



**Western Cape Strengthened
Mathematics Strategy
2022 - 2027**

Team Maths

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FOREWORD: SG : Mr B Walters



I am pleased to introduce to you the Western Cape Education Department (WCED) Mathematics Strengthening Strategy: 2022- 2027.

The improvement of Language and Mathematics skills is a priority of the WCED. While Language provides the foundation for all learning, Mathematics plays a crucial role in understanding the contents of other school subjects and it plays a vital role in all aspects of life. In many professions, a strong mathematical background is required. It also encourages analytical thinking and problem-solving which are important skills for the 21st century.

Whilst we have invested heavily in teacher training and development over the years, the recent pandemic and subsequent learning losses have accelerated the need to further support our educators' understanding and delivery of Mathematics in the classroom, particularly in this ever-changing digital world. The Western Cape systemic tests, conducted in 2021, highlighted the need to strengthen our existing Language and Mathematics strategies further, thus ensuring that our schools and educators are capacitated to facilitate high-quality learning in Language and Mathematics.

This requires further professional development and training, the constructive use of productive pedagogies, the creation of professional learning environments, research, partnerships, advocacy, and parental and community support. If we are to attain our vision for quality education for every child, in every classroom, in every school in the Province, then we also have to reinforce the overall quality learning experience of the learner, i.e. their classroom environment, their resources and their self-esteem.

The results of the 2021 systemic tests were a harsh reminder of what needs to be achieved. The COVID-19 pandemic has impeded upon many of the gains we had made prior to 2020, but we also face the realisation that our world, the environment in which we operate, and the opportunities that our learners will be presented with in future, have also changed forever.

What has remained constant is the importance attached to reading, writing, and calculating, therefore, the alignment of all our strategies is required.

This document, together with the other strategies implemented by the WCED, will serve as a platform for further progression, innovation and support as we all work together in attaining our vision for quality education for all.

FOREWORD: DDG: Mr H Mahomed



The need to continuously strengthen the teaching and learning of mathematics is self-explanatory in education generally, and in South Africa, in particular. Competence in the skills offered in mathematical learning is necessary to perform all the tasks of living i.e birth, shelter, food, relationships, productive and creative activity and burial. The core skills to be learnt in maths such as working with numbers, reasoning, proportions, time, space, shapes, size, forming conclusions are required universally. However, there are many challenges with universal access and success in mathematical learning. Among these, is the difficulty levels with the most highly developed forms of Maths knowledge and its consequent unpopularity with many learners.

In South Africa, the legacy of unequal education and training, and inferior Maths education for the majority of learners has led to a low base of learning improvement in the subject and the change efforts in post-Apartheid South Africa has led to improvements but at a very slow pace.

For example, in the last TIMSS (Third International Maths and Science Study), the South African mathematics score of 389 and the science score of 370 at Grade 9 Level is an increase of 17 points for mathematics and 12 points for science from the 2015 TIMSS report. However, this constitutes 41% of mathematics learners demonstrating that they had acquired basic mathematical knowledge and 36% of science learners acquiring basic science knowledge. From 2011 to 2019, Western Cape achievement scores significantly increased by 33 TIMSS points for mathematics and 26 TIMSS points for science. The best achievement improvements were among the lowest performing learners. In 2019, six in ten learners demonstrated that they had acquired basic mathematical and scientific knowledge, but there are differences by school type.

Whilst we celebrate the improvements nationally and provincially, the size, scope, and complexity of the quest to attain quality maths learning for all learners, remains a huge task which requires ongoing attention, resourcing, planning and execution. The WCED Curriculum team thus, after reflecting on the progress with Mathematics and Science performance, decided to strengthen the work done in the field to maintain the upward trajectory and accelerate and deepen levels of attainment where possible.

This document aims to strengthen in the following areas, increased attention to primary school & science, language proficiency and reading for meaning, writing exercises, textbooks and workbooks, safety and orderliness in schools, much stronger educator preparation, and Professional Development, and classroom engagement practices.

Given the large declines in Maths performance caused by the two years of reduced learning time, the challenge becomes even more severe and the WCED, therefore, encourages all schools to keenly implement school based professional development programmes as these have demonstrated to be highly effective.

We look forward to the contributions of all role-players in this work: the WCED, educators, learners, parents, higher education institutions, unions, NGOs, private sector, community, faith-based, sporting and cultural organisations.

1. INTRODUCTION

Mathematics is a compulsory subject in South African schools up to Grade 9. All learners in Grades 10 to 12 choose between Mathematics and Mathematical Literacy. Learners at Technical High Schools choose between Mathematics and Technical Mathematics. Before 2006, many learners in these grades opted out of taking any form of Mathematics.

Various international assessments have provided evidence of poor learner performance in Mathematics in South Africa.

Against this background, this provincial mathematics strategy aims to achieve the following:

- Enhance the quality of Mathematics teaching in all schools
- Improve mathematical learning for all learners
- Improve the quality of passes in the school subjects
- Increase the number of learners taking and passing Mathematics in Grades 10 to 12

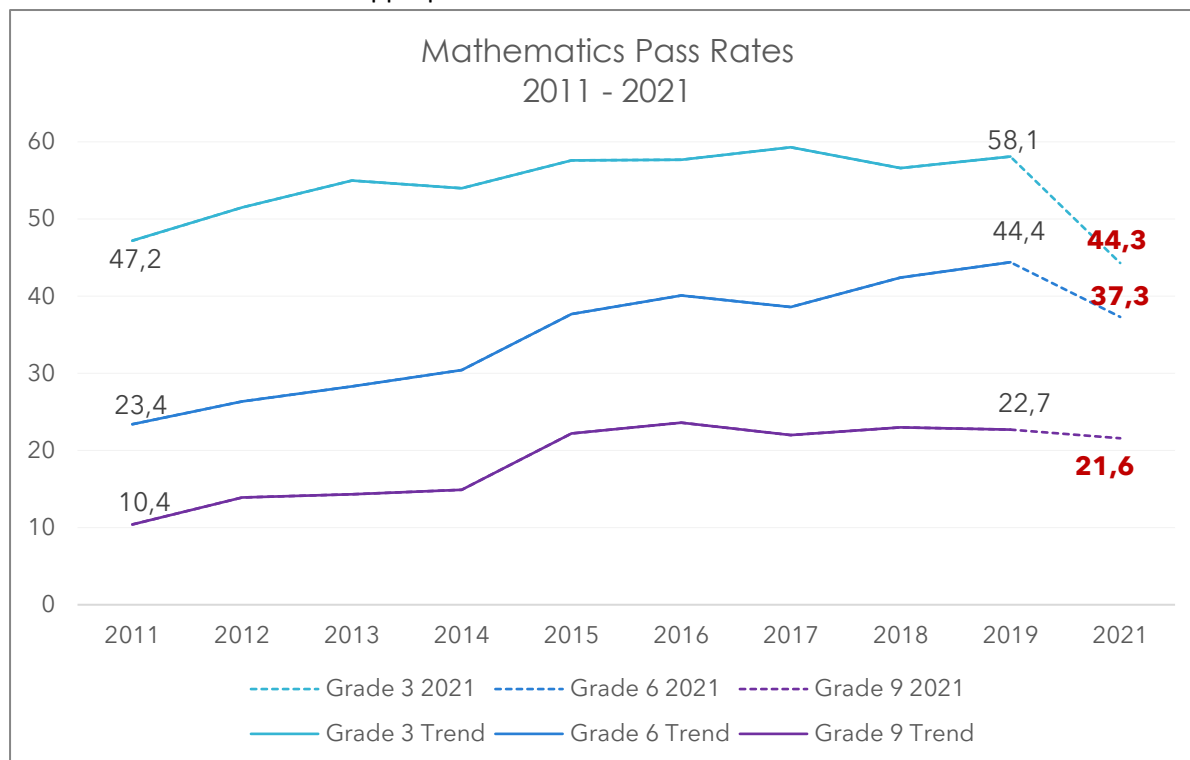
2. PREAMBLE TO THE WCED MATHEMATICS STRENGTHENING STRATEGY

2.1. CONTEXTUALISATION:

2.1.1 WCED SYSTEMIC TESTING:

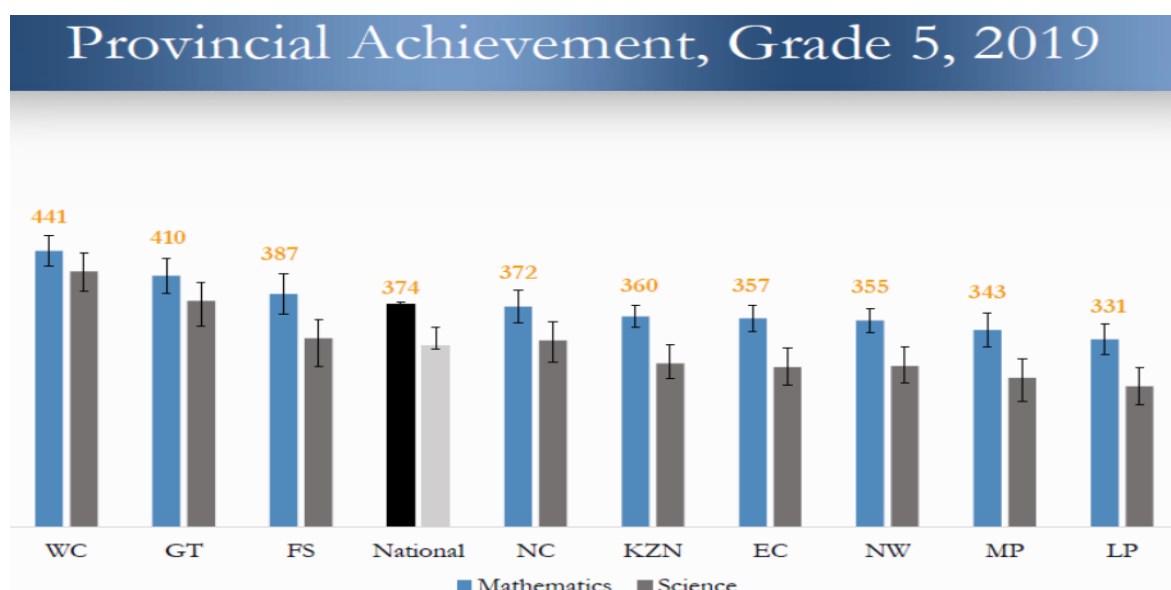
The objectives of Systemic Evaluation are to:

- determine the context in which learning and teaching is taking place
- obtain information on learner achievement
- identify factors that affect learner achievement and
- make conclusions about appropriate education interventions



The 2021 Systemic results showed a drastic decline in the pass percentage in Gr 3 and 6. This could be attributed to the impact of the Covid-19 pandemic. A general drop in results was expected, taken the huge time losses as well as the reduced curriculum into consideration and the reciprocal exposure to a full scoped test series, based on a full time and full curriculum.

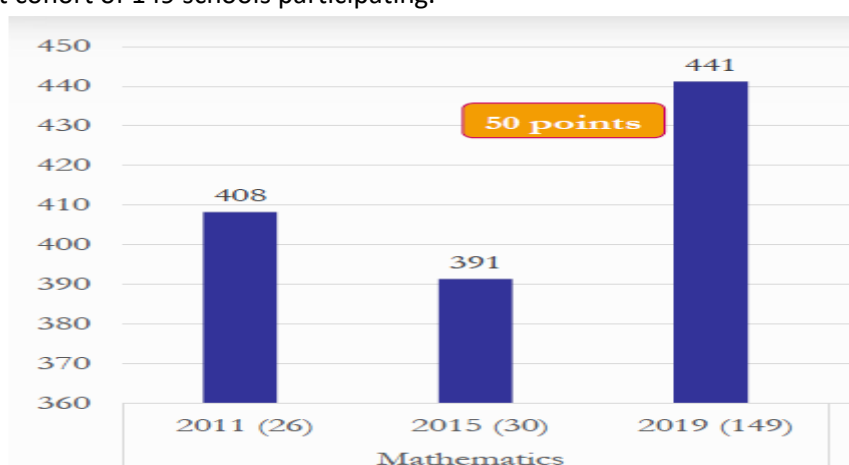
2.1.2 **TIMMS (Trends in International Mathematics and Science Study) Grade 5: 2019**
TIMMS 2019



The Gr 4 TIMMS 2019 assessment was written by Grade 5 learners. The TIMSS achievement scale is set to a Centrepont (point of reference which remains constant from assessment to assessment) of 500 and a standard deviation of 100. The three countries with the lowest achievements were South Africa (374), Pakistan (328) and the Philippines (297). South Africa’s performance in both mathematics and science are amongst the lowest of the 64 countries and entities who participated at the Grade 4/5 level. On the TIMSS scale, learners who achieve above 400 TIMSS points are described as having acquired the basic mathematical knowledge for that Grade.

TIMMS (Trends in International Mathematics and Science Stud) Grade 9: 2019

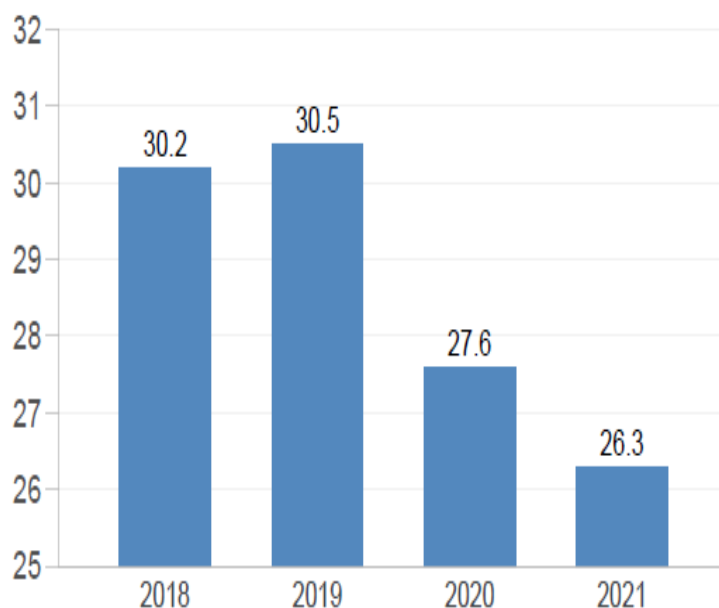
The diagram indicates the performance of the Western Cape in 2011, 2015 and 2019. In South Africa, the Grade 8 TIMMS 2019 assessment was written by Grade 9 learners. The TIMSS achievement scale is set to a Centrepont (point of reference which remains constant from assessment to assessment) of 500 and a standard deviation of 100. South Africa’s performance in both mathematics and science are amongst the lowest of the countries and entities who participated though the Western Cape saw a significant improvement in 2019 with a test cohort of 149 schools participating.



