teaching and learning of functions, with particular emphasis on the Grades 10–12 syllabus. GeoGebra software was incorporated in the teaching and learning of functions. Further resources such as PowerPoint presentations and GeoGebra applets were also shared during the training.

Since facilitators are the single most important resource for the programme, it was considered essential to recruit the right people and make sure that they were appropriately trained, supervised and supported in fulfilling their role. A facilitation skills training was conducted by a NECT trainer. Facilitators were taken through the full process of facilitation from start to finish. There was a notable improvement in facilitation skills after this training.

A sample item analysis which was prepared and discussed during the workshop provided an opportunity for the team to come up with strategies to assist teachers in the training. It also provided a template for analysing the pre-test and post-test results.

The MQA team recommended that CASME put together a PoE exemplar and circulate it during the workshop for further discussion in the plenary session. They also requested CASME to provide teachers with the course name and code. All these recommendations were put into effect.

3.3.3.2 Portfolio of evidence

Issues regarding the PoE were discussed in the plenary to establish uniform understanding and implementation. Feedback to teachers needed to be clear, concise and unproblematic. A revised outline/structure was discussed, together with exemplars of certain parts of the requirements. CASME was tasked with leading these discussions. The following decisions were taken:

- CASME to design an exemplar PoE and share timeously with all the teachers
- All PoEs to be collected on the last day of the last workshop
- CASME tasked to assess all the PoEs

3.3.3.3 Integration of ICT

Facilitators were agreed that incorporation of GeoGebra in teaching and learning functions unlocked the abstract concepts and helped to clear any misconceptions that might arise during the training.

3.3.3.4 General

- Attendance was very good, although the Pinetown team were unable to attend because they had clashing schedules. Arrangement was made to bring them up to speed.
- Facilitators participated actively in the sessions and worked with full concentration. They were alert at all times and completed all the activities.
- The venue was convenient for the exercise.
- The facilitators enjoyed the content dealt with and the way it was presented to them.
- All recommendations and suggestions by the evaluators and facilitators were put into effect and revised material was circulated to all concerned.

3.4 Design for Science

In the first two Train-the-Trainer workshops, the attendance was good. In Workshop 3 most trainers were unable to attend the last session because of workplace committments.

Purpose of the Train-the-Trainer sessions:

- to acquaint and familiarize the trainers with the workshop manuals that they will use to train teachers
- to discuss the methodology and resources to be used to train teachers
- to deliberate and discuss how they will assist teachers to compile their PoEs

The work covered in each of the Train-the-Trainer sessions may be summarized as follows:

The training in Mathematics focused on teaching and learning of probability and functions while the Science training focused on acids and bases and organic chemistry, with particular emphasis on the Grade 10 -12 syllabus. Geogebra open-source software was used in teaching and learning of

probability and functions. ChemSketch open-source software was used for science simulations and the generating of learner tests.

The facilitators were given an introduction to ChemSketch and then went on to complete all of the activities in the facilitator's guide with the help of the master trainer, who went around and helped those who had difficulties.

In the Science session the focus was on PhET.

3.4.1 Training the Trainers Workshop 1

Workshop 1 began with a plenary session which focused on the following items:

- NECT project overview
- Background to selected topics
- Brief introduction to ICT skills
- Training on the use of Sharp calculators

Following the plenary sessions, the parallel sessions in mathematics and science commenced. The science sessions focused on:

- Unpacking of the manuals to the trainers
- ICT integration

3.4.2 Training the Trainers Workshop 2

This workshop also began with a plenary session in which the following points were discussed:

- Programme highlights
- Project reporting
- Pre-test marks and analysis

The training took place over three days and all six districts were represented. Participants included curriculum coaches and education curriculum specialists. Mr Dikgomo from DBE was present and addressed the group. A member of the MQA team was also in attendance.

This session focused on acids and bases and organic chemistry at FET level. The trainers used the pre- test to identify teacher misconceptions in relation to the topics under discussion. These then became focal points in the content coverage.

The parallel sessions followed, and discussion on teacher workshops 2 and 3 took place through unpacking of the materials. The facilitators were introduced to ChemSketch and then went on to complete all the activities in the facilitator's guide with the help of the master trainer who circulated to help those having difficulties.

3.4.3 Training the Trainers Workshop 3

In the first two train-the-trainer workshops, the attendance was good. In Workshop 3 most trainers were unable to attend the last session because of other committments.

KZN coaches were unfortunately not represented in this session. Some of the facilitators also arrived late on the first day due to logistical problems.

The objectives of the workshop were as follows:

- To discuss how pre-tests should be analysed.
- To equip trainers with workshop facilitation skills.
- To discuss Workshop 3 content (i.e. Electrodynamics) and how to incorporate ICT in teaching it.
- To discuss how trainers can guide teachers in compiling their PoEs.

3.4.3.1 Brief report on the workshop

Day 1:

- There were parallel sessions where participants discussed how pre-tests should be analysed using the guidelines circulated by NECT.
- A plenary session followed in there was an NECT presentation on presentation skills.
- The day was wrapped up with an NECT presentation on item analysis.

Day 2

- There were parallel sessions in which the two groups were given opportunity to apply the knowledge derived from pre-test analysis in analyzing a sample of teachers' pre-test scripts.
- This was followed by a discussion of teaching strategies in Electrodynamics.
- ICT skills were incorporated with Electrodynamics.
- There was a plenary session to discuss the final draft of PoE guidelines.

3.4.3.1.1 ChemSketch

ACD/ChemSketch is a powerful all-purpose chemical drawing and graphics package from ACD/Labs that enables chemists to quickly and easily:

- draw molecular structures, reactions, and schematic diagrams
- calculate chemical properties, and
- design professional reports and presentations.

Facilitators were given a systematic introduction to the software, following which they were able to complete all the software-related activities. All were confident about the ChemSketch software and keen to use in their training.

3.5 Critique and Recommendations

No objectives for the workshop were mentioned, displayed or read in either the Science or Maths training rooms. Outcomes and outputs could have been facilitated in a more mediatory way; they were also not mentioned consistently in the handouts given to the participants. This feedback was given to CASME for urgent rectification before the second training session. Facilitators needed to gauge participants' expectations and this did not happen; this was also brought to the attention of CASME.

3.5.1 Mathematics

For Mathematics Session 2, a content manual and memo guide was used which included a sequenced list of activities to be covered, but with no indication of the time to be spent on each. There was no guidance on methodologies for covering the content activities. Participants were not informed about materials and/or resources that would be needed for each activity, such as laptops,

calculators and memory sticks. In using GeoGebra to train on probability, exposure to manipulatives like dice and cards would have improved participants' understanding of GeoGebra die rolling. Shortage of laptops meant that there was insufficient time for practicing with GeoGebra.

In Session 2 the facilitation skills were poor. One example was that the facilitator sat at his desk and lectured with the help of a laptop and data projector, but effectively discouraging participation through lack of eye contact with participants. The layout of the room was also unsatisfactory, as not all participants had a good view of the displayed demonstration. There was minimal group discussion and very little interaction between participants and facilitators. Participants had very little opportunity to share prior or new knowledge. Only one of the three facilitators used the layout effectively, with participants then being eager to participate and interact.

In Session 3, a sample of the EC pre-test was displayed reflecting analysis of each question per cognitive level and level of achievement on a rating scale. A sample was used, as not all of the marking had been completed or captured (three months after the pre-test was written). The pre-test result had been intended to emphasize the methodologies and content level for the subsequent trainings. When this was queried by the MQA team it became apparent that there was uncertainty as to who should have done the marking.

The "functions" topic was presented informally, and participants failed to give full attention to the facilitator. The facilitator from CASME then repeated the presentation seated at his laptop.

3.5.2 Physical Science

Session 2 focus was on content emanating mainly from issues identified in the marking of teachers' pre-test scripts, and without a set structure or input from the participants. Coverage of content was pitched at a level that assumed that the trainees were experts in the area, which they were. Use of ChemSketch was comprehensively explored, and participants were given adequate guidance on how to use the program – as was evident in the way they enjoyed the associated activities. Other than the ChemSketch session, there was a lack of variety in presentation methodology. Some of the content covered in Session 2 would have been better dealt with through practical demonstrations. None of the activities in the manual were attempted in the session, which meant that participants had no opportunity for practical application of new learning or concepts. Participants came across as not knowing what was expected of them.

In Session 3, the second facilitator arrived at midday with the materials for the workshop, and on the second day the facilitators left the training because they had other commitments. One facilitator expressed her appreciation for the feedback given by the NECT MQA team on the structure and quality of facilitation, which, she said, led to better training delivery in Session 2. In Session 3 there was a plenary workshop on facilitation skills for adults, in response to the feedback from Session 2 of Train-the-Trainer. Unfortunately no district officials were present as they had other engagements.

3.5.3 Recommendations

- All facilitators who will be running training sessions should attend the Training-the-Trainer session so that training is standardized in all districts.
- A training session should start with registration, welcome and introductions, and participants should be given name tags.
- All participants should attend the training session from start to finish. In one of the training sessions, four of the facilitators arrived midway on day 1 and left midway on day 3. This

meant they lost a day's training, with potential detriment to their subsequent training of teachers.

- The contract with the service provider needs to be very clearly defined in regard to the specific roles and deliverables of the service provider.
- Any changes to the agenda should be communicated to participants.
- The facilitators should also complete a PoE.

4 METHODOLOGY 2: PRE-TESTS AND POST-TESTS

4.1 Introduction

Pre-testing/post-testing measures the learning received during a course by comparing what the student knew before and after the class experience. We used pre-test/post-test for the following objectives:

- to quantify the knowledge attained in the course by students with diverse learning styles and educational backgrounds
- to indicate how the students are learning in the course
- to acquire data that targets the students requiring extra help
- to identify teaching and learning methods that need to be changed or developed

4.2 Purpose and Design for Mathematics and Science

Pre-tests and post-tests were administered to quantify the knowledge attained in the course by a group of teachers with diverse learning styles and educational backgrounds. More specifically, the tests indicated how the teachers had fared, and quantified how much learning had taken place during the course.

The purpose of the pre-test is

- to measure the amount of pre-existing knowledge on the course topic
- to inform facilitators about which topics need to be covered in the course in relation to teachers' previous knowledge
- to indicate the learning level of the course topic

The purpose of the post-test is

- to measure the learning that results from the course experience
- to analyse the appropriateness of the learning objectives
- to identify teachers who still need additional help
- to target any instructional needs for improvement of the course

In addition, test items were developed for instructional purposes, for assessing effects of the educational interventions, or for educational research purposes. In-depth item analysis which is thereby made possible will be useful for a range of educational stakeholders, and especially for schools and educators. Such analysis can also evaluate the quality of every item in the test and the quality of the test as a whole. In general, the term *item analysis* refers to specific evaluations of test items for purposes of test construction or reconstruction and revision. Clearly, it is not just the outcomes and results that are important; the process of test construction must be also understood and foregrounded. For this reason, item construction in both science and mathematics should be underpinned by rigorous research so that the results obtained will be reliable and valid across years to allow for comparisons.

One key aim of these tests was to produce results at the level of individual questions that would allow diagnosis of learning and teaching problems which relate specifically to competencies in the curriculum. This kind of assessment, if understood well, can serve as a tool for effecting change in

classroom teaching and thus influence the learning of mathematics and improve teachers' pedagogical content knowledge.

The item-level results assume that there is a match between what is taught and what is assessed, but it is also important to test for more complex levels of understanding – hence the range of cognitive levels incorporated in the tests. Test developers need to avoid over-sampling from items that only assess basic/easy levels of knowledge, thereby failing to register the possibility of declining learner motivation and an inflation of marks. If, on the other hand, these tests are too difficult it could easily lead to learner frustration and lower marks. In this regard tests can be significantly improved by maintaining and developing a pool of valid items (piloting these is important) from which future tests can be drawn.

Test designers need to have appropriate criteria for balanced and equitable assessment of all learners. The selection of test items will ultimately assist teachers through the set of examples they see of how difficult a good test item should be. In most instances, a test should include items of various difficulty levels in order to distinguish between learners who are not prepared at all, who are fairly prepared, and who are well prepared. The tests should accordingly aim to avoid returning the same level of attainment for learners who did not prepare, who half-prepared and who studied exceptionally hard.

4.3 Critique and Recommendations

4.3.1 Pre-Test

4.3.1.1 Mathematics

Print quality of the pre-test was unacceptable. Graphics were poor because pixel levels had been overcompressed to reduce image size. There was no standard framework in relation to instructions and time allocation; there were questions that required calculator work but no calculators were provided and participants said they had not been told to bring calculators. There was also an error in one of the questions on the paper and the required information to complete the question was missing. In Pinetown, the time allocation was extended to 120 minutes, even though the paper stipulated 90 minutes.

4.3.1.2 Physical Science

Print quality of the pre-test was unacceptable. Graphics were poor because pixel levels had been overcompressed to reduce image size. There was no standard framework in relation to instructions and time allocation.

4.3.2 Post-Test

4.3.2.1 Mathematics

There was no indication of a timeframe on the test paper, and in Pinetown, at the end of the stipulated 90 minutes, the teachers said that they still hadn't finished, so the time was extend by another 30 minutes, giving them a total of two hours to complete the test.

4.3.2.2 Physical Science

There was inconsistency between the instructions on the question paper and what the teachers were told when they wrote the test. The pre-test instructions were simply copied and pasted to the post-test. In uThungulu teachers were more at ease when they wrote the post-test, possibly

because they had spent the previous day going over the pre-test. In in Session 3 in Eastern Cape the post-test was professionally organised. Time allocation for the test was two hours, except in uThungulu where the teachers had only 90 minutes.

4.3.3 Recommendations

- An external marker should be appointed to mark the pre-tests so that there is standardization in the marking.
- Pre-test and post-test should be moderated for standardization of test requirements in relation to content coverage per cognitive level and CAPS weighting in the topics covered in the short course.
- These steps should then be used to inform the subsequent training.
- Time frames and conditions of pre-test and post-test should be adhered to and standardised for all districts.

5 METHODOLOGY 3: Train the Teacher

5.1 Introduction

In seeking to provide a guiding model for classroom teaching of maths and science topics, the objective, rather than focusing exclusively on content knowledge, was to integrate content into a TPCK framework that included critical aspects of assessment and planning. Teacher training materials were structured to include activities that would involve participants in problem solving, group discussions and feedback to or from the larger group. Specific topics identified for maths were Euclidean Geometry, Probability, and Functions; and for science, Vertical Projectile Motion, Work Energy and Power, Electrodynamics, Organic Chemistry, and Acids & Bases.

5.2 Attendance

Table 2: Overall district attendance for mathematics and science

District	Mathematics % Attendance	Science % Attendance	% Attendance
Libode	74	69	71
Mt Frere	94	68	80
Pinetown	63	69	66
uThungulu	97	91	94
Waterberg	90	78	84
Vhembe	81	91	86
AVERAGE	83.2	77.7	80.2

Table 3: Attendance per workshop per district

District	Session / Day	Mathematics			Physical Sciences			Totals (Maths & Physics combined)		
		Expected	Actual	% Att	Expected	Actual	% Att	Expected	Actual	% Att
Libode District	Session 1: Day 1	42	37	**88%**	43	33	**77%**	85	70	**82%**
	Session 1: Day 2	42	26	**62%**	43	30	**70%**	85	56	**66%**
	Session 1: Day 3	42	26	**62%**	43	26	**60%**	85	52	**61%**
	Session 2: Day 1	42	29	**69%**	43	29	**67%**	85	58	**68%**
	Session 2: Day 2	42	30	**71%**	43	30	**70%**	85	60	**71%**
	Session 2: Day 3	42	28	**67%**	43	27	**63%**	85	55	**65%**
	Session 3: Day 1	42	36	**86%**	43	30	**70%**	85	66	**78%**
	Session 3: Day 2	42	35	**83%**	43	32	**74%**	85	67	**79%**
	Session 3: Day 3	42	31	**74%**	43	30	**70%**	85	61	**72%**
	Libode Total			**74%**			**69%**			**71%**
Mt Frere District	Session 1: Day 1	35	28	**80%**	40	18	**45%**	75	46	**61%**
	Session 1: Day 2	35	24	**69%**	40	25	**63%**	75	49	**65%**
	Session 1: Day 3	35	26	**74%**	40	13	**33%**	75	39	**52%**
	Session 2: Day 1	35	32	**91%**	40	28	**70%**	75	60	**80%**
	Session 2: Day 2	35	35	**100%**	40	30	**75%**	75	65	**87%**
	Session 2: Day 3	35	33	**94%**	40	30	**75%**	75	63	**84%**
	Session 3: Day 1	35	40	**114%**	40	35	**88%**	75	75	**100%**

	Session 3: Day 2	35	40	**114%**	40	35	**88%**	75	75	**100%**
	Session 3: Day 3	35	39	**111%**	40	31	**78%**	75	70	**93%**
	MT Frere Total			**94%**			**68%**			**80%**
Pinetown District	Session 1: Day 1	40	24	**60%**	40	24	**60%**	80	48	**60%**
	Session 1: Day 2	40	25	**63%**	40	25	**63%**	80	50	**63%**
	Session 1: Day 3	40	24	**60%**	40	23	**58%**	80	47	**59%**
	Session 2: Day 1	40	30	**75%**	40	35	**88%**	80	65	**81%**
	Session 2: Day 2	40	29	**73%**	40	34	**85%**	80	63	**79%**
	Session 2: Day 3	40	29	**73%**	40	33	**83%**	80	62	**78%**
	Session 3: Day 1	40	21	**53%**	40	26	**65%**	80	47	**59%**
	Session 3: Day 2	40	23	**58%**	40	26	**65%**	80	49	**61%**
	Session 3: Day 3	40	22	**55%**	40	24	**60%**	80	46	**58%**
	Pinetown Total			**63%**			**69%**			**66%**
Uthungulu District	Session 1: Day 1	35	33	**94%**	36	35	**97%**	71	68	**96%**
	Session 1: Day 2	35	35	**100%**	36	36	**100%**	71	71	**100%**
	Session 1: Day 3	35	35	**100%**	36	34	**94%**	71	69	**97%**
	Session 2: Day 1	35	33	**94%**	36	32	**89%**	71	65	**92%**
	Session 2: Day 2	35	34	**97%**	36	32	**89%**	71	66	**93%**
	Session 2: Day 3	35	34	**97%**	36	31	**86%**	71	65	**92%**
	Session 3: Day 1	35	33	**94%**	36	32	**89%**	71	65	**92%**
	Session 3: Day 2	35	35	**100%**	36	32	**89%**	71	67	**94%**
	Session 3: Day 3	35	33	**94%**	36	32	**89%**	71	65	**92%**

	Uthungulu Total			**97%**			**91%**			**94%**
Waterberg District	Session 1: Day 1	**45**	**30**	**67%**	**45**	**32**	**71%**	**90**	**62**	**69%**
	Session 1: Day 2	**45**	**32**	**71%**	**45**	**35**	**78%**	**90**	**67**	**74%**
	Session 1: Day 3	**45**	**32**	**71%**	**45**	**34**	**76%**	**90**	**66**	**73%**
	Session 2: Day 1	**45**	**47**	**104%**	**45**	**38**	**84%**	**90**	**85**	**94%**
	Session 2: Day 2	**45**	**47**	**104%**	**45**	**38**	**84%**	**90**	**85**	**94%**
	Session 2: Day 3	**45**	**46**	**102%**	**45**	**36**	**80%**	**90**	**82**	**91%**
	Session 3: Day 1	**45**	**44**	**98%**	**45**	**35**	**78%**	**90**	**79**	**88%**
	Session 3: Day 2	**45**	**44**	**98%**	**45**	**34**	**76%**	**90**	**78**	**87%**
	Session 3: Day 3	**45**	**44**	**98%**	**45**	**35**	**78%**	**90**	**79**	**88%**
	Waterberg Total			**90%**			**78%**			**84%**
Vhembe District	Session 1: Day 1	**45**	**37**	**82%**	**45**	**41**	**91%**	**90**	**78**	**87%**
	Session 1: Day 2	**45**	**30**	**67%**	**45**	**41**	**91%**	**90**	**71**	**79%**
	Session 1: Day 3	**45**	**29**	**64%**	**45**	**42**	**93%**	**90**	**71**	**79%**
	Session 2: Day 1	**45**	**34**	**76%**	**45**	**42**	**93%**	**90**	**76**	**84%**
	Session 2: Day 2	**45**	**36**	**80%**	**45**	**42**	**93%**	**90**	**78**	**87%**
	Session 2: Day 3	**45**	**36**	**80%**	**45**	**42**	**93%**	**90**	**78**	**87%**
	Session 3: Day 1	**45**	**43**	**96%**	**45**	**38**	**84%**	**90**	**81**	**90%**
	Session 3: Day 2	**45**	**43**	**96%**	**45**	**41**	**91%**	**90**	**84**	**93%**
	Session 3: Day 3	**45**	**41**	**91%**	**45**	**41**	**91%**	**90**	**82**	**91%**
	Vhembe Total			**81%**			**91%**			**86%**

5.3 Implementation Field Report

Table 4 provides information relating to implementation, evaluative components and methods

Table 4: Implementation strategies

Implementation domain	Evaluation components	Observation methods
Adherence	Use of policy document (CAPS)	All sessions were observed by the district officials, PILO district and NECT Curriculum Coaches and NECT Management team. M&E team observed session 2 & 3
Dosage	Nine-day short course offered in three block sessions	Original attendance registers
Quality of delivery	Quality of presentation and facilitator-participant relationship	Observations of all sessions and evaluation questions about quality of delivery were completed by the M&E, district officials and the teachers.
teacher responsiveness	Teacher satisfaction and engagement in the sessions	All teachers were given a questionnaire to evaluate the training on the last day of each block. In addition, MQA team administered a random sample of 10 at the end of block sessions 2 and 3.

5.4 Critique and Recommendations: Eastern Cape

5.4.1 Mathematics

In Session 2 the teachers from the two districts (Mt Frere and Libode) trained at the same venue and in the same room. Although the workshop was residential, the teachers from Mt Frere arrived late because they had to travel for up to two hours to reach the training venue. This affected the start time of the workshop.

The facilitators mentioned the objectives at the start of the workshop but did not refer to them again in the rest of workshop. The facilitators also made regular adjustments to the agenda but without informing the teachers. This led to some confusion during the programme as it was not always clear where the facilitators were.

The facilitators tried to gauge the teachers' expectations but met with reluctant responses and then just muddled through, with no further mention of what expectations might be of the workshop objectives. Teachers' content knowledge varied greatly, and the facilitators were not always aware of this as they mostly just stood at the front of the room using the data projector with their back to the teachers, instead of circulating among the groups. Another concern was that the facilitators spent much of the time lecturing, especially on the first day. Only one activity was given on the first day, so there was little opportunity to see whether the teachers had understood the content and

could apply it. The MQA person recommended that the facilitators use a variety of facilitations skills, and this improved over the next two days.

On the second and third day the teachers were given plenty of exercises, and especially in probability, as this was where some of them appeared to struggle. However, at report-back time there was no feedback from facilitators to the group doing the report-back, so it was never clear whether other methods could be used to get an answer or what was wrong with the method that the group had used.

The session on ICT was not done effectively as most of the teachers had not brought their laptops.

In Session 3 facilitation skills improved.

Mathematics teachers solving a probability problem

5.4.2 Physical Science

Session 2 was facilitated by four curriculum coaches and two subject advisors, with CASME present to give support. Attendance by teachers was good. The fact that teachers from the two districts were trained in the same venue created a problem with audibility and visibility, although the venue was appropriate in being able to accommodate all the teachers and facilitators.

A mop-up session for teachers who had missed Session 2 was conducted two days before Session 3.

One problem identified in both sessions was that CASME did not communicate with the facilitators. The facilitators worked together beforehand to finalize a program, and when CASME came to observe they then wanted the program to be altered to fit their own requirements.

Session 2 was very practical, giving some teachers their first opportunity to experience experiments for themselves. The equipment used (none of which was provided by CASME) came from the mobile science lab and there was concern about using the equipment in a room without windows and without the necessary safety precautions. Workshop objectives were read and discussed, showing that the feedback from Train-the-Trainer had been heeded, and the workshop was participatory from the start to finish. Teachers worked in small groups to conduct the experiments, then reported back, and the report-back gave the facilitation team an opportunity to identify and address possible teacher misconceptions.

In Session 3 there was an improvement in the time management and the session continued to be very participatory. Individual teachers able to contribute more were given a discussion platform where they could share with others. During group work the facilitators sat with the groups and gave assistance where needed, and the CASME representative who was there to monitor the session also supported the facilitators where necessary. The teachers' enthusiasm could be seen when they

asked the facilitators to demonstrate the experiments on acids and bases from Session 2. Activities concluded with a computer simulation on generation of hydro-electric power.

Teachers doing an experiment in titration in the Eastern Cape

5.4.3 Recommendations

- Teachers should be told in advance to bring their calculators and laptops.
- Training should be held closer to the district to avoid the travelling (as in the case of Mt Frere teachers who had to travel to Mthatha).
- Any changes to the agenda should be communicated to teachers.

5.5 Critique and Recommendations: KwaZulu-Natal

5.5.1 Pinetown

5.5.1.1 Mathematics

Most of the teachers thought that Session 2 was a Jika iMfundo training session and not an ETDP SETA Session. Time scheduling was not adhered to and the session was interrupted for the launch of the FET phase Jika iMfundo programme. This took up an hour and a half, which was not made up in the remaining session time. The Jika iMfundo brief was then followed by a SETA, with the ETDP SETA representative asking teachers to re-complete forms they had already completed in the first training session. The reason given was that the forms had been altered and needed to be completed again.

In the Mathematics venue, lecture-style layout was used for all three days, with ITC Skills being presented using a laptop and data projector. Software was loaded to all laptops that were present, although it failed to work on some of the laptops because the applet link was outdated. The facilitator used lecture-style methods to demonstrate the use of the software, and various examples of probability were shown using dice, probability trees, Venn diagrams, etc.

The facilitator, with the assistance of a lead teacher, tried to make sure that all instruction was in the same key. The skills and content material presented for ITC were at an appropriate level and often led to vigorous debate amongst attendees. When teachers were given an activity to do individually or in a group and then gave feedback to the rest of the group this often led to strong debate on content and methodology. On completion of individual activities the facilitator used the writing board to give solutions; plenty of time was allocated for this, and teachers often got involved in individual discussions.

5.5.1.2 Physical Science

In Session 2 the focus was on organic chemistry. Starting on time, the session began with group work, but the facilitator found it difficult to stay focused and the discussion digressed into a life-skills session on learner motivation. The session was further interrupted by a Jika iMfundo presentation which included a motivational TED Talk video. A SETA session then took place in which teachers were asked to complete forms that had not been done correctly in the Session 1 workshop. All of these activities took time which was not made up in the rest of the workshop.

The ICT session had been expected to happen later in the day but because of problems with the software and the other disruptions the ICT facilitator was unavailable and the session was therefore moved to the following day by swapping the sessions for day 1 and day 2. The participants were notified as this took place.

On day 2 the participants were rushed through activities on worksheets 1 to 5. This part of the session had been scheduled for two hours but was completed in 45 minutes. In the ICT session which was supposed to start after tea, the ICT facilitator failed to arrive so the facilitator from the organic chemistry session tried to do the facilitation in his place. This replacement facilitator had some difficulty using the software but teachers familiar with the software were fortunately able to assist. On both days the training ended before the allocated time on the agenda.

In Session 3, the facilitator did not always accept the recommendations made by the teachers, which tended to make them feel excluded. The lead teacher who was supposed to help present the session did not arrive, so the facilitator who presented the first session was left to do the training for the entire period. There were difficulties where the facilitator struggled with organic chemistry and ended up lecturing to teachers who did not really understand the information and failed to engage with the content. Because of the way the programme unfolded, the facilitator omitted acids and bases, explaining that he hadn't done the initial training. Two experiments were demonstrated to the full group, and this caused problems because teachers had difficulty seeing what was being done. The acid and bases session was the most productive because the facilitator was very competent in this area, but it would have been more practical for the experiments to have been done in two sessions. No objectives or outcomes were mentioned during the workshop.

None of the manuals were used in Session 3. The initial focus was on the pre-test and past question papers were then gone over with the facilitator, doing remediation of the paper rather than error analysis. The topics focused on were mechanics and electrodynamics, and although there was an ITC section on the agenda it was not covered at all.

Teachers being exposed to an electromagnetic experiment

5.5.1.3 Recommendations:

- The training should be made a practical as possible, with the teachers able to do experiments where necessary.
- It is important to adhere to the time frames on the agenda.
- Facilitators should not be expected to train for all three days on their own and this would be avoided if other facilitators had attended training of the trainer. A better co-facilitation plan should be in place.
- Content areas that teachers are struggling with should be given more time.
- Participants were from CASME, and district-level ownership of the training was lacking. Subject advisors should be encouraged to lead the training sessions as this would establish their authority in knowledge of the subject content.
- Software should be tested and tried before workshop.
- Any changes to the agenda should be communicated to teachers.

5.5.2 UThungulu

5.5.2.1 Mathematics

Session 2 began with 12 teachers and ended up with 33. Overall, the workshop adhered to the proposed time schedule for the three days. The overall purpose or goal of the workshop was mentioned to the teachers on the first day but there was no subsequent reference to it in the remainder of the workshop.

The facilitator did mention each day what the teachers were going to do but he did not try to relate this to the purpose or goal of the workshop. The facilitator asked the teachers to write down their expectations but did not take it further by asking them to share these expectations.

Plenty of activities were included, but despite there being sufficient materials for all the teachers, the facilitator failed to make the most of the resources. There was only a single facilitator presenting, and in the course of the session teachers were telling the facilitator how to write things on the board. The curriculum specialist attended for part of the session.