2.1.3. WCED NSC MATHEMATICS:

The Mathematics participation of learners in Grade 12 is very low. You will notice a huge drop from 2019 to 2021 from 30,59% to 26,3% as can be seen in the diagram below.

Provincial Percentage taking Mathematics as subject



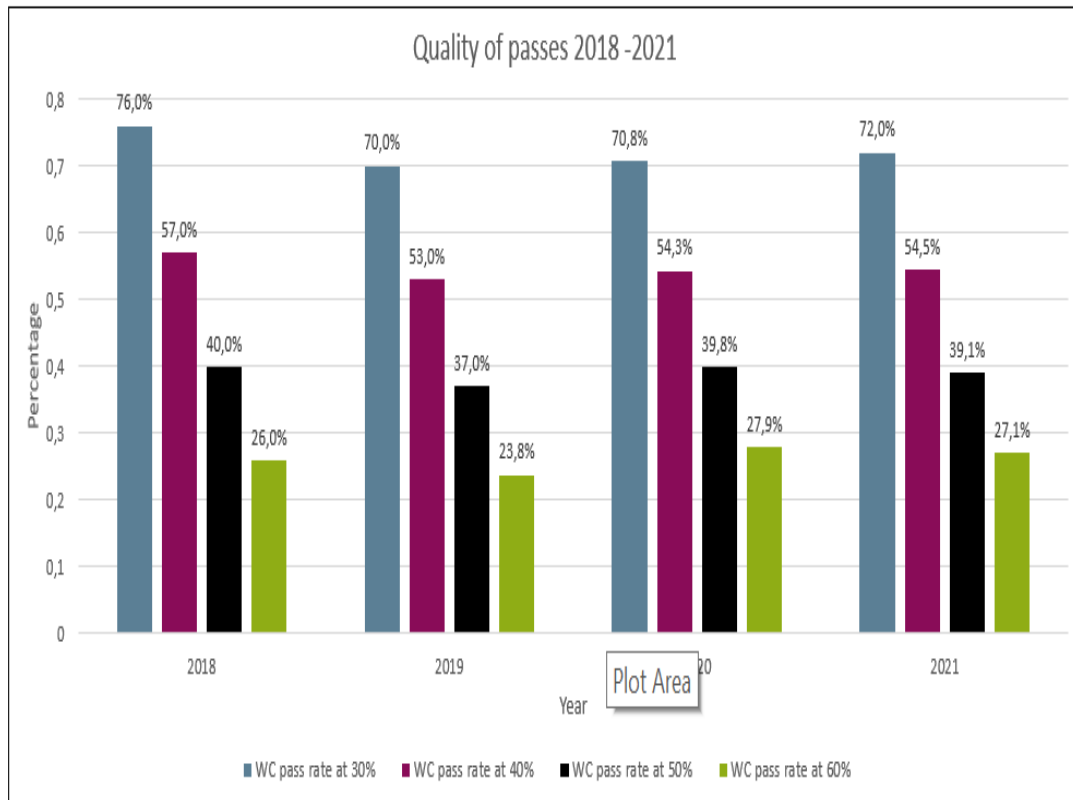
There are various reasons given by teachers for this drop in learner participation. These include:

- Learners' basic content knowledge in Grade 10 is very weak, particularly in Algebra and Geometry.
- Learners choose Mathematical Literacy as they can succeed with less effort and be able to gain University access and bursaries for certain degrees.

To improve learner participation in FET Mathematics the content knowledge of learners needs to be addressed much more extensively in earlier grades. The poor content knowledge of learners can be attributed to poor content knowledge of teachers, poor pedagogical knowledge in teaching the content and poor techno-pedagogical content knowledge. In the high schools Mathematics Subject Advisors find it difficult to support Grade 8 and 9 teachers because of the intensive demands and support required by FET teachers.

With one of the performance measures of the Province being the percentage of learners obtaining over 60% for Mathematics in Grade 12, it will therefore be critical that learners be supported in all grades so that they can perform better in the FET band.

The table following reflects the Grade 12 learner performance at different percentage levels for 2018 – 2021.

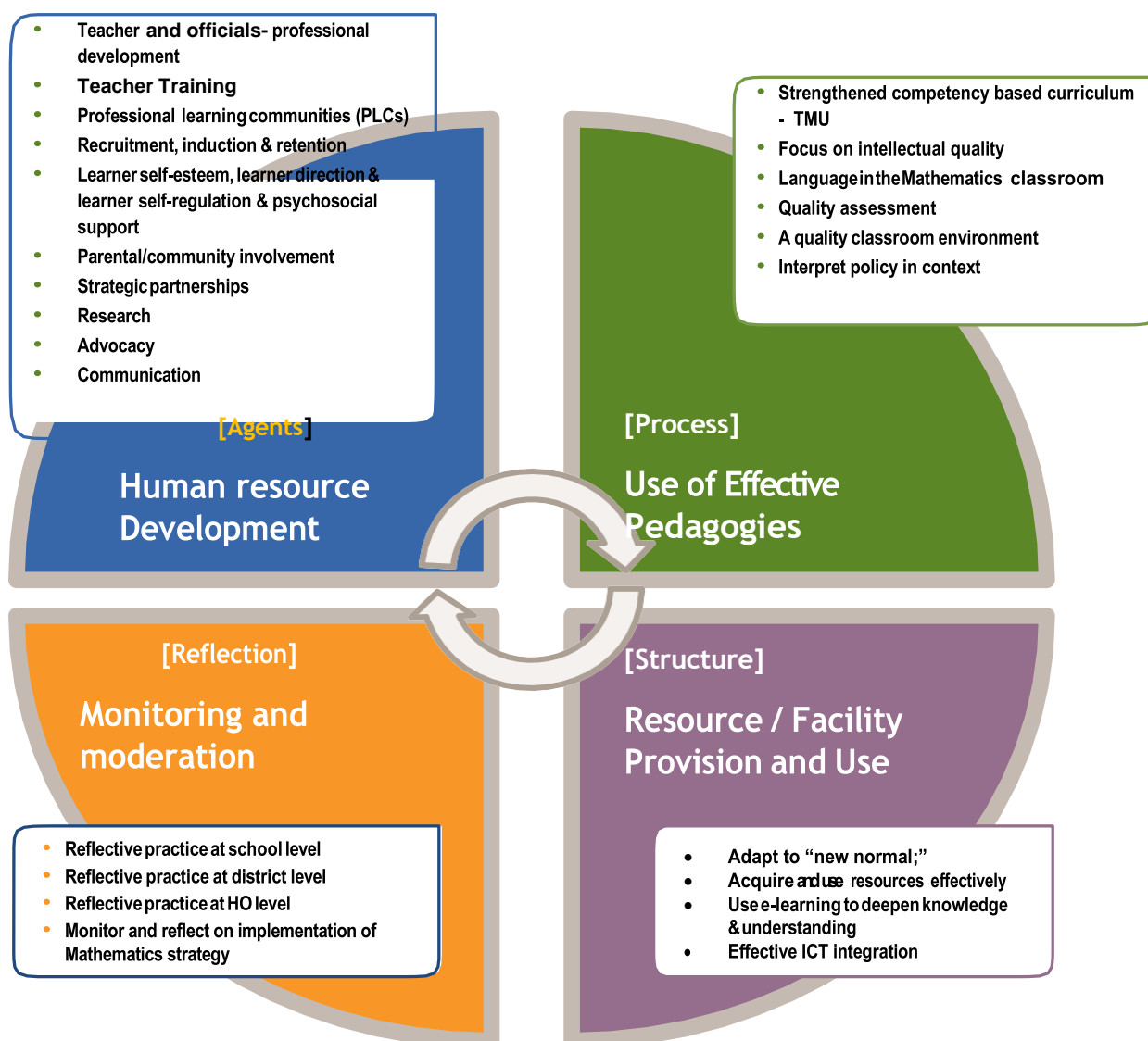


3. DETAILS OF THE MATHEMATICS STRATEGY

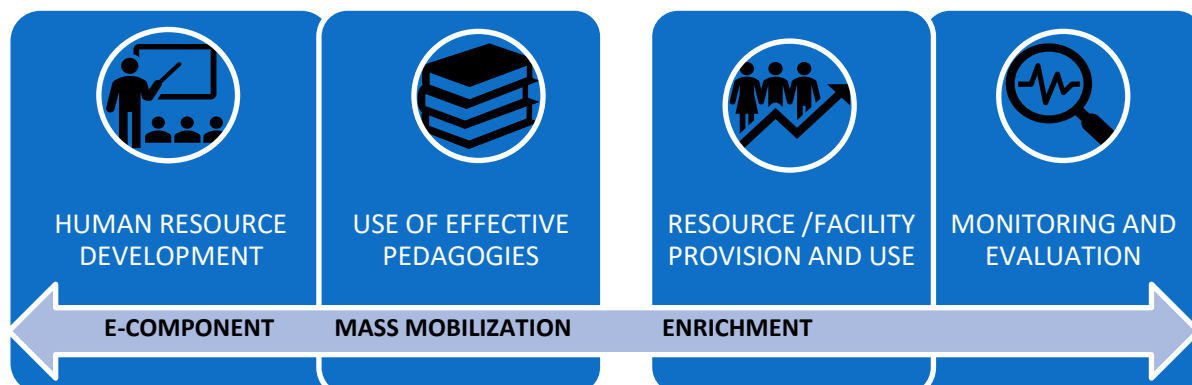
The Mathematics strategy seeks to facilitate high-quality learning in Mathematics. The strategy focuses on integrating four dimensions of working towards and sustaining quality Mathematics teaching and learning.

These dimensions and their respective elements are (see also the diagram below):

- 3.1 Human resource development (investing in the agents involved)
- 3.2 Productive pedagogies (using effective teaching strategies that will result in learning)
- 3.3 Resource/facility provision and use (acquisition and effective use of resources)
- 3.4 Monitoring and evaluation (*continuous in(tro)spection to reflect on success*)



THE FOUR PILLARS OF THE MATHEMATICS STRATEGY ELABORATED:



The four pillars of the strategy represented in the diagrammatic representation above, are supported by the E-component, mass mobilisation and enrichment which impacts across all Mathematical Subjects.

3.1 HUMAN RESOURCE DEVELOPMENT

The Mathematics Strategy promotes the professional development of all those involved in Mathematics teaching in the province: teachers, officials, learners, parents, HEIs and other subject relevant partners.

a) *Teacher and official professional development*

- Conduct a skills audit and establish a database of teachers' qualifications, capacity, out-of-field practices and Mathematics competencies to establish reliable profiles and training needs.
- Pre-Service Teachers:
 - Higher Education Institutions (HEIs) to provide increased opportunity to practical teaching experience at selected schools
 - Higher/increased threshold of credits at HEI level. (B.Ed)
- (Novice) In-Service Training:
 - Structured mentoring programme led by identified lead teachers
 - A "1 + 9/14/21" program implemented where targeted teachers get taken out of school for 1 day and receive support in "how to teach" the next topic in the Annual Teaching Plans (ATP)
 - ACE course for content training
- Improve Mathematics content knowledge and pedagogical knowledge in Mathematics. Provide face-to-face as well as virtual teacher professional development (TPD) focussing inter alia on support for differentiated teaching which include AMESA – TPD initiatives.
- Focus on both learner and teachers' differential needs.
- Provide a deep understanding of curriculum continuity and progression across grades and phases.
- Develop teachers' ability to align learning aims, teaching strategies, assessment and feedback.
- Support the development of realistic lesson plans and Annual Teaching Plans (ATPs).
- Improve teaching competence to help learners acquire mathematical processes and other skills e.g. applying, doing problem-solving, etc.
- Develop strategic curriculum leadership and effective management by ensuring that DHs and Mathematics subject heads participate in regular Mathematics strengthening forums eg. AMESA.
- Ensure that high performing teachers keep abreast of subject developments and related research.
- Support and encourage in-service training opportunities offered at school and district level.
- Participate in professional body initiatives and development.
- Collaborate across directorates and government departments.

b) Professional Learning Communities (PLCs)

- Guide SAs, SMTs and lead teachers to establish, facilitate and use Professional Learning Communities (PLCs) at and between schools to promote the sharing of best practices, resources and further collaboration.
- Conduct cluster work sessions, to address teaching gaps identified as well as learner support strategies emanating from results of school-based assessment, systemic testing and diagnostic evaluations.
- Identify and provide incentives for lead teachers/PLC coordinators e.g., subsidised AMESA membership.
- Virtual PLCs via WhatsApp on prioritised topics with the purpose of Helpline resource.

c) Recruitment, induction and retention strategies

- Embark on a vigorous recruitment drive at HEIs for mathematically competent teachers.
- Incentivise talented learners to pursue teaching as a career or become involved in related support initiatives.
- Provide incentives to retain productive and competent teachers.
- Promote the appointment of capable Mathematics specialist teachers.
- Provide incentives for lead teachers and subject heads/DH in their early careers who display potential.
- WCED bursaries for accredited in service training/short courses at CTLI or HEIs.
- Design an induction programme (CTLI) for new teachers to drive best practice and develop Mathematics teaching skills.

d) Learner self-esteem (T2P), learner direction and learner self-regulation & psychosocial support

- Support learners in developing a positive self-esteem and a growth mind-set as stated in the WCED T2P initiative, ie:
 - Learners need clear and sustained guidance from teachers so that they take responsibility and appropriate steps to address weaknesses
 - Develop a classroom culture that ensure learners enjoy learning and understand that their learning matters
 - Learners do homework and take ownership of their own learning and discover that success demands sacrifice and hard work
 - Develop and exercise meta-cognitive thinking processes required in Mathematics
 - Use teaching practices that help learners to link new knowledge to their background knowledge, to connect new learning to the world beyond the classroom and to integrate knowledge within and across subject boundaries

e) Parental / community involvement

- Advocate the WCED Mathematics strategy as a teaching and learning improvement plan.
- Expand the family numeracy programme guiding parents in the preparatory skills needed to improve and sustain their children's competence in Mathematics, i.e. family Mathematics events where parents and learners engage in mathematics-based activities such as puzzles, quizzes, Mathematics games, etc.
- Communicate quarterly with parents on learner progress and related support programmes.

f) Strategic partnerships

- Partner with NGOs, HEIs and private sector initiatives that provide school-based/ on-site support to teachers.
- Provide targeted interventions that support districts and schools in setting and attaining appropriate targets as articulated in DIPs and SIPs.

g) Research

Staying abreast of common trends in mathematics Nationally and Internationally.

h) Advocacy

Structured and regular advocacy through media and the life orientation domain.