Teachers solving a mathematical problem

In Session 3, 19 of the 34 participants were female. Traditional “cinema” or “classroom” style (best used for short lectures to large groups) was not ideal for a workshop and using this style meant that communication tended to be one-way; it was mainly during feedback presentations that teachers interacted with the facilitator. The facilitator tried to circulate along the side aisle but restricted space made this difficult; power supply was also a problem because of awkwardly located power points. Despite these difficulties, teachers were actively involved in the session and used many of the

activities to add to their PoE; the programme was also amended in consultation with the teachers to provide more time for support of the PoE. The training session ended on a high, with submission of 33 out of of 34 PoEs submitted, and teachers were confident and positive when they sat for the post-test.

5.5.2.2 Physical Science

Session 2 training did not start on time as the teachers and facilitators were late. When the facilitators arrived they went straight into the session without doing registration. The required number of participants had not been met and it was decided not to replace them. As the weekend progressed some teachers also left early. Mr Moodley, from the district, visited the session to check attendance and other logistic matters and motivated for a continuation of the programme.

The facilitator made no mention of objectives or outcomes at any point during the three-day training session, despite previous recommendation to CASME that the objective for each session and the expected outcome to be achieved should be specified.

The workshop agenda was followed closely but very little reference was made to the participants' manual. A number of activities from the manual were completed but when definitions were required the facilitator never referred participants to the manual. Instead, definitions were requested from the teachers. Each person gave their own definition, and these were corrected, but no final definition was ever given or arrived at, even though definitions were provided in the manual which the facilitator could have referred the teachers to.

The teachers found ChemSketch interesting and enjoyed using it to explore acids and bases

In Session 3 attendance was poor and those who were present did not attend consistently. It was, however, encouraging to see that two-thirds of the participants were female. Mr Moodley from the district visited the session to motivate the teachers.

Participants caused continuous disruptions over which the facilitator had no control. The teachers who attended admitted that they had a content gap and said that the workshop was very beneficial for them, but it was unfortunate that not a single experiment was conducted during the workshop. The facilitator did ask two of the teachers to illustrate the use of PhET for simulations and this showed the other teachers that they too could master the skills; misconceptions around the PhET

were ironed out by the Maths facilitator. It is recommended that simulations be used as a substitute for practicals and experiments.

There was some anxiety about PoEs, which most teachers had not completed. At least 16 PoEs were handed in by the end of the session and the facilitator checked that they met the minimum requirements before accepting them. Both teacher and facilitator signed on submission of PoE, and those who failed to submit had to make a commitment to submit by the middle of the following week. To ensure timeous submission of comprehensive and high calibre PoEs it is suggested that facilitators provide structured guidelines for PoEs at the beginning of the training programme and check on milestones at every session.

Despite repeated feedback, the facilitator failed to arrange for black markers to use on the flip chart. This would have enabled teachers' answers in activities to be put up on the wall for further reference, each group having answered different questions.

Teachers engrossed in a practical exercise

5.5.2.3 Recommendations

- Facilitators should have the objectives of the course written up, and these objectives should be referred to during the workshop.
- To clear up any misunderstanding, teachers' expectations should be gauged before the workshop starts.
- Any changes to the agenda should be communicated to participants.
- Facilitators should always have flip chart markers and white board markers at hand.

5.5.3 Waterberg

5.5.3.1 Mathematics

Although the scheduled starting time for Session 2 was 12h00, day 1 began at 12h33. Forty-eight teachers had been expected but only 31 turned up. On day 2, arrangements were made for teachers who had not written the pre-test to do so during the session, which meant that they lost out on 90 minutes of the programme. The three-day programme handed out on day 1 outlined the sessions, but there was no agenda on day 3. In Session 2 there was a shortage of materials, and no materials were distributed at the start of the workshop.

The first day was mostly an introductory session which gave a background to the training and how it would be applicable to teachers' classroom practice. A point that particularly captured the teachers' attention was emphasis on how learners learn. The facilitators used Plickers software as a visual

teaching aid which enabled the teachers to interact with the content area and which showed how learner participation could be tracked. The beetle game and probability counting were briefly mentioned, but no activities were done around these. The time scheduled for ICT integration was compromised due to an excess of content and problems with software installation. Facilitation style differed from one facilitator to another. Some interacted easily with the teachers while others struggled to engage with them. The facilitators felt that all of them should have been invited to Train-the-Trainer, which only one facilitator from Waterberg had attended.

In Session 3, an ETDP SETA official was present to oversee the final registration of the participants. A program for the session was only available on soft copy, because it had not been printed out ahead of the workshop. A printer was accordingly set up to print various outstanding documents for use in the course of the session. The programme was read out and later put up for teachers to see, and printed copies arrived at 13h30. The session was temporarily held at an alternative venue because the venue that would have normally been used was already occupied by group from the Department of Health. Both venues provided suitable accommodation for training.

Although the facilitators had rearranged the venue from a module set-up to a traditional lecture-room set-up to accommodate the test writing, norms and standards for a testing environment were not adhered to. There was no time keeping. The test was scheduled to start at 10h00 but began at 10h40. The test was set for 90 minutes, but the last participant submitted her test at 13h35, which was 25 minutes after it was supposed to have been completed.

5.5.3.2 Science

In Session 2, only one person had attended Train-the-Trainer and the facilitators felt this was unfair. The single facilitator lectured to the teachers without participation from the teachers.

The facilitator did ask some of the teachers to demonstrate certain ICT sections, and this worked well because it allowed the teachers to feel involved and be seen and heard and gave encouragement to the others. The facilitators were always punctual on all three days. One of the subject advisors presented each day, which also worked well because the presenter was very passionate about her subject and very knowledgeable, heightening teachers' interest in the subject. The facilitator who had not attended any of the ToT sessions used lecturing methods and relied heavily on whole-group discussions. As a result there was a lot of noise and a few teachers dominated the session. The ICT section went very well as this topic was new to teachers and they saw its value as a tool in their teaching/learning environment. The facilitator for ICT used the manual effectively and referenced it to all the teachers.

The teachers were very interested in the district official's Acids and Bases presentation and took copious notes. The district official promised to share the presentation with all the teachers.

Session 3 began late due to late arrivals. Teachers were given an agenda that covered only two of the three days. The training venue could have been larger, and the session was interrupted after lunch by an unplanned SACE session which lasted for an hour and had not been taken into account in in the facilitator's scheduled presentation. This time was not made up.

The facilitators mainly used lecture style, but on day 1 there was also active group participation in an experiment. For many teachers this was the first time they had physically experienced making a

generator, although the facilitators could have mediated better by guiding the teachers when there was a problem. Because day 1 started late and there was the additional presentation, the program had to be adjusted and this was not explained to the teachers, making it difficult for them to keep track of the agenda. The planning and assessment session could have been more interactional, instaed of simply being lectured by the facilitator. Overall, the facilitation process could have been improved, since in many instances the teachers had their own side meetings and continuously moved in and out of the venue. The PhET software was not presented effectively due to time constraints, and should have had an extended session rather than just 30 minutes.

5.5.3.3 Recommendation:

- All participants should have name tags.
- The software should be distributed the day before, or time made to install the software before the start of the programme.
- The introductory session on day 1 was very long, lasting approximately an hour and 45 minutes. Facilitators should consider a formal time keeping mechanism.
- Only activities included in Train-the-Trainer should be presented.
- The agenda contained a diagnostic report feedback session on the 2015 NSC with special reference to probabilities, and a probability section was also reflected on the agenda. To avoid repetition and redundancy the agenda should not duplicate sessions, and items of this kind should instead be handled in unison.
- Facilitators must assist one another where problems occur.
- Additional pre-tests should to be done at the end of a day's training instead of during the training session.
- Sufficient time should be allocated for ICT, as the skills being taught are unfamiliar for most teachers.

5.5.4 Vhembe

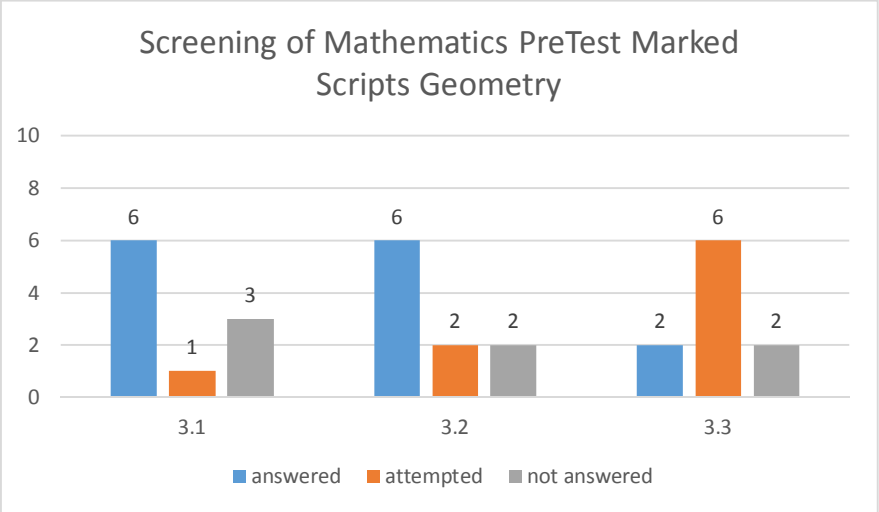
5.5.4.1 Mathematics

In Session 1 there were four apologies during roll call: one from DBE and three from teachers who would join on the Saturday because of a clash with another project. The purpose of the course was explained by a facilitator from CASME.

Attendance was fairly good; 41 teachers were present and confirmed that they had been informed in advance about the workshop. However, the workshop only began at 14h30, due to lack of planning and miscommunications in which teachers had not all been given the same starting time for the workshop.

As this was Session 1 in Vhembe, a pre-test was included to establish where participant stood and to highlight areas that needed more attention. It was emphasized to the teachers that this was not being done to discredit their work or their knowledge in any way. Problems encountered with the pre-test were that many of the teachers did not have calculators and some were uncomfortable with writing their names on the tests.

Figure 1: Screening of Mathematics pre-test marked scripts



Lecture method was used to demonstrate the use of software, and only one example of triangle theorems and one example of circle theorems were included. The facilitator did not make sure that all participants were on the same key instructionally, and merely asked them whether they were on track. Often teachers were so engrossed in carrying out instruction 1 that they failed to register other verbal guidance. Although ITC Skills was covered in Session 1 only, geometry content featured in all three sessions. Not all activities in the manual were undertaken, and the principal focus was theorems and activity questions for grades 10, 11 and 12.

The geometry activities selected followed an initial feedback on pre-test marked scripts. The teachers were not really able to relate as they did not have their marked scripts or the question paper on hand, so the facilitator simply spoke about the findings. Teachers were given an activity to do individually or as a group, followed by feedback to the class. Plenty of time was allocated for this activity, which allowed teachers to have individual discussions on task completion.

Session 2 lost a lot of time because of a late start. There was no mention of either objectives or outcomes, making it difficult to know whether what had been prepared by the facilitators corresponded the learners' expectations. Teachers were asked to write down their expectations and their papers were then simply collected with no further discussion.

The subsequent sessions dealt mainly with content, done in group work with feedback sessions

Teachers did a recap of the 17 (ICT) skills that had been briefly introduced in the first session. The facilitators then suggested that those who had mastered the skills should go help those who were still struggling.

Session 3 opened with registration, followed by lunch. The plenary began at 14h00 with introductions and welcomes. NECT PM Nathi and DSM for Vhembe addressed the teachers and welcomed NECT and CASME. Program for the weekend and time frames were mentioned as follows:

- PoE submission time 09h00 to 09h45, Sunday (day 3)
- Post-test at 09h45 on day 3 – duration 90 minutes

- Day 2: start 08h00; times adjusted to give additional time for PoE support
- Day 2: Departmental official Mr Baloye (Head of Curriculum) to attend part of day 2.

The timetable adjustments were done in consultation with the teachers.

Workshop objectives and outcomes were not mentioned. On day 2 there was another session of GeoGebra, recapping Graphs and GeoGebra terminologies by navigating in the application. Day 3: no objectives mentioned; program began with PoE support and submission, followed by writing of post-test.

The facilitator from CASME mainly used group work as a facilitation style, and began with definitions. The group work was followed by a feedback and questions session that gave rise to good debate. Participants were given clarification and closure on the questions they posed. The facilitator was able to deliver the full day 1 programme with enough time to induct participants in the use of GeoGebra by doing revision, through demonstration and presentation, of the ICT skills covered in Sessions 1 and 2. The teachers were actively involved and questions were addressed, although many teachers were without their laptops on day 1. On day 2 there were demonstrations of Functions and Trigonometry in GeoGebra, incorporating practice and observation. Teachers who were more proficient in GeoGebra gave support to their colleagues. The facilitator made every effort to pace the GeoGebra skills session so that all teachers were on track, and gave acknowledgement to teachers for initiative in their use of GeoGebra.

The curriculum support coaches and the district department official also circulated among participants to give support and assistance. Time management was good, considering the content that needed to be covered. Facilitators emphasised differentiated teaching and rectifying gaps instead of just skipping past them; they also shared possible suggestions on how to improve performance in functions and trigonometry and encouraged participants to share their practices

5.5.4.2 Science

No content was covered in Session 1 because the teachers were writing a test. Question papers were handed out without any communication with the participants, which meant that no cut-off time was stipulated for the test. Many of the teachers used their cell phones as calculators as they had not been told to bring calculators. On day 2 teachers felt bewildered and overwhelmed, getting restless because the facilitator kept moving on to a new section while some of them were still trying to make sense of the previous section. The facilitator assumed that the teachers had basic IT skills, whereas many of them did not have the Java or ChemSketch software on their computers. This led to teachers moving around the class trying to install the software while others were sharing laptops, creating noisy confusion which the facilitator struggled to control.

At the end of the day the facilitator confidently declared that the teachers had learned 17 skills – which most had in fact either not attempted or not effectively mastered. On day 3, although participation was good, there was insufficient time for the teachers to cover the section on vertical projectile motion. Teachers were put into pairs to do the activity included in the guide and had to compile a memorandum for the questions asked. Time was given to complete the exercise and teachers were then randomly selected to come to the front of the class and give the answer on the board. Not all the questions were dealt with, and the facilitator did not indicate whether the answers were correct or incorrect.

5.6 MQA Observations of the Science Pre-Test Papers

The Science pre-test sample result reflected a mixture of good and bad marks, but the general performance across ten scripts was fair.

Table 5: Science pre-test content domain reflections

Question number	Topic	Performance reflected
1	Vertical projectile motion	adequately
2	Graphs of motion	struggled
3	Work, energy and power	struggled
4	Electricity and magnetism	adequately

Attendance for Session 2 remained at 45 and the workshop began at 14h00 instead of 11h00. Time management improved on the subsequent days. The session began with a recap of ICT skills from Session 1, which left little time for Organic Chemistry. The recap reflected only 50% mastery and was a problem in that not all teachers had brought their laptops. The presentation on ChemSketch was rushed, making it difficult for teachers to keep up. The session was not well structured, with facilitators in and out of class attending to other tasks and no curriculum support coaches to assist. Although there was a balance of activities, feedback sessions were not well managed because teachers were given no indication of correctness or error. Most of the content covered, apart from ChemSketch, did allow for interactive participation by teachers.

Experiments were done by demonstration, and participants were attentive, using it as an opportunity to complete the PoE. ChemSketch was again used, but with no improvement as there was still an assumption that teachers had mastered the ICT skills. The facilitators lacked confidence in content presentation, seldom responding to questions and often simply passing the questions back to the teachers. The district official gave continuous motivational commentary.

In Session 3, 40 teachers participated. Starting time was scheduled for 12h00, but was delayed until 15h00 due to logistical issues. The venue had one small problem in that the lighting was very dim. Specific, measureable and achievable objectives and outcomes for the session were mentioned in passing by the facilitator.

Most of the lessons included in the session were based on ICT skills using Plickers and Chemsketch, with revision, using demonstations, of previous training in the use of ChemSketch.

Activities were restricted because poor internet access meant that the section on Plickers had to be suspended and the late start to the day meant that ChemSketch activities were rushed and cut short. Some teachers did manage to keep up with the pace but most found this too difficult.

The facilitator was knowledgeable about content, and when the network connection deteriorated he used his phone instead to show certain concepts. The network problem significantly affected the training objectives, making it doubtful whether the teachers had understood the session and would be able to apply things on their own.

Throughout the session some teachers continued to do their own things, causing confusion and making it hard for the facilitator to cope. He tended to focus on teachers who understood the material and ignore those who didn't, unless explicitly stopped by the teachers and asked to start

over again, causing him to get quite impatient with some of the teachers. The post-test was written on day 3.

5.6.1 Recommendations

- The programme agenda should state objectives and outcomes along with participants' expectations.
- Facilitators should practice and master the ICT skills before presenting.
- All facilitators should be present to circulate and help teachers when ICT skills are being demonstrated.
- Affirmation should be given to teachers when they do feedback sessions.
- More experiments could be done to ensure mastery.
- Curriculum coaches who are selected to give support need to know and master the work that the facilitators will be doing with the teachers, and circulate among the teachers to support the facilitator during the ICT presentation.
- Venues for training should have appropriate network coverage.

6 QUANTITATIVE DATA ANALYSIS

6.1 Introduction

This chapter covers analysis of the pre-test and comparative analysis for pre- and post-tests, focussing on achievement levels, content domain levels, and item analysis for both mathematics and science.

The purpose of this quantitative analysis is to show as clearly as possible the state of mathematics and science through a rigorous baseline. The first part of analysis provides detailed coverage of the pre-test outcomes. The following section provides a general overview of the post-test results. This is followed by a district analysis comparing pre-and post-test results, but emphasizing what has shifted.

Additionally, we provide the F-ratio statistical descriptor which indicates whether the shift in results can be attributed to our intervention or is merely a chance improvement. F-value is a measure of how different the means are relative to the variability within each sample (i.e. level of difference in teachers' knowledge before and after the intervention). F-value is thus a measure of the size of the effect. If, for example, the F-ratio is 8.080491 and the F-critical is 4.351244, the fact that the F-ratio is greater than F-critical makes it more likely that the differences between the means are due to something other than chance alone. When the F-ratio is greater than the F-critical we can assume that the training intervention played a significant role in the percentages shift from pre-test to post-test.

6.2 Data Collection, Data Capture and Marking

Data Collection: The pre-tests were administered on day 1 and collected by representatives of CASME and/or NECT Curriculum Coaches. Collecting, marking and capturing the mathematics and science tests was done by CASME for KZN and EC, and by the NECT Curriculum Coaches for Limpopo.

The initial plan was to mark these scripts on day 1 and then provide some feedback to the teachers by making use of the results in a formative assessment approach on day 2. In the event, this put too much pressure on the already overloaded facilitators, and the marking was done after the conclusion of Workshop 1.

Data Capture: Each script and every test item was captured. It was decided that the "no attempt" category would receive a "0" instead of a coded "99". All districts were captured in exactly the same way.

Marking: A memorandum was provided and alternative methods/approaches were included for completeness.

6.3 Pre-Test Analysis

6.3.1 Mathematics

6.3.1.1 Achievement levels

Table 6: Achievement levels for Mathematics pre-test

District	29 and less %	30 -39 %	40 - 49 %	50 - 59 %	60 - 69 %	70 - 79 %	80 & above %	total Students
Waterberg	21	8	5	5	5	3	1	48
Vhembe	10	11	6	5	2			34
Libode	10	5	5	4	1	4		29
Mt Frere	16	2	2					20
Pinetown	10	4	0	3	2	3		22
uThungulu	17	6	6	3	3			35
TOTAL	84	36	24	20	13	10	1	188
Average %	44.7	19.1	12.8	10.6	6.9	5.3	0.5	100.0

- 44.7% of teachers scored less than 30%
- 76.6% of teachers scored less than 50%
- 1 teacher scored greater than 80%
- 11 teachers out of 188 (only 5.8%) scored above 70%
- All 20 Mt Frere teachers scored less than 50%
- Waterberg: 34 out of 48 teachers (70.8%) scored less than 50 %
- Vhembe: 27 out of 34 teachers (79.4%) scored less than 50%
- Libode: 20 out of 29 teachers (68.9%) scored less than 50%
- Pinetown: 14 out of 22 teachers (63.6%) scored less than 50%
- uThungulu: 29 out of 35 teachers (82.8%) scored less than 50%
- The pre-test results were extremely low: item analysis showed that many items received a zero score and most items scored less than 50% on average per district.
- The section on Functions was the best performing topic domain, with Probability and Geometry receiving equally low scores.

6.3.1.2 *Content domain analysis*

Table 7: Content domain analysis for Mathematics pre-test

District	Probability (max 31)		Functions (max 37)		Geometry (max 34)		Average %
	Ave score	Probability average %	Ave score	Function average %	Ave score	Geometry average %	Average %
Waterberg	7.5	24.30%	15.5	42%	13.8	40.70%	35.70%
Vhembe	7.4	23.70%	17.1	46.10%	12.2	35.90%	35.20%
Libode	9	29.20%	13.8	37.30%	10.8	31.80%	32.80%
Mt Frere	4.1	13.40%	8.3	22.40%	5.5	16.20%	17.30%
Pinetown	10.1	32.60%	15.7	42.40%	10.9	32%	35.70%
uThungulu	7.3	23.60%	13.9	37.70%	12.6	37.10%	32.80%
mean score	7.6	24.5%	14.1	37.90%	11	32.30%	31.60%

- On average, all content domain areas had achievement below 40%.
- Mt Frere results are particularly concerning.
- None of the districts had an average above 50%.
- Only Waterberg scored above 40% average for Geometry, while only Vhembe and Pinetown scored above 40% average for Functions.
- It is clear that our teachers are not teaching Probability, with all districts scoring below 33% average.

6.3.1.3 Item analysis

Probability

Table 8: Item analysis for Probability in pre-test

Item	Skill/Sub skill/Learning objective	Max.	samp 22	samp 26	samp 14		samp 48	samp 34
			Pinetown	Libode	Mt Frere	Uthungulu	Waterberg	Vhembe
1.1	Identify and solve probability problems involving independent events.	4	1.0	0.7	0.0	0.9	0.9	0.4
1.2.1	Using contingency tables as an aid to solve probability problems.	2	1.0	0.9	0.2	1.0	1.0	0.4
1.2.2	Using contingency tables as an aid to solve probability problems.	2	0.4	0.7	0.2	0.7	0.5	0.5
1.3.1	Identify and solve probability problem involving mutually exclusive events.	2	1.2	1.2	1.2	1.3	1.1	1.3
1.3.2	Identify and solve probability problems involving independent events.	2	0.8	0.6	0.9	0.6	0.6	0.6
1.4.1	Using tree diagram as an aid to solve probability problems.	4	1.9	1.6	0.2	0.8	1.4	1.1
1.4.2	Using tree diagram as an aid to solve probability problems.	2	0.8	0.7	0.5	0.3	0.6	0.8
1.4.3	Using tree diagram as an aid to solve probability problems.	2	0.6	0.5	0.1	0.2	0.0	0.0
1.5	Identify and solve probability problem involving dependent events.	3	0.1	0.6	0.0	0.1	0.4	0.6
1.6.1	Apply the fundamental counting principle to solve probability problems.	1	0.5	0.4	0.2	0.3	0.4	0.4

1.6.2	Apply the fundamental counting principle to solve probability problems.	3	0.9	0.5	0.1	0.5	0.2	0.4
1.7.1	Apply the fundamental counting principle to solve probability problems.	2	0.2	0.4	0.4	0.4	0.3	0.6
1.7.2	Apply the fundamental counting principle to solve probability problems.	2	0.9	0.3	0.1	0.2	0.2	0.4
		31	10.2	9.0	4.1	7.3	7.5	7.4

- The key observation here is that on almost all the items the average was below 50% across all six districts
- Even test items regarded as easy fell short of maximum mark on average.

Functions

Table 9: Item analysis for Functions in pre-test

items	Skill/Sub skill/Learning objective	max	Pinetown	Libode	Mt Frere	Uthungulu	Waterberg	Vhembe
2.1	application of quadratic equation	7	1.3	0.3	0.5	0.5	0.8	0.8
2.2.1	basic trig graph	1	1.0	0.8	0.9	0.7	0.8	0.7
2.2.2	basic trig graph	1	1.0	0.9	0.9	0.9	0.8	0.9
2.2.3	basic trig graph	1	0.9	0.9	0.9	1.0	0.9	0.9
2.2.4	basic trig graph	1	0.9	0.9	0.6	0.9	0.9	0.9
2.2.5	applications of trig graphs	2	1.3	1.2	0.4	0.6	1.3	1.2
2.3.1	interpreting trig graphs	4	1.4	1.3	0.9	1.1	1.5	2.0
2.3.2	interpreting trig graphs	2	0.8	0.7	0.4	0.6	0.7	0.9
2.4.1	Determine and sketch graphs of the inverses of the functions defined by:	1	0.6	0.6	0.3	0.7	0.6	0.6

2.4.2	Determine and sketch graphs of the inverses of the functions defined by:	1	0.7	0.7	0.3	0.7	0.8	0.9
2.5.1	Determine and sketch graphs of the inverses of the functions defined by:	1	0.6	1.0	0.4	0.9	0.9	1.0
2.5.2	determining the equation of exp function	1	1.0	0.7	0.3	0.7	0.8	0.9
2.5.3	sketching graphs of the inverses of the functions defined by:	3	1.4	1.8	1.1	1.6	1.8	2.1
2.6.1	sketching graphs of the inverses of the functions defined by:	4	0.4	0.4	0.1	0.8	0.6	1.0
2.7.1	determining equation of cubic function	4	1.5	0.7	0.2	1.2	1.4	1.2
2.7.2	application of cubic functions	3	1.4	1.1	0.2	1.2	0.9	1.1
		37.0	**16.0**	**13.8**	**8.3**	**13.9**	**15.5**	**17.1**

- Scores were slightly better than for Probability, but low test-item scores remain a concern since this is not a new topic in CAPS.

Euclidean Geometry

Table 10: Item analysis for Euclidean Geometry

items	Skill/Sub skill/Learning objective	max	pinetown	Libode	Mt Frere	Uthungulu	Waterberg	Vhembe
3.1	optimisation	7	2.6	2.8	1.6	2.3	2.9	2.6
3.2.1	application of geometry riders	6	3.7	3.6	1.5	4.4	4.3	4.4
3.2.2	riders	2	0.8	1.0	0.7	1.3	0.9	1.2
3.2.3	riders	4	0.9	1.0	0.3	1.3	0.7	1.2
3.3.1	riders	4	1.5	1.1	0.6	1.6	2.0	1.4
3.3.2	riders	3	0.9	0.2	0.3	0.6	1.1	0.6
3.3.3	riders	3	0.5	0.6	0.4	0.5	0.9	0.5
3.3.4	riders	2	0.3	0.2	0.1	0.2	0.6	0.1

3.3.5	riders	3	0.1	0.2	0.1	0.3	0.5	0.3
		34.0	**11.1**	**10.8**	**5.5**	**12.6**	**13.8**	**12.2**

- Euclidean Geometry is still a concern, with low test-item averages across all districts.
- Waterberg teachers exceeded the 40% average.

6.3.2 Physical Science

6.3.2.1 Achievement levels

Table 11: Achievement levels for Science pre-test

District	29 and less %	30 -39 %	40 - 49 %	50 - 59 %	60 - 69 %	70 - 79 %	80 & above %	total Students
Waterberg	20	11	6	3	4			**44**
Vhembe	10	11	5	3	4	6	1	**40**
Libode	18	2	5	3	4	2	1	**35**
Mt Frere	20	2	1	3	5	4	1	**36**
Pinetown	2	2	1	4	5	5	6	**25**
uThungulu	10	5	6	4	4	5	2	**36**
TOTALS	**80**	**33**	**24**	**20**	**26**	**22**	**11**	**216**
Average %	**37.0**	**15.3**	**11.1**	**9.3**	**12.0**	**10.2**	**5.1**	**100.0**

- 37% of teachers scored less than 30%
- 63.4% of teachers scored less than 50%
- 11 teachers scored above 80%
- 33 teachers of 216 scored above 70% or only 15.2% of teachers scored above 70%
- Mt Frere: 23 out of 36 teachers (63.9%) scored less than 50%
- Waterberg: 37 out of 44 teachers (84%) scored less than 50 %
- Vhembe: 26 out of 40 teachers (65%) scored less than 50%
- Libode: 25 out of 35 teachers (71.4%) scored less than 50%
- Pinetown: 5 out of 25 teachers (20%) scored less than 50% - the best performing district in Science
- uThungulu: 21 out of 36 teachers (58.3%) scored less than 50%
- As with the Mathematics results, the Science pre-test results were extremely low. Item analysis showed that many items received a zero score, and for most items average score was less than 50%. per district
- The section on Acids & Bases was the worst performing topic domain, with Electrodynamics showing the best scores.

6.3.2.2 Content domain analysis

Table 12: Content domain analysis for Science pre-test

District	Vertical Projectile Motion		Work, Energy, Power		Elecro-dynamics		Organic Chemistry		Acids and Bases		
	Ave score	VPM Ave %	Ave score	WEP Ave %	Ave score	ED Ave %	Ave score	OC Ave %	Ave score	AB Ave %	AVE %
Waterberg	7.4	24.7	1.9	16.9	6.3	37.0	11.4	43.9	4.2	23.5	31.2
Vhembe	11.2	37.4	3.0	26.8	8.8	51.6	14.4	55.2	6.6	36.8	43.9
Libode	10.8	36.1	3.9	35.3	6.5	38.2	9.9	38.1	2.0	11.0	33.1
Mt Frere	8.3	27.5	3.6	32.3	8.4	49.2	8.1	31.1	4.2	23.1	32.4
Pinetown	19.3	64.3	6.4	57.9	11.4	67.3	17.3	66.7	9.0	50.2	63.5
uThungulu	10.8	35.8	4.3	39.4	8.4	49.5	13.4	51.7	8.4	46.9	45.4
Means	**11.3**	**37.6**	**3.8**	**34.8**	**8.3**	**48.8**	**12.4**	**47.8**	**5.7**	**31.9**	**41.6**

- All content domains showed below 50% averages.
- Electrodynamics showed the best average at 48.8%, followed by Organic Chemistry.