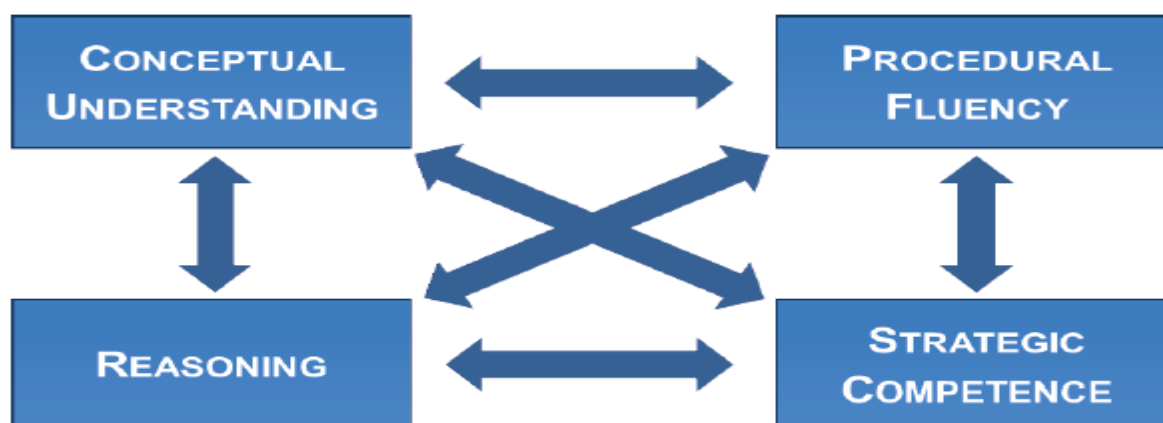
l) Communication

Establish communication platforms to encourage robust discussions amongst various stakeholders to promote the quality of Mathematics education.

3.2 USE OF PRODUCTIVE PEDAGOGIES

Productive pedagogies refer to teaching and learning practices that support improved learner performance. This strategy promotes productive pedagogies in Mathematics teaching by emphasising intellectual quality, the importance of language in the mathematics classroom, assessing for learning, creating quality classroom environments and the effective reading and interpretation of education policies.

a) Strengthened, competency based curriculum (National Framework – TMU)



Competency-based education (CBE) is a student-centered methodology of instruction that incorporates elements of constructivist philosophy, 21st century skills education, and flexible learning models. CBE teaching methods differ from traditional teaching methods in pacing, structure and goals. The end goal is not for students to “cover the content,” pass a test, or prepare for college or a specific career, but rather master skill sets that will allow learners to successfully pursue their goals, no matter what they choose to do in life.

Conceptual understanding

Conceptual understanding enables learners to see mathematics as a connected web of concepts. Learners should be able to explain the relationships between different concepts and make links between concepts and related procedures. Conceptual knowledge and understanding enable learners to apply ideas and justify their thinking.

Procedural fluency

These are the processes through which mathematics is done. Learners need to perform mathematical procedures accurately and efficiently. They also need to know when to use a relevant procedure.

Strategic competence

Learners should be able to identify and use appropriate strategies and devise their own strategies to solve mathematical problems.

Examples include: • Guess and check • Look for a pattern • Make an orderly list • Draw a picture • Eliminate possibilities • Solve a simpler problem • Use symmetry • Use a model • Consider special cases • Work backwards • Use direct reasoning • Use a formula • Solve an equation • Be ingenious

Reasoning

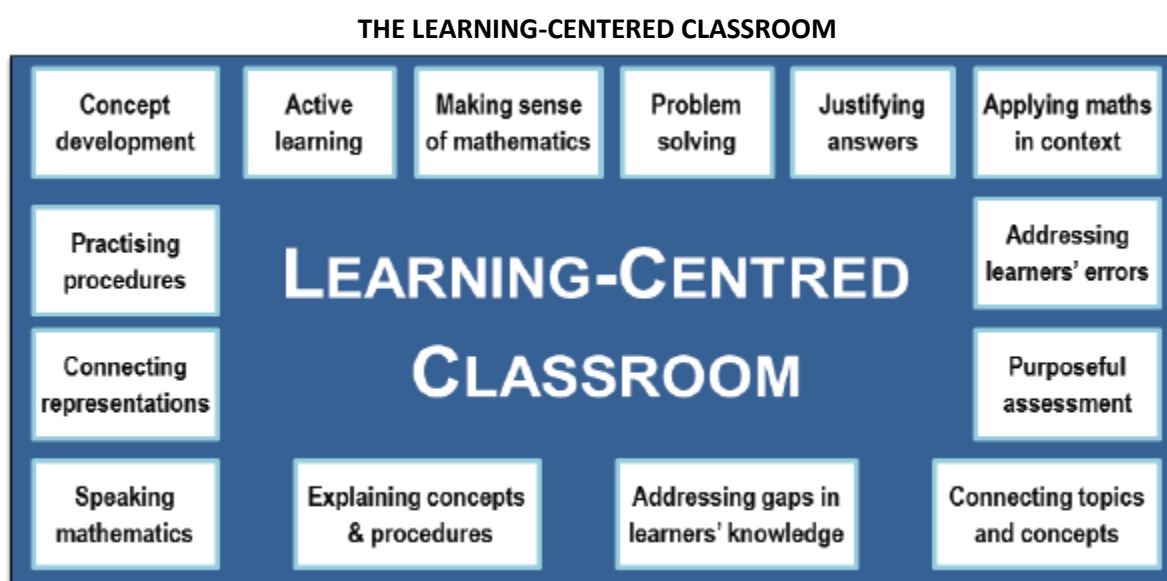
Reasoning includes justifying and explaining one's mathematical ideas and communicating them using mathematical language and symbols. Mathematical reasoning includes deductive and inductive reasoning processes.

Examples of Inductive Reasoning

- Start with a specific true statement: 1 is odd and 3 is odd, the sum of which is 4; an even number.
- Now show it is true for the rest: an odd number is an even number plus 1. Thus, two odd numbers are really two even numbers plus 2.
- The sum of even numbers is always even.

Examples of Deductive Reasoning

- All numbers ending in 0 or 5 are divisible by 5.
- Suppose that $A = 4$ and $B = 4$ then deductively we can conclude that, $A = B$
- If $P = Q$ and $Q = R$ then deductively we can conclude that $P = R$.



A learning-centered classroom focuses on learning – where the teacher designs learning experiences to help learners learn mathematics, using whatever teaching and learning strategies are most suitable for the specific lesson that will be taught.

b) *Focus on intellectual quality*

- Develop deep concept knowledge and understanding.
- Develop, demonstrate and implement structured Mental Mathematics programmes.
- Develop a teaching and learning strategy focussed on developing number sense.
- Emphasise and consolidate calculations by sharing trajectories and strategies per grade and across phases.
- Use questioning and examples that span the range of cognitive levels.
- Ensure assessment activities straddle different cognitive levels.

- Teaching should include substantive conversations about Mathematical concepts and topics, and how they help learners to understand and mediate their world better.

c) *Language in the Mathematics classroom*

- Language is an essential tool for developing and conveying meaning.
- Establish the practice of learners discussing their thinking and reasoning.
- Use correct and appropriate mathematical terminology in learning conversations.
- Devise extra support for learners who do not have the school's LoLT as their mother tongue.
- Analyse assessment data to identify the effects of language deficits and plan the necessary interventions.
- Use a Mathematics word wall.
- Encourage the use of appropriate mathematical language when teachers and learners interact which include important concepts and ideas encountered in Mathematics.

d) *Quality assessment to enhance teaching and learning*

- Conduct a baseline assessment according to phase specific requirements.
- Emphasise formative assessment and regular informal assessments.
- Assess to promote learning and not only for promotion purposes.
- Design assessment activities that provide reliable, valid information about the success of teaching and the actual level of performance of the learner in terms of specific topics.
- Develop and use item banks and exemplar assessment tasks to design own tasks that are responsive to teacher and learner needs.
- Provide learners with prompt *feedback* and *feed-forward* aimed at closing the gap between the actual and desired learner achievement.
- Analyse and use evidence from assessments to draft plans for improving teaching and learner support.
- Increase the number of schools participating in Mathematics Challenges, Competitions and Olympiads.

e) *A quality classroom environment*

- Design a welcoming classroom and school environment that is supportive, encouraging and focussed on learning so that learners can achieve their full potential.
- Learners respect each other, work individually, in pairs and groups to develop a deeper understanding and take responsibility for their own learning and support peer learning.
- Create a Mathematics resource-rich classroom that supports productive teaching and learning.
- Encourage self-regulation which is supported by the teacher – both through the example set and guidance to the learner.
- Teaching and learning interactions should be orderly, sequenced and well-planned.
- Establish routine learner structures and activities to enhance classroom order.

f) *Interpret policy in context*

- Principals, DHs and teachers interpret the stated Mathematics curriculum correctly in terms of teaching and assessment requirements as well as time-tabling.
- The correct notional time is allocated for mathematics.
- Teachers understand continuity and progression of prescribed content/skills from grade to grade, phase to phase and how the teaching and consolidation of prescribed content/skills in the one grade/phase forms the basis for mathematical learning in the next.

3.3 Resource/facility provision and use

Effective Mathematics teaching requires the appropriate selection and effective integration of available resources and the use of facilities to deepen and enhance Mathematics learning.

a) Adapt to the “new normal” (e.g. Covid context)

- Explore new strategies to deal with new realities such as the rotational model, eg. Blended learning.
- Improve online learning possibilities/ models.

b) Acquire and use facilities/resources appropriately

- Schools do a baseline asset assessment and progressively procure textbooks, grade-appropriate learner manipulatives and teacher demonstration Mathematics kits.
- Ensure appropriate LTSM for teaching different topics over grades and design teaching methodologies accordingly.
- Ensure that all learners have access to learning and teaching support material (LTSM).
- Manage asset registers to monitor the use and retrieval of resources, use allocated funds and other means to supplement equipment/facilities as required to implement the SIP of Mathematics.

c) Use resources effectively

- Teachers use phase appropriate teaching and learning resources and materials.
- Teachers plan per term for resources required for teaching.
- Share ideas about effective use of accessible resources to help mediate key concepts in Mathematics. This can be demonstrated in school subject meetings or PLCs in district context.
- Encourage collaboration between schools in developing and sharing resources and facilities.

d) Use e-learning and ICT to deepen knowledge and understanding

- Create, improve, and upload material on WCED E-Portal.
- Teachers use IT available and selected appropriate teaching sources on the Internet.
- Support teachers in the selection of e-learning resources to deepen learners’ knowledge and understanding of concepts and skills.
- Review and recommend e-learning software and digital resources that support differentiated learning.
- Provide guidance to parents about resources available on the WCED E-portal to support and enhance Mathematics learning at home.

3.4 Monitoring and Evaluation

The improvement of practices that will sustain better Mathematics teaching and learning depends on reflection at different levels of the education system. These reflections should suggest changes to the Mathematics Strategy and how it is advocated.

a) Reflective practice at school level

- Each school develops a target-driven Mathematics improvement plan with collective staff input.
- Monitor teaching and learning by tracking progress and adjusting plans.
- Evaluate efficiency and impact of assessment by monitoring curriculum delivery and performance in SBAs at schools.
- Evaluate learner performance in Formal Assessment Tasks.
- Review the effectiveness of LTSM management.
- Continually improve Mathematics performance by adjusting internal SBA in the light of data from national and provincial systemic assessments.
- Reflect on the language proficiency of learners in terms of the LOLT(s) used and suggest realistic ways to address the challenges effectively.
- Schools follow an internal moderation policy and continually improve it considering subject developments and better teaching practices.

- SMTs support the subject head/DH to manage the subject team by ensuring time on task, by moderating assessments and taking responsibility to address shortcomings.
- Improve the management and monitoring strategies of SMTs.

b) Reflective practice at district level

- Ensure competent appointments to strengthen district support.
- Recruit and develop district officials and teachers responsible for Mathematics.
- Evaluate curriculum coverage, impact and pace in accordance with provincial and national targets.
- Moderate lesson plans and the use of LTSM to gauge if gaps are addressed.
- Districts develop a Mathematics Improvement Plan within their DIP for reporting to provincial and national structures.
- Districts (1) monitor curriculum delivery as well as time on task at schools; (2) ensure that every school has an internal assessment and moderation policy; (3) moderate and verify the SBA; (4) monitor the use and safe keeping of resources including textbooks.
- Specialists from schools and other organisations are recruited to conduct workshops to support officials and teachers to attain the desired Mathematics outcomes.

c) Reflective practice at Head Office level

- Refine management and monitoring strategies of head office officials.
- Research external test results to inform teaching support measures in school and district improvement plans.
- Influence the design of teacher development and leadership courses in order to develop strategic curriculum leadership and management.
- Include Mathematics monitoring and support in induction courses at CTLI for all in management and leadership positions.
- Review the strategy annually to ensure that the targets of the provincial strategy are met and if necessary effect adjustments to ensure effective implementation.
- Consult with leading academics or related professional bodies on subject improvement.

d) Monitor and reflect on implementation of Mathematics strategy

- Evaluate the understanding and implementation of the provincial Mathematics strategy at districts, schools, and within communities.
- Ensure all role players understand the importance of this strategy.
- Substantiate changes to the planned strategy where needed.
- Advocate the importance of being numerate and being able to choose to have Mathematics as part of a learner's subject choice in Grade 10.

4. THE STRATEGY UNPACKED PER PHASE

4.1 FOUNDATION PHASE: Gr R - 3:

4.1.1 HUMAN RESOURCE DEVELOPMENT

a) Teacher/Officials professional development

- Create opportunities for SAs to be trained in understanding mathematical **concepts/topics** within Curriculum and Assessment Policy Statements/ Annual Teaching Plans for critical engagements with teachers.
- Identify and develop a core group of Subject Advisers to specialise in Mathematics training of teachers. Regular upskilling of SAs to create an informed support structure for teachers.
- Pre Service Teachers:
 - Negotiate a drastic increase in credits of B.Ed qualification in Mathematics; 28 – 100 per degree
 - HEIs to provide increased opportunities for practical teaching experience at selected schools
 - Higher / increased threshold of credits at HEI level. B.Ed qualification in Mathematics; 28 – 100 per degree
- (Novice) In-Service Training:
 - A structured mentoring programme led by identified lead teachers receiving monthly stipends
 - A “1 + 9/14/21” program implemented where targeted teachers get taken out of school for 1 day and receive support in “how to teach” the next topic in the ATP
 - Encourage participation in in-service training courses offered by Higher Education Institutions (HEIs) eg. ACE course
 - Alternatively, provide face-to face as well as virtual Teacher Professional Development (TPD) focussing on improving Mathematics content knowledge and
 - Cross-district virtual targeted support underperforming schools/struggling teachers on prioritised topics
 - Districts: targeted teacher support with school visits and classroom support
 - Districts: targeted teacher development pedagogical knowledge/techniques in Mathematics
 - Focus on both learner and teachers’ differential needs
- In-service training/attending short courses for identified Mathematic teachers.
- CTLI short courses for in-service training (online and physical) for identified IP Mathematics teachers.
- Grow strategic curriculum leadership and management by ensuring that DHs and Mathematics subject heads participate in regular Mathematics strengthening forums eg AMESA/ High performing teachers in system to keep abreast of subject developments.
- Establish close collaboration opportunities and systems with LSEN Directorate.
- Identify and develop lead teachers.

b) Professional Learning Committees

- Establish subject committees at provincial, district and school level to keep abreast of policy and content changes within the Mathematics curriculum.
- Encourage professional learning communities and community of practice at provincial, district and school level. SAs, DHs and subject coordinators to lead.
- Establish lead SAs in Mathematics and establish lead teachers at district level and supportive Mathematics coordinators at school level.
- Mathematics and E – learning Subject Adviser development led by DBE, HEI academics and SCPs.

c) Recruitment, induction, and retention strategies

- Create a provincial guideline supporting recruitment and induction of subject advisers.
- Design a mentoring plan for novice teachers and new Advisers within the Mathematics subject.
- Retention of Mathematics specialists supported by ongoing professional development.

d) Learner Self-esteem, self-regulation, and psychosocial support

- Creating a mathematical context using Mathematics in real life examples, that encourages a love and appreciation for mathematics through establishing a print rich mathematics resource enabling environment.
- Promote and motivate time management habits that encourages learner self-regulation and self-reflection opportunities. Create a psychosocial supportive context that is underpinned by the Transform to Perform intentions.

e) Parental /Community involvement

- Create partnerships with parents to enable Family Numeracy. Encourage school and parent engagements to support Family Numeracy.
- Advocacy at provincial level through media broadcasting, WCED e-portal access, pamphlets, etc.

f) Strategic Partnerships

- Form partnerships through accessible projects which can impact positively the learning of Mathematics e.g. MCO, Bala Wande, Schools Development Unit courses etc.

g) Research

- Stay abreast of common trends in mathematics Nationally and Internationally. Use external research data to inform and support improvement and reorganisation of planned teaching and learning within the province, district and at school level.

h) Advocacy

- Structured and regular advocacy through media at provincial level e.g. radio broadcasting and other media.
- Advocate appropriate pedagogies at district and school level for implementation.

i) Communication

- Establish communication platforms to encourage robust discussions amongst various stakeholders to promote the quality of Mathematics education.
- Upskill SAs and educators in appropriate pedagogies to communicate at an appropriate level at provincial, district and school.
- quality intellectual level of communication in terms of mathematics teaching.

4.1.2 USE OF PRODUCTIVE PEDAGOGIES

a) Strengthened, competency-based curriculum (National Framework – TMU)

WCED will implement the TMU framework as advocated by DBE for Foundation Phase where the following elements will be included in teaching and learning:

○ **Conceptual understanding**

- Conceptual understanding enables learners to see mathematics as a connected representation of concepts.

Conceptual understanding enables learners to see mathematics as a connected web of concepts. Learners should be able to explain the relationships between different concepts and make links between concepts and related procedures. Conceptual knowledge and understanding enable learners to apply ideas and justify their thinking.

- Learners with conceptual understanding know more than isolated facts and methods.
- Learners should be able to explain the relationships between different concepts and make links between concepts and related procedures.
- Conceptual knowledge and understanding enable learners to apply and justify their thinking.
- Determine how learners in Foundation Phase respond to learning with concrete manipulatives, then pictorial and finally reaching the abstract stage to achieving mastery in mathematics topics/concepts (CPA Method).

○ **Procedural fluency**

This refers to knowledge of procedures, knowledge of when and how to use procedures appropriately, and the skill in performing them flexibly, accurately, and efficiently. Learners need to perform mathematical procedures accurately and efficiently. They also need to know when to use a relevant procedure.

○ **Strategic competence**

Learners should be able to identify and use appropriate computational strategies and be able to devise their own algorithm to solve mathematical problems. The Mental Strategies Assessment Project supports building strategic thinking, leading to strategic competency.

○ **Reasoning**

Reasoning includes justifying and explaining one's mathematical ideas and communicating them using mathematical language and symbols. Mathematical reasoning includes deductive and inductive reasoning processes.

**EXAMPLES ILLUSTRATING THE TMU:
FOUNDATION PHASE**

Example 1:

(a) CONCEPTUAL UNDERSTANDING (TMU pg.15)

63 – 49 =

Lay out 63 using base ten blocks subtracting 49

Exchange one ten for ten ones

14 remains

I have 6 tens and 3 ones from Which I must subtract 49	I have 5 tens and 13 ones after I exchange in order to be able to subtract.	If I take away 4 tens and 9 ones, I have 1 ten and 4 ones left, that is 14 left.
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The concrete working with base ten blocks shown above demonstrates the exchange needed to do the subtraction. This concrete activity builds up learners’ conceptual understanding of numbers and operations. The written record of the procedure is based on conceptual knowledge. Learners need connections to be made explicit to become fluent in the use of procedures.

(b) PROCEDURAL FLUENCY (TMU PG 16)

Developing procedural fluencies for adding and subtracting numbers is essential for further mathematical learning. Fluency is developed through much repetition and practice.

Adding or subtracting 10 to any 2-digit number (without counting in ones), adding a single digit to any 2- digit number.

(c) STRATEGIC COMPETENCE (TMU PG 17)

63 – 49 =

Strategy 1:

$$63 - 49 = 63 - 40 - 9 \text{ (the learner broke down 40 into 40 and 9 ...)}$$

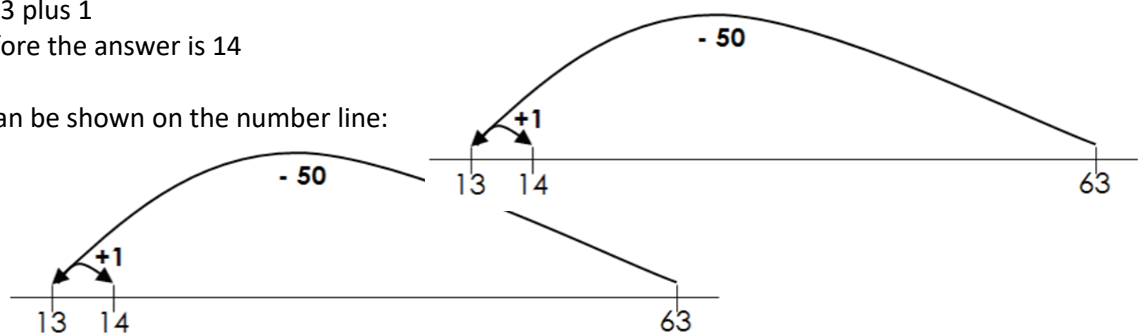
$$= 23 - 9$$

$$= 14$$

Strategy 2:

63 – 49 = 63 – 50 then add 1 back
thus 13 plus 1
therefore the answer is 14

This can be shown on the number line:



(d) **REASONING**

In the example below the Grade 2 learner's answer shows the use of mathematical language to explain how he/she reasoned when finding a solution based on given information.

Given that $63 - 50 = 13$ learners can reason that $63 - 49$ must be 14 and explain that 'if you subtract 49 from 63, that is taking away one less than 50 so the answer must be one more. There are various elements of reasoning across the strategies described above.

○ **Learning-centered classroom**

A learning-centered classroom enables the foci to be on learning to understand – where the teacher designs learning experiences to help learners learn with understanding mathematics, using appropriate teaching, and learning strategies s/he thinks are most suitable for the specific lesson that will be taught.

b) **Focus on intellectual quality**

Teaching and learning will focus on:

➤ **Developing and expanding conceptual knowledge and understanding.**

Knowledge is expanded because the focus is intended to sustain the key ideas or concepts throughout the lesson as well as the understanding.

➤ **Develop problematic knowledge**

Knowledge is seen as socially constructed, with multiple and/or conflicting interpretations, presented and explored. Groupwork is advocated in the Foundation Phase. Differentiated teaching is planned to accommodate all learning styles.

➤ **Develop higher order thinking:**

Use different types of questioning levels and examples that elicit a range of cognitive thinking skills. This is included in daily informal activities.

➤ **Metalanguage:**

Consistent and continuous use of metalanguage. The lesson engagement is underscored with frequent commentary on language use. Learners reflect on lesson content and provide feedback.

➤ **Substantive communication:**

Teaching should include substantive conversations about Mathematical concepts and topics and how they help learners to understand and respond to their world better. Peer conversations are encouraged during mathematics content conversations.

c) **Language in the Mathematics classroom**

➤ Use of correct terminology in class. The same terminology used in class should be used in assessments.

➤ Establish the practice of learners discussing their computational thinking and reasoning.

➤ Language is an essential tool for developing and conveying meaning. Opportunities are created for learner expression.

➤ Teachers should make an extra effort to assist learners who struggle with the LOLT – code switching may be used.

- Ensure each class has a Mathematical Dictionary to use during the mathematics lesson and allow learners to use it if they do not understand the terminology.
- Use correct Mathematics terminology in learning conversations (vocabulary).
- Mathematical word walls are encouraged.
- Officials should encourage the use of appropriate mathematical language between teachers and learners which includes the important concepts and ideas encountered in Mathematics.
- Encourage a Mathematics diary. What I know and understand and, what I need more support in.

d) Quality assessment to enhance teaching and learning

- Brief baseline assessment before the teaching of a new concept will inform differentiated planning and teaching.
- Emphasis on formative assessment and regular informal assessment.
- Assess to promote learning and not for promotion purposes only.
- Only assess what has been taught in class.
- Design assessment activities that provide reliable, valid information about the success of teaching and learning.
- Use an item bank and exemplar assessment tasks to design own tasks that are responsive to teacher and learner needs.
- Provide learners with prompt *feedback* and *feed-forward* aimed at closing the gap between the actual and desired learner achievement.
- Analyse and use evidence from assessments to draft plans for improving teaching and learner support.
- Encourage schools to participate in Mathematics Challenges, Competitions and Olympiads and Mathematics Quizzes.

e) A quality classroom environment

- Develop a strategy to construct and organize a welcoming classroom and school environment that is supportive, encouraging and focussed on learning so that learners can achieve at their full potential.
- Learners respect each other, works individually or in pairs and as groups to develop a deeper understanding, and take responsibility for their own learning and support peer learning.
- Create a Mathematics resource-rich classroom that supports productive teaching and learning.
- Encourage self-regulation and skilled preparation habits.
- Teaching and learning interactions should be orderly and well planned. Strategic classroom management planned for learners. Sufficient resources are planned.
- Establish routine learner structures to enhance classroom order.

f) Interpret policy in context

- Principals, DHs, and teachers interpret the stated Mathematics curriculum correctly in terms of teaching and assessment requirements as well as timetabling.
- Teachers understand continuity and progression of prescribed content/skills from phase to phase and how the teaching and consolidation of prescribed content/skills in one phase forms the basis for mathematical learning in the next phase.
- The correct notional time is allocated for mathematics.

4.1.3 RESOURCE/FACILITY PROVISION AND USE

- Design a Recovery plan to operate within a context of change (Covid -19).
- Review and reorganise operational plans to implement the Mathematics curriculum (ATPS/Recovery ATPS).
- Acquire appropriate mathematics resources for effective and optimal use.
- Acquire appropriate teacher and learner manipulatives to support the process of understanding mathematical concepts/Topics.
- Use the E-learning opportunities to navigate revision and consolidation of mathematics concepts/topics.
- Use ICT effectively with dedicated timetables and engage in the optimal access of data feedback from the system.
- Monitor and manage the effective use of resources.
- Manage of resources through inventory lists, elearning infrastructure support plans etc.

4.1.4 MONITORING AND EVALUATION

Monitoring & Moderation

- Monitor curriculum implementation. Review and reflect on observations.
- Analyse term performance and informal daily assessments.
- Province, districts, and schools review and reflect on quarterly term performance results.
- Moderation conducted at school level. District's quality assure school moderation reports. Districts do random sampling. Province quality assures moderation reports. Supports accordingly at provincial, district and school level.
- Monitor and reflect on the implementation of the Mathematics Strategy on a quarterly basis.
- All levels of strategies to be aligned, Provincial, District and School.