6.3.2.3 Item analysis

Vertical Projectile Motion and Work, Energy and Power

Table 13: Item analysis for VPM and WEP for the pre-test

Question	CONTENT TOPIC	Skill / subskill (Process skills)	Max. points	Waterberg	Vhembe	Libode	Mt Frere	Pinetown	Uthungulu
1.1	Vertical Projectile Motion	Recall	1	0.8	0.8	0.7	0.6	0.9	0.8
1.2	Vertical Projectile Motion	Comprehension	4	2.3	3.2	2.4	0.6	3.0	3.1
2.1	Graphs of motion	Application	2	0.6	0.4	0.6	0.7	1.4	0.6
2.2	Graphs of motion	Application & Analysis	5	0.3	1.2	1.5	0.7	2.6	1.1
2.3	Graphs of motion	Analysis	1	0.3	0.5	0.5	0.5	0.6	0.5
2.4	Graphs of motion	Application & Analysis	4	1.2	1.2	1.3	1.3	2.2	1.4
2.5	Graphs of motion	Application & Analysis	5	0.6	1.5	0.8	1.0	2.2	1.0
2.6.1	Graphs of motion	Analyze information & draw	5	0.4	1.3	1.9	1.6	3.7	1.0
2.6.2	Graphs of motion	Analyze information & draw	3	0.9	1.2	1.1	1.3	2.6	1.3
			30	**7.4**	**11.2**	**10.8**	**8.3**	**19.3**	**10.8**
3.1	Work, Energy & Power	Recall	2	1.2	1.2	1.1	0.9	1.8	1.5

3.2	Work, Energy & Power	Analyze information & calculate	6	0.5	1.175	2.1	1.7	3.3	1.9
3.3	Work, Energy & Power	Analyze information & calculate	3	0.3	0.575	0.7	0.9	1.3	0.9
			11	**1.9**	**3.0**	**3.9**	**3.6**	**6.4**	**4.3**

- Only Pinetown scored above 50% for VPM and for WEP.
- Waterberg scored only 1.9 out of 11 points, despite some easy items.

ELETRO-DYNAMICS

Table 14: Item analysis for Electrodynamics for pre-test

Question	CONTENT TOPIC	Skill or subskill (Process skills)	maximum points	Waterberg	Vhembe	Libode	Mt Frere	Pinetown	Uthungulu
4.1	Electrodynamics	Recall	2	1.0	1.3	1.4	1.6	2.0	1.5
4.2	Electrodynamics	Comparison	2	0.0	0.8	1.0	1.2	1.6	1.4
4.3	Electrodynamics	Comprehension	3	1.6	1.8	1.3	1.6	2.0	1.2
4.4.1	Electrodynamics	Recall	2	0.5	0.7	0.4	0.8	0.7	0.4
4.4.2	Electrodynamics	Application	1	0.2	0.5	0.3	0.3	0.7	0.4
4.5.1	Electrodynamics	Recall	2	1.0	1.1	0.7	1.2	1.7	1.4
4.5.2	Electrodynamics	Recall	1	0.3	0.7	0.2	0.1	0.4	0.4
4.5.3	Electrodynamics	Analysis	2	1.2	1.1	0.8	0.9	1.6	0.9
4.5.4	Electrodynamics	Analysis	2	0.5	0.8	0.4	0.7	0.7	0.8
			17	**6.3**	**8.8**	**6.5**	**8.4**	**11.4**	**8.4**

- Characterized by higher averages, with four districts scoring 50% or above

Organic Chemistry and Acids & Bases

Table 15: Item analysis for Organic Chemistry and Acids & Bases

Ques	Content topic	Skill or subskill (process skills)	Max points	Waterberg	Vhembe	Libode	Mt Frere	Pinetown	uThungulu
5.1	Organic molecules (nomenclature)	Recall	1	0.3	0.4	0.6	0.2	0.4	0.3
5.2.1	Organic molecules (reactions)	Recall	1	0.8	0.75	0.6	0.4	0.9	0.9
5.2.2	Organic molecules (structures)	Comprehension	2	1.0	1.15	0.9	0.8	1.6	1.1
5.3.1	Organic molecules (reactions)	Recall	1	0.5	0.85	0.5	0.5	0.9	0.6
5.3.2	Organic molecules (reactions)	Recall	1	0.6	0.575	0.4	0.3	0.9	0.6
5.4.1	Organic molecules (classification)	Recall	1	0.5	0.725	0.6	0.5	0.9	0.8
5.4.2	Organic molecules (structure)	Recall	1	0.6	0.8	0.5	0.5	1.0	0.6
5.4.3	Organic molecules (reactions)	Recall	1	0.7	0.85	0.5	0.4	0.9	0.8

Ques	Content topic	Skill or subskill (process skills)	Max points	Water berg	Vhembe	Libode	Mt Frere	Pinetown	uThungulu
5.5.1	Organic molecules (reactions)	Application	1	0.4	0.525	0.3	0.3	0.6	0.4
5.5.2	Organic molecules (reactions)	Analysis	2	0.4	0.35	0.3	0.4	0.6	0.6
5.5.3	Organic molecules (reactions)	Application	3	0.5	1.525	0.6	0.7	1.9	0.9
6.1	Organic molecules (physical properties)	Analysis	1	0.8	0.775	0.5	0.4	1.0	0.8
6.2	Organic molecules (physical properties)	Recognize patterns & trends	2	1.2	1.075	1.1	0.5	1.2	0.9
6.3.1	Organic molecules (physical properties)	Identify variables	1	0.4	0.65	0.5	0.3	0.8	0.5
6.3.2	Organic molecules (physical properties)	Identify variables	1	0.7	0.8	0.5	0.4	0.7	0.5
6.4	Organic molecules (physical properties)	Recall	1	0.5	0.525	0.4	0.3	0.8	0.6
6.5	Organic molecules (physical properties)	Comparison, Evaluate and synthesize	1	0.5	0.775	0.5	0.3	0.7	0.5
6.6	Organic molecules (physical properties)	Recall	4	1.1	1.25	0.7	0.8	1.6	1.9
			26	**11.4**	**14.4**	**9.9**	**8.1**	**17.4**	**13.4**
7.1	Acids & Bases	Recall	1	0.7	0.7	0.2	0.4	1.0	0.7
7.2	Acids & Bases	Recall	1	0.7	0.8	0.3	0.4	1.1	0.9
7.3	Acids & Bases	Analyze and calculate	2	1.2	1.3	0.5	0.6	1.6	1.2
7.4.1	Acids & Bases	Analyze, evaluate & calculate	4	1.0	1.4	0.7	0.8	2.3	2.1
7.4.2	Acids & Bases	Application	5	0.5	1.4	0.2	0.4	1.8	2.3
7.5	Acids & Bases		3	0.0	1.2	0.0	0.7	0.7	1.2
			16	**4.2**	**6.6**	**2.0**	**3.3**	**8.4**	**8.4**

- Characterized by low test-item averages
- Only Pinetown scored above 50% for both these sections
- EC averages very low: well below 50% for all test items

6.4 Pre- and Post-test Results Compared

6.4.1 Overview: Mathematics

Table 16: Post-test Achievement Analysis per district

District	below 29%	30%-39%	40%-49%	50%-59%	60%-69%	70%-79%	above 80%	Sample
Pinetown POST	4	2	4	2	3	1	3	19
uThungulu POST	3	4	6	8	5	4	2	32
Vhembe POST	7	10	4	7	6	3	4	41

Waterberg POST	6	4	7	4	5	7	5	38
Libode POST	3	4	6	6	2	6	2	29
Mt Frere POST	16	3	3	4	6	2		34
Total	39	27	30	31	27	23	16	193
Average	20.2	14.0	15.5	16.1	14.0	11.9	8.3	100.0

Table 17: Comparing achievement levels in pre- and post-test

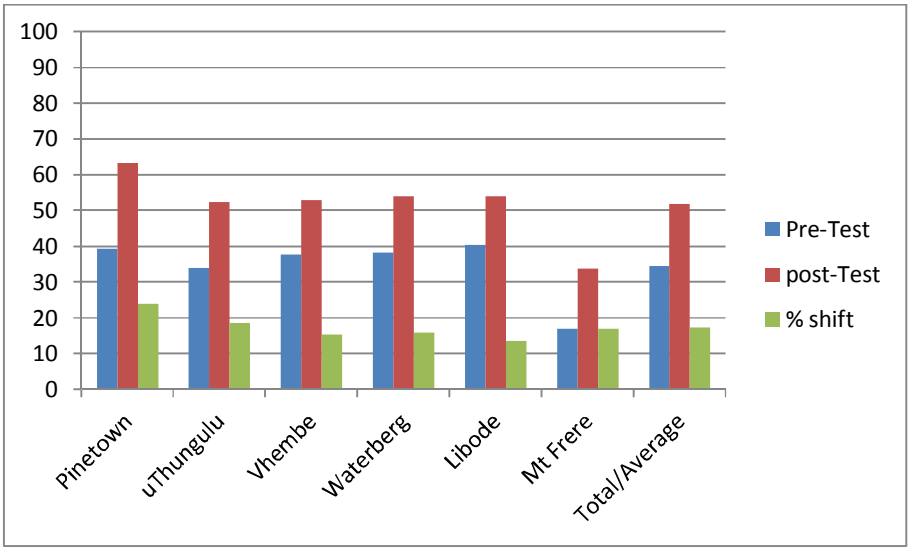
TESTS	below 29%	30%-39%	40%-49%	50%-59%	60%-69%	70%-79%	above 80%	Sample
Pre-TOTAL	84	36	24	20	13	10	1	188
Pre-Average %	44.7	19.1	12.8	10.6	6.9	5.3	0.5	100
Post-Total	39	27	30	31	27	23	16	193
Post Average %	20.2	14.0	15.5	16.1	14.0	11.9	8.3	100

- 188 teachers wrote the pre-test and 193 wrote the post-test.
- 151 teachers wrote both pre-test and post-test. The projected number of teachers for the project was 250 for Mathematics, the registered number of teachers for Mathematics was 232, meaning that only 151 of 232 wrote both tests, a percentage of 65%.
- 76.6% of teachers scored below 50% for the pre-test, which subsequently improved to 49.7% of teachers. This is still a substantial number of teachers who are performing well below the expected standard.
- It is encouraging to see the increase at the top achievement levels where 20.2% scored above 70% compared with only 5.8% for the pre-test.
- The 39 teachers who scored above 70% should be recognised as being on the journey to become the district's appointed Lead teachers. However, much work must still be done to improve the skills level of these teachers.
- At the bottom end of the achievement levels more work must be done for these teachers who displayed massive content deficiencies.

Table 18: District shifts in pre- and post-test

District	total	Pre-Test	post-Test	% shift
Pinetown	11	39.3	63.2	23.9
uThungulu	32	33.9	52.5	18.6
Vhembe	27	37.6	52.9	15.3
Waterberg	38	38.2	53.9	15.7
Libode	29	40.3	53.9	13.6
Mt Frere	14	16.9	33.8	16.9
Total/Average	**151**	**34.4**	**51.7**	**17.3**

Figure 2: District percentage shifts in pre- and post-test



- All Districts displayed significant shifts, with an average of 17.3%.
- Pinetown improved by the biggest percentage shift, while Libode improved by the smallest percentage shift.

Table 19: F-ratio and F-critical scores per district

	F-ratio	F-critical
Pine town	8.080491	4.351244
uThungulu	20.00393	3.995887.
vhembe	9.001478	4.026631.
Waterberg	9.194402	3.97023.
libode	7.674403	4.01
Mt Frere	6.67	4.23

- The F-ratio is 8.080491 and the F-critical is 4.351244. Since the F-ratio is greater than F-critical, the likelihood is that the differences between the means are due to something other than chance alone.
- Since the F-ratio scores for all districts are greater than the F-critical we can assume that the nine-day ETDP SETA Short Course was beneficial and contributed to the improvements evidenced in the positive shifts from pre-test scores.

6.4.2 Overview: Science

Table 20: Post-test achievement analysis per district

Districts	Below 29%	30% - 39%	40%-49%	50%-59%	60%-69%	70%-79%	above 80%	Sample
PinetPOST		1		5	2	8	7	23
UTHUNGPOST	2	1	4	6	4	5	8	**30**
Vhembe POST	3	4	13	6	6	3	6	**41**
Waterberg POST	5	8	3	6	7	4	2	**35**
Libode POST	10	0	3	6	1	3	7	**30**
Mt Frere POST	8	3	5	8	2	6	1	**33**
Total	**28**	**17**	**28**	**37**	**22**	**29**	**31**	**192**
Average	**14.6**	**8.9**	**14.6**	**19.3**	**11.5**	**15.1**	**16.1**	**100.0**

Table 21: Comparing achievement levels in pre- and post-tests

TESTS	Below 29%	30% - 39%	40%-49%	50%-59%	60%-69%	70%-79%	above 80%	Sample
Pre-TOTAL	80	33	24	20	26	22	11	216
Pre-Average %	37.0	15.3	11.1	9.3	12.0	10.2	5.1	100.0
Post-Total	28	17	28	37	22	29	31	192
Post Average %	14.6	8.9	14.6	19.3	11.5	15.1	16.1	100.0

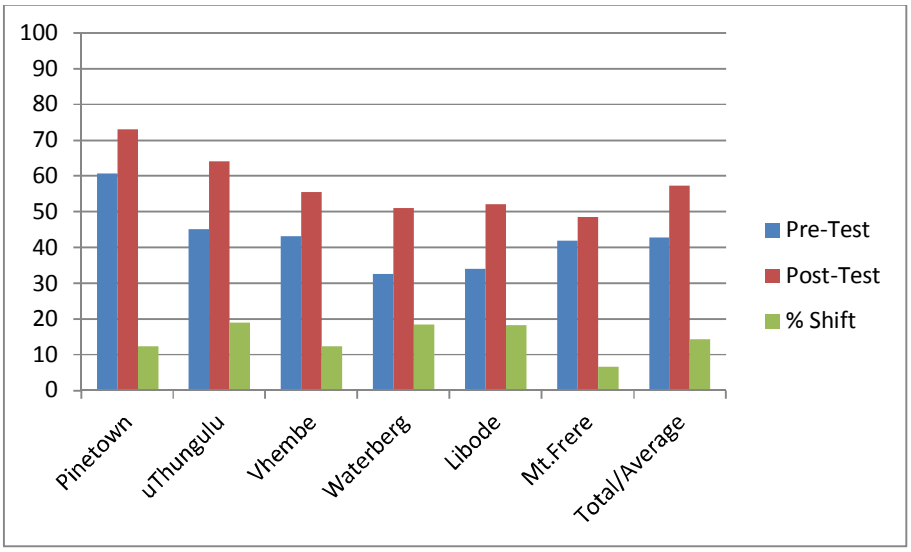
- 216 teachers wrote the pre-test and 192 wrote the post-test.
- 169 teachers wrote both pre-test and post-test. The projected number of teachers for the project was 250 for Science and the registered number of teachers for Science was 219, which means that only 169 of 219 (77%) wrote both tests.
- 63.4% of teachers scored less than 50% for the pre-test, which improved in the post-test to 38.1% of teachers. This is still a substantial number of teachers performing well below the expected standard.
- It is encouraging to see the increase at the top achievement levels, where 31.2% scored above 70% compared with only 15.3% for the pre-test.
- The 60 teachers who scored above 70% should be recognised as being on track to becoming district-appointed Lead teachers. However, much work must still be done to improve the skills level of these teachers.
- At the bottom end of the achievement levels more work must be done for teachers who displayed massive content deficiencies.

Table 22: District shifts in pre- and post-test

District	total	Pre-Test	post-Test	% shift
Pinetown	14	60.7	73	12.3
uThungulu	30	45	64	19
Vhembe	37	43.1	55.5	12.4

Waterberg	35	32.6	51	18.4
Libode	30	33.9	52.1	18.2
Mt Frere	23	41.9	48.5	6.6
Total/Average	169	42.9	57.4	14.5

Figure 3: District percentage shifts in pre- and post-test



- All districts showed significant shifts, with an average shift of 14.5%.
- uThungulu improved by the biggest percentage shift, while Mt Frere improved by the smallest percentage shift.

Table 23: F-ratio and F-critical scores per district

	F-ratio	F-critical
Pine town	3.59997	4.2252
uThungulu	11.92673	4.006873
Vhembe	7.788993	3.973897
Waterberg	18.24342	3.981896
Libode	7.39	4.01
Mt Frere	0.730554	4.061706

- The F-ratio is 8.080491 and the F-critical is 4.351244. Since the F-ratio is greater than F-critical, the likelihood is that the differences between the means are due to something other than chance alone.
- Since four of the F-ratio scores for the districts are greater than the F-critical we can assume that the nine-day ETDP SETA Short Course was beneficial and contributed to the improvements evidenced in the positive shifts from pre-test scores in uThungulu, Vhembe, Waterberg and Libode.
- Pinetown and Mt Frere had F-ratio scores that were less than F-critical, suggesting that improvements from the pre-test could be the result of chance.

6.4.3 Mathematics

6.4.3.1 Pinetown Analysis

- 22 teachers wrote the pre-test and 19 teachers wrote the post-test.
- Only 11 teachers wrote both pre-test and post-test.

Table 24: Pre- and post-test achievement levels

	Below 29%	30% - 39%	40%- 49%	50%- 59%	60%- 69%	70%- 79%	above 80%	Sample
Pinetown PRE	10	4	0	3	2	3	0	**22**
Pinetown POST	4	2	4	2	3	1	3	**19**

Table 25: Pinetown teachers: pre- and post-tests and percentage shift

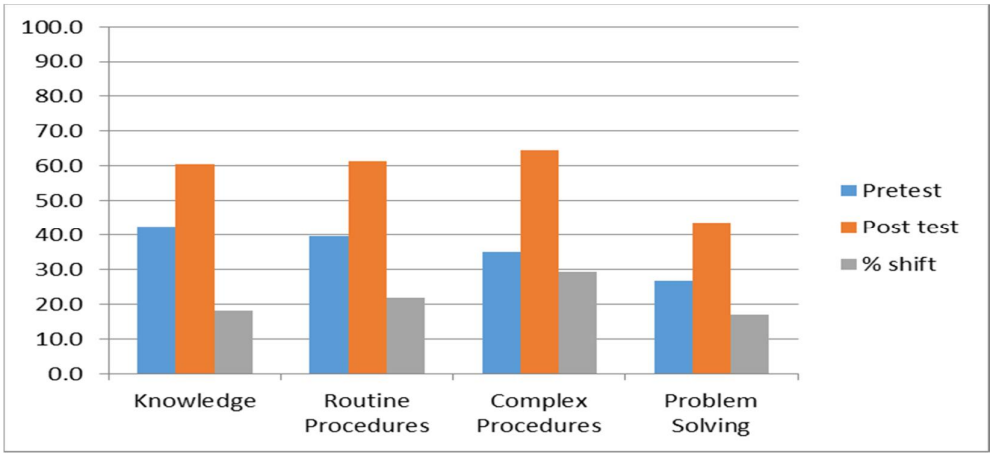
	Pre-Test	post-Test	% shift
Teacher 1	19	42	**23**
Teacher 2	35	59	**24**
Teacher 3	72	91	**19**
Teacher 4	61	69	**8**
Teacher 5	29	45	**16**
Teacher 6	63	84	**21**
Teacher 7	12	36	**24**
Teacher 8	33	51	**18**
Teacher 9	35	60	**25**
Teacher 10	56	87	**31**
Teacher 11	17	71	**54**
Average	**39.3**	**63.2**	**23.9**

- The F-ratio is 8.080491 and the F-critical is 4.351244. Since the F-ratio is greater than F-critical, the likelihood is that the differences between the means are due to something other than chance alone.

Table 26: Pinetown teachers: percentage shifts in cognitive levels

Cognitive levels	Pre-test	Post-test	% shift
Knowledge	**42.4**	**60.6**	**18.2**
Routine Procedures	**39.6**	**61.5**	**21.9**
Complex Procedures	**35.0**	**64.4**	**29.4**
Problem Solving	**26.6**	**43.5**	**16.9**

Figure 4: Pinetown teachers: percentage shifts in cognitive levels

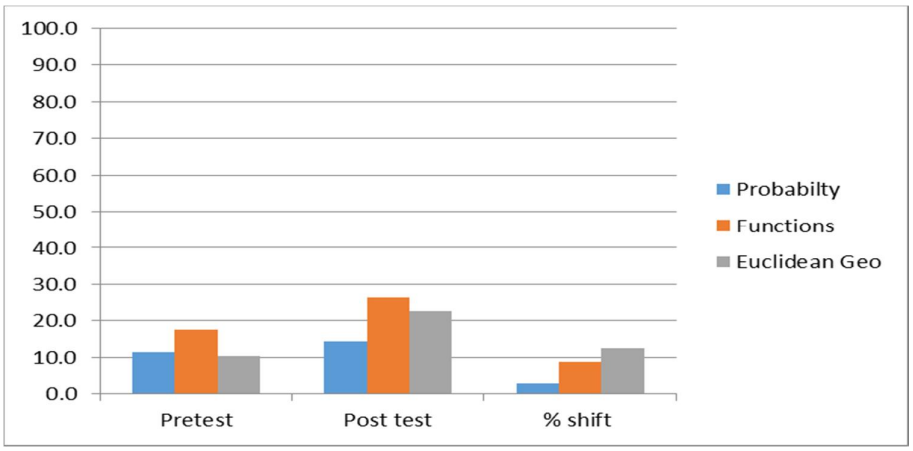


- There was a noticeable improvement in performance across the cognitive levels. Biggest improvement was in complex procedures, which is an indication that the teachers have mastered some of the skills shared in the training sessions. Problem solving is still a challenge for the majority of teachers.

Table 27: Pinetown teachers: percentage shifts in content domains

Content levels	Pre-test	Post-test	% shift
Probability	**11.5**	**14.3**	**2.8**
Functions	**17.5**	**26.3**	**8.7**
Euclidean Geo	**10.3**	**22.6**	**12.4**

Figure 5: Pinetown teachers: percentage shifts in content domains



- Majority of teachers are still battling with the concept of probability (% shift 2.8).

6.4.3.2 uThungulu Analysis

- 35 teachers wrote the pre-test and 32 teachers wrote the post-test.
- Only 32 teachers wrote both pre- and post-test.

Table 28: UThungulu teachers: pre and post-test achievement levels

District	29 and less %	30 -39 %	40 - 49 %	50 - 59 %	60 - 69 %	70 - 79 %	80 & above %	sample
UThungulu PRE	17	6	6	3	3	0	0	**35**
UThungulu POST	3	4	6	8	5	4	2	**32**

Table 29: uThungulu teachers: pre- and post-tests, and percentage shift

Surname	Pre-test	post-test	% shift
Teacher 1	69	80	11
Teacher 2	22	37	15
Teacher 3	26	60	34
Teacher 4	64	76	12
Teacher 5	23	58	35
Teacher 6	33	58	25
Teacher 7	46	50	4
Teacher 8	52	72	20
Teacher 9	40	31	-9
Teacher 10	39	55	16
Teacher 11	22	43	21
Teacher 12	16	71	55
Teacher 13	24	78	54
Teacher 14	24	21	-3
Teacher 15	42	60	18
Teacher 16	14	63	49
Teacher 17	38	58	20
Teacher 18	26	20	-6
Teacher 19	22	54	32
Teacher 20	47	68	21
Teacher 21	34	42	8
Teacher 22	41	51	10
Teacher 23	38	67	29
Teacher 24	26	15	-11
Teacher 25	42	55	13
Teacher 26	63	85	22
Teacher 27	26	39	13
Teacher 28	56	48	-8
Teacher 29	28	44	16
Teacher 30	21	45	24
Teacher 31	13	45	32
Teacher 32	8	31	23
Average	**33.9**	**52.5**	**18.6**

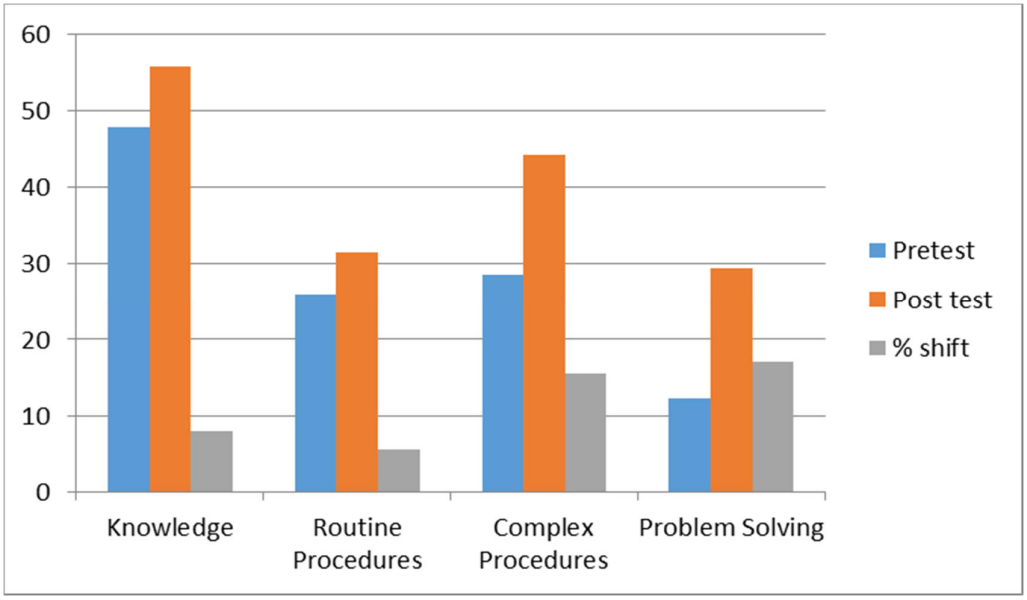
- If we exclude the four negative shift scores then the positive shifts average is 22.3. Three of the teachers with a negative shift are in the under 29% category: their level of mathematics is at the heart of the matter. Despite nine days of mathematics they showed no progress, and in fact performed worse.

- The F-ratio is 20.00393 and the F-critical is 3.995887. Since the F-ratio is greater than F-critical, the likelihood is that the differences between the means are due to something other than chance alone.

Table 30: uThungulu teachers: percentage shifts in cognitive levels

Cognitive levels	Pre-test	Post-test	% shift
Knowledge	47.9	55.8	7.9
Routine procedures	26	31.5	5.5
Complex procedures	28.6	44.2	15.6
Problem solving	12.3	29.4	17.1

Figure 6: uThungulu teachers: percentage shifts in cognitive levels

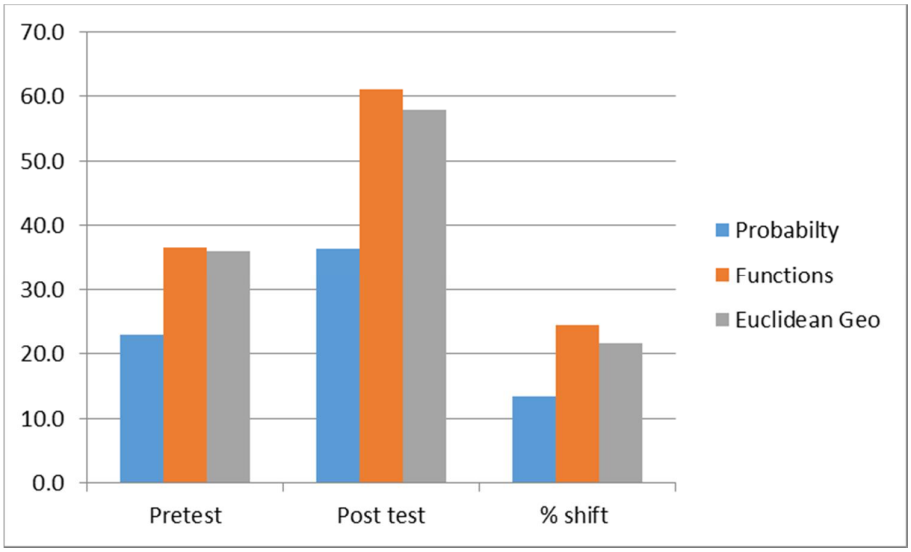


- There was a noticeable improvement in performance across the cognitive levels. Biggest improvement was in complex procedures, which is an indication that the teachers have mastered some of the skills shared in the training sessions. Problem solving showed a fairly good shift.

Table 31: uThungulu teachers: percentage shifts in content domains

Content levels	Pre-test	Post-test	% shift
Probability	22.9	36.4	13.4
Functions	36.6	61.1	24.5
Euclidean Geometry	36.1	57.8	21.7

Figure 7: uThungulu teachers: percentage shifts in content domains



- Majority of teachers are still battling with the concept of probability. Larger shifts in geometry and functions.

6.4.3.3 Vhembe

- 34 teachers wrote the pre-test and 41 teachers wrote the post-test.
- Only 28 teachers wrote both pre-test and post-test.

Table 32: Vhembe teachers: pre- and post-test achievement levels

District	29 and less %	30 -39 %	40 - 49 %	50 - 59 %	60 - 69 %	70 - 79 %	80 & above %	sample
Vhembe PRE	10	11	6	5	2	0	0	**34**
Vhembe POST	7	10	4	7	6	3	4	**41**

- Only a slight improvement at the lower end, with 21 teachers scoring below 50% in the post-test compared with 27 in the pre-test. It should be noted, though, that only 28 wrote both pre-test and post-test.

Table 33: Vhembe teachers: pre- and post-tests and percentage shift

Teacher	Pre-test	Post-test	% shift
Teacher 1	65	88	23
Teacher 2	69	84	15
Teacher 3	53	82	29
Teacher 4	54	81	27
Teacher 5	48	76	28
Teacher 6	55	76	21
Teacher 7	44	70	26

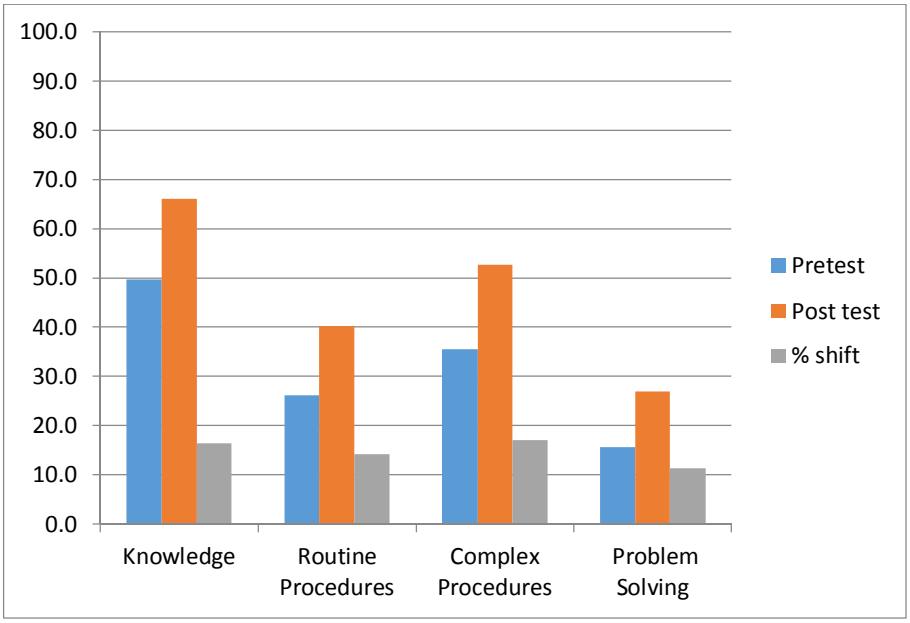
Teacher 8	51	69	18
Teacher 9	31	67	36
Teacher 10	26	66	40
Teacher 11	59	65	6
Teacher 12	46	61	15
Teacher 13	30	56	26
Teacher 14	32	55	23
Teacher 15	37	52	15
Teacher 16	21	46	25
Teacher 17	34	41	7
Teacher 18	21	39	18
Teacher 19	27	36	9
Teacher 20	34	35	1
Teacher 21	22	33	11
Teacher 22	37	33	-4
Teacher 23	36	32	-4
Teacher 24	30	29	-1
Teacher 25	17	22	5
Teacher 26	18	20	2
Teacher 27	18	14	-4
Average	**37.6**	**52.9**	**15.3**

- If we exclude the four negative shift scores then the positive shifts average is 18.5.
- In general there was a substantial shift, with 11 teachers improving by more than 20%. One teacher improved by 40%.
- The F-ratio is 9.001478 and the F-critical is 4.026631. Since the F-ratio is greater than F-critical, the likelihood is that the differences between the means are due to something other than chance alone.

Table 34: Vhembe teachers: percentage shifts in cognitive levels

Cognitive levels	Pre test	Post-test	% shift
Knowledge	49.7	66.0	16.4
Routine procedures	26.1	40.2	14.1
Complex procedures	35.5	52.6	17.1
Problem solving	15.6	27.0	11.4

Figure 8: Vhembe teachers: percentage shifts in cognitive levels

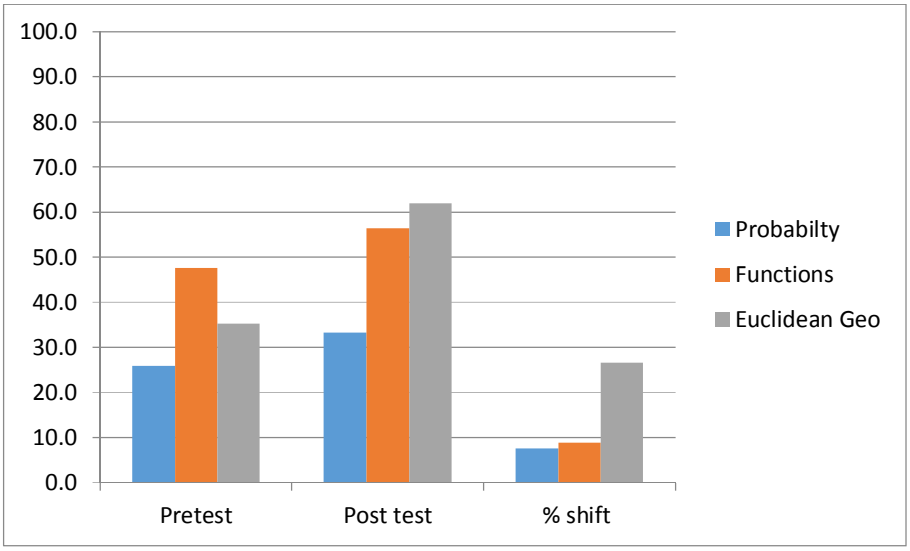


- There was a noticeable improvement in performance across the cognitive levels. Biggest improvement was in complex procedures, which is an indication that the teachers have mastered some of the skills shared during the training sessions. Problem solving showed a fairly good shift.

Table 35: Vhembe teachers: percentage shifts in content domains

Content levels	Pre-test	Post-test	% shift
Probability	25.8	33.3	7.5
Functions	47.6	56.4	8.7
Euclidean Geometry	35.2	61.9	26.7

Figure 9: Vhembe teachers: percentage shifts in content domains



- The biggest shift was in geometry, which is encouraging since geometry is not taught well in the majority of schools.
- Minor shifts in the other two content domains are a positive sign that teachers gained some knowledge from the short course.

6.4.3.4 Waterberg

- 48 teachers wrote the pre-test and 38 teachers wrote the post-test.
- Only 38 teachers wrote both pre-test and post-test.

Table 36: Waterberg teachers: pre and post-test achievement levels

District	29 and less %	30 -39 %	40 - 49 %	50 - 59 %	60 - 69 %	70 - 79 %	80 & above %	sample
Waterberg PRE	21	8	5	5	5	3	1	**48**
Waterberg POST	6	4	7	4	5	7	5	**38**

Table 37: Waterberg teachers: pre- and post-tests and percentage shift

Teacher	Pre-test%	Post-test%	% shift
Teacher 1	40.6	58.0	17.4
Teacher 2	24.0	77.0	53.0
Teacher 3	5.0	50.0	45.0
Teacher 4	30.4	21.0	-9.4
Teacher 5	58.7	84.0	25.3
Teacher 6	57.8	47.0	-10.8
Teacher 7	58.4	75.0	16.6
Teacher 8	37.5	51.0	13.5
Teacher 9	33.4	51.0	17.6
Teacher 10	22.1	44.0	21.9
Teacher 11	17.1	44.0	26.9

Teacher	Pre-test%	Post-test%	% shift
Teacher 12	2.0	5.0	3.0
Teacher 13	8.1	14.0	5.9
Teacher 14	66.7	87.0	20.3
Teacher 15	60.5	79.0	18.5
Teacher 16	30.4	72.0	41.6
Teacher 17	23.3	29.0	5.7
Teacher 18	27.4	46.0	18.6
Teacher 19	19.1	46.0	26.9
Teacher 20	67.9	76.0	8.1
Teacher 21	11.0	33.0	22.0
Teacher 22	70.7	86.0	15.3
Teacher 23	42.7	64.0	21.3
Teacher 24	5.0	14.0	9.0
Teacher 25	28.3	72.0	43.7
Teacher 26	44.7	61.0	16.3
Teacher 27	28.2	64.0	35.8
Teacher 28	15.1	19.0	3.9
Teacher 29	91.0	88.0	-3.0
Teacher 30	54.8	46.0	-8.8
Teacher 31	58.5	65.0	6.5
Teacher 32	35.6	38.0	2.4
Teacher 33	31.4	45.0	13.6
Teacher 34	28.4	37.0	8.6
Teacher 35	79.9	89.0	9.1
Teacher 36	49.4	64.0	14.6
Teacher 37	26.2	36.0	9.8
Teacher 38	60.9	71.0	10.1
Average	**38.2**	**53.9**	**15.7**

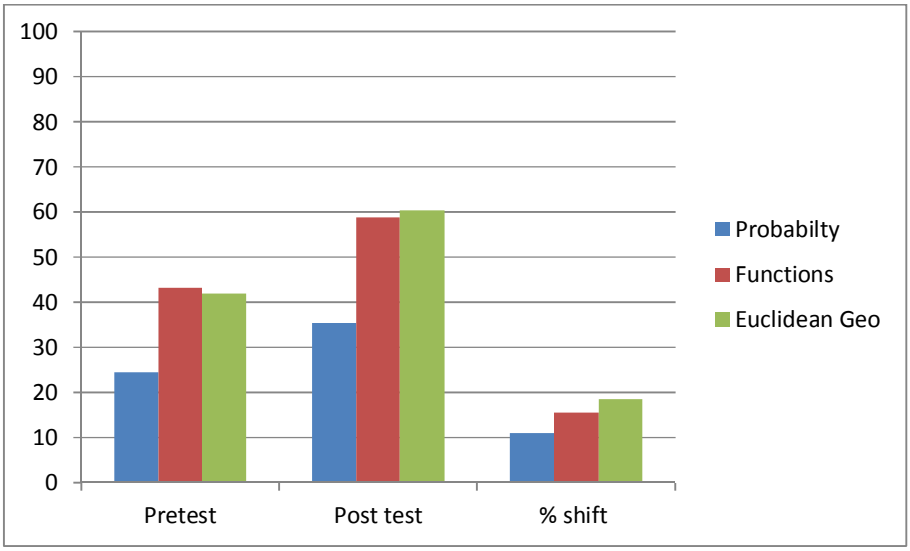
- If we exclude the four negative shift scores then the positive shifts average is 18.5. These negative shifts were all less than 10% except for one with a 10.8 negative shift.

- The F-ratio is 9.194402 and the F-critical is 3.97023. Since the F-ratio is greater than F-critical, the likelihood is that the differences between the means are due to something other than chance alone.

Table 38: Waterberg teachers: percentage shifts in content domains

Content levels	Pre-test	Post-test	% shift
Probability	24.5	35.5	11
Functions	43.2	58.8	15.6
Euclidean Geometry	41.9	60.4	18.5

Figure 10: Waterberg teachers: percentage shifts in content domains



- Majority of teachers are still battling with the concept of probability seen by the smallest percentage improvement. Larger shifts in geometry and functions.

6.4.3.5 Libode

- 29 teachers wrote the pre-test and 29 teachers wrote the post-test.
- All 29 teachers wrote both pre-test and post-test.

Table 39: Libode teachers: pre- and post-test achievement levels

District	29 and less %	30 -39 %	40 - 49 %	50 - 59 %	60 - 69 %	70 - 79 %	80 & above %	sample
Libode PRE	10	5	5	4	1	4	0	**29**
Libode POST	3	4	6	6	2	6	2	**29**

- Substantial improvement: 20 teachers scored less than 50% in the pre-test compared with 13 in the post-test, but only 3 scored less than 30 % in the post-test.
- 8 teachers scored above 70% in the post-test compared with 4 in the pre-test.

Table 40: Libode teachers: pre- and post-tests and percentage shift

Teacher	Pre-test	Post-test	% shift
Teacher 1	49	85	36
Teacher 2	77	80	3
Teacher 3	48	75	27
Teacher 4	70	75	5
Teacher 5	72	75	3
Teacher 6	34	73	39
Teacher 7	70	73	3
Teacher 8	52	71	19
Teacher 9	15	69	54

Teacher	Pre-test	Post-test	% shift
Teacher 10	32	67	35
Teacher 11	12	59	47
Teacher 12	38	58	20
Teacher 13	27	57	30
Teacher 14	27	56	29
Teacher 15	63	55	-8
Teacher 16	50	54	4
Teacher 17	46	48	2
Teacher 18	26	48	22
Teacher 19	42	47	5
Teacher 20	56	46	-10
Teacher 21	40	45	5
Teacher 22	26	44	18
Teacher 23	29	39	10
Teacher 24	56	35	-21
Teacher 25	26	34	8
Teacher 26	36	30	-6
Teacher 27	31	27	-4
Teacher 28	9	20	11
Teacher 29	11	19	8
Average	**40.3**	**53.9**	**13.6**

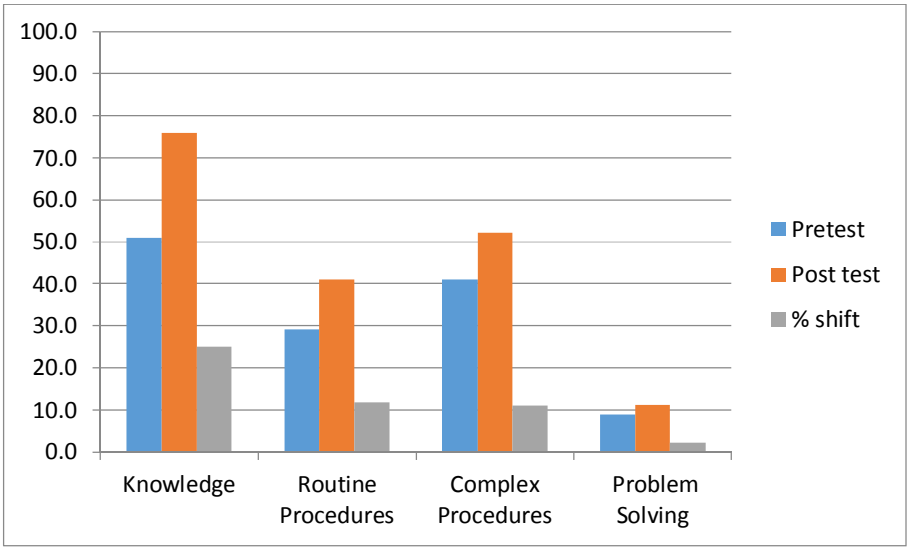
- If we exclude the five negative shift scores then the positive shifts average is 18.5. One teacher with a 21% negative shift is a concern.

- The F-ratio is 7.674403 and the F-critical is 4.01. Since the F-ratio is greater than F-critical, the likelihood is that the differences between the means are due to something other than chance alone.

Table 41: Libode teachers: percentage shifts in cognitive levels

Cognitive levels	Pre-test	Post- test	% shift
Knowledge	50.9	75.9	25.0
Routine Procedures	29.1	41.1	11.9
Complex Procedures	41.1	52.1	11.1
Problem Solving	8.9	11.1	2.2

Figure 11: Libode teachers: percentage shifts in cognitive levels

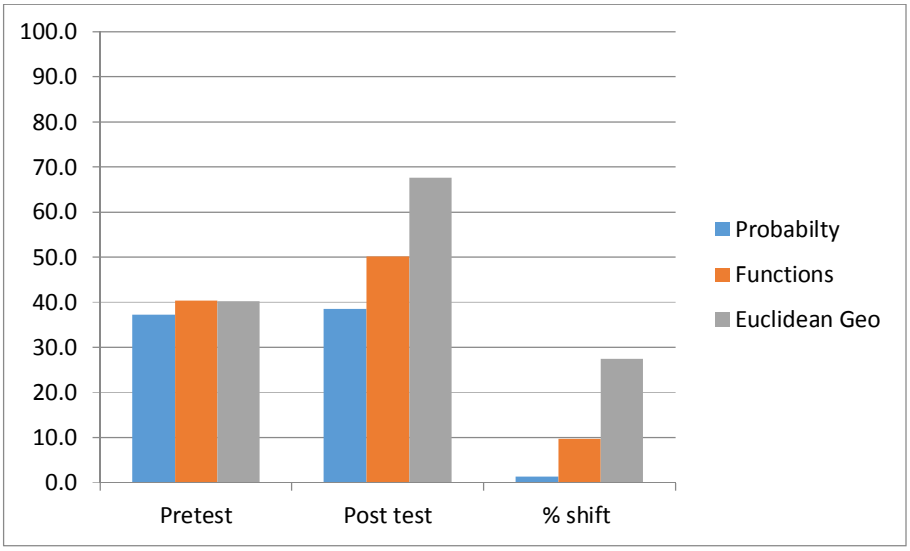


- There was a noticeable improvement in performance across the cognitive levels. Biggest improvement was in knowledge, which is an indication that the teachers have mastered some of the skills shared during the training sessions. Problem solving showed a fairly good shift.

Table 42: Libode teachers: percentage shifts in content domains

Content levels	Pre-test	Post-test	% shift
Probability	37.2	38.5	1.3
Functions	40.4	50.1	9.7
Euclidean Geometry	40.3	67.6	27.4

Figure 12: Libode teachers: percentage shifts in content domains



- Majority of teachers are still battling with the concept of probability. Larger shifts in geometry and functions.

6.4.3.6 Mt Frere

- 20 teachers wrote the pre-test and 34 teachers wrote the post-test.
- Only 14 teachers wrote both pre-test and post-test.

Table 43: Mt Frere teachers: pre- and post-test achievement levels

District	29% & below	30 -39 %	40-49 %	50-59 %	60-69 %	70-79 %	80% & above	sample
Mt Frere PRE	16	2	2	0	0	0	0	**20**
Mt Frere POST	16	3	3	4	6	2	0	**34**

Table 44: Mt Frere teachers: pre- and post-tests and percentage shift

Teacher	Pre-test	Post-test	% shift
Teacher 1	11	65	54
Teacher 2	28	65	37
Teacher 3	35	54	19
Teacher 4	48	52	4
Teacher 5	14	52	38
Teacher 6	15	42	27
Teacher 7	9	34	25
Teacher 8	8	25	17
Teacher 9	16	22	6
Teacher 10	26	19	-7
Teacher 11	4	13	9
Teacher 12	11	11	0
Teacher 13	8	10	2

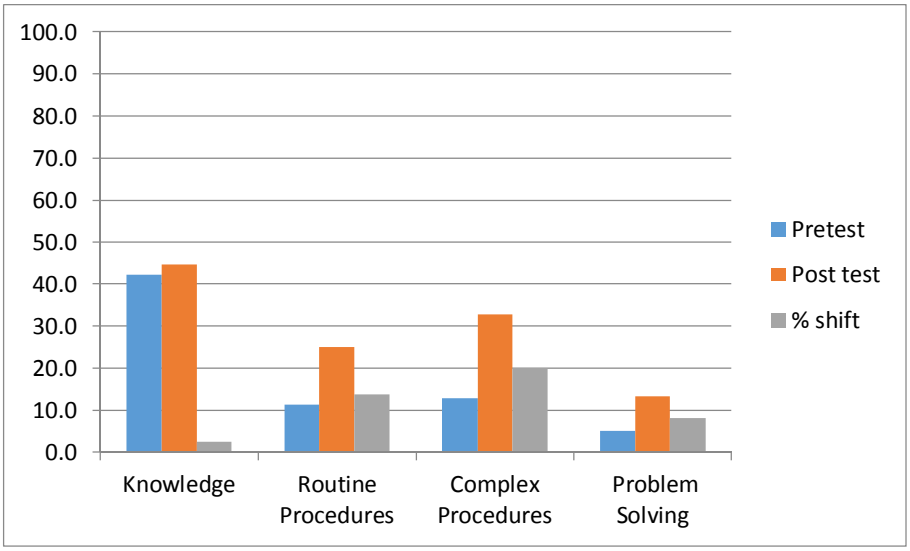
Teacher	Pre-test	Post-test	% shift
Teacher 14	3	9	6
Average	**16.9**	**33.8**	**16.9**

- Only one teacher showed a negative shift (-7%).
- One teacher improved by 54%.
- Seven teachers improved by more than 15%, with 2 improving by more than 35%.
- The heart of the matter is low level of teachers' mathematics. Despite nine days of mathematics, six teachers showed only minimal improvement.
- An positive shift of 16.9% is substantial and encouraging.
- The F-ratio is 6.67 and the F-critical is 4.23. Since the F-ratio is greater than F-critical, the likelihood is that the differences between the means are due to something other than chance alone.

Table 45: Mt Frere teachers: percentage shifts in cognitive levels

Cognitive levels	Pre-test	Post-test	% shift
Knowledge	42.3	44.6	2.4
Routine Procedures	11.2	25.0	13.8
Complex Procedures	12.8	32.8	20.0
Problem Solving	5.1	13.3	8.2

Figure 13: Mt Frere teachers: percentage shifts in cognitive levels

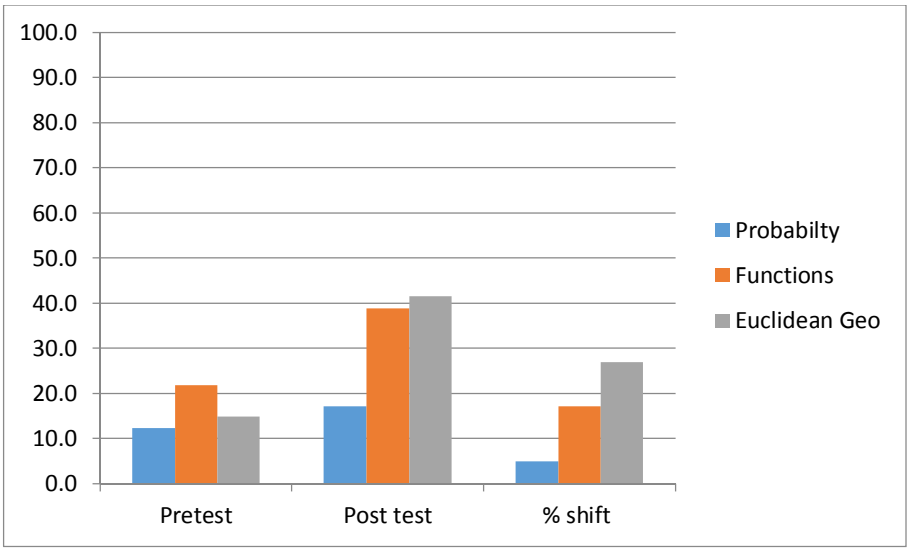


- There was a noticeable improvement in performance across the cognitive levels. Biggest improvement was in complex procedures which is an indication that the teachers have mastered some of the skills shared during the training sessions. Problem solving showed a fairly good shift.

Table 46: Mt Frere teachers: percentage shifts in content domains

Content levels	Pre-test	Post-test	% shift
Probability	12.2	17.1	4.8
Functions	21.8	38.8	17.0
Euclidean Geography	14.7	41.6	26.9

Figure 14: Mt Frere teachers: percentage shifts in content domains



- Majority of teachers are still battling with the concept of probability. Larger shifts in geometry and functions.

6.4.4 Science

6.4.4.1 Pinetown

- 25 teachers wrote the pre-test and 23 teachers wrote the post-test.
- Only 14 teachers wrote both pre-test and post-test.

Table 47: Pre- and post-test achievement levels

	Below 29%	30% - 39%	40%-49%	50%-59%	60%-69%	70%-79%	above 80%	Sample
Pinetown PRE	2	2	1	4	5	5	6	25
Pinetown POST	0	1	0	5	2	8	7	23

Table 48: Pinetown teachers: pre- and post-tests and percentage shift

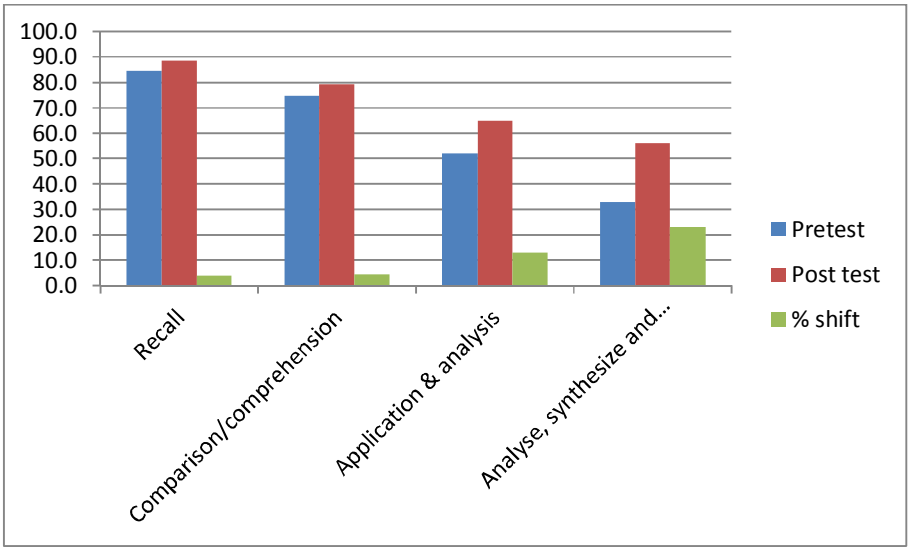
teachers	pre-test	post-test	% shift
Teacher 1	82	94	**12**
Teacher 2	57	76	**19**
Teacher 3	69	85	**16**
Teacher 4	66	74	**8**
Teacher 5	62	94	**32**
Teacher 6	32	39	**7**
Teacher 7	43	60	**17**
Teacher 8	71	88	**17**
Teacher 9	76	78	**2**
Teacher 10	76	89	**13**
Teacher 11	64	50	**-14**
Teacher 12	56	70	**14**
Teacher 13	24	52	**28**
Teacher 14	72	73	**1**
Averages	**60.7**	**73.0**	**12.3**

- The F-ratio is 3.59997 and the F-critical is 4.225201273. Since the F-value is less than F-critical, the likelihood is that the differences between the means are due to chance.
- Most of the teachers improved their pre-test scores.
- If we exclude the one negative shift then the average percentage shift is 14.3.

Table 49: Pinetown teachers: percentage shifts in cognitive levels

Cognitive levels	Pre-test	Post-test	% shift
Recall	84.6	88.6	3.9
Comparison/comprehension	74.7	79.1	4.4
Application & analysis	51.9	64.9	13.1
Analyse, synthesize and evaluate	33.0	56.0	23.1

Figure 15: Pinetown teachers: percentage shifts in cognitive levels

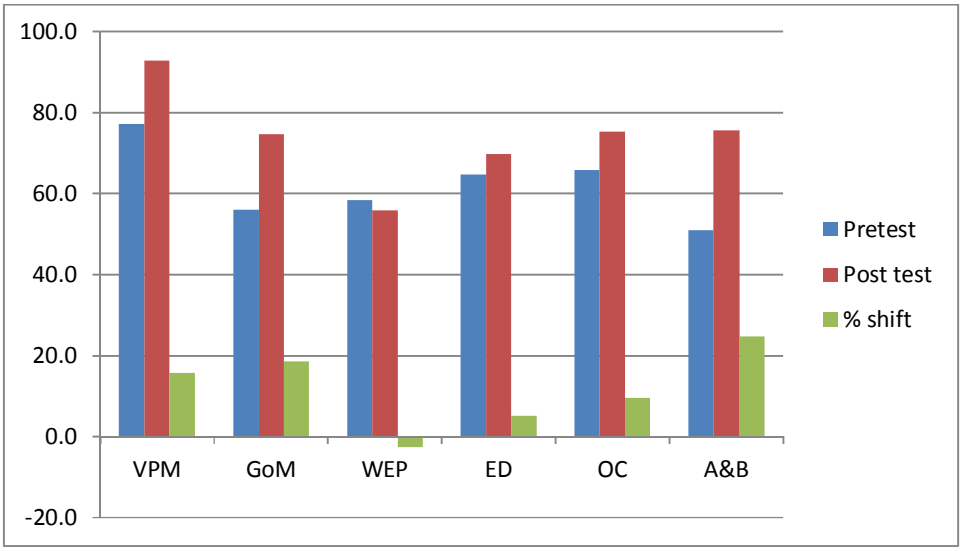


- There was a noticeable improvement in performance across the cognitive levels. Biggest improvement was for level 4 which is an indication that the teachers have mastered some of the skills shared during the training sessions.

Table 50: Pinetown teachers: percentage shifts in content domains

Topics	Abbr.	Pre-test	Post-test	% shift
Vertical projectile	**VPM**	77.1	92.9	15.7
Graph of motion	**GoM**	56.0	74.6	18.6
Work, energy and power	**WEP**	58.4	55.8	-2.6
Electrodynamics	**ED**	64.7	69.7	5.0
Organic chemistry	**OC**	65.9	75.4	9.5
Acids and bases	**A&B**	51.0	75.7	24.8

Figure 16: Pinetown teachers: percentage shifts in content domains



- Only WEP showed a negative shift on average
- Biggest shift was in Acids and Bases

6.4.4.2 uThungulu

- 36 teachers wrote the pre-test and 30 teachers wrote the post-test.
- Only 30 teachers wrote both pre-test and post-test.

Table 51: Uthungulu teachers: pre- and post-test achievement levels

District	29 and less %	30 -39 %	40 - 49 %	50 - 59 %	60 - 69 %	70 - 79 %	80 & above %	sample
uThungulu PRE	10	5	6	4	4	5	2	**36**
uThungulu POST	2	1	4	6	4	5	8	**30**

- Only 7 teachers scored less than 50% in the post-test, compared to the 21 who scored less than 50% in the pre-test.
- After the post-test there were 13 teachers who scored above 70% compared with 7 teachers in the pre-test.