4.2 INTERMEDIATE PHASE: Gr 4 – 6

4.2.1 HUMAN RESOURCE DEVELOPMENT

a) Teacher / Officials professional development:

- Conduct a skills audit and establish a database of teachers' qualifications, capacity, out-of-field practices and Mathematics competencies to establish reliable profiles and training needs.
- Pre-Service Teachers:
 - Negotiate drastic increase in credits of B.Ed qualification in Mathematics – 28 – 100 per degree
 - HEIs to provide increased opportunity to practical teaching experience at selected schools
 - Higher / increased threshold of credits at HEI level. (B.Ed) qualification in Mathematics – 28 – 100 per degree
- (Novice) In-Service Training:
 - A structured Mentoring program led by identified lead teachers receiving monthly stipends
 - A “1 + 9/14/21” program implemented where targeted teachers get taken out of school for 1 day and receive support in “how to teach” the next topic in the ATP
 - Encourage participation in in-service training courses offered by Higher Education Institutions (HEIs) e.g. ACE course
 - Alternatively provide face-to face as well as virtual (TPD) focussing on improving Mathematics content knowledge
 - Cross-district virtual targeted support to underperforming schools/struggling teachers on prioritized topics
 - Districts: targeted teacher support with school visits and classroom support
 - Districts: targeted teacher development in pedagogical knowledge/techniques in Mathematics
 - Focus on both learner and teachers' differential needs
- Mathematics and Elearning Subject Adviser development led by DBE, HEI academics and SCPs.
- Subsidise in-service training/attending short courses for identified Mathematics teachers.
- CTLI short courses for in-service training (online and physical) for identified IP Mathematics teachers.
- Lead teachers to be identified and additional PD support and specialised training offered.
- Problem Solving online courses and cascading thereof.
- Grow strategic curriculum leadership and management by ensuring that DHs and Mathematics subject heads participate in regular Mathematics strengthening forums e.g. AMESA. Teachers to keep abreast of subject developments.
- Establish close collaboration opportunities and systems with LSEN Directorate.
- Identify and develop lead teachers.
- Teacher development foci:
 - deep understanding of curriculum continuity and progression across grades and phases
 - Problem-solving
 - Participation in Professional Bodies e.g. AMESA
 - Collaboration /touch base across pillars and government departments

- b. **Professional Learning Communities (PLCs):**
- Guide SAs, SMTs and lead teachers to start, facilitate and use PLCs at and between schools to promote the sharing of best practices and collaboration.
 - Cluster sessions, in demographic context, to address teaching gaps identified in school-based assessment, systemic testing and diagnostic report and design interventions.
 - Lead teachers to lead the small clusters.
 - PLC for novice teachers, geographically.
 - Standard induction programme for novice teachers.
 - PLC for novice DH supported by experienced DH clusters sharing good practices of systems in place.
 - Certified recognition for lead teachers who host a minimum number of workshops annually.
 - Content for PLC will be determined by the needs of the cluster or the group and based on PSIP (Provincial Subject Improvement Plan).
- c) **Recruitment, induction and retention strategies**
- Identify teachers for in-service training at HEIs. Bursaries to be sourced/provided.
 - Identify lead teachers with excellent mathematics practices for vacant positions.
 - Identify experienced Mathematics teachers with excellent track records to serve as mentors to newly appointed/novice Mathematics teachers and provide the mentors with incentives.
- d) **Learner self-esteem (T2P), learner direction and learner self-regulation & psychosocial support**
- In collaboration with T2P branch offer motivational programs encouraging and guiding self-directed learning.
 - Cross-pillar collaboration in teacher and learner support focussing on:
 - Create a classroom environment that supports freedom of expression.
 - Encourage learners to feel confident about talking through mathematical concepts as well as reasoning.
 - Address factors leading to mathematics anxiety – making errors in a safe environment can lead to understanding and enhanced performance. Praise learners for their efforts.
 - Build and support self confidence in the subject.
 - Convey realistic expectations, goals and accommodations to include all learners' unique strengths and needs.
 - Encourage risk taking to implement strategies.
 - Build self-reliance.
 - Use of creative practices like music, songs and dance to develop the love for Mathematics.
 - Math games and playing of Math games can be of great value, because learners can engage, have fun and learn while playing. Games regarded as safe way to practice, to make mistakes, but also to grow.
 - Celebration of children's work by including their efforts in their context on a display wall.
 - Positive feedback leads to positive thinking and positive outcomes.
 - Make use of various mental mathematics strategies, so learners do not feel like it's a repetitive routine.
 - Aim for excellence but setting realistic expectations and goals that are manageable and reasonable will allow learners to see how much they've grown.

e) **Parental / community involvement:**

- Efficient communication from school with parents focussing on pro-active planning and sharing of positives especially successes.
- Guidance to parents towards maximizing involvement.
- Promote family numeracy creating an acute awareness of the elegance and joy of the subject.
- Effective use of Google classroom.
- Encourage WhatsApp groups per class.

f) **Strategic partnerships:**

- Identify potential partners to roll out strategic objectives. Examples are:
 - Growsmart
 - Mathematics 24
 - AMESA
 - SAMF – South African Mathematics Foundation
 - Horizon Education Trust
 - Zenex Foundation
- Partner with NGOs, HEIs and private sector initiatives that provide school-based/ on-site support to teachers.
- Analyse data to determine needs for interventions.
- Provide targeted interventions that support districts and schools in setting and attaining appropriate targets as articulated in DIPs and SIPs.

g) **Research**

- Stay abreast of common trends in mathematics nationally and internationally.
- Use data analyses and statistics for quantitative research.
- Collaborate with HEIs, NGOs in research projects.
- Integration of topics across subjects: Thematic approach.
- Explore alternative pedagogies: i.e.
 - Flipped classroom
 - PBL – Project based learning
 - Enquiry based learning
 - Blended learning
 - Mathematical modelling (SP)

h) **Advocacy**

- Structured and regular advocacy through media and the life orientation domain.
- Officials, teachers and stakeholders involved in Mathematics education conversations – promoting the subject.
- Close collaboration with Communications Directorate advocating tendencies in Mathematics.
- Utilising WCED NEWS to advocate subject events.
- Regular uploading of subject material on the WCEDePortal (<https://wcedportal.co.za/>).
- Celebrating successes and achievements in the subject.
- Advocacy of subject events e.g., National Mathematics (Science) week.

i) **Communication**

- Management perspective:
 - Establish communication platforms to encourage robust discussions amongst various stakeholders to promote the quality of Mathematics education.
- Teaching and learning perspective:
 - Give students informative feedback
 - Praise students for perseverance in problem solving
 - Share positive attitudes in Mathematics
 - Involve parents
 - Informal assessment is the best way of giving feedback or to assess the success of a lesson
 - Encourage code-switching in class

4.2.2. **USE OF PRODUCTIVE PEDAGOGIES:**

a) **Strengthened, competency-based curriculum (National Framework – TMU)**

WCED will implement TMU framework in the Intersen on instruction from DBE where the following elements will be included in teaching and learning:

- **Conceptual understanding**
Conceptual understanding enables learners to see mathematics as a connected web of concepts. Learners should be able to explain the relationships between different concepts and make links between concepts and related procedures. Conceptual knowledge and understanding enable learners to apply ideas and justify their thinking.
- **Procedural fluency**
These are the processes through which mathematics is done. Learners need to perform mathematical procedures accurately and efficiently. They also need to know when to use a relevant procedure.
- **Strategic competence**
Learners should be able to identify and use appropriate strategies and to devise their own strategies to solve mathematical problems.
- **Reasoning**
Reasoning includes justifying and explaining one's mathematical ideas and communicating them using mathematical language and symbols. Mathematical reasoning includes deductive and inductive reasoning processes.
- **Learning-centered classroom**
A learning-centered classroom focuses on learning – where the teacher designs learning experiences to help learners learn mathematics, using teaching and learning strategies s/he thinks are most suitable for the specific lesson that will be taught.

b) **Focus on intellectual quality**

Teaching and learning to focus on:

- **Develop deep concept knowledge and understanding.**
Knowledge is deep because focus is sustained on key ideas or concepts throughout the lesson as well as understanding.

- **Develop problematic knowledge**
Knowledge is seen as socially constructed, with multiple and/or conflicting interpretations, presented and explored.
- **Develop higher order thinking:**
Use questioning and examples that span the range of cognitive levels.
- **Metalanguage:**
High use of metalanguage. The lesson proceeds with frequent commentary on language use.
- **Substantive communication:**
Teaching should include substantive conversations about Mathematical concepts and topics and how they help learners to understand and mediate their world better.

c) Language in the Mathematics classroom

- Use of correct subject terminology in class. The same terminology used in class should be used in assessment.
- Establish the practice of learners discussing their thinking and reasoning.
- Acknowledge language as an essential tool for developing and conveying meaning.
- Teachers should make extra effort to assist learners who struggle with the LOLT – code switching may be used.
- Ensure each class has Mathematical Dictionaries.
- An online dictionary can be used.
- Mathematical word walls with example should be used. Organise as topics progress during the term.
- Officials to encourage the use of appropriate mathematical language between teachers and learners which include important concepts and ideas encountered in Mathematics.

d) Quality assessment to enhance teaching and learning

- Brief baseline assessment before the teaching of a new concept will inform differentiated planning and teaching.
- Emphasis on regular informal assessments.
- Assess in order to promote learning and not for promotion purposes only.
- Only assess what has been done in class.
- Design assessment activities that provide reliable, valid information about the success of teaching and learning.
- Use item banks and exemplar assessment tasks to design own tasks that are responsive to teacher and learner needs.
- All formal assessment tasks must be accompanied by an assessment framework.
- Formal assessments must reflect the weightings of the different cognitive levels as per CAPS document, Section 4.
- Provide learners with prompt *feedback* and *feed-forward* aimed at closing the gap between the actual and desired learner achievement.
- Analyse and use evidence from assessments to draft plans for improving teaching and learner support and inform interventions.
- Increase the number of schools participating in Mathematics Challenges, Competitions and Olympiads.

e) A quality classroom environment

- Construct a welcoming classroom and school environment that is supportive, encouraging and focussed on learning so that learners can achieve their full potential.
- Learners respect each other, work individually in pairs and groups to develop a deeper understanding and take responsibility for their own learning and support peer learning.
- Create a Mathematics resource-rich classroom that supports productive teaching and learning.
- Encourage self-regulation and lead by example in preparation.
- Teaching and learning interactions should be orderly and well planned.
- Establish routine learner structures to enhance classroom order.
- Establish classroom rules that every learner bought into, respect and apply in the classroom.
- Make learners aware of their safe spaces, which are based on freedom to express themselves and show respect for the opinions of others, are protected so that the classroom environment becomes a welcoming place for learners to be in.
- Ensure that the core values are referred to regularly so that the learning environment is a welcoming space/place to be in every day.

f) Interpret policy in context

- Develop frameworks and instructional material for the development of a core mathematics curriculum.
- Develop understanding in the sequencing of topics and the connections of correlating topics.
- Strengthen connections between Mathematics in the class and skills learners can apply in context - in the future.
- Focus on developing 21st century skills: i.e.
 - Critical thinking
 - Communication skills
 - Creativity
 - Problem solving
 - Perseverance
 - Collaboration
- Officials, principals, DHs and teachers interpret the stated Mathematics curriculum correctly in terms of teaching, assessment requirements and time-tabling.
- Officials, teachers understand continuity and progression of prescribed content/skills from phase to phase and how the teaching and consolidation of prescribed content/skills in one phase forms the basis for mathematical learning in the next phase.

4.2.3 RESOURCE/FACILITY PROVISION AND USE

a) Adapt to “new normal” Covid context

- Explore new strategies e.g. Blended learning,
- Improve online learning possibilities/ models

b) Acquire and use facilities/resources appropriately

- Schools do a baseline asset assessment and progressively procure necessary textbooks, grade-appropriate learner manipulatives and teacher demonstration Mathematics kits.
- Ensure that all learners have access to learning and teaching support material (LTSM).

- Manage asset registers to monitor the use and retrieval of resources, use allocated funds and other means to supplement equipment/facilities as required to implement the SIP of Mathematics.

c) Use resources effectively

- Teachers use phase appropriate teaching and learning resources and materials.
- Teachers plan in advance per term for resources required for teaching.
- Share ideas about effective use of accessible resources to help mediate key concepts in Mathematics – demonstrate in PLC context.
- Encourage collaboration between schools in developing and sharing resources and facilities. (Community of practice)

d) Use E-learning and ICT to deepen knowledge and understanding

- Screen E- resource offers from service providers, for compatibility and coordination purposes.
- Structured guidance to teachers implementing E–resources to enhance teaching and learning.
- Create, edit, and upload material on WCED ePortal.
- Teachers use IT available in school and selected appropriate teaching sources on the Internet.
- Support teachers in the selection of e-learning resources to deepen learners’ knowledge and understanding of concepts and skills.
- Review and recommend e-learning software and digital resources that support differentiated learning.
- Advocacy to parents about resources available on the WCED ePortal to support and enhance Mathematics learning.

4.3. SENIOR PHASE: GR 7 - 9

4.3.1 HUMAN RESOURCE DEVELOPMENT

a) Teacher / Officials professional development:

- Conduct a skills audit and establish a database of teachers' qualifications, capacity, out-of-field practices and Mathematics competencies to establish reliable profiles and training needs.

Pre-Service Teachers:

- Negotiate drastic increase in credits of B.Ed qualification in Mathematics – 28 – 100 per degree.
- HEIs to provide increased opportunity to practical teaching experience at selected schools.
- Higher / increased threshold of credits at HEI level. B.Ed qualification in Mathematics – 28 – 100 per degree.

(Novice) In-Service Training:

- A structured Mentoring program led by identified lead teachers receiving monthly stipends.
- A "1 + 9/14/21" program implemented where targeted teachers get taken out of school for 1 day and receive support in "how to teach" the next topic in the ATP.
- Encourage participation in in-service training courses offered by Higher Education Institutions (HEIs) eg. ACE course.
- Alternatively provide face-to face as well as virtual Teacher Professional Development (TPD) focussing on improving Mathematics content knowledge.
- Cross-district virtual targeted support to underperforming schools/struggling teachers on prioritized topics.
- Districts: targeted teacher support with school visits and classroom support.
- Districts: targeted teacher development in pedagogical knowledge/techniques in Mathematics.
- Focus on both learner and teachers' differential needs.
- Mathematics and E-learning Subject Adviser development led by DBE, HEI academics and SCs.
- Subsidise in-service training/attending short courses for identified Mathematics teachers.
- CTLI short courses for in-service training (online and physical) for identified IP Mathematics teachers.
- Lead teachers to be identified and additional PD support and specialised training offered.
- Problem Solving online courses and cascading thereof.
- Grow strategic curriculum leadership and management by ensuring that DHs and Mathematics subject heads participate in regular Mathematics strengthening forums e.g. AMESA. Teachers to keep abreast of subject developments.
- Establish close collaboration opportunities and systems with LSEN Directorate.
- Identify and develop and remunerate lead teachers.
- Teacher development foci:
 - deep understanding of curriculum continuity and progression across grades and phases
 - Problem-solving
 - Participation in Professional Bodies e.g. AMESA
 - Collaboration /touch base across pillars and government departments

b) Professional Learning Communities (PLCs):

- Guide SAs, SMTs and lead teachers to start, facilitate and use PLCs at and between schools to promote the sharing of best practices and collaboration.
- Conduct cluster work sessions, in demographic context, to address teaching gaps identified in school-based assessment, systemic testing and diagnostic report and design interventions.
- Lead teachers to lead the small clusters.
- PLC for novice teachers, geographically.
- Standard induction program for novice teachers.
- PLC for novice DH supported by experienced DH clusters sharing good practices of systems in place.
- Certified recognition for lead teachers who host a minimum number of workshops annually.
- Content for PLC will be determined by the needs of the cluster or the group and based on PSIP.

c) Recruitment, induction and retention strategies

- Identify teachers for in-service training at HEIs: bursaries to be sourced.
- Identify lead teachers with excellent mathematics practices for vacant positions.
- Identify experienced Mathematics teachers with excellent track records to serve as mentors to newly appointed/novice Mathematics teachers and provide the mentors with incentives.

d) Learner self-esteem (T2P), learner direction and learner self-regulation & psychosocial support.

- In collaboration with T2P branch offer motivational programs encouraging and guiding self-directed learning, as learners had to learn independently during the pandemic.
- Cross-pillar collaboration in teacher and learner support focussing on:
 - Create a classroom environment that supports freedom of expression.
 - Encourage learners to feel confident about talking through mathematical concepts as well as reasoning.
 - Address factors leading to mathematics anxiety – making errors in a safe environment can lead to understanding and enhanced performance. Praise learners for their efforts.
 - Build and support self confidence in the subjects.
 - Convey realistic expectations, goals and accommodations to include all learners' unique strengths and needs.
 - Encourage risk taking to implement strategies.
 - Build self-reliance.
- Use of creative practices like music, songs and dance to develop the love for Mathematics.
- Math games and playing of Math games can be of great value, because learners can engage, have fun and can learn while playing. Games regarded as safe way to practice, to make mistakes, but also to grow.
- Celebration of children's work by including their efforts in their context on a display wall.
- Positive feedback leads to positive thinking and positive outcomes.
- Make use of various mental Mathematics strategies, so learners do not feel like it's a repetitive routine.
- Aim for excellence but set realistic expectations and setting goals that are manageable and reasonable will allow learners to see how much they've grown.

e) Parental / community involvement:

- Efficient communication from school with parents focussing on pro-active planning and sharing of positives especially successes.
- Guidance to parents towards maximizing involvement.
- Promote family numeracy creating an acute awareness of the elegance and joy of the subject.
- Effective use of Google classroom where parents have access to classroom resources and materials enabling them to assist learners at home.
- Encourage WhatsApp groups per class to enhance community involvement by being informed about school activities.

f) Strategic partnerships:

- Identify potential partners to roll out strategic objectives. e.g.
 - Olico
 - HEIs
 - Living Maths
 - Maths 24
 - AMESA
 - SAMF – South African Mathematics Foundation
- Partner with NGOs, HEIs and private sector initiatives that provide school-based/ on-site support to teachers.
- Analyse data to determine needs for interventions.
- Provide targeted interventions that support districts and schools in setting and attaining appropriate targets as articulated in DIPs and SIPs.

g) Research

- Stay abreast of common trends in mathematics nationally and internationally
- Use data analyses and statistics for quantitative research
- Collaborate with HEIs , NGOs in research projects
- Integration of topics across subjects: Thematic approach
- Explore alternative pedagogies: i.e.
 - Flipped classroom
 - PBL – Project based learning
 - Enquiry based learning
 - Blended learning
 - Mathematical modelling (SP)

h) Advocacy

- Structured and regular advocacy through media and the life orientation domain.
- Officials, teachers and stakeholders involved in Mathematics education conversations – promoting the subject.
- Close collaboration with Communications Directorate advocating tendencies in subject.
- Utilising WCED NEWS to advocate subject events.
- Regular uploading of subject material on Eportal.
- Celebrating successes and achievements in subject.
- Advocacy of subject events e.g. National Mathematics (science) week.

i) Communication

- Management perspective:
 - Establish communication platforms to encourage robust discussions amongst various stakeholders to promote the quality of Mathematics education.
- Teaching and learning perspective:
 - Give students informative feedback.
 - Praise students for perseverance in problem solving.
 - Share positive attitudes in Mathematics.
 - Involve parents.
 - Informal assessment is the best way of giving feedback or to assess the success of a lesson.
 - Encourage code-switching in class.

4.3.2. USE OF PRODUCTIVE PEDAGOGIES:

a) Strengthened, competency based curriculum (National Framework – TMU)

WCED will implement TMU framework in the Senior Phase on instruction from DBE where the following elements will be included in teaching and learning:

- **Conceptual understanding**

Conceptual understanding enables learners to see mathematics as a connected web of concepts. Learners should be able to explain the relationships between different concepts and make links between concepts and related procedures. Conceptual knowledge and understanding enable learners to apply ideas and justify their thinking.

- **Procedural fluency**

These are the processes through which mathematics is done. Learners need to perform mathematical procedures accurately and efficiently. They also need to know when to use a relevant procedure.

- **Strategic competence**

Learners should be able to identify and use appropriate strategies and to devise their own strategies to solve mathematical problems.

- **Reasoning**

Reasoning includes justifying and explaining one's mathematical ideas and communicating them using mathematical language and symbols. Mathematical reasoning includes deductive and inductive reasoning processes.

<p>Conceptual Understanding: <i>comprehension of mathematical concepts, operations, and relations</i></p>	<p>Procedural Fluency: <i>the ability to apply procedures accurately, efficiently, and flexibly</i></p>
<p>Students have an understanding that the product 3.14×4.5 must be between 12 and 20 and might more accurately estimate the product to be close to 14</p>	<p>Students use a procedure or algorithm to compute the product $3.14 \times 4.5 = 14.13$, and they use their <i>conceptual understanding</i>, to assess the reasonableness of the result</p>

Example 2: What is 25% of R84?

<p>Conceptual Understanding: <i>comprehension of mathematical concepts, operations, and relations</i></p>	<p>Procedural Fluency: <i>the ability to apply procedures accurately, efficiently, and flexibly</i></p>
<p>A student with strong conceptual understanding might recall that 25% is the same as $\frac{1}{4}$, and be able to use mental math to find the result, understanding that “25% of”, “one-fourth of”, multiplying by 0.25, and dividing by 4, are all different ways to understand this one problem.</p>	<p>A student with procedural knowledge and fluency could generalize their conceptual knowledge to the procedure of finding the product of $0.25 \times 84 = 21$ to solve the problem. This procedure could be practiced to improve the efficiency of solving this common type of problem.</p>

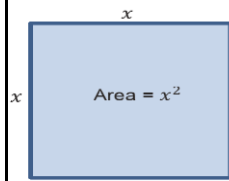
Example 3: Understanding Area

<p>Conceptual Understanding:</p> <p><i>comprehension of mathematical concepts, operations, and relations</i></p>	<p>Procedural Fluency:</p> <p><i>the ability to apply procedures accurately, efficiently, and flexibly</i></p>
<p><i>Students can understand conceptually that the two by three rectangle has an area of 6 square units, without the use of an area formula or algorithm. The idea or concept that area is measured in square units is supported by the visual.</i></p>	<p><i>Students could recognise the multiplicative relationship between the side lengths and the area and use this observation to identify a procedure for efficiently computing the area of any rectangle = length x width.</i></p>

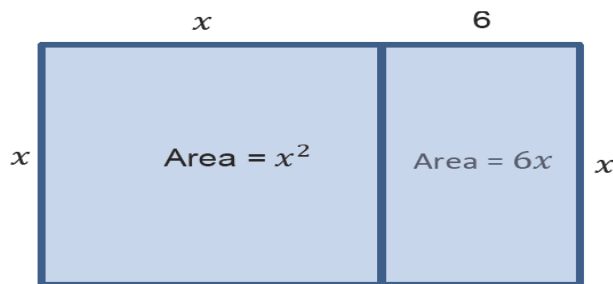
Example 3:

<p>Conceptual Understanding:</p> <p><i>comprehension of mathematical concepts, operations, and relations</i></p>	<p>Procedural Fluency:</p> <p><i>the ability to apply procedures accurately, efficiently, and flexibly</i></p>
<p>What must be added to $x^2 + 6x$ for it to be a perfect square?</p> <p>This could be taught to learners as, to complete the square you add the square of half the coefficient of . And when learners are asked why they would respond that the teacher said so. This does not reflect conceptual understanding. To support learners with conceptually understanding it is important to show learners why it works. This could be explained using a visual.</p> <p>See below/ on next page</p>	<p>Procedurally learners should be able to fluently and accurately apply the steps they used to complete the square of, $x^2 + 6x$ to completing the square of $x^2 + 8x$.</p>

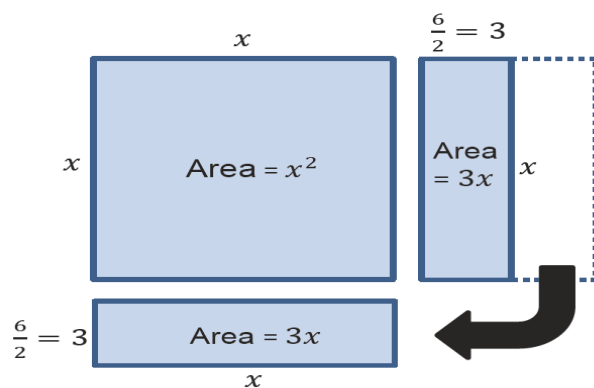
A square with side x has an area of x^2



So $x^2 + 6x$ can be represented with the following rectangle:



The above rectangle is the same as:



The above shape is almost a square, so to make it a square we have to add a square with side 3 , which is in fact $\frac{1}{2}$ of 6

○ **Learning-centered classroom**

A learning-centered classroom focuses on learning – where the teacher designs learning experiences to help learners learn mathematics, using teaching and learning strategies s/he thinks are most suitable for the specific lesson that will be taught.

b) Focus on intellectual quality

Teaching and learning to focus on:

- **Develop deep concept knowledge and understanding.**
Knowledge is deep because focus is sustained on key ideas or concepts throughout the lesson as well as understanding.
- **Develop problematic knowledge**
Knowledge is seen as socially constructed, with multiple and/or conflicting interpretations, presented and explored.
- **Develop higher order thinking:**
Use questioning and examples that span the range of cognitive levels.
- **Metalanguage:**
High use of metalanguage. The lesson proceeds with frequent commentary on language use.
- **Substantive communication:**
Teaching should include substantive conversations about Mathematical concepts and topics and how they help learners to understand and mediate their world better.

c) *Language in the Mathematics classroom*

- Use of correct subject terminology in class. The same terminology used in class should be used in assessment.
- Establish the practice of learners discussing their thinking and reasoning.
- Language is an essential tool for developing and conveying meaning.
- Teachers should make extra effort to assist learners who struggle with the LOLT – code switching may be used.
- Ensure each class has a Mathematical Dictionary.
- An online dictionary can be used.
- Mathematical word walls with examples should be used. Organise as topics progress during the term.
- Officials to encourage the use of appropriate mathematical language between teachers and learners which include important concepts and ideas encountered in Mathematics.

d) *Quality assessment to enhance teaching and learning*

- Brief baseline assessment before the teaching of a new concept will inform differentiated planning and teaching.
- Emphasis on regular informal assessments.
- Assess in order to promote learning and not for promotion purposes only.

- Only assess what has been done in class.
- Design assessment activities that provide reliable, valid information about the success of teaching and learning.
- Use item banks and exemplar assessment tasks to design own tasks that are responsive to teacher and learner needs.
- All formal assessment tasks must be accompanied by an assessment framework.
- Formal assessments must reflect the weightings of the different cognitive levels as per CAPS document, Section 4.
- Provide learners with prompt *feedback* and *feed-forward* aimed at closing the gap between the actual and desired learner achievement.
- Analyse and use evidence from assessments to draft plans for improving teaching and learner support and inform interventions.
- Increase the number of schools participating in Mathematics Challenges, Competitions and Olympiads.

e) A quality classroom environment

- Construct a welcoming classroom and school environment that is supportive, encouraging and focussed on learning so that learners can achieve their full potential.
- Learners respect each other, work individually in pairs and groups to develop a deeper understanding and take responsibility for their own learning and support peer learning.
- Create a Mathematics resource-rich classroom that supports productive teaching and learning.
- Encourage self-regulation and lead by example in preparation.
- Teaching and learning interactions should be orderly and well planned.
- Establish routine learner structures to enhance classroom order.
- Establish classroom rules that every learner bought into, respect and apply in the classroom.
- Make learners aware of their safe spaces, which are based on freedom to express themselves and show respect for the opinions of others, are protected so that the classroom environment becomes a welcoming place for learners to be in.
- Ensure that the core values are referred to regularly so that the learning environment is a welcoming space/place to be in every day.

f) Interpret policy in context

- Develop frameworks and instructional material for the development of a core mathematics curriculum.
- Develop understanding in the sequencing of topics and the connections of correlating topics.
- Strengthen connections between Mathematics in the class and skills learners can apply in context - in the future.
- Focus on developing 21st century skills: i.e.
 - Critical thinking.
 - Communication skills.
 - Creativity.
 - Problem solving.
 - Perseverance.
 - Collaboration.
- Officials, principals, DHs and teachers interpret the stated Mathematics curriculum correctly in terms of teaching, assessment requirements and timetabling.
- Officials, teachers understand continuity and progression of prescribed content/skills from phase to phase and how the teaching and consolidation of prescribed content/skills in one phase forms the basis for mathematical learning in the next phase.

g) Research

- Staying abreast of common trends in mathematics nationally and internationally.
- Conduct quantitative research by using Data Analyses and the use of statistics.
- Collaborate with HEIs, NGOs in research projects.
- Integration of topics across subjects: Thematic approach.
- Explore alternative pedagogies: i.e.
 - Flipped classroom
 - PBL – Project based learning
 - Enquiry based learning
 - Blended learning
 - Mathematical modelling (SP)

h) Advocacy

- Structured and regular advocacy through media and the life orientation domain.
- Officials, teachers and stakeholders involved in Mathematics education conversations – promoting the subject.
- Close collaboration with Communications Directorate advocating tendencies in the subject.
- Utilising WCED NEWS to advocate subject events.
- Regular uploading of subject material on E Portal.
- Celebrating successes and achievements in the subject.
- Advocacy of subject events e.g. National Mathematics (science) week.

i) Communication

- **Management perspective:**
 - Establish communication platforms to encourage robust discussions amongst various stakeholders to promote the quality of Mathematics education.
- **Teaching and learning perspective:**
 - Give students informative feedback.
 - Praise students for perseverance in problem solving.
 - Share positive attitudes in Mathematics.
 - Involve parents.
 - Informal assessment is the best way of giving feedback or to assess the success of a lesson.
 - Encourage code-switching in class.