Table 52: uThungulu teachers: pre- and post-tests and percentage shift

Teachers	pretest	post-test	% shift
Teacher 1	37	61	24
Teacher 2	4	16	12
Teacher 3	70	93	23
Teacher 4	31	42	11
Teacher 5	59	58	-1
Teacher 6	61	82	21
Teacher 7	71	94	23
Teacher 8	31	49	18

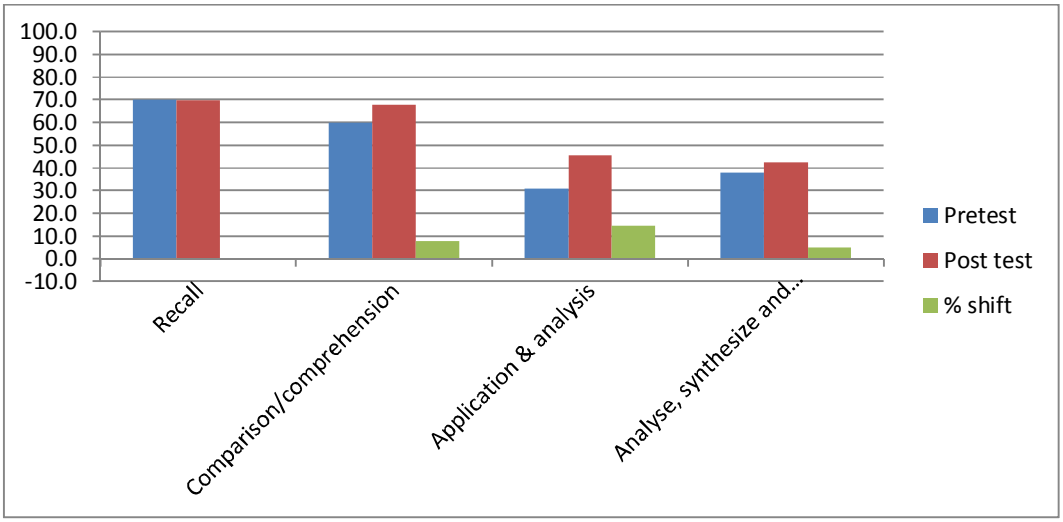
Teachers	pretest	post-test	% shift
Teacher 9	47	70	23
Teacher 10	52	57	5
Teacher 11	23	78	55
Teacher 12	68	45	-23
Teacher 13	48	66	18
Teacher 14	30	71	41
Teacher 15	39	51	12
Teacher 16	79	90	11
Teacher 17	58	94	36
Teacher 18	16	33	17
Teacher 19	58	58	0
Teacher 20	82	85	3
Teacher 21	44	59	15
Teacher 22	76	88	12
Teacher 23	45	74	29
Teacher 24	29	69	40
Teacher 25	40	75	35
Teacher 26	42	61	19
Teacher 27	64	87	23
Teacher 28	22	41	19
Teacher 29	19	53	34
Teacher 30	6	20	14
Average	**45.0**	**64.0**	**19.0**

- Only two teachers showed negative shifts and if we take away the two negative shifts then the average improvement will be 21.2%.
- The F-ratio is 11.92673 and the F-critical is 4.006873. Since the F-ratio is greater than F-critical, the likelihood is that the differences between the means are due to something other than chance alone.

Table 53: uThungulu teachers: percentage shifts in cognitive levels

Cognitive levels	Pretest	Post-test	% shift
Recall	**70.1**	**69.9**	**-0.3**
Comparison/comprehension	**59.8**	**67.7**	**7.9**
Application & analysis	**31.0**	**45.4**	**14.4**
Analyse, synthesize and evaluate	**37.8**	**42.6**	**4.8**

Figure 17: uThungulu teachers: percentage shifts in cognitive levels

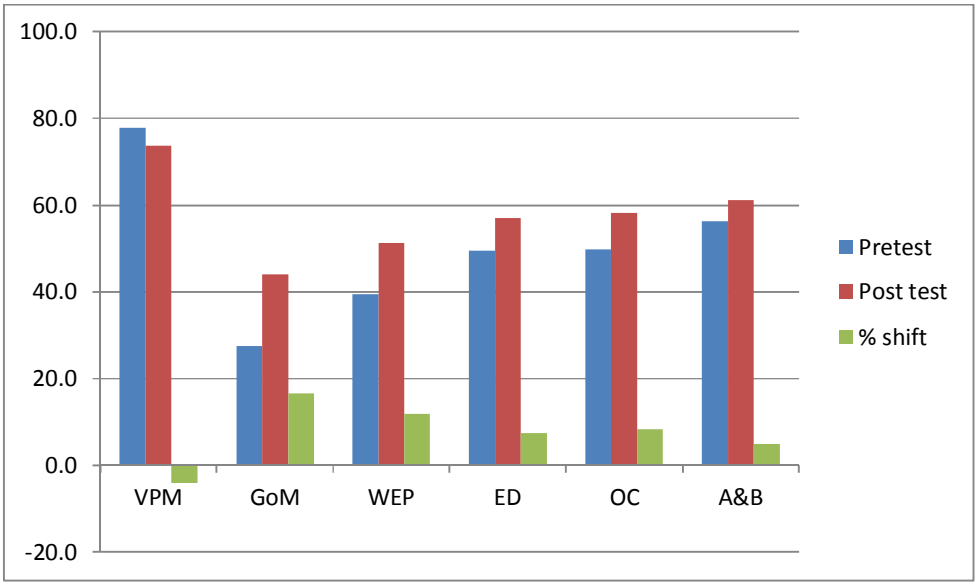


- There was a noticeable improvement in performance across the higher cognitive levels. Biggest improvement was in application and analysis, which is an indication that the teachers have mastered some of the skills shared during the training sessions.
- Recall, as a cognitive level, showed a negative shift.

Table 54: uThungulu teachers: percentage shifts in content domains

Topics	Abbr.	Pre-test	Post-test	% shift
Vertical projectile	VPM	77.8	73.7	-4.1
Graph of motion	GoM	27.4	44.0	16.6
Work, energy and power	WEP	39.4	51.2	11.8
Electrodynamics	ED	49.5	57.0	7.5
Organic chemistry	OC	49.8	58.1	8.3
Acids and bases	A&B	56.3	61.1	4.8

Figure 18: uThungulu teachers: percentage shifts in content domains



- Majority of teachers are still battling with the concept VPM. Larger shifts in GoM and WEP.
- Only VPM showed a negative shift on average.

6.4.4.3 *Vhembe*

- 40 teachers wrote the pre-test and 41 teachers wrote the post-test.
- Only 37 teachers wrote both pre-test and post-test.

Table 55: Vhembe teachers: pre- and post-test achievement levels

District	29 and less %	30 -39 %	40 - 49 %	50 - 59 %	60 - 69 %	70 - 79 %	80 & above %	sample
Vhembe PRE	10	11	5	3	4	6	1	**40**
Vhembe POST	3	4	13	6	6	3	6	**41**

- Only 7 teachers scored less than 40% in the post-test, compared with the 21 who scored less than 40% in the pre-test.
- After the post-test there were 9 teachers who scored above 70% compared with 7 teachers in the pre-test, but 6 scored above 80% in the post-test compared with 1 in the pre-test.

Table 56: Vhembe teachers: pre- and post-tests and percentage shift

Initial	Pre test	Post-test	% shift
Teacher 1	73	64	**-9**
Teacher 2	19	26	**7**
Teacher 3	13	40	**27**
Teacher 4	21	28	**7**
Teacher 5	70	89	**19**
Teacher 6	34	44	**10**
Teacher 7	77	81	**4**

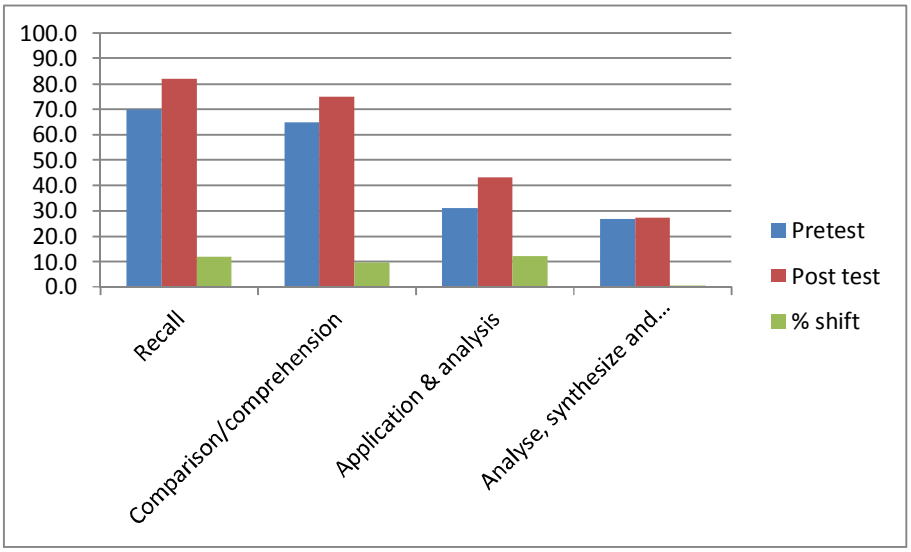
Initial	Pre test	Post-test	% shift
Teacher 8	54	54	**0**
Teacher 9	41	40	**-1**
Teacher 10	21	45	**24**
Teacher 11	65	77	**12**
Teacher 12	18	53	**35**
Teacher 13	36	46	**10**
Teacher 14	64	81	**17**
Teacher 15	70	86	**16**
Teacher 16	73	62	**-11**
Teacher 17	35	41	**6**
Teacher 18	28	45	**17**
Teacher 19	58	79	**21**
Teacher 20	32	40	**8**
Teacher 21	49	63	**14**
Teacher 22	39	66	**27**
Teacher 23	34	48	**14**
Teacher 24	66	88	**22**
Teacher 25	12	25	**13**
Teacher 26	66	75	**9**
Teacher 27	27	42	**15**
Teacher 28	37	53	**16**
Teacher 29	70	81	**11**
Teacher 30	32	42	**10**
Teacher 31	36	45	**9**
Teacher 32	40	47	**7**
Teacher 33	20	38	**18**
Teacher 34	59	68	**9**
Teacher 35	42	59	**17**
Teacher 36	18	60	**42**
Teacher 37	47	34	**-13**
Average	**43.1**	**55.5**	**12.4**

- Only four teachers showed negative shifts, and if we exclude the four negative shifts then the average improvement is 14.9%.
- The two negative shifts of more than 10% are a concern.
- The F-ratio is 7.788993 and the F-critical is 3.973897. Since the F-ratio is greater than F-critical, the likelihood is that the differences between the means are due to something other than chance alone.

Table 57: Vhembe teachers: percentage shifts in cognitive levels

Cognitive levels	Pre-test	Post-test	% shift
Recall	70.0	82.0	12.0
Comparison/comprehension	65.0	74.9	9.9
Application & analysis	31.0	43.3	12.3
Analyse, synthesize and evaluate	26.7	27.2	0.5

Figure 19: Vhembe teachers: percentage shifts in cognitive levels

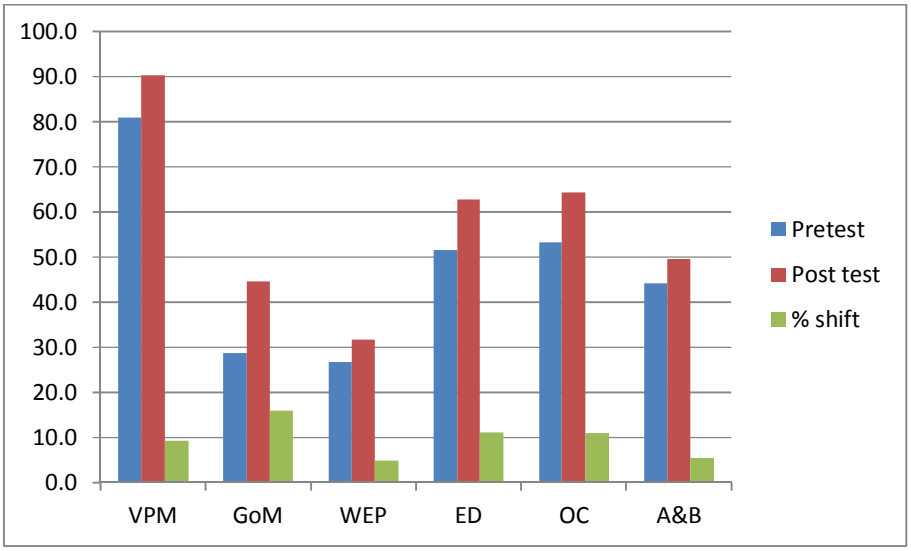


- There was a noticeable improvement in performance on the first cognitive level (Recall) and the third higher cognitive level (Application and analysis), but minimal shift in cognitive level 4. There is an indication that the teachers have mastered some of the skills shared during the training sessions.

Table 58: Vhembe teachers: percentage shifts in content domains

Topics	Abbr.	Pre-test	Post-test	% shift
Vertical projectile	VPM	81.0	90.2	9.2
Graph of motion	GoM	28.7	44.7	16.0
Work, energy and power	WEP	26.8	31.7	4.9
Electrodynamics	ED	51.6	62.8	11.2
Organic chemistry	OC	53.1	64.2	11.1
Acids and bases	A&B	44.2	49.6	5.4

Figure 20: Vhembe teachers: percentage shifts in content domains



- Substantial improvement in all content domains.
- The most-improved content area is Graphs of Motion.
- Electrodynamics and Organic Chemistry show improvements greater than 10%.

6.4.4.4 Waterberg

- 44 teachers wrote the pre-test and 35 teachers wrote the post-test.
- Only 35 teachers wrote both pre-test and post-test.

Table 59: Waterberg teachers: pre- and post-test achievement levels

District	29 and less %	30 -39 %	40 - 49 %	50 - 59 %	60 - 69 %	70 - 79 %	80 & above %	sample
Waterberg PRE	20	11	6	3	4	0	0	**44**
Waterberg POST	5	8	3	6	7	4	2	**35**

- Only 16 teachers scored less than 50% in the post-test compared to the 37 who scored less than 50% in the pre-test.
- After the post-test there are 6 teachers who scored above 70% compared with 0 teachers in the pre-test.
- Only 7 teachers scored above 50% in the pre-test, now 19 teachers scored above 50%.

Table 60: Waterberg teachers: pre- and post-tests and percentage shift

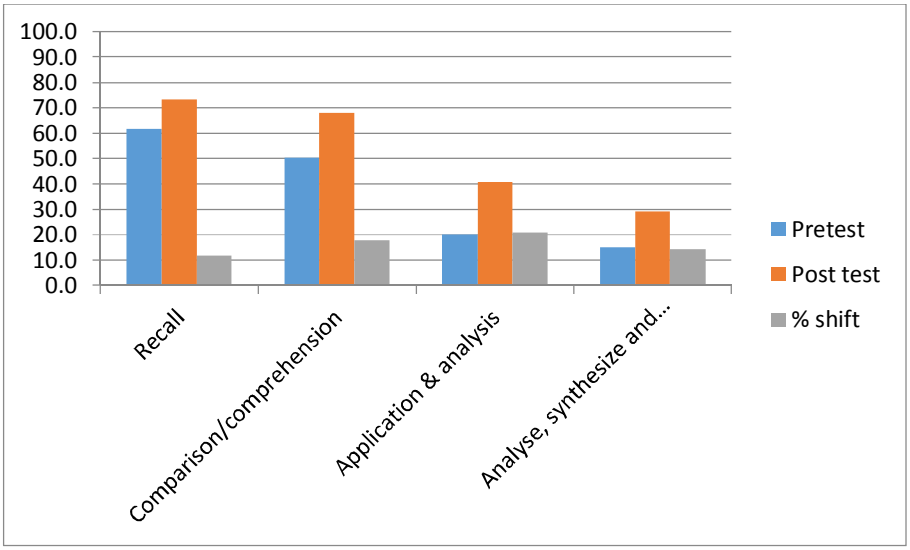
Teachers	Pre-test	Post-test	% shift
Teacher 1	55	72	17
Teacher 2	43	68	25
Teacher 3	34	53	19
Teacher 4	9	17	8
Teacher 5	30	48	18
Teacher 6	1	11	10
Teacher 7	30	47	17
Teacher 8	18	57	39
Teacher 9	49	78	29
Teacher 10	30	30	0
Teacher 11	62	89	27
Teacher 12	18	36	18
Teacher 13	65	81	16
Teacher 14	26	37	11
Teacher 15	32	57	25
Teacher 16	36	38	2
Teacher 17	64	73	9
Teacher 18	41	54	13
Teacher 19	27	54	27
Teacher 20	50	68	18
Teacher 21	18	47	29
Teacher 22	35	69	34
Teacher 23	53	39	-14
Teacher 24	23	68	45
Teacher 25	23	28	5
Teacher 26	39	62	23
Teacher 27	38	64	26
Teacher 28	23	52	29
Teacher 29	30	66	36
Teacher 30	15	26	11
Teacher 31	44	74	30
Teacher 32	16	36	20
Teacher 33	23	31	8
Teacher 34	6	17	11
Teacher 35	34	38	4
Average	**32.6**	**51.0**	**18.4**

- Only one teacher showed a negative shift and if we exclude that negative shift then the average improvement is 19.4%.
- The improvement on average is a substantial and significant.
- The F-ratio is 18.24342 and the F-critical is 3.981896. Since the F-ratio is greater than F-critical, the likelihood is that the differences between the means are due to something other than chance alone.

Table 61: Waterberg teachers: percentage shifts in cognitive levels

Cognitive levels	Pre-test	Post-test	% shift
Recall	61.7	73.3	11.6
Comparison/comprehension	50.3	68.1	17.8
Application & analysis	19.9	40.8	21.0
Analyse, synthesize and evaluate	14.9	29.2	14.3

Figure 21: Waterberg teachers: percentage shifts in cognitive levels

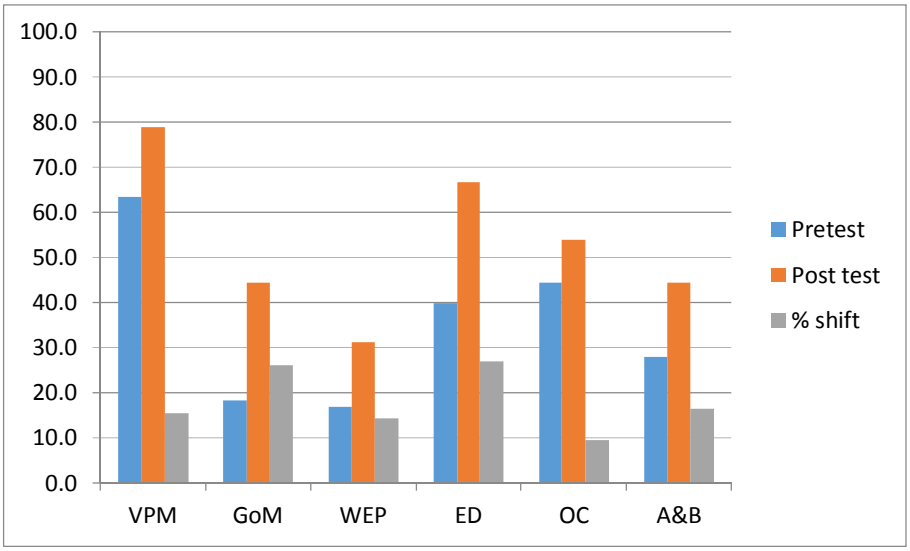


- There was a noticeable improvement in performance across all the cognitive levels. The third higher cognitive level (Application and analysis) showed an improvement of more than 20%, but there was minimal shift in cognitive level 1 (recall). There is an indication that the teachers have mastered some of the skills shared during the training sessions.

Table 62: Waterberg teachers: percentage shifts in content domains

Topics	Abbr.	Pre-test	Post-test	% shift
Vertical projectile	VPM	63.4	78.9	15.4
Graph of motion	GoM	18.3	44.3	26.1
Work, energy and power	WEP	16.9	31.2	14.3
Electrodynamics	ED	39.8	66.7	26.9
Organic chemistry	OC	44.4	53.9	9.4
Acids and bases	A&B	28.0	44.4	16.4

Figure 22: Waterberg teachers: percentage shifts in content domains



- Substantial improvement in all content domains.
- The most-improved content area is Graphs of Motion and Electrodynamics.
- Only Organic Chemistry showed a single-digit shift.

6.4.4.5 Libode

- 35 teachers wrote the pre-test and 30 teachers wrote the post-test.
- Only 30 teachers wrote both pre-test and post-test.

Table 63: Libode teachers: pre- and post-test achievement levels

District	29 and less %	30 -39 %	40 - 49 %	50 - 59 %	60 - 69 %	70 - 79 %	80 & above %	sample
Libode PRE	18	2	5	3	4	2	1	**35**
Libode POST	10	0	3	6	1	3	7	**30**

- Only 10 teachers scored less than 40% in the post-test compared to the 20 who scored less than 40% in the pre-test.
- After the post-test there were 10 teachers who scored above 70%, compared with 3 in the pre-test, but 7 scored above 80% in the post-test compared with 1 in the pre-test.

Table 64: Libode teachers: pre- and post-tests and percentage shift

Teachers	Pre-test	Post-test	% shift
Teacher 1	30	89	59
Teacher 2	77	89	12
Teacher 3	45	88	43
Teacher 4	58	87	29
Teacher 5	75	84	9
Teacher 6	41	84	43
Teacher 7	55	83	28
Teacher 8	67	77	10
Teacher 9	76	76	0
Teacher 10	25	72	47
Teacher 11	64	69	5
Teacher 12	31	59	28
Teacher 13	13	59	46
Teacher 14	52	58	6
Teacher 15	21	55	34
Teacher 16	48	54	6
Teacher 17	65	52	-13
Teacher 18	23	47	24
Teacher 19	41	46	5
Teacher 20	6	41	35
Teacher 21	14	26	12
Teacher 22	5	25	20
Teacher 23	16	23	7
Teacher 24	7	22	15
Teacher 25	1	21	20
Teacher 26	14	21	7
Teacher 27	3	17	14
Teacher 28	12	17	5
Teacher 29	15	11	-4
Teacher 30	16	10	-6
Average	**33.9**	**52.1**	**18.2**

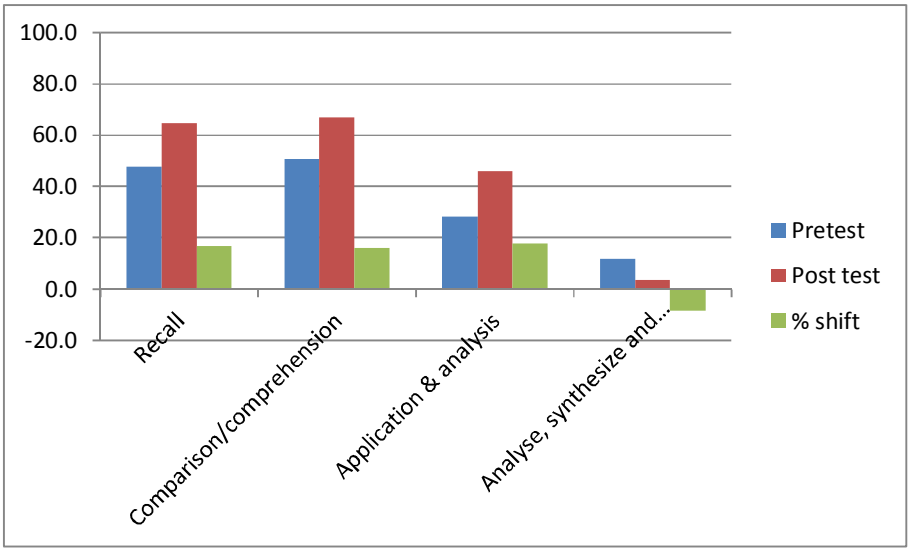
- Only three teachers showed negative shifts and if we exclude the three negative shifts then the average improvement is 21.1%.
- Only one of the negative shifts exceeds 10%.

- The F-ratio is 7.39 and the F-critical is 4.01. Since the F-ratio is greater than F-critical, the likelihood is that the differences between the means are due to something other than chance alone.

Table 65: Libode teachers: percentage shifts in cognitive levels

Cognitive levels	Pre-test	Post-test	% shift
Recall	47.8	64.7	16.8
Comparison/comprehension	50.8	66.9	16.2
Application & analysis	28.3	45.9	17.7
Analyse, synthesize and evaluate	11.8	3.3	-8.5

Figure 23: Libode teachers: percentage shifts in cognitive levels

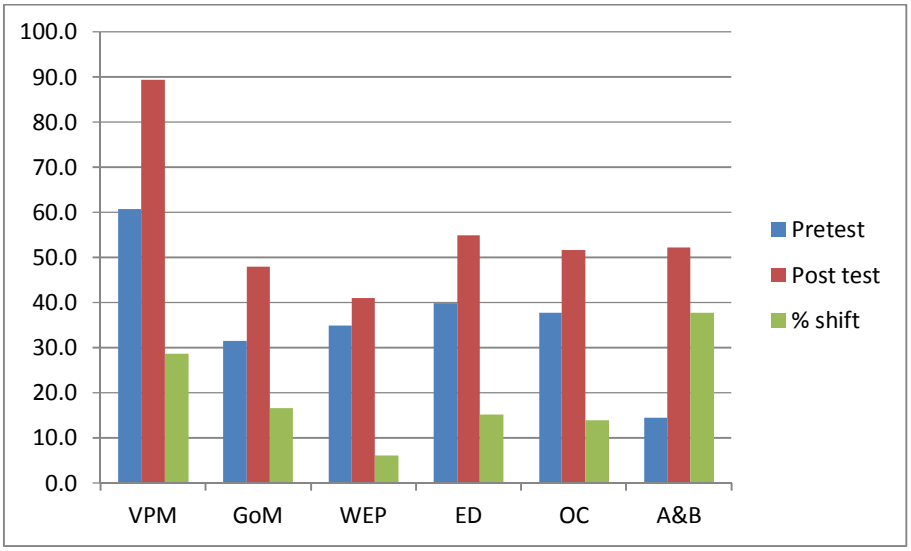


- There was a noticeable improvement in performance across the first three cognitive levels, but a negative shift in cognitive level 4. Despite this negative shift, there is an indication that the teachers have mastered some of the skills shared in the training sessions.

Table 66: Libode teachers: percentage shifts in content domains

Topics	Abbr.	Pre-test	Post-test	% shift
Vertical projectile	VPM	60.7	89.3	28.7
Graph of motion	GoM	31.5	48.0	16.5
Work, energy and power	WEP	34.8	40.9	6.1
Electrodynamics	ED	39.8	54.9	15.1
Organic chemistry	OC	37.8	51.6	13.8
Acids and bases	A&B	14.4	52.2	37.8

Figure 24: Libode teachers: percentage shifts in content domains



- Substantial improvement in all content domains.
- The most improved content area is Acids and Bases, an improved shift of 28.7%.
- Vertical Projectile showed a substantial shift of 37.8%.
- Electrodynamics and Organic Chemistry showed improvements greater than 10%.

6.4.4.6 Mt Frere

- 36 teachers wrote the pre-test and 33 teachers wrote the post-test.
- Only 23 teachers wrote both pre-test and post-test.

Table 67: Mt Frere teachers: pre- and post-test achievement levels

District	29 and less %	30 -39 %	40 - 49 %	50 - 59 %	60 - 69 %	70 - 79 %	80 & above %	sample
Mt Frere PRE	20	2	1	3	5	4	1	**36**
Mt Frere POST	8	3	5	8	2	6	1	**33**

- Only 11 teachers scored less than 40% in the post-test, compared with 22 who scored less than 40% in the pre-test.
- In the post-test only 7 teachers scored above 70%, compared with 5 teachers in the pre-test; only one teacher scored above 80% in both pre-test and post-test.

Table 68: Mt Frere teachers: pre- and post-tests and percentage shift

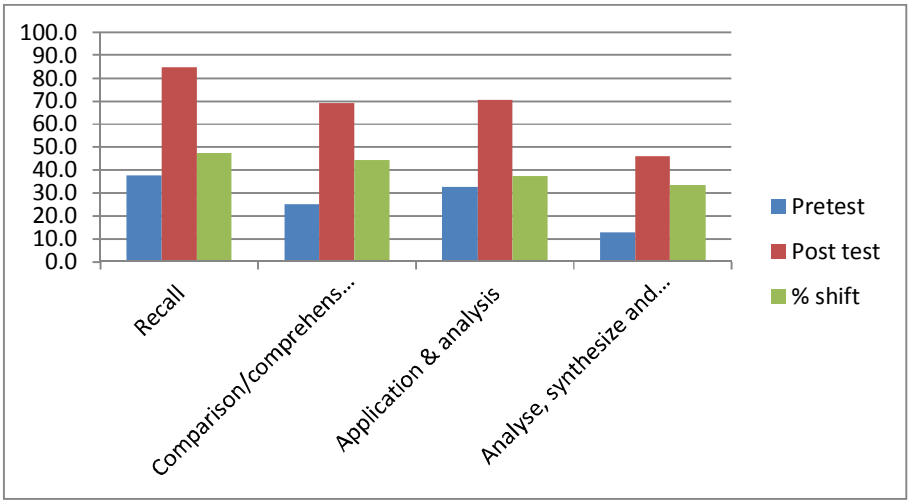
Teacher	Pre-test	Post-test	% shift
Teacher 1	66	53	-13
Teacher 2	61	37	-24
Teacher 3	22	12	-10
Teacher 4	17	24	7
Teacher 5	35	47	12
Teacher 6	7	57	50
Teacher 7	75	72	-3
Teacher 8	24	66	42
Teacher 9	3	50	47
Teacher 10	78	87	9
Teacher 11	8	10	2
Teacher 12	68	71	3
Teacher 13	6	17	11
Teacher 14	15	28	13
Teacher 15	22	28	6
Teacher 16	35	43	8
Teacher 17	66	58	-8
Teacher 18	6	18	12
Teacher 19	59	58	-1
Teacher 20	82	78	-4
Teacher 21	54	53	-1
Teacher 22	77	74	-3
Teacher 23	78	74	-4
Average	**41.9**	**48.5**	**6.6**

- Results are characterized by a very low average shift of 6.6%.
- A number of teachers showed a negative shift, meaning that the overall short course for Science was not effective for Mt Frere teachers.
- The F-ratio is 0.730554 and the F-critical is 4.061706. Since the F-ratio is less than F-critical, the likelihood is that the differences between the means are due to chance.

Table 69: Mt Frere teachers: percentage shifts in cognitive levels

Cognitive levels	Pre-test	Post-test	% shift
Recall	37.7	85.0	47.3
Comparison/comprehension	25.1	69.2	44.1
Application & analysis	32.9	70.4	37.5
Analyse, synthesize and evaluate	12.7	46.2	33.4

Figure 25: Mt Frere teachers: percentage shifts in cognitive levels

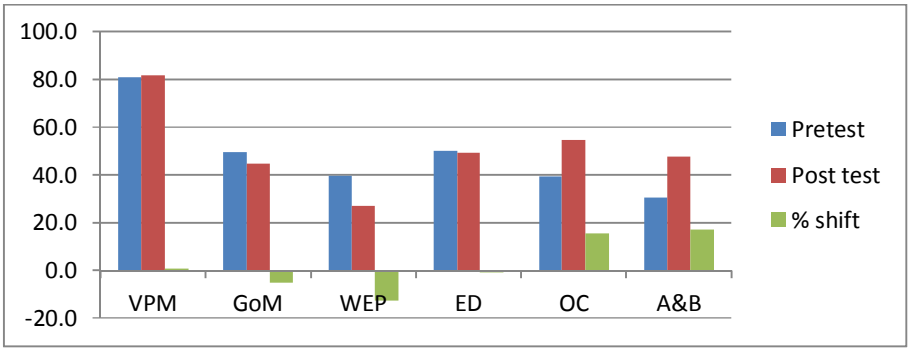


- There was a noticeable improvement in performance on the first cognitive level (Recall) and the third higher cognitive level (Application and analysis), but minimal shift in cognitive level 4. There is an indication that the teachers have mastered some of the skills shared during the training sessions.

Table 70: Mt Frere teachers: percentage shifts in content domains

Topics	Abbr.	Pre-test	Post-test	% shift
Vertical projectile	VPM	80.9	81.7	0.9
Graph of motion	GoM	49.7	44.7	-5.0
Work, energy and power	WEP	39.5	26.9	-12.6
Electrodynamics	ED	50.1	49.1	-1.0
Organic chemistry	OC	39.5	54.8	15.3
Acids and bases	A&B	30.4	47.5	17.1

Figure 26: Mt Frere teachers: percentage shifts in content domains



- Only substantial improvements are in Organic Chemistry and Acids and Bases
- Negative or minimal improvements in the rest of the content domains

7 QUALITATIVE ANALYSIS

7.1 Introduction

At the end of each of the three-day workshops, all respondents were asked to complete the CASME evaluation form. The monitoring and quality assurance team also administered a different evaluation tool in both mathematics and science, but to a sample of the respondents.

The key evaluation criteria were:

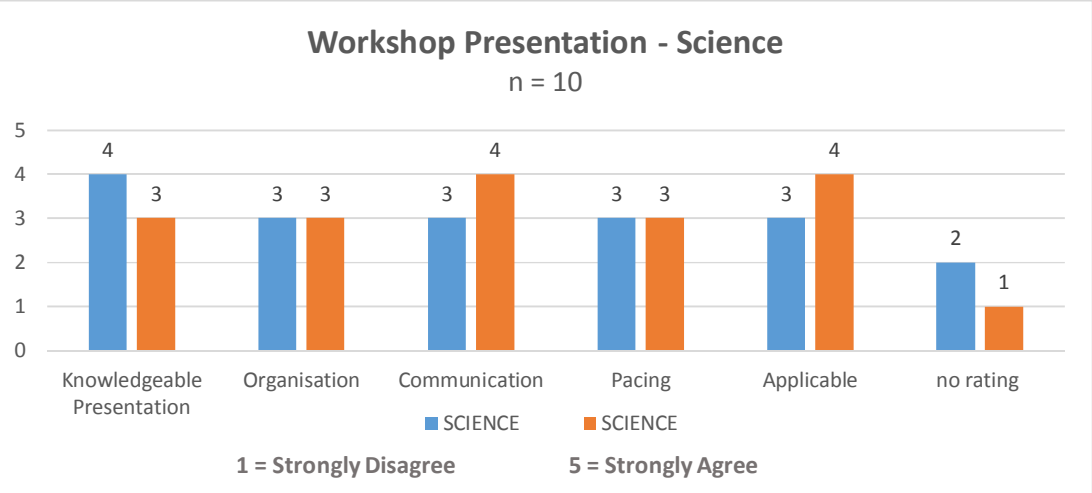
- Workshop presentation
- Workshop rating
- Respondents perceptions
- Respondents' future needs

7.2 Teacher Evaluation of Workshops

7.2.1 Eastern Cape Sessions 2 & 3

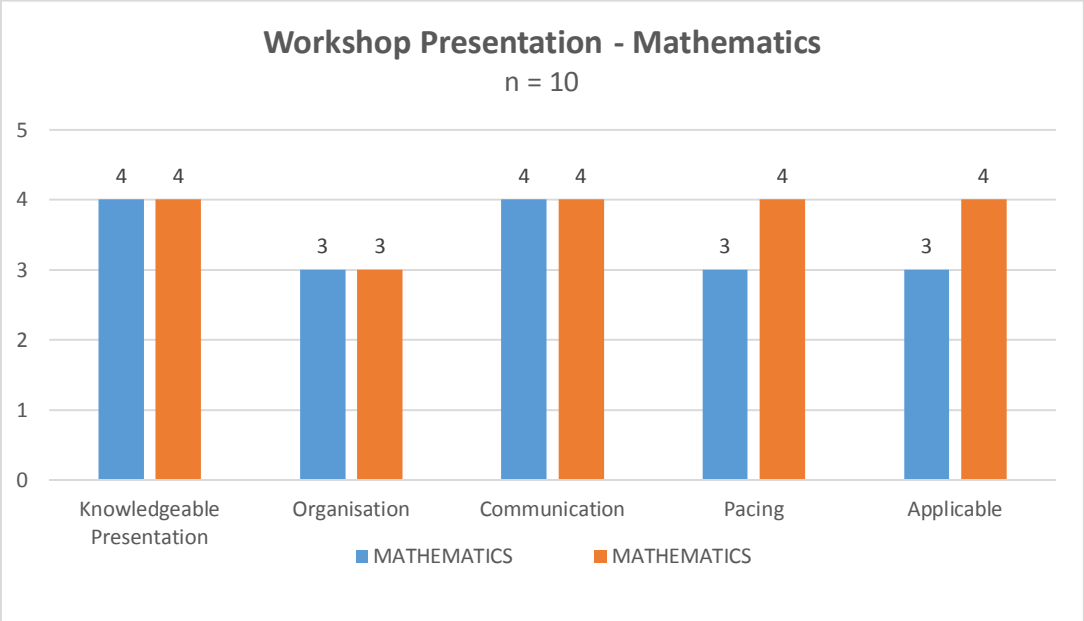
Of the 34 Science and 33 Mathematics teachers attending the workshop on day 3, a sample of 30% (± 10 per subject) took part in evaluations of different training sessions. Average years of professional teaching experience for those in the sample were 13 to 15 years. Figures 27 to 32 below show the responses obtained from the sample.

Figure 27: EC ScienceSessions 2 & 3: workshop presentation



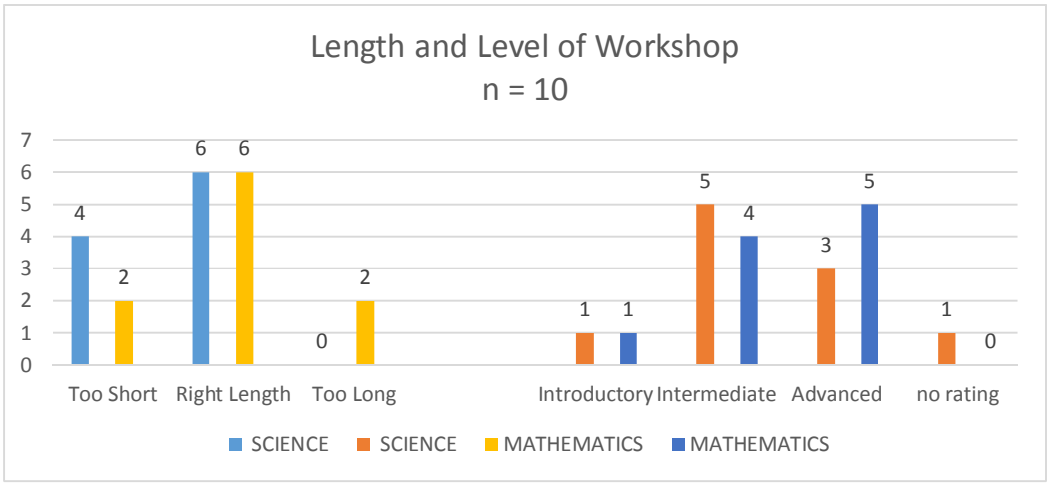
On the presentation of the workshops in Science, pacing and organisation received lower ratings than knowledge, levels of communication and applicability.

Figure 28: EC Mathematics Sessions 2 & 3: workshop presentation



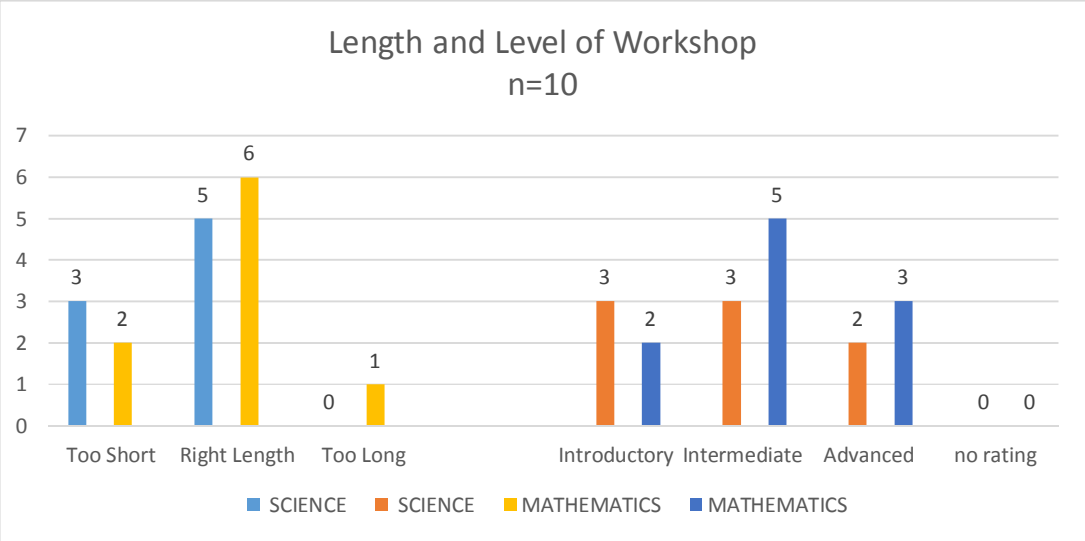
In the Mathematics training sessions teachers gave generally high ratings for the overall presentation, but especially in Knowledgeable Presentation and Communication. Organisation has the lowest ratings while Pacing and Applicability had average ratings.

Figure 29: EC Mathematics Session 2 and Science Session 2: length and level of workshop



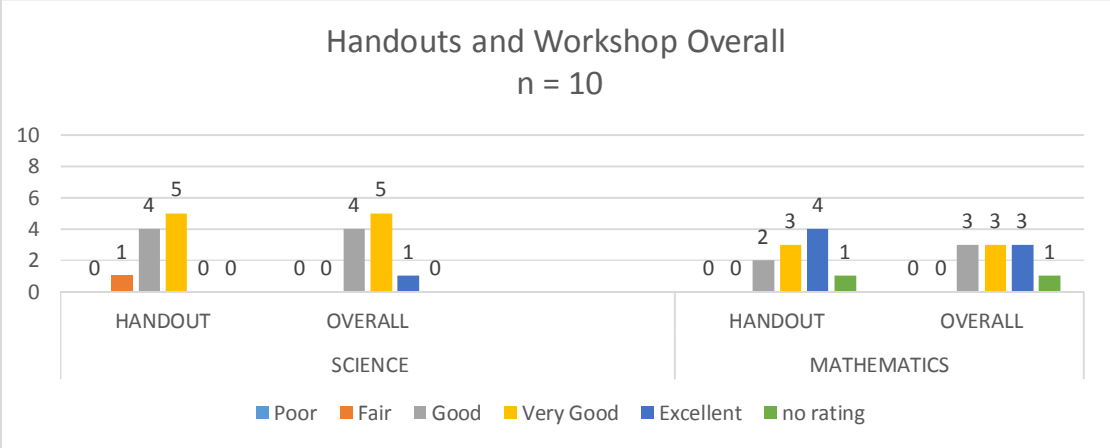
In Science Session 2, 60% of the teachers felt that the workshop was the right length, and none of the teachers felt that the workshop was too long. Similar perceptions were expressed for Science in Session 3. Eight of the ten teachers felt that the workshop was pitched at intermediate and advanced levels. Only one of the teachers felt that the workshop was introductory. These evaluations reflect that the three-day workshop sufficed for the content that had to be covered.

Figure 30: EC Mathematics Session 3 and Science Session 3: length and level of workshop



In Mathematics Sessions 2 and 3, six out of ten teachers felt that the workshop was of the right length. Only two teachers thought that it was too short and one thought that it was too long. Only three teachers out of the ten thought that Mathematics Session 3 was introductory. Three teachers felt that it was intermediate, and two thought that it was advanced.

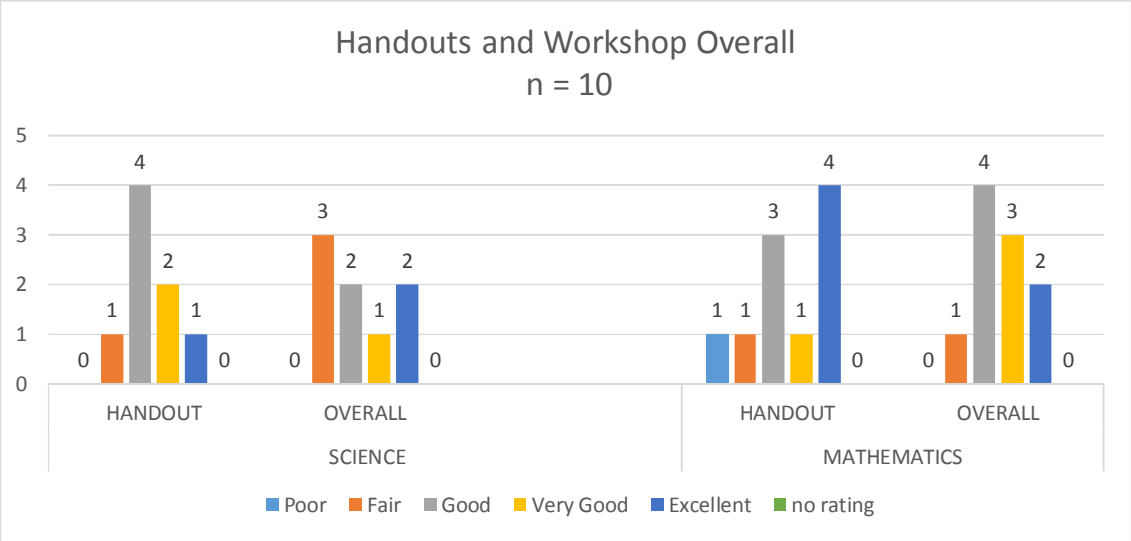
Figure 31: EC Mathematics Session 2 and Science Session 2: handouts and workshop overall



In Science Session 2, most of the teachers felt that the handouts and the training overall were Good or Very Good. None of the teachers felt that the workshop handouts were Poor, and one gave a rating of Excellent for the overall experience.

In Maths Session 2, more teachers gave a rating of Excellent for both handouts and overall experience. The minimum rating was a Good for both aspects. However, two teachers gave no rating.

Figure 32: EC Mathematics Session 3 and Science Session 3: handouts and workshop overall



In Science Session 3, the most frequent rating for handouts was Good. None of the teachers felt that the handouts were poor. The overall experience was rated as fair or good by more than half of the teachers. In Maths Session 3 on the other hand, the most frequent rating for handouts was Excellent; although one teacher gave a rating of Poor. In Mathematics, ratings for the overall experience mostly ranged from Good to Excellent with a single rating of Fair.

In Science Sessions 2 and 3, a large number of teachers noted that what they enjoyed were the discussions and methodology. One commented that "The discussion and debates made some science aspects and topics clearer." Another teacher valued "Sharing of ideas about different approaches on different topics." Teachers also appreciated the coverage on ChemSketch as it made setting of tests and exams easier. Other points favourably highlighted were experiments that made concepts more concrete for them, input on content knowledge, and collaboration with other teachers. Teachers also commented that the facilitators were informative and that the course inspired them to teach better in future.

Several teachers in Science Sessions 2 and 3 noted that time could have been better managed to avoid activities dragging on for too long: in the words of one teacher, "Time frames when given to tasks as a group need to be reviewed, as groups were taking too long. If a facilitator said 10 minutes this should have meant 10 minutes and not 20 minutes later groups … still discussing". Some teachers felt that they would have benefited from doing more experiments: one mentioned "Availability of practical apparatus and chemicals, written instructions on how to conduct the experiment, unless the purpose is to plan it". Other teachers expected that they would be given resources like laptops.

On the question of what respondents appreciated most about the workshop, most teachers in the Mathematics training sessions mentioned that they gained in content knowledge and in the methodology of teaching the topics that were dealt with. Collaboration among the teachers was also noted as a highlight; one such comment was "Contribution from fellow educators on ways to solving problems, I appreciate the practical demonstration of solving problems."

Teachers made favourable mention of the knowledge they had gained in using GeoGebra for teaching, the quality of the handouts, and the residential nature of the workshop. A large number of teachers felt that the content was pitched too high for most programme participants, and that they would have benefited from more emphasis on skills for teaching difficult topics like probability. They felt that the facilitators could have done better in wrapping up and giving feedback after presentations. As one teacher put it, "Facilitators should comment on presentation done by educators so as to know whether we are on track or not".

Most of the teachers acknowledged the need for such training, but felt that those who did not have laptops lost out on the ICT section. Another teacher also expressed the need for all Maths FET teachers to be given training on topics like probability, as most of them had not covered this at college. One such comment was "All the mathematics teachers should be involved in such a workshop for capacity building. It should not be limited to one teacher per school."

7.2.2 Teachers Perception from the Evaluation Forms

The following tables give some of the teacher responses on the contact sessions:

Table 71: Teacher perceptions for Science S2 and S3 EC

What did you most appreciate/ enjoy/ think was best about the workshop content and delivery?	Which aspects of the workshop content and delivery do you think could be improved?
The problems discussed and some of them with solutions via demonstration and debate.	Content knowledge.
Discussions of topics and addressing misconceptions.	Time for discussions.
ChemSketch training empowered with Improved knowledge in ICT e.g. ChemSketch.	The space and set-up so that we can all hear each other and not have to move around when presentations are done.
The discussion and debates made some science aspects and topics clearer. The software we were given will contribute towards improvement, especially in setting papers.	More presentations especially from the coordinators (facilitators).
	We should be given things that demonstrate experiments because we do not have energy operations.
The methodology of how to approach some topics.	Time management, could be improved.
Respondents were all involved in the learning process.	Practical demonstration of some experiment on hard to some but respondents need to see these experiments done in workshops.
Assisted in acid-base calculations and how to reach organic chemistry, naming molecules using ChemSketch.	Time frames when given to tasks as a group need to be reviewed as groups were taking too long. And 10 mins is 10 mins [Don't] say 10 mins, and 20mins later groups are still discussing.
Doing the experiments and discussing the approach to the problems.	Plan and ensure time to perform the prescribed experiment/s.
Sharing of ideas about different approaches on different topics.	NECT should consider calling grade 10 &11 respondents only at some point for they are the ones giving the foundation.

It was respondents orientated; everybody was given a chance to participate.	I think day of the workshop must be extended because the workshop was too short and the respondents must be given the laptops so that they must not struggle to research things.
You get a platform to share your ideas with other educators. You get an energized feeling ready to face the challenge we are having in the Eastern Cape.	To do more practical work.
Th workshop was helpful; it was very good and the content session covered was good.	Since most of respondents were not having laptops, so when it comes to those sessions that include the usage of laptops most of respondents were positive.
I gained a lot in the way of approaching difficult topics, especially acids and bases.	Presentation by tutors and strategy.
Discussion and presentation were very informative. We also did practicals which were very important for us and learners. Facilitators were informative.	Availability of practical apparatus and chemicals, written instructions of how to conduct the experiment unless the purpose is to plan it.
Opportunity to see other respondents present; sharing of practices.	Calculations in the chemistry.
Presenting of topics, discussions, and views of approach in teaching planning of presentation and teaching methods, practical demonstrations.	
Discussions and feedback amongst different groups has enhanced by teaching strategy.	

Table 72: Teacher perceptions for EC S2 and S3 Mathematics

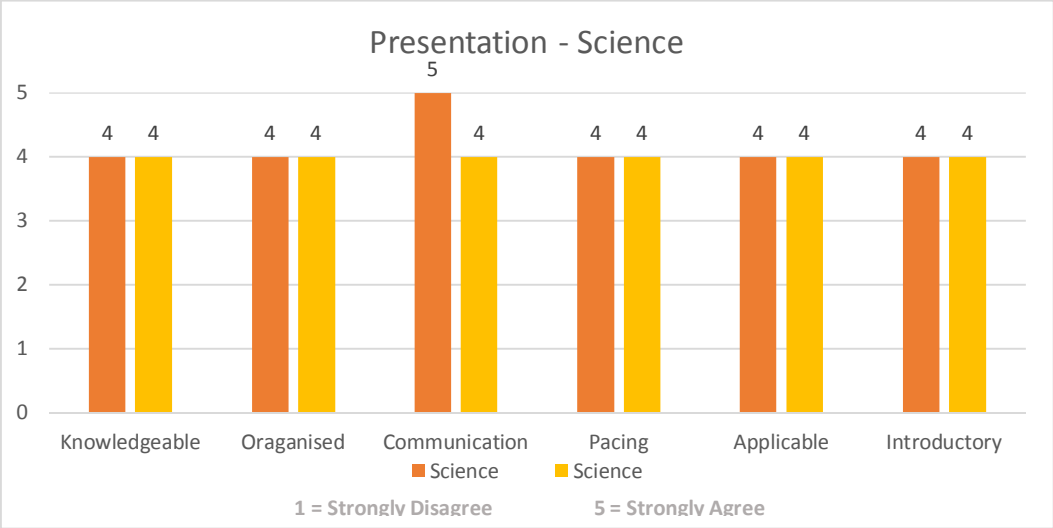
What did you most appreciate/ enjoy/ think was best about the workshop content and delivery?	**Which aspects of the workshop content and delivery do you think could be improved?**
Preparing the lesson and delivering it in a way that is understandable.	Minimize the activities that are being done.
Workshop excellent.	The way the topic was presented was not the most ideal as some educators have not done probability as a part of the course.
The content discussed in this workshop enhanced my subject knowledge.	Facilitators should allow educators to correct them, facilitators should rely on basics as a lot of the young educators seem to know next to nothing of the topic.
Contribution from fellow educators on ways to solving problems, I appreciate the practical demonstration of solving problems.	Those who have powers can increase the number of the training days.
I gained more knowledge about probability and activities provided by facilitators were prepared and done.	All the mathematics respondents should be involved in such a workshop for capacity building. It should not be limited to one respondent per school.

What did you most appreciate/ enjoy/ think was best about the workshop content and delivery?	Which aspects of the workshop content and delivery do you think could be improved?
The topic probability is somehow new and therefore more time is needed for respondents, especially those that did not study probability at their reflective FET schools	To me, using of formulas.
The tree diagrams and Venn diagram.	The first duration and then content arrangement it must be arranged according to the policy documents, because most of educators are new in the field, it must be done to anchor them to the ways of delivering the information to learners.
The way it occurred and their arrangement mostly I enjoy the sharing of practice and information part	Grade 11 probability.
Up to standard and beneficial to us.	Activities need to be improved to be familiar in GeoGebra usage.
Strategies on functions, lesson presentation	We were left behind on the usage of GeoGebra because we did not have laptops; if it can be possible to at least to have laptops to make sure things are done good; venue and accommodation of workshops must not change, this one was good.
Lesson presentation , handouts and at this I mostly appreciate the accommodation it was so convenient for the workshop	Providing learners with much resource books to use in our class.
The way how we can teach geometry, probability and functions to your learners	More strategies to teach probability and geometry.
Lesson presentation	Grade 12 probability.
Strategies to teach probability	Probability especially when the focus is on complementary events and facilitators should comment on the presentations that have been done.
It was most appreciated when my colleagues coached some of us who were unable to grasp especially in probability	I have a feeling that the respondents who came here are not comfortable in probability, still have that problem they had. I was not happy with the way presentation took place .we focused on solving problems other than being given skills and strategies on how to deliver probability to learners.
Workshop as a group with Venn diagram and use of GeoGebra in determining the probability using tree diagrams	Facilitation should comment on presentation done by education so as to know whether we are on track or not.
	When a group has been tasked to do a certain exercise ,the facilitators should wrap up after presentation by the group and make the solution clear to everything.

7.2.3 KwaZulu-Natal Evaluations

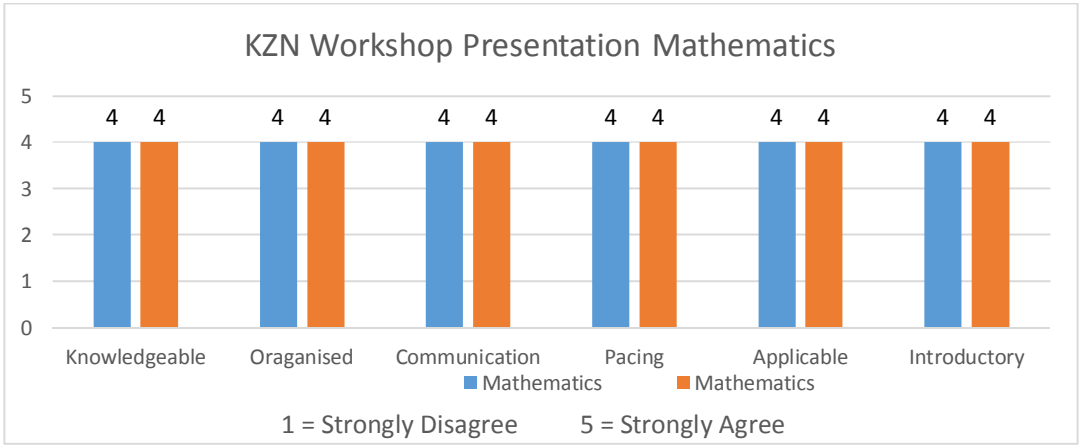
The following section presents the teachers' responses on the NECT MQA Evaluation forms from KwaZulu-Natal.

Figure 33: KZN Science Workshops Sessions 2 and Session 3: presentation



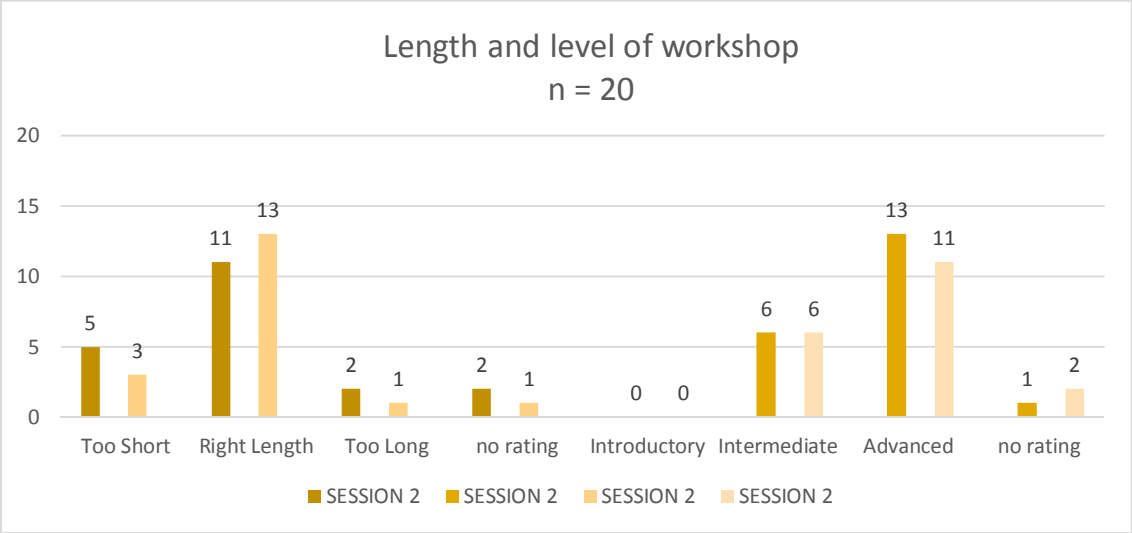
Teachers rated highly all aspects of the workshop presentations in the Science training, and in particular communication. No aspects of workshop presentation were rated poorly.

Figure 34: KZN Science – Presentation of Session 2 & Session 3 Workshops



In the Mathematics training sessions that were observed, all aspects of the workshop presentation were rated equally as being good. No aspect of the workshop presentation was rated poorly.