4.3.3 RESOURCE/FACILITY PROVISION AND USE

a) Adapt to “new normal” Covid context

- Explore new strategies e.g. Blended learning.
- Improve online learning possibilities/ models.

b) Acquire and use facilities/resources appropriately

- Schools do a baseline asset assessment and progressively procure necessary textbooks, grade-appropriate learner manipulatives and teacher demonstration Mathematics kits.
- Ensure that all learners have access to learning and teaching support material (LTSM).

- Manage asset registers to monitor the use and retrieval of resources, use allocated funds and other means to supplement equipment/facilities as required to implement the SIP of Mathematics.

c) *Use resources effectively*

- Teachers use phase appropriate teaching and learning resources and materials.
- Teachers plan per term for resources required for teaching.
- Share ideas about effective use of accessible resources to help mediate key concepts in Mathematics – demonstrate in PLC context.
- Encourage collaboration between schools in developing and sharing resources and facilities. (Community of practice).

d) *Use e-learning and ICT to deepen knowledge and understanding*

- Constantly explore and consider new developments in E – resources that will impact successfully in Mathematics.
- Explore new applications to enhance Mathematics teaching and learning.
- Create, edit and upload material on WCED EPortal.
- Teachers use IT available in school and selected appropriate teaching sources on the Internet.
- Support teachers in the selection of e-learning resources to deepen learners' knowledge and understanding of concepts and skills.
- Review and recommend e-learning software and digital resources that support differentiated learning.
- Advocacy to parents about resources available on the Eportal to support and enhance Mathematics learning.

4.4 FURTHER EDUCATION AND TRAINING FET PHASE: Gr 10 – 12

4.4.1 HUMAN (PEOPLE) RESOURCE DEVELOPMENT

a) *Teacher and official professional development*

- Skills audit will be done to establish a database of Mathematics teachers in the province with their qualification, their content knowledge and pedagogical training needs.
- Virtual teacher support to novice teachers at the start of the academic year focusing on effective classroom and time management, important content areas and support offered by WCED.
- Virtual/physical teacher support to novice teachers at end of each term with the focus on the following term's methodology and content.
- Grow strategic curriculum leadership and management by ensuring that Departmental Heads and Mathematics subject heads participate in regular subject strengthening forums.
- Lead teachers to keep abreast of subject developments in order to support and develop teachers so that they will contribute to learners developing the critical twenty first century skills required.
- Teacher support:
 - All teacher support must consider the teaching skills teachers require to develop learners twenty first century skills.
 - Continuous cross-district virtual targeted support for underperforming schools/struggling teachers on prioritised topics.
 - Districts: targeted teacher support with school visits and classroom support
 - Districts: targeted teacher development aligned with differential needs of teachers and learners as found in each district.
- Monitoring and developing blended teaching/learning skills to enhance the understanding and progress in Mathematics and to develop learners to become critical thinkers and problem solvers.
- Teacher development foci:
 - Teacher development (Focused content and teaching methodology on-site as well as virtual) and related support so that both learner and teachers' differential needs are addressed.
 - Provide a deep understanding of curriculum continuity and progression across grades.
 - Develop teachers' ability to align learning aims, teaching and assessment and in this process improve teacher competence in integrating higher order cognitive skills in teaching and assessment.
 - Support the development of realistic lesson plans to support learners acquiring mathematical process and other skills e.g. solving a quadratic equation, finding the equation of a straight line, doing problem-solving, etc. and the understanding of Annual Teaching Plans(ATPs).

- Improve teaching competencies to help learners acquire basic mathematical skills e.g. solving a quadratic equation, finding the equation of a straight line, doing problem-solving, etc.
- Develop teachers' ability to use ICT e.g. document viewer, Geogebra, Graph, equation editor to enhance teaching and assessment.
- Collaboration /touch base across pillars and government departments.
- Participation in Professional bodies e.g. AMESA.
- Subsidise in-service training, by registering identified teachers for short Mathematics courses at HEIs.
- Lead teachers to be identified and additional Professional Development offered.
- Sponsor AMESA Institution/Individual membership for institution of lead teachers.
- Offer bursaries for in-service Mathematics teachers to improve their qualification at a Higher Education Institute.
- Provide a deep understanding of curriculum continuity and progression across grades and phases.
- **Professional Learning Communities (PLCs)**
 - Guide Subject Advisers, School Management Teams and lead teachers to start, facilitate and use PLCs at and between schools to promote the sharing of best practices and collaboration.
 - Conduct cluster work sessions, in demographic context, to address teaching gaps identified in school-based assessment, systemic testing and diagnostic report and design interventions.
 - Lead teachers to be identified, developed and encouraged to lead the small clusters.
 - PLC for novice teachers, geographically. (dependent on numbers).
 - Content for PLCs will be determined by the findings of the latest diagnostic report and findings of subject advisers in districts.
 - Provide incentives for lead teachers.
 - Certified recognition for lead teachers who host a certain minimum number of workshops annually.
 - Create focussed PLCs to promote greater collaboration and sharing of resources across the province, e.g. Geogebra, each of the Mathematics topics, Investigations, Online Teaching, Typing Mathematics, e-portal, Telematics etc.
- **Recruitment, induction and retention strategies**
 - Embark on a recruitment drive at Higher Education Institutions and schools to appoint educators that are qualified and competent in teaching Mathematics.
 - Subject advisers must give input on the appointment of Mathematics Teachers and Departmental Heads for Mathematics.
 - A Departmental Head for Mathematics must be a Mathematics specialist.

- Bursaries to be made available for learners to pursue a career as a Mathematics teacher.
 - Conduct a needs analysis, how many Mathematics teachers are leaving the system annually and the reason viz. retirement, leaving education, moving to other subject vs how many enter the system.
 - Provide quintile 1-3 schools with an incentive for each grade 12 Mathematics learner doing Mathematics as well as for each learner who achieved over 60%.
 - Design an induction programme (CTLI) for new teachers to drive best practice and develop Mathematics teaching skills.
 - Provide appropriate training for all new teachers and Departmental Heads to ensure they can competently implement CAPS.
 - Provision of mentoring for identified novice teachers.
 - ***Learner self-esteem (T2P), learner direction and learner self-regulation & psychosocial support***
 - Support learners in developing a positive self-esteem based on a “growth mindset” using Transform to Perform and the WCED values.
 - Provide support and guidance to learners in terms of career and study opportunities using Mathematics as a subject choice (see Annexure B).
 - Develop a classroom culture that ensures learners enjoy learning and understand that their learning matters.
 - Creating a classroom environment that supports freedom of expression, in which learners develop confidence to talk about mathematics concepts.
 - Support learners to create various online accounts to support learning e.g. ePortal, Telematics Schools Project, Siyavula, Vodacom, etc.
 - Teachers to integrate eLearning platforms (e.g. Siyavula or Vodacom resources etc.) into their teaching to promote learners doing regular revision of Mathematics, and hence developing positive self-esteem.
 - Teachers support learners to navigate the online resources and to find help where and when it’s required.
 - Encourage and sustain self-directed learning by developing and distributing resources to learners such as:
 - terminology booklets,
 - examination guidelines,
 - term revision materials,
 - tips for success,
 - WCED lesson plans etc. to consolidate their knowledge.
- Ensure regular interaction between SLES and schools with learners that experience personal issues or barriers to learning.

- Teachers to constantly motivate learners to work at Mathematics and to highlight how doing Mathematics has a personal value to everyone by developing their brain power.
- Provisioning of differentiated tutoring programme for identified Grade 10 – 12 Mathematics learners.
- ***Parental / community involvement***
 - The WCED Mathematics strategy to be launched as an improvement plan.
 - The WCED Mathematics strategy to be broadcast at the entrance of all schools.
 - A communication is to be sent to all parents informing them of the support available to learners, the importance of learners doing Mathematics, importance of learners regularly working at Mathematics.
 - Ensure that parents are aware of the possible career and study options that learners taking Mathematics have.
 - Raise awareness with parents on the available e- resources as well as how to access and effectively use these platforms and resources.
 - At parents meetings the principals and teachers are to highlight the skills needed to improve and sustain their children’s competence in mathematics and developing critical twenty-first century skills.
 - At parents meetings the principals and teachers are to remind parents to support and encourage their children to work daily at Mathematics.
 - Sensitise parents to the fact that their expectations are important influences on their child’s achievement.
 - Improved communication with parents from the school.
- ***Strategic partnerships***
 - Partners and/or HEIs to keep all role players abreast with the latest developments in the subject field.
 - Identify potential partners to implement the strategy.
 - Analyse data to determine needs for interventions.
 - Partner with NGOs, HEIs and private sector initiatives that provide school-based/ on-site support to teachers.
 - Provide targeted interventions that support districts and schools in setting and attaining appropriate targets as articulated in DIPs and SIPs.
- ***Research***
 - Stay abreast of common trends in Mathematics nationally and internationally.
 - Analysis of provincial and national statistics to inform interventions.
 - Collaborate with HEI and NGOs to embark on identified research projects, e.g. Success and gaps of Mathematics strategy, Reasons for poor participation in Mathematics and how to improve it.

- Explore alternative pedagogies: e.g. Flipped classroom, Project based learning, Enquiry based learning, blended learning, Mathematical modelling etc.
- **Advocacy**
 - Structured and regular advocacy through media and the life orientation domain.
 - Officials, teachers and stakeholders involved in Mathematics education to promote Mathematics at schools.
 - Close collaboration with Communications Directorate advocating tendencies in subject.
 - Utilising WCED NEWS to advocate subject events.
 - Regular uploading of subject material on ePortal.
 - Celebrating successes and achievements in subject.
 - Advocacy of subject events e.g. National Mathematics (science) week.
 - Posters promoting careers with Mathematics.
- **Communication**
 - Establish a communication platform to encourage robust discussions amongst various stakeholders to promote the quality of Mathematics education.
 - Teaching and learning perspective:
 - Give students informative feedback.
 - Praise students for perseverance in problem solving.
 - Share positive attitudes in Mathematics.
 - Involve parents
 - Informal assessment is the best way of giving feedback or to assess the success of a lesson.

4.4.2 USE OF PRODUCTIVE PEDAGOGIES

a) ***Strengthened, competency based curriculum (National Framework – TMU)***

- The Teaching Mathematics with understanding document will be communicated with all teachers the expectation will be for teachers to start by teaching the examples discussed as recommended.
- The Cape Town Science Centre to develop more examples that could be taught in a way to promote conceptual understanding, procedural fluency, strategic competence, reasoning and a learning centred classroom.

- **Conceptual understanding**

Conceptual understanding enables learners to see Mathematics as a connected web of concepts. Learners should be able to explain the relationships between different concepts and make links between concepts and related procedures. Conceptual knowledge and understanding enable learners to apply ideas and justify their thinking.

- **Procedural fluency**

These are the processes through which Mathematics is done. Learners need to perform mathematical procedures accurately and efficiently. They also need to know when to use a relevant procedure.

- **Strategic competence**

Learners should be able to identify and use appropriate strategies and to devise their own strategies to solve mathematical problems.

- **Reasoning**

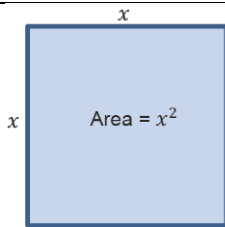
Learners need to interpret the mathematical context and perform mathematical calculations, to draw a conclusion and provide a justification based on their findings.

- **Learning-centered classroom**

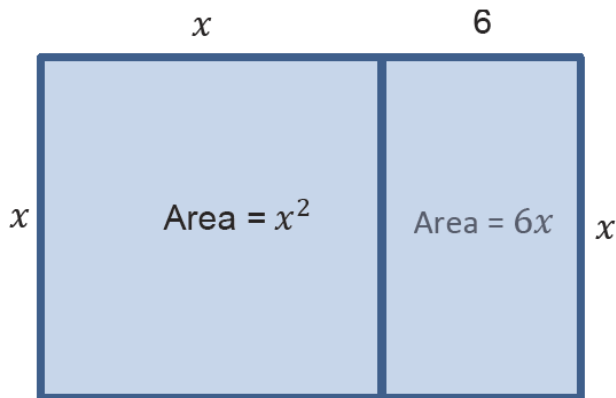
A learning-centered classroom focuses on learning; where the teacher designs learning experiences to help learners explore and understand Mathematics, using teaching and learning strategies he/she thinks are most suitable for the specific lesson that will be taught.

The following are examples of each of the above. These examples have been taken from the National Department document, "MATHEMATICS TEACHING and LEARNING FRAMEWORK FOR SOUTH AFRICA".