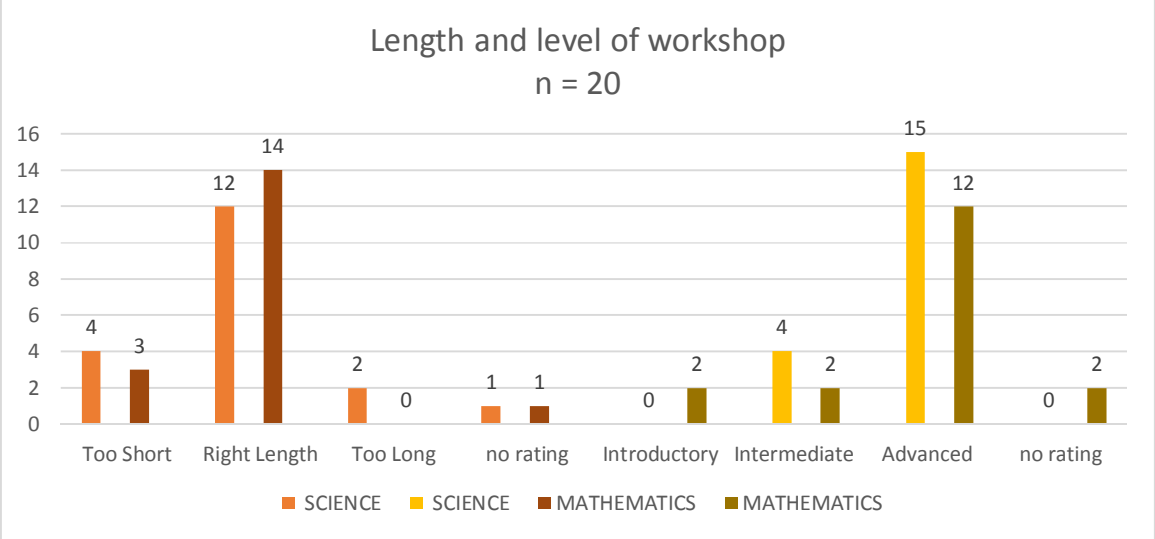
Figure 35: KZN Mathematics Session 2 and Science Session 2: length and level of workshop



In Science Session 2, more than half of the teachers felt that the workshop was the right length, but up to a quarter thought it was too short. A few teachers thought that the workshop was too long. In Mathematics Session 2 most teachers felt that the workshop was the right length.

In both Session 2 for Maths and Science, most respondents felt that the workshop was pitched at either advanced or intermediate level. None of the teachers regarded it as introductory level.

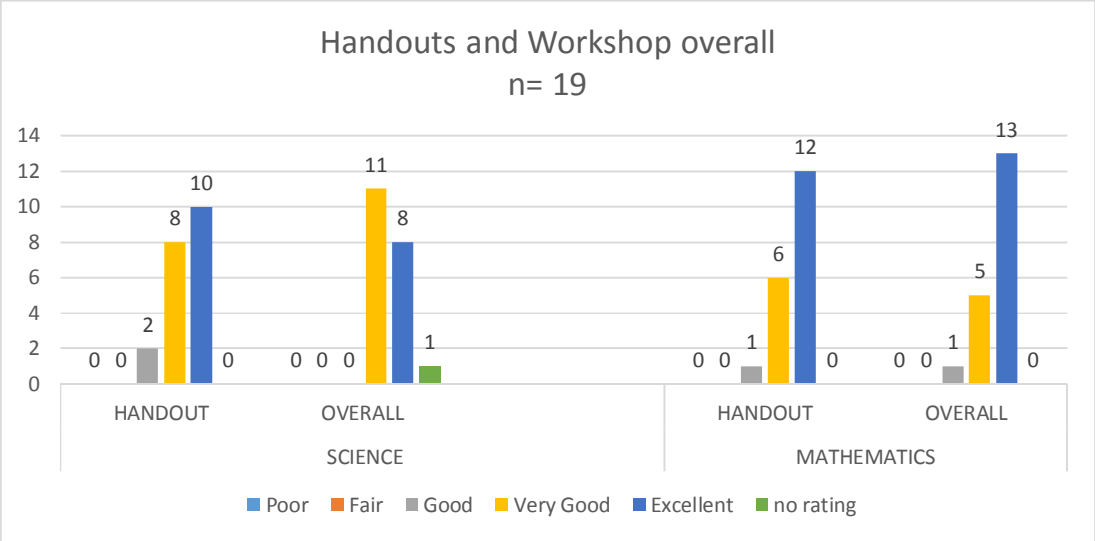
Figure 36: KZN Mathematics Session 3 and Science Session 3: length and level of Workshop



In both Maths and Science Session 3, most teachers felt that the workshop was the right length. A small number thought that it was either too long or too short.

The majority of teachers were satisfied with the pitch of the workshop, rating as advanced level. A small number thought it was at intermediate level and an even smaller number thought it was introductory.

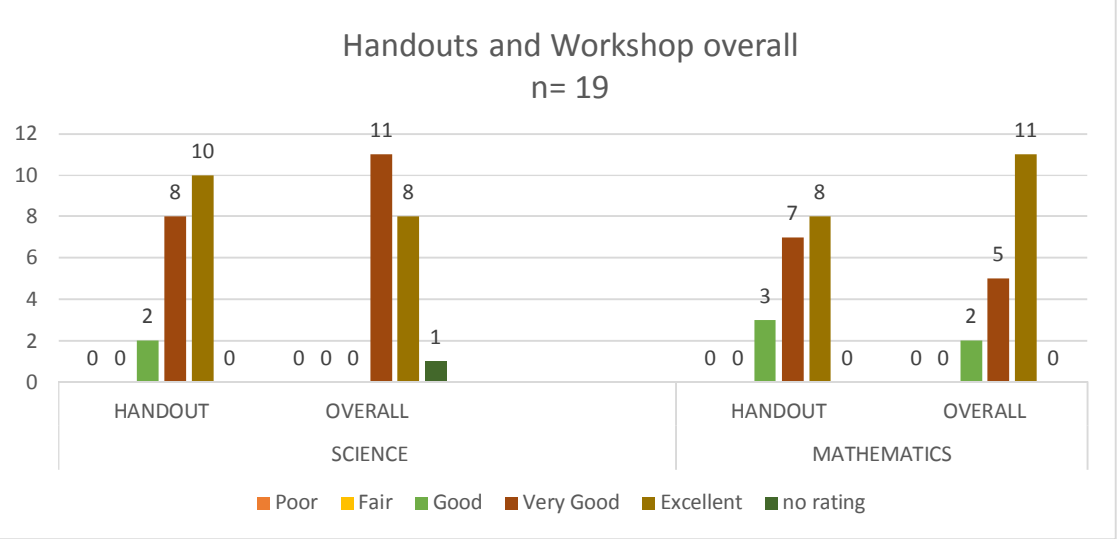
Figure 37: KZN Mathematics Session 2 and Science Session 2: handouts and workshop overall



In Science Session 2, most of the teachers felt that the handouts were Very Good to Excellent. Lowest rating for handouts was Good, given by only 10% of the teachers. The overall experience also received high ratings.

In Maths Session 2, more teachers rated both handouts and overall experience as Excellent. A small number felt that these were just Good.

Figure 38: KZN Mathematics Session 3 and Science Session 3: handouts and workshop overall



In Science Session 3, rating of handouts ranged from Good to Excellent, with just 2 out of 20 giving a rating of Good. Rating of workshop overall wasequally favourable.

In Maths, the handouts were given a consistently positive rating with most rating being Very Good or Excellent. There was a sub stantial majority rating of Excellent for overall experience in Mathematicss a rating of Excellent with a small minoity rating of Good. No rating of Poor was given for either aspect.

On the question of what teachers appreciated about the workshops, a large number mentioned opportunity to collaborate with other teachers and use of ICT in teaching maths and science. Also appreciated was coverage of content, methodology and trainers' facilitation skills. One teacher said they enjoyed "Being introduced to the new way of explaining concepts and drawing the structures."

On the question of what can be improved, many teachers felt they would benefit from more practicals and better time management. Some commented that the workshops were so good that they hoped they would continue: as one theacher put it, "I cannot see anything that needs any improvement, this workshop boosts us in terms of confidence and there is no workshop of any nature that I have attended like this. It is very informative and full of great ideas. It is super excellent!!! Keep it!!!"

Below are some of the opinions expressed by the KZN teachers.

Table 73: KZN teacher perceptions of workshops

What did you most appreciate/ enjoy/ think was best about the workshop content and delivery?	Which aspects of the workshop content and delivery do you think could be improved?
Group discussion and feedbacks making use of IT Skills	Nothing much except that duration for the workshop each day is a bit long.
In this workshop educators were given platform to share ideas on methods of teaching learners with difficulties.	Practical demonstration will be highly appreciated.
The content was very good.	I cannot see anything that needs any improvement, this workshop boosts us in terms of confidence and there is no workshop of any nature that I have attended like this. It is very informative and full of great ideas. It is super excellent!!! Keep it!!!
The respect of opinion from the teacher to another when presenting. The respect of opinion from the teacher in the facilitation.	Exposure on hands on practicals
If helps me to share information with other educators.	99
Sharing of information amongst educators	Material given to educators
Computer Usage	99
Software	Writing material, boards, smart technology
Being introduced to the new way of explaining concepts and drawing the structures	Time allocated to deal with curriculum matters on the school level
ICT (ChemSketch) and IT skills acids for bases	The presentation of facilitator
Explicit explanation and demonstration of permutations, combinations, Venn diagrams on ICT	More practice of ICT (technology) by teachers.
The workshop was well structure and well facilitated.	The use of technology in maths teachers
Explicit explanation and demonstration of permutations, combinations, Venn diagrams on ICT	More practice of ICT (technology) by teachers.
The workshop was well structured and well facilitated.	The use of technology in maths teachers

What did you most appreciate/ enjoy/ think was best about the workshop content and delivery?	Which aspects of the workshop content and delivery do you think could be improved?
The discussion and the information presented relevant to the work I do in class was very helpful.	Probability, I would have loved if we did more challenging worker or activities so as to see if we understood it; however, the work we did was very helpful.
The unpacking of Grade 12 counting principles and GeoGebra, the ICT part	So far what was alone was excellent but if they can also address other topics we find challenges on.
Sharing ideas with other teachers as well as getting the solution to GeoGebra	99
Discuss and debate around probability	Software part need more time
Venn diagram	ICT skills
To exchange views about mathematics. Learn from more practical experienced colleagues and share.	There must be more emphasis on the content, more practical examples and demonstration.
Enjoyed the meals, Appreciated the presentation buy Prof Msomi..	Fundamentals counting principles

7.2.4 CASME Evaluations

All Science (32) and Mathematics (293) respondents attending the workshop on day 3 took part in CASME workshop evaluations of different training sessions.

Libode

Figure 39: Libode Session 2: contact sessions

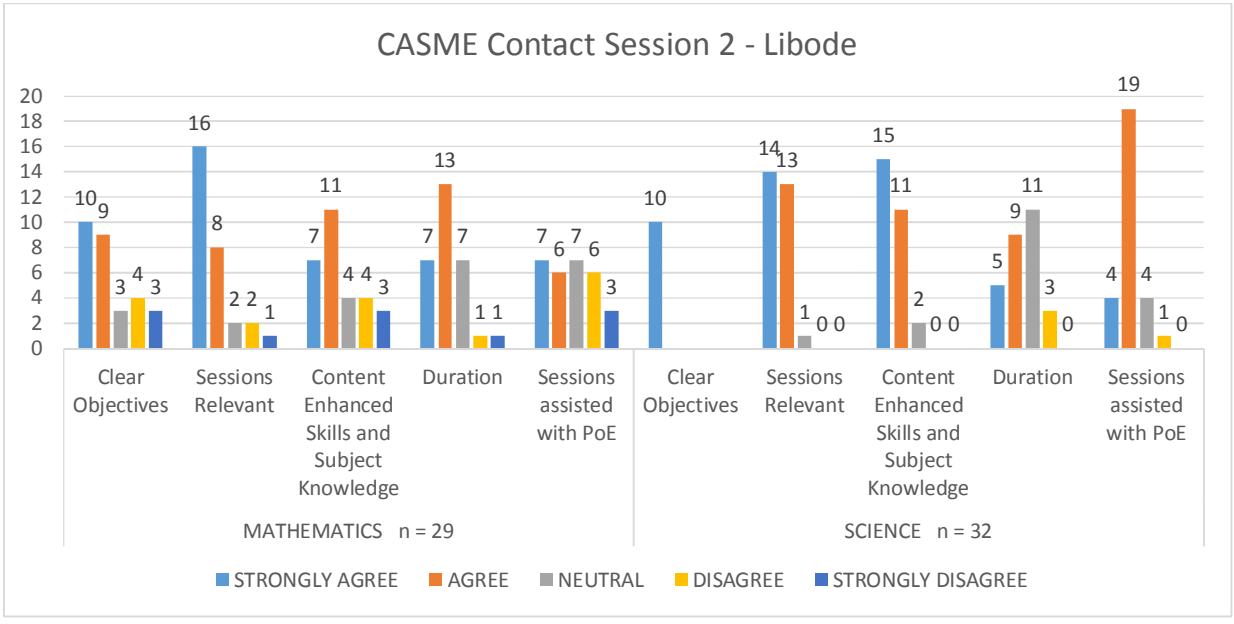
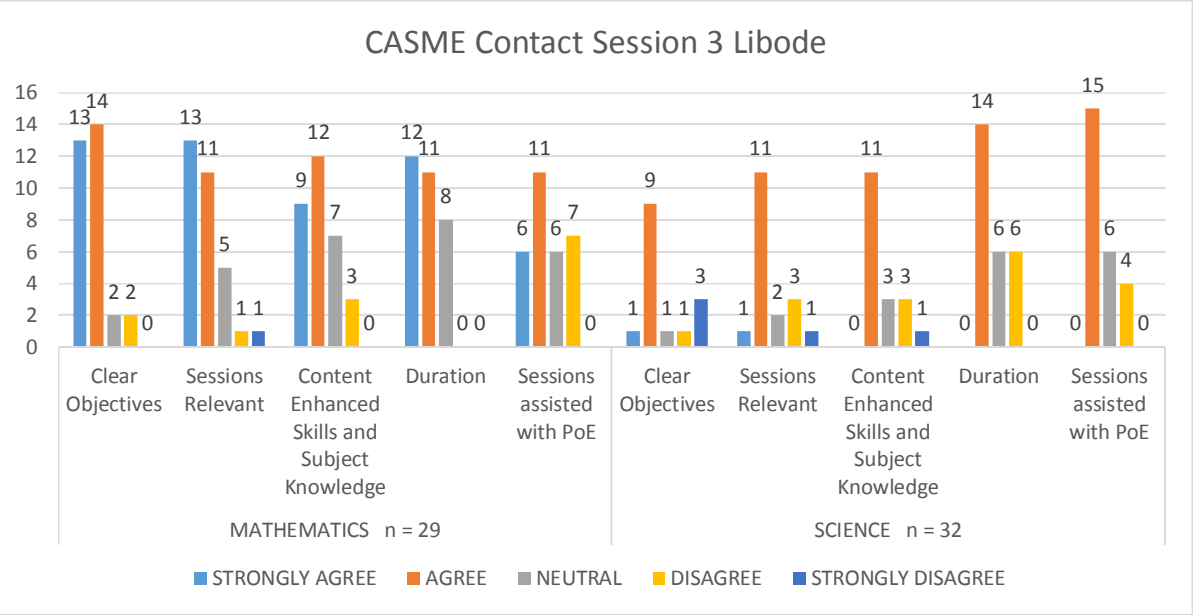


Figure 40: Libode Contact Session 3



In the rating on Contact Sessions 2 and 3 of the workshops for Mathematics and Science, the teachers rated the objectives to be clear and indicated that the content enhanced their skills and subject knowledge thus making the session relevant. In the PoE support, the Maths and Science groups differed in their rating: in Maths only 6 and 11 teachers in the respective sessions felt that the sessions guided them in the completion of their PoE, whereas in Science respectively 19 and 15 teachers agreed. Duration of each session was seen to be in line with the teachers expectations.

Figure 41: Libode Session 2: training in general

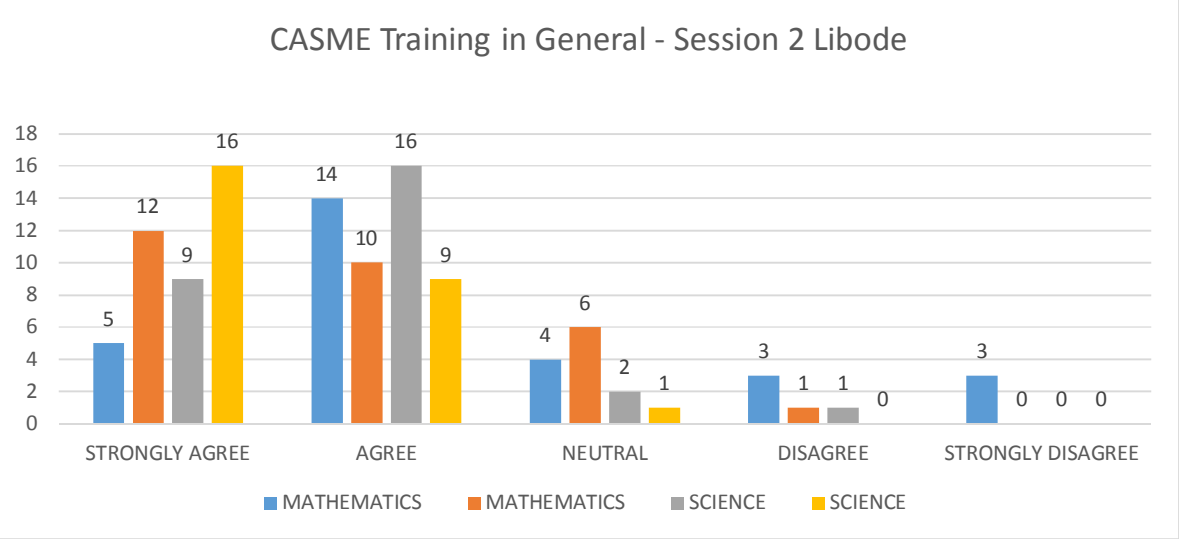
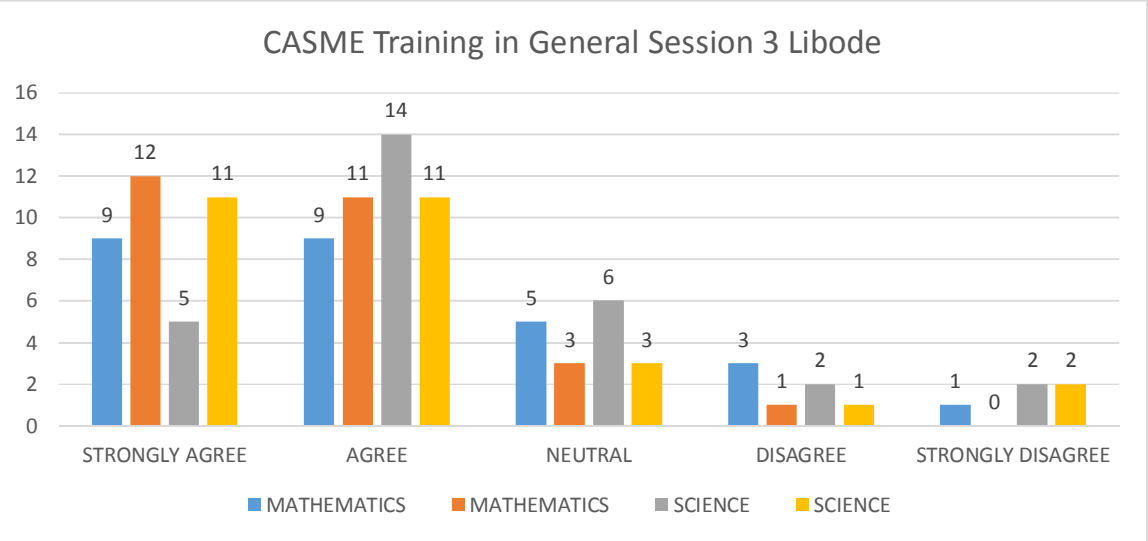


Figure 42: Libode Session 3: training in general



The charts provided above give confirmation that teachers found the facilitators knowledgeable about content and felt that the training experience would help them when they returned back to school.

The following table gives some of the responses from teachers on what they regarded as the most and least valuable aspects of the contact sessions.

Table 74: Responses on most and least valuable aspects of the training sessions

What do you feel were the MOST VALUABLE aspects of the sessions?	What do you feel were the LEAST VALUABLE aspects of the sessions?
Exposure to use of GeoGebra	Time management
Discussions and presentations	In probability the facilitators lost time management and concentration on their duties and the presentation were dull with no directions at all.
I am not because as I came here was expecting the introduction of function and laptop as promised in January session but no one is met.	All chapters must be revised on these programmes … no revision.
Knowledge on GeoGebra and Euclidean geometry. The use of technology in teaching.	When I came to this workshop I was expecting more method of teaching functions.
The presentation from the teachers.	Discussion that were time consuming unnecessarily.
To work as a group and share some ideas and skills.	There were times when facilitators were unsure about what to do next.
To stick to those which are difficult for the learners to apply.	

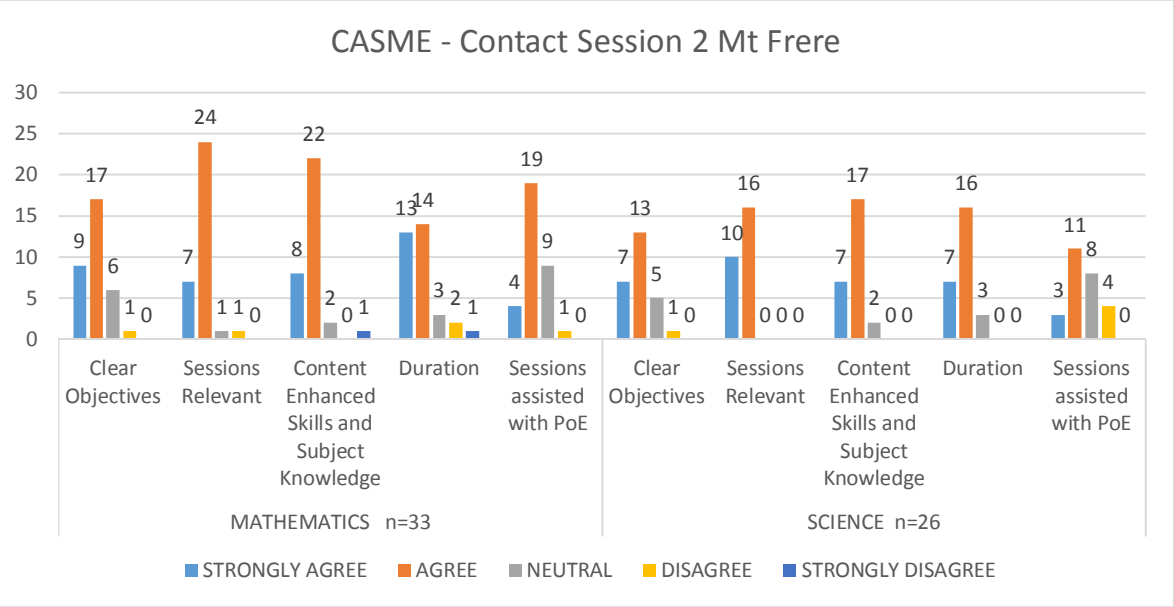
Mt Frere

At the end of the workshop teachers were asked to evaluate the training online by logging onto a link sent via email and were given an evaluation form to complete.

This was administered and completed on day 6 of Session 2 and day 9 of Session 3 in Mathematics and Science. The evaluation covers the following fields: contact sessions, training in general and most and least valuable aspects.

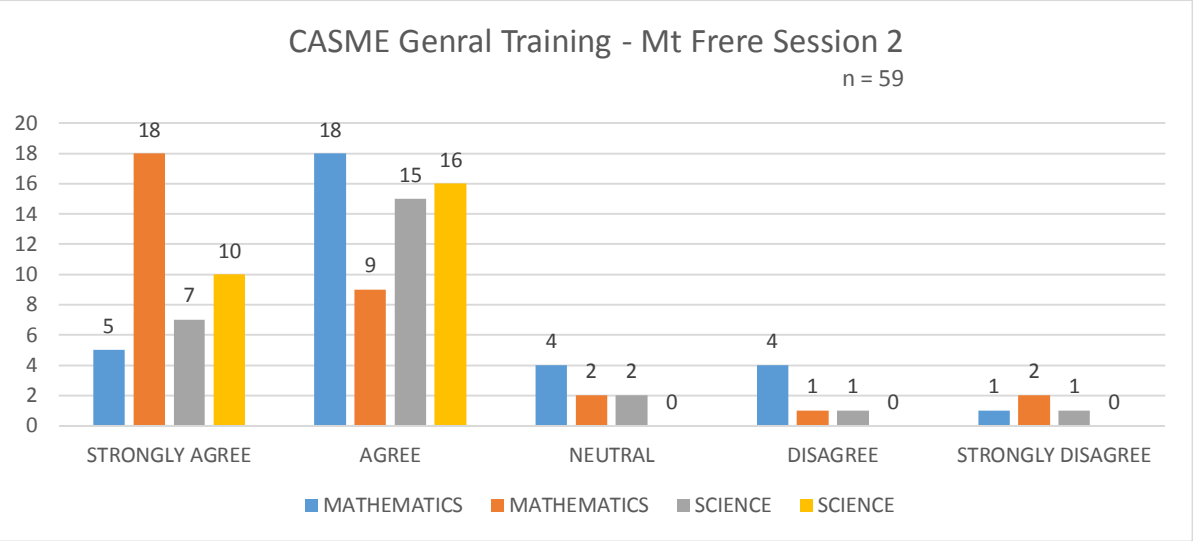
All of the 79 workshop participants participated in evaluations of different training sessions. The rating were from 1 to 5, where 1 = strongly agree and 5 = strongly disagree. A summary of the responses obtained from the participants is given below:

Figure 43: Mt Frere Contact Session 2



At least 72% of the teachers found Session 2 relevant to their needs. There was a positive response on whether the sessions assisted understanding of the PoE.

Figure 44: Mt Frere general training in Session 2

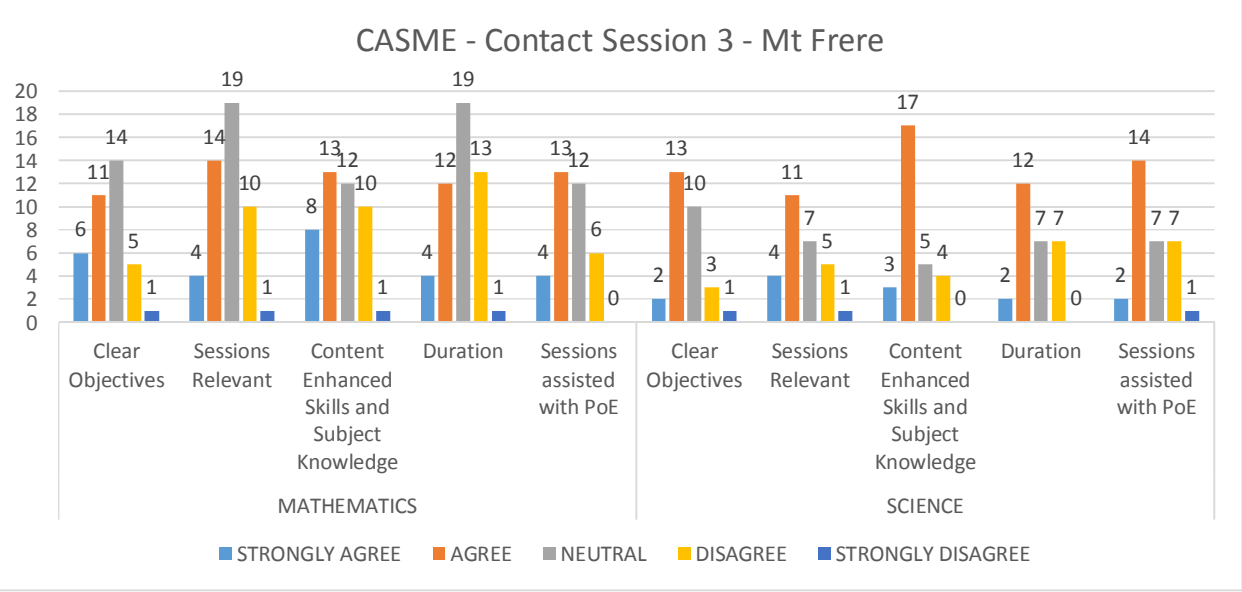


Overall, 74% of maths and science teachers found the training to be very useful in their work, with some who disagreed on this point.

Table 75: Mt Frere responses on most and least valuable aspects of the training sessions

What do you feel were the MOST VALUABLE aspects of the sessions?	What do you feel were the LEAST VALUABLE aspects of the sessions?
The presentation from various groups doing the activities, the sharing of different possible ways to answer the same question.	My colleagues helped me instead of assistance from the facilitators.
The presentations were good, the activities we were given were assisting a lot and also the different methods.	Time was not managed properly.
The grade 11 work on probability was thoroughly covered.	Tutors did not give us answers (in most cases) on the activities given.
Probability section was discussed clearly by the facilitators, and it is where I needed help the most.	None. Suggestion! Next time contact session like this one are conducted, there should be more focus on the how part i.e. How to introduce topics more than the content itself.
Under probability using the tree diagram to answer questions and permutations and combination we valuable.	Where We went through the programme book was a mere reading of what was in the manual.
The most valuable aspects of the session were the ways of presenting the content to the learners.	Time management can be improved.
To improve the knowledge in probability also different types of questions were discussed it help the learners to understand.	The facilitators must present the content and teacher must give addition not the other way round to entrance more understanding.
Group works, demonstration of GeoGebra.	
The session was very good because the issue of probability is a challenge in my school.	
The most valuable aspects of this session is that this training experience will be useful in my work.	
The content and strategies to introduce probability.	
The discussion was good because I managed to correct some misconception where I do not understand.	

Figure 45: Mt Frere Contact Session 3



In Mathematics Session 3, the teachers tended to be neutral about the training, especially on content area and workshop duration. This contrasted with Session 2, where they thought the session was relevant and the duration was appropriate. The science teachers were happy with the contact session overall, with not much change from the previous session. There were fewer teachers disagreeing with the statements on the evaluation form.

Figure 46: Mt Frere general training Session 3

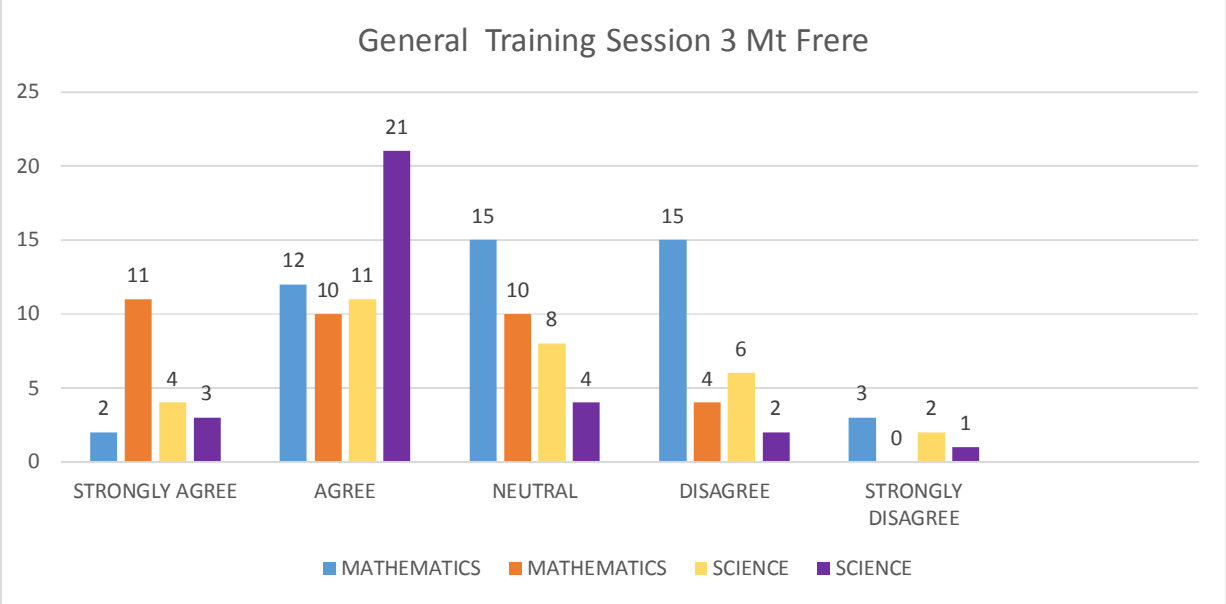


Figure 46 shows that the science teachers found the training very useful and felt they would be able to use it in their teaching, more so than the mathematics teachers did. The mathematics teachers gave low ratings on tutor content and mastery. This related to some of the comments given below in which mathematics teachers comment that the facilitators were not strong enough in their content knowledge and did not give sufficient assistance where needed.

Table 76: Mt Frere responses on most and least valuable aspects of the training sessions

What do you feel were the MOST VALUABLE aspects of the sessions?	What do you feel were the LEAST VALUABLE aspects of the sessions?
The presentation from various group doing the activities, the sharing of different possible ways to answer the same question	My colleagues helped me instead of assistance from the facilitators.
Content	Need to hire specialist in the topics.
The Grade 11 work on probability was thoroughly covered.	Time was not managed properly.
The most valuable aspects of the session were the ways of presenting the content to the learners.	Tutors did not give us answers (in most cases) on the activities given.
To improve the knowledge in probability also different types of questions were discussed it help the learners to understand.	Suggestion! Next time contact session like this one are conducted, there should be more focus on the how part, i.e. How to introduce topics, more than the content itself.
Under probability, using the tree diagram to answer questions and permutations and combination were valuable	The facilitators must present the content and teacher must give addition not the other way round to entrance more understanding.
Contributions and collaboration amongst experienced or inexperienced educators.	Where We went through the programme book was a mere reading of what was in the manual.

UThungulu

All Science (32) and Mathematics (33) teachers attending the workshop on day 3 took part in CASME workshop evaluations of different training sessions.

Figure 47: uThungulu CASME Contact Session 2

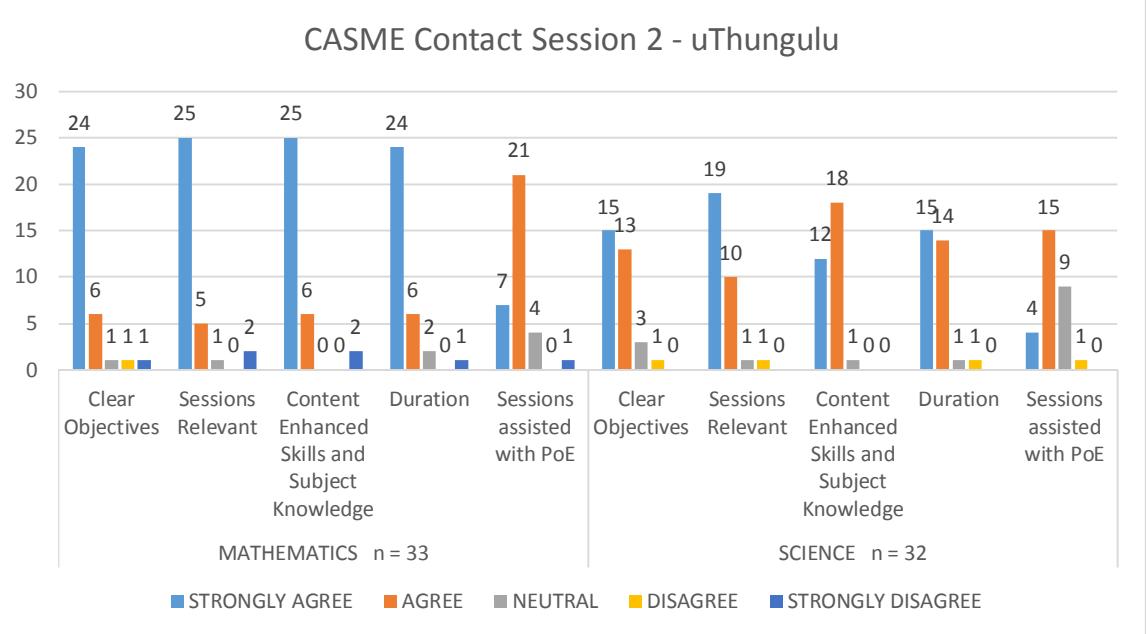
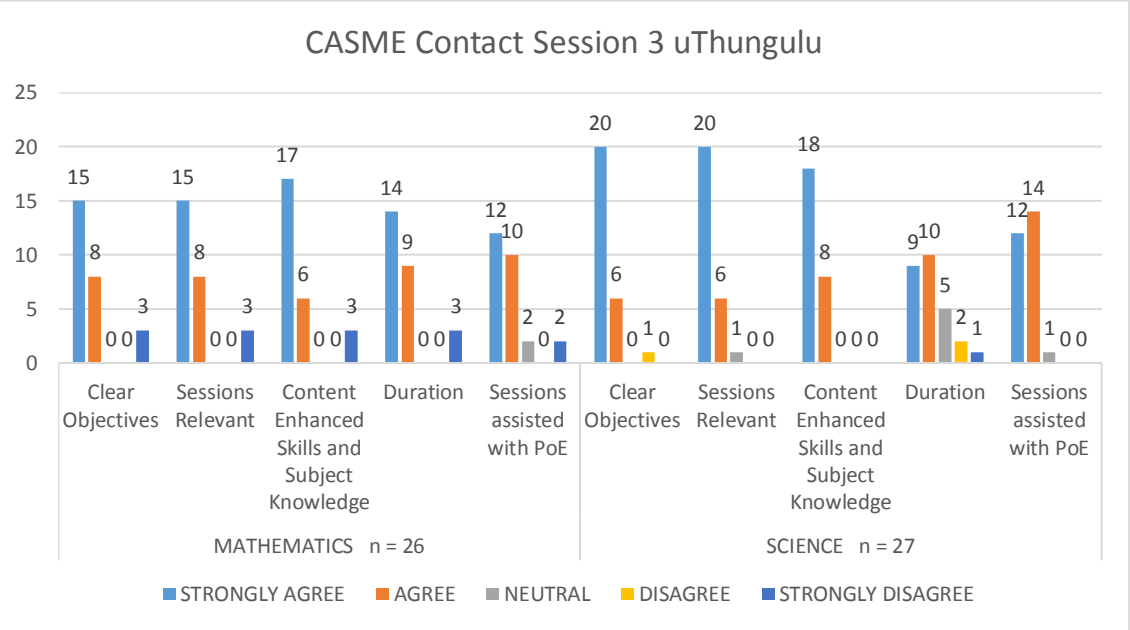


Figure 48: uThungulu CASME Contact Session3



In their ratings on Contact Sessions 2 and 3 of the workshops for Mathematics and Science, the teachers found the objective to be clear and felt that the content enhanced theirs skills and subject knowledge, thus making the session relevant. Support for PoE received lower ratings in Mathematics than in Science.

In Mathematics and Science Session 2, 60% of the teachers felt that the general training in the workshop was competently presented and that the training was useful for their field of work. Similar perceptions were expressed for Science in Session 3. Only three teachers in Mathematics and one in Science strongly disagreed that the three-day workshop sufficed for the content that had to be covered

Figure 49: uThungulu training in general

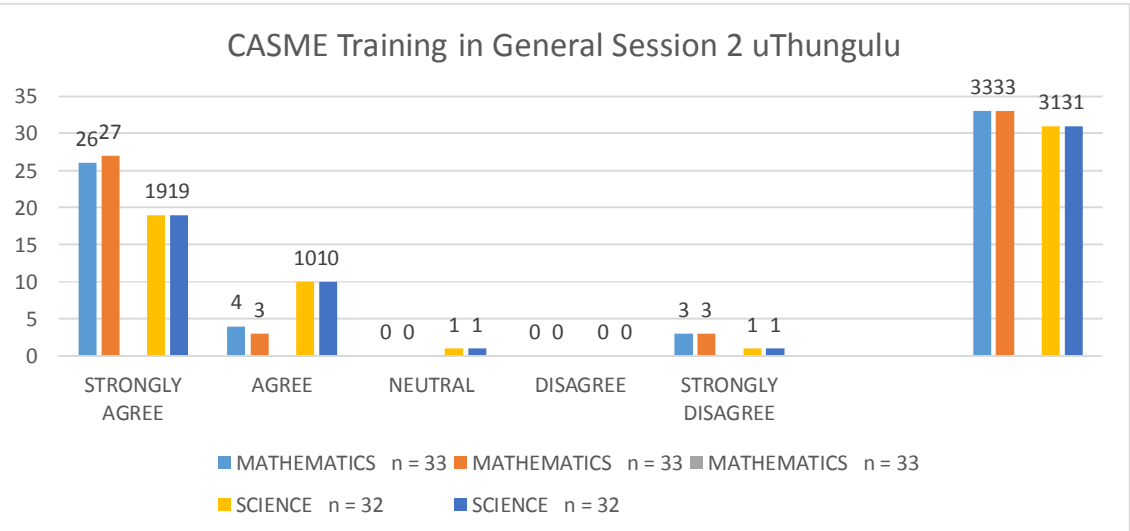
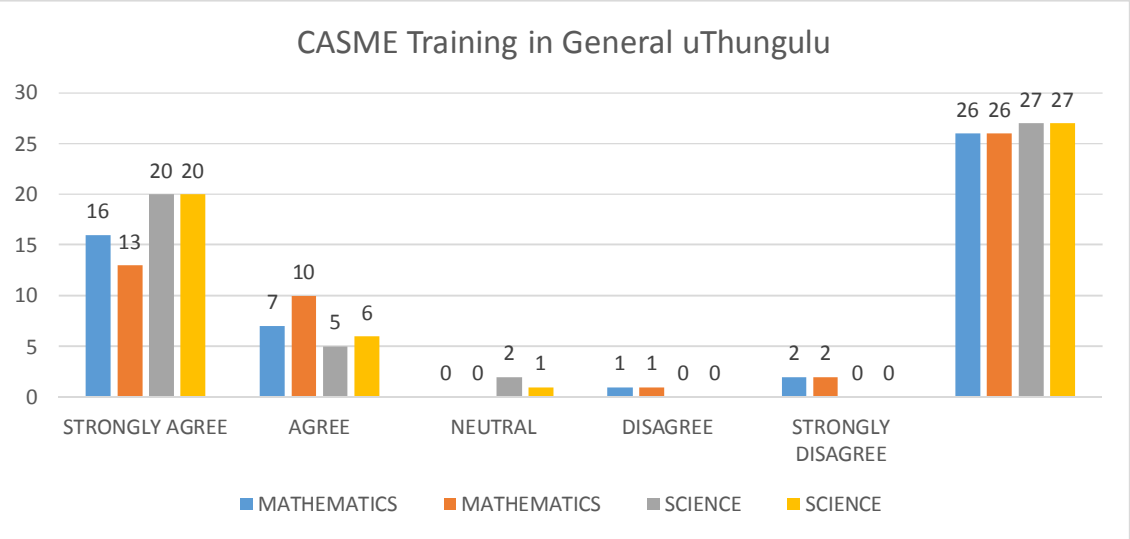


Figure 50: uThungulu training in general



In Science Sessions 2 and 3, a large number of teachers gave responses on what they found most valuable and least valuable in the training. These are tabled below:

Table 77: uThungulu responses on most and least valuable aspects of the training sessions

What do you feel were the MOST VALUABLE aspects of the sessions?	What do you feel were the LEAST VALUABLE aspects of the sessions?
Learning functions in GeoGebra	Time management
The use of laptops to type, enhancing skills	I would prefer it to be over the school holidays, rather than the on weekends.
Skills learnt in a practical way	The Pre-evaluation and post-evaluation
Hands on practicals and activities	Less Discussion in the last contact session, unlike the first two contact sessions
The drawing of Graphs when setting test	
Use of GeoGebra to draw graphs	
Explanation of Content	

Pinetown

Figure 51: Pinetown CASME Contact Session

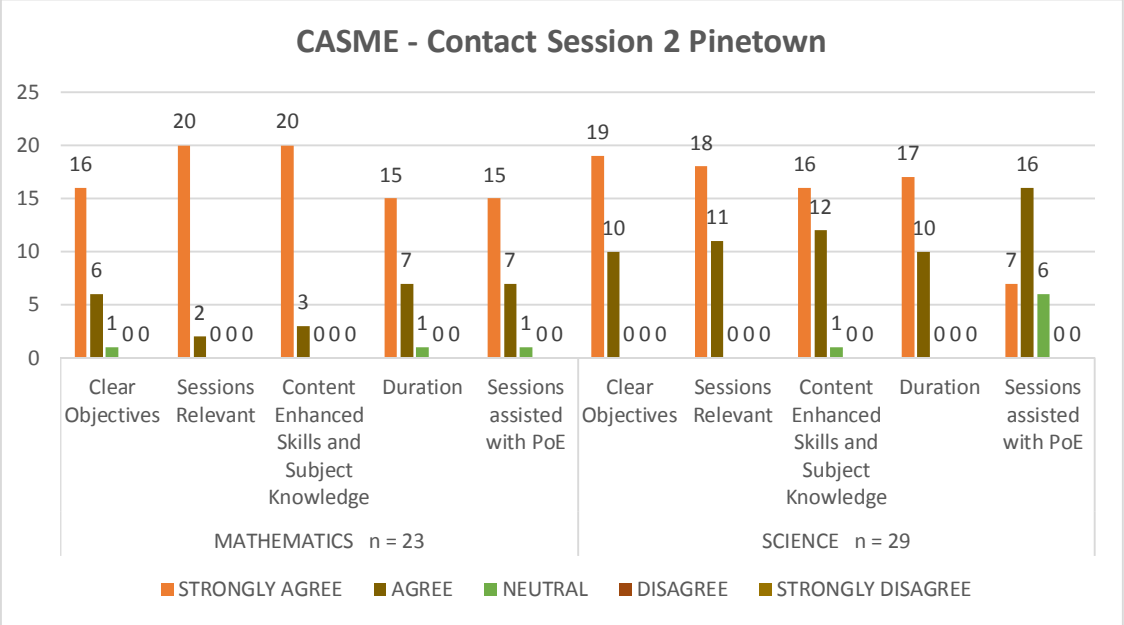


Figure 51 indicates that the Pinetown teachers enjoyed their Session 2 contact, with 73% finding the sessions very relevant and useful for their classroom teaching.

Figure 52: Pinetown training in general

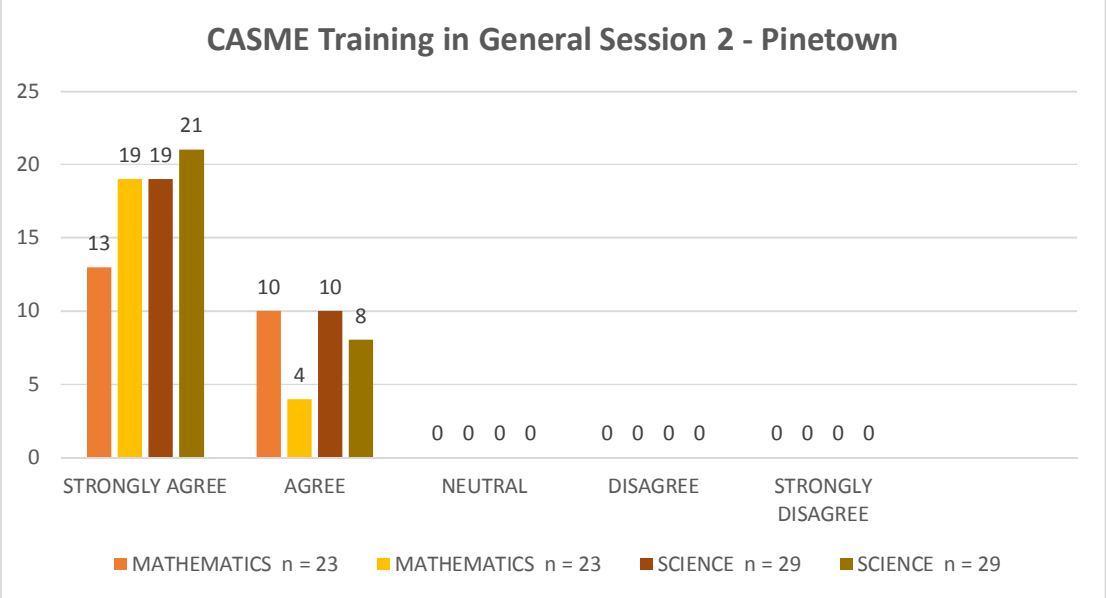


Figure 52 indicates that all the teachers in Session 2 at Pinetown found the facilitators' content knowledge very good and effective in their training sessions.

Figure 53: Pinetown Contact Session 3

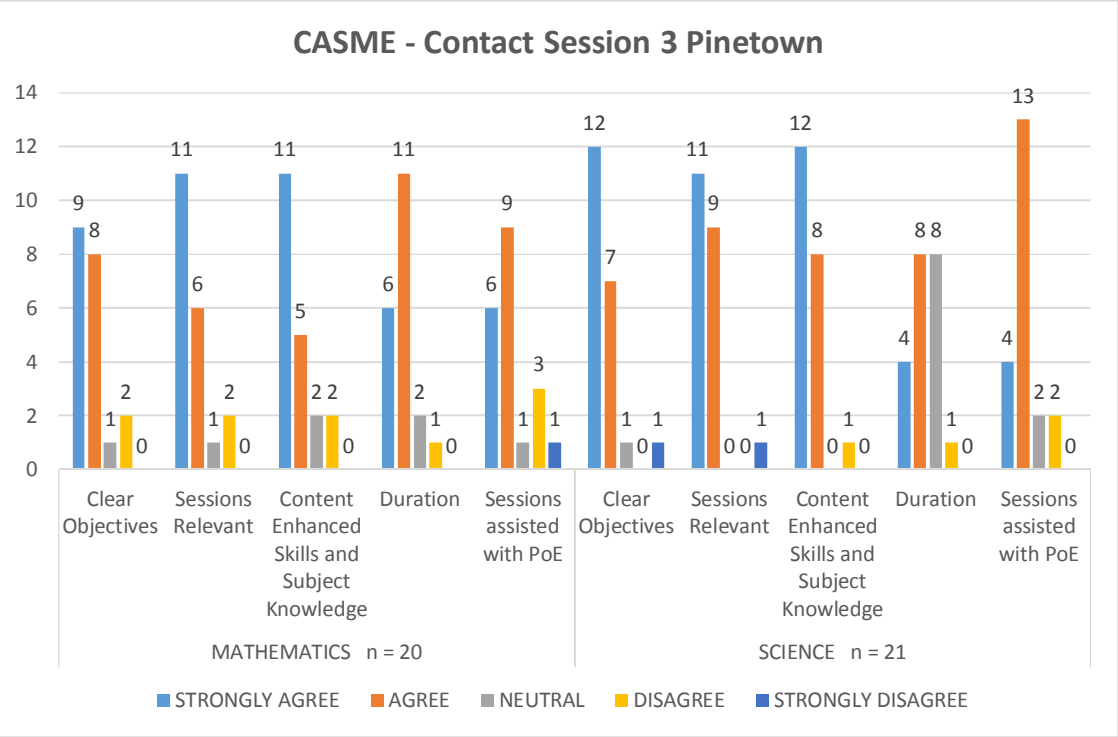
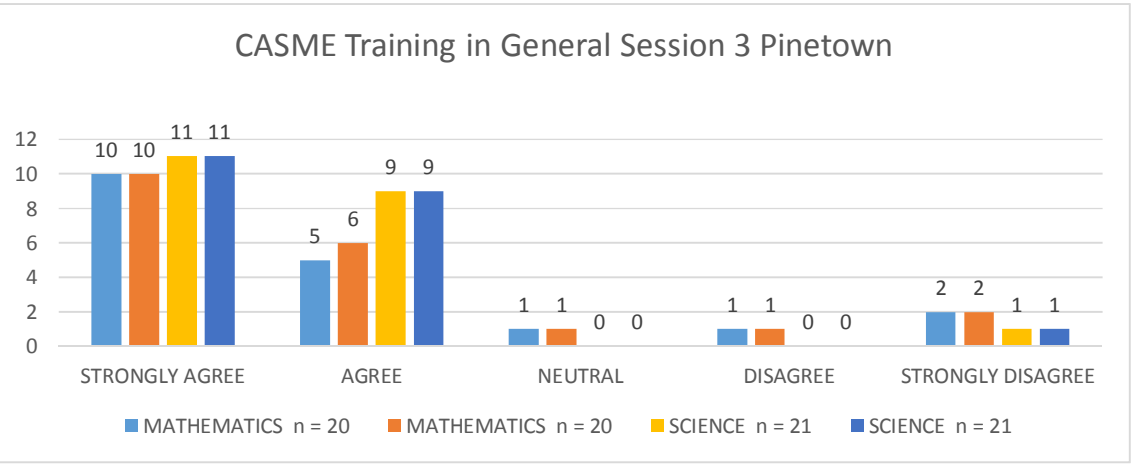


Figure 53 indicates overall that the contact session was successful. At least half the teachers thought the sessions were very relevant and felt they would be able to use this in the classroom.

Figure 54: Pinetown general training Session 3



Only a few of the teachers felt that the training was not useful. One teacher in Science and two teachers in Mathematics thought that the training was not applicable. Three teachers said that the facilitator's content knowledge was inadequate.

Table 78: Pinetown responses on most and least valuable aspects of the training sessions

What do you feel were the MOST VALUABLE aspects of the sessions?	What do you feel were the LEAST VALUABLE aspects of the sessions?
Interaction between teachers and facilitators	Portfolio of Evidence was confusing.
Trigonometry, GeoGebra and Functions	Organic Chemistry and Acids and Bases.
Learning the application of ICT in classroom practice and discussing the misconception of each topic at school and how to address it	If there were more practical demonstrations that are helpful to teachers.
The use of GeoGebra and more practical examples	If there were more practical demonstrations that are helpful to teachers.
Sharing ideas with other teachers. Content coverage, how to answer, How to teach the content and New strategies	Time.
Discussions - when people voiced out their expertise concerns, challenges, experiences so we all benefited and learnt from each other	

7.3 Portfolio of Evidence

7.3.1 Introduction and Purpose

The Portfolio of Evidence (PoE) puts emphasis on collection of evidence to validate and describe relevant accomplishments in the Short Course for SACE accreditation.

In addition to serving as a personal reflection of participants' learning, the PoE provided a mechanism for encouraging teachers to take what they had learnt in the contact sessions back to their classrooms.

As part of the course teachers completed a PoE and a Post-Assessment. One of the PoE requirements tasked participants with setting a 50-marks question paper with suggested solutions for the topic of their choice across the FET band. Teachers were asked to pay particular attention to cognitive level of questions. This component of the PoE is to be submitted electronically and will provide an assessment of ICT skills application.

These papers will be graded and corrected and compiled into a CD. Teachers will then use these CDs as a question bank.

8 CONCLUSION

In relation to curriculum and pedagogy the results of this study suggest that the following measures (not necessarily mutually exclusive) are likely to have the most effect on learner performance:

- Supporting teacher knowledge on basic fundamental concepts such as the number system and guiding them on how to build a sound grasp of the number system and basic mathematical functions.
- Assisting teachers in fast-tracking learning outcomes, such as comprehension skills and abstract operations, expected to be routine for Grade 10 learners.
- Introducing methods which utilise a flexible understanding of the number system as the foundation for all higher-order problem-solving skills in mathematics.
- Monitoring and supporting teachers in achieving all outcomes at the end of each respective Grade, especially in secondary schools. Such measures should include regular assessment of learner performance which is moderated and monitored at school and district levels.
- Taking account of the need for foundational skills in mathematics.
- Exposing teachers to valued knowledge such as "applied" mathematics concepts and ways of imparting these skills to the learners.

Having the teachers write the pre- and post-tests enabled us to see that with some of the teachers, despite good training presentations, there was very little improvement in the prescribed domains (just three in mathematics and five in science). This raises serious concerns for teaching and development of mathematical and scientific concepts in regard to "progression of knowledge through the grades or curriculum", what teachers are expected to do and can do, and the skills and competencies they should have acquired. The fact that almost half our teachers scored no more than 50% shows that they have learnt very little (if any) mathematics and science despite years of experience.

This forces each of us to reflect on our own career in education going back to the 80s and 90s and then the commencement of testing in 2002. What, then, has been achieved and how does this round of short courses help in trying to move forward? This report of our short-course project is a brief snapshot of activities and achievements from which, as researchers and developers, we may be able to extract meaning and insight.

The paramount question that these statistics raise for us is "When did a 50% average become a mark of excellence for teachers or learners?" One possible explanation may be fear of statistics for most ordinary people which makes them clutch at 50% as something they can understand. Would Mandela have condoned even just discussing 50% as a benchmark? In his memory it behoves us, as a nation, to aim higher in all dimensions and the time has come for educational activism. Kader Asmal once said that governments cannot run campaigns, so it is civil society that must stand up and count and read! "Each one, teach one" becomes a watchword that must be heeded for true liberatation.

Looking at the competency levels nationally brings several important points to light.

This round of teacher testing may have disclosed a dismal baseline, but the post-test after the intervention revealed pockets of excellence that indicate what can potentially be done. Small numbers of teachers *are* doing extremely well, but there are too few of them. The results tells us in

no uncertain terms that that the content/pedagogy/knowledge of our teachers compounds the disadvantages of the disadvantaged, dispelling any chance they might have had for further education.

Sleight of hand is being perpetrated on the masses; mathematics results in the higher grades, particularly Grade 9 onwards, are frightening, and if the trend is not reversed we may end up with 90% of our learners doing Mathematical Literacy, which will hugely extinguish hopes for national achievement. Expediture needs to be redirected where it can really make a difference, and there are are enough knowledgeable people in education in South Africa who could be put in harness to help government make this difference.

The fall-off in ability to answer questions in the baseline evaluation is a damning commentary on the way teachers have been misdirected in their calling over the last 20 years. Similarly the continuing numbers of teachers unable to reach 50% will have long-term repercussions for the growing numbers of unemployable youth in the country.

Part of the problem is that teaching now aims at the lowest common denominator and it is definitely time to introduce creatively designed differentiated teaching approaches that teachers can handle in the 40+ classes which most of them are still faced with. Mathematics, Science and Language (we MUST include Language) are gateway subjects and need particular kinds of attention for particular learners; one size cannot fit all. At the crucial juncture that we have now come to in our classrooms, what government, through the ETDP SETA, can and should do is to ensure that teacher tests (such as those that feature in this report) are of the highest quality in terms of accuracy and levels of questioning.

This ETDP SETA Short Course should be a leading example to government and teachers of where exactly teachers should be in terms of ability and achievement. Excellence amongst teachers should be rewarded. These results offer interesting new insights for national education and every opportunity should be seized, particularly through additional qualitative and ethnographic studies, to get a better understanding of why teacher performance takes on the characteristics that have emerged in this ETDP SETA Short Course intervention.

APPENDICES

ALL APPENDICES WILL BE ADDED TO A CD