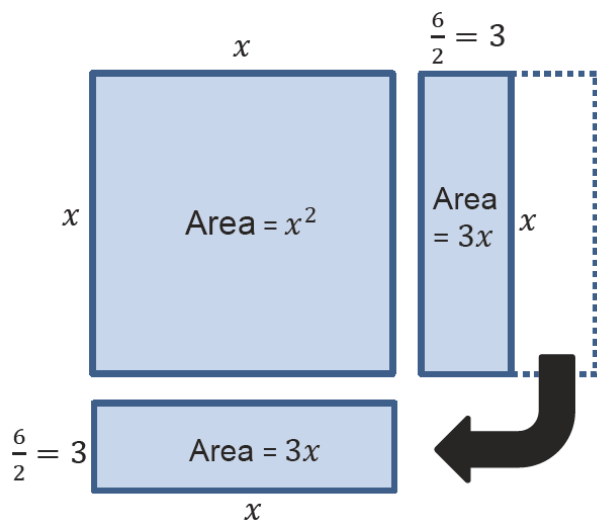
<p>Conceptual Understanding:</p> <p><i>comprehension of mathematical concepts, operations, and relations</i></p>	<p>Procedural Fluency:</p> <p><i>the ability to apply procedures accurately, efficiently, and flexibly</i></p>
<p>This could be taught to learners as, to complete the square you add the square of half the coefficient of . And when learners are asked why, they would respond that the teacher said so. This does not reflect conceptual understanding. The following could support with conceptually understanding. This could be explained using a visual. See below.</p> <p>A square with side x has an area of x^2</p>	<p>In the explanation under conceptual understanding a visual is used to help the learner to make sense of what completing the square means.</p> <p>Procedurally we would want learners to be able to fluently and accurately apply the following steps to complete the square of, $x^2 + 6x$.</p> <p>Step 1:</p> <p>Identify the coefficient of x is: 6</p>



So $x^2 + 6x$ can be represented with the following rectangle:



The above rectangle can also be represented as:



The above shape is almost a square, so to make it a square we have to add a square with side 3, which is in fact $\frac{1}{2}$ of 6.

What must be added to $x^2 + 6x$ for it to be a perfect square?

Step 2:

Divide the coefficient of x by 2: $\frac{6}{2} = 3$

Step 3:

Take the square: $\left(\frac{6}{2}\right)^2 = 3^2 = 9$

Step 4:

Adding 9 to $x^2 + 6x$ then gives,

$$x^2 + 6x + 9 = (x + 3)^2$$

Following the same procedure learners should be able to complete the square of, $x^2 - 4x$ amongst others. If learners can complete the square of similar expressions, procedural fluency has been attained.

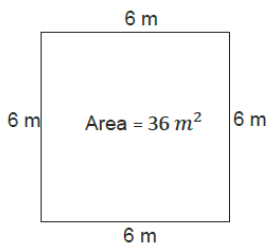
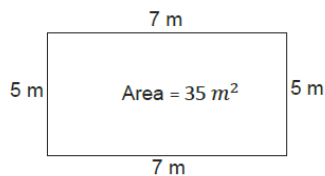
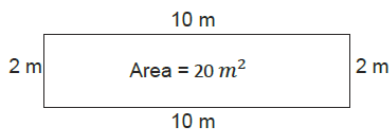
Strategic Competence:

It is important for learners to be able to decide on appropriate procedures to solve mathematical problems. Learners are required to think carefully about the problem given in example 4, to come up with their own approach to solve the problem. Even though there is one answer there can be numerous approaches. It is important for learners to be able to determine whether the conclusion or answer arrived at is with absolute certainty.

Learners could do Example 4 differently. Consider the following Methods:

Method 1:

The learner could sketch different rectangles, by using different lengths for the one side of the rectangle, determine what the other side of the rectangle will be. Then calculate the area. The learner could start with the length being 2 continue selecting other possible lengths like 3, 4, 5 and 6 and each time calculating the corresponding area for the rectangle. In this process the learner will find that when choosing one side of the rectangle to be 6 the other side is also 6 and the area is 36. The learner then finds that when choosing 7 the areas of the rectangle get smaller again and then conclude that the sides must 6 for the rectangle/square with maximum area of $36m^2$. See the visuals below.



The above sketches reflect that the rectangle/square with all sides 6 has the maximum area. Can we be sure that the rectangle/square with all sides $6m$ have the maximum area?

Method 2:

Using the approach in method 1, a table could be compiled as follows:

Length in m	Width in m	Area in m^2
0	12	0
1	11	11
2	10	20
3	9	27
4	8	32
5	7	35
6	6	36
7	5	35
8	4	32
9	3	27
10	2	20
11	1	11
12	0	0

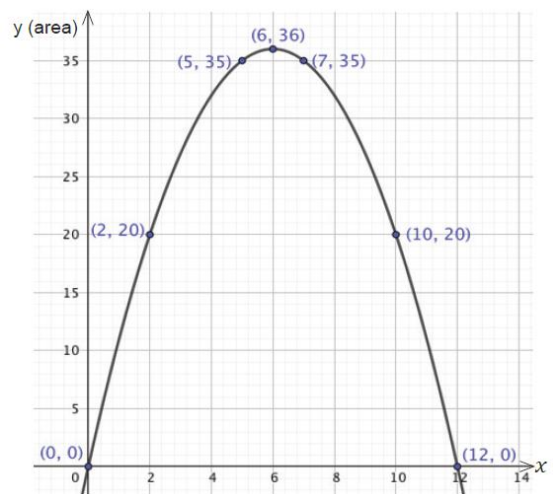
From this table it also looks like the rectangle/square with all sides 6m has the maximum area. Again one can ask, can one be sure that this is the rectangle/square with maximum area. Only whole numbers have been used for the sides of the rectangle. The side of the rectangle could be a real number. Can one be sure that if one side is some other real number (a fraction) that the area will be less than $36m^2$?

Method 3:

Using the table below a graph could be plot of the one side versus the area.

Length in m	Width in m	Area in m^2
0	12	0
1	11	11
2	10	20
3	9	27
4	8	32
5	7	35
6	6	36
7	5	35
8	4	32
9	3	27
10	2	20
11	1	11
12	0	0

From the above table one can make the conjecture that $36 m^2$ is the maximum area. But to justify this conjecture we must consider all possible real values and not only integers. Plotting some or all the above points the graph of a parabola emerges if we join the points as in the graph. Joining the points includes all possible real numbers. See the given sketch:

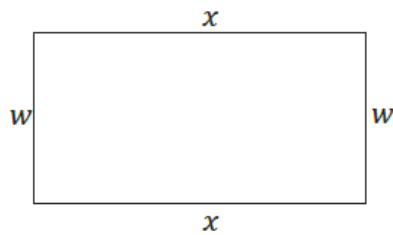


We can thus with more confidence conclude that it seems by looking at the visual image that the maximum area for the rectangle enclosed by 24m is $36m^2$.

Method 4: Algebraic Method

Instead of working with specific lengths for the sides.

Let, the length of rectangle be x and the width of the rectangle be w .



Then, $24 = 2x + 2w$, as the perimeter of the rectangle is 24.

$$\therefore 12 = x + w$$

$$\therefore w = 12 - x$$

The area of the rectangle is then: $A = x(12 - x)$

A could be replaced by y . Therefore, we have $y = x(12 - x)$, where y represent the area of the rectangle.

$y = x(12 - x)$ is a parabola with x -intercepts, $x = 0$ and $x = 12$

\therefore axis of symmetry is 6, as it is in the middle between the two x -intercepts. This is a parabola with a maximum value.

Substituting the axis of symmetry into the equation, $= x(12 - x)$, we are able to obtain the maximum value.

$$\text{Maximum value is: } y = 6(12 - 6) = 36$$

We can thus conclude with certainty that the maximum area of the garden is $36m^2$.

Please note there are more ways that this could be done algebraically.

Reasoning

Inductive Reasoning:

Examples:

Start with a specific true statement: 1 is odd and 3 is odd, the sum of which is 4; an even number.

it is true for the rest:

- an odd number is an even number plus 1.
- two odd numbers are really two even numbers plus 2.
- The sum of even numbers is always even.

Deductive Reasoning:

Examples:

- a) Suppose that $A = 4$ and $B = 4$ then deductively we can conclude that, $A = B$
- b) If $P = Q$ and $Q = R$ then deductively we can conclude that $P = R$.

b) Focus on intellectual quality

➤ **Developing deep concept knowledge and understanding.**

Lessons as well as formal and informal assessment should include questions covering all cognitive levels.

Focus on conceptual understanding of the following amongst others, Area, equation of a straight line, factorizing a quadratic, finding product, completing the square and understanding using the turning point of a parabola to answering questions related to optimisation.

➤ **Develop problematic knowledge**

Expose learners to problem solving questions as far as possible in lessons and assessments.

➤ **Develop higher order thinking:**

Use questioning and examples that span the range of cognitive levels. Every assessment to include questions testing understanding.

➤ **Substantive communication:**

Teaching should include substantive conversations about Mathematics concepts and topics and how they help learners to understand and mediate their world better.

b) Language in the Mathematics classroom

- Teachers to always use LOLT in the Mathematics classroom with correct Mathematical terminology.
- All terminology relevant to a particular topic must be given to learners as well as being available on the walls in and out of the Mathematics classroom.

- Learners must be given sufficient opportunity to practice and discuss the solving of Mathematics problems and share their reasoning.
- Encourage conversations between teachers and learners which include important concepts and ideas encountered in Mathematics.
- Emphasise the instructional verbs in questions and what is expected of each.

c) Quality assessment to enhance teaching and learning

- Provide learners with a Siyavula or other online assessments, to determine the level of the required pre-knowledge for a topic that is to be taught.
- This should inform the guidance provided to learners as well as links to resources, revision recordings to support learners with the required learning gaps.
- Learners should be given informal assessment daily to serve as formative assessment. Siyavula could support with this.
- The informal assessment must culminate in what learners can expect in an examination paper. Once again Siyavula could be used to support learners with this.
- Teachers to provide learners with questions from UCT Mathematics competition and South African Mathematics Olympiad test papers relevant to the topic taught.
- The Cape Town Science Centre to support with compiling the UCT Mathematics competition and South African Mathematics Olympiad questions into the various school topics.
- Formal assessment must reflect the weightings of the different cognitive levels as per the abridged CAPS document (Section 4.).
- Provide learners with prompt *feedback* and *feed-forward* aimed at closing the gap between the actual and desired learner achievement.
- Analyse and use evidence from assessments to draft plans for improving teaching and learner support.

d) A quality classroom environment

- Develop a strategy in constructing a welcoming classroom and school environment that is supportive, encouraging and focused on learning so that learners can achieve their full potential.
- Learners respect each other, work individually, in pairs and groups to develop a deeper understanding and take responsibility for their own learning and support peer learning.
- Encourage self-regulation and lead by example in preparation.
- Teaching and learning interactions should be orderly and well planned.
- Establish routine learner structures to enhance classroom order.
- Every Mathematics classroom to have the relevant terminology and content formula etc. on the walls. Create a Mathematics resource-rich classroom that support productive teaching and learning.
- When learners enter their Mathematics classroom, they are clear on the outcome of the lesson.

- Teachers are ready to start the lesson at the beginning of the period.
- Teaching and learning interactions should be orderly and well planned.
- Encourage discussion on given problems/contexts to develop understanding and integrating Mathematical knowledge in new problems.
- Principals to prioritise the Mathematics classrooms/teachers for the provisioning of a data projector and laptop.
- Principals to ensure that teachers and learners in a Mathematics classroom can access internet.
- Principals to acquire scientific calculators for Mathematics learners from the allocation for LTSM.

e) Interpret policy in context

- Principals, Departmental Heads and teachers to study the CAPS, the abridged section 4, the examination guideline, the available grade 10, 11 and 12 nationally compiled end of year examination papers and memorandum to obtain clarity in terms of teaching and assessment requirements.
- Teachers should understand continuity and progression of prescribed content/skills from phase to phase and how the teaching and consolidation of prescribed content/skills in one phase forms the basis for mathematical learning in the next phase.
- Focus on developing 21st century skills: i.e.
 - Critical thinking.
 - Communication skills.
 - Creativity.
 - Problem solving.
 - Perseverance.
 - Collaboration.
- The correct notional time (4,5 hours per week) is allocated for mathematics.

4.4.3 Resource/facility provision and use

a) Adapt to “new normal” Covid context

- Explore new strategies e.g. Blended learning,
- Improve online learning possibilities/ models
- Increase the participation rate of students using online resources and materials.

b) *Acquire facilities/resources appropriately*

- An Audit to be done of state of teaching resources like laptops, projectors etc. at COSAT and Cape Academy.
- An Audit to be done of MST schools in terms of whether they will pursue the aims and objectives of MST schools. Schools that do not intend to pursue the aims and objectives of MST schools to be removed and the additional teacher to be redistributed.
- Districts to identify two Mathematics and Science focus schools and two of their feeder schools. These schools to become part of a special project. The plan is for these schools to move towards offering Mathematics as a grade 10 compulsory subject.
- These schools acquire, grade-appropriate learner manipulatives and teacher demonstration Mathematics kits.
- Schools do a baseline asset assessment and progressively procure necessary textbooks/resources.
- Identified Grade 9 and 10 learners to be provided with additional support. These learners to receive support materials and data.
- Keep asset registers to monitor the use and retention of resources and use allocated funds and other means to supplement equipment/facilities as needed to implement the SIP for Mathematics.

c) *Use resources effectively*

- The additional mathematics/science teacher at the 50 MST schools is to be utilised as a remedial teacher to provide additional support to Mathematics learners. This teacher is to be identified by name at the various schools. Regular meetings to be held with these teachers to reflect on progress and challenges identified.
- Educators use grade appropriate teaching and learning resources and materials.
- All teachers to receive training to ensure that that they are competent in using computers and other digital equipment as well as able to source teaching/learning resources to enhance learning.
- All teachers plan ahead per term for resources needed in teaching, for example timetable the use of the computer lab etc.
- Share ideas about effective use of accessible resources to help mediate key concepts in Mathematics – demonstrate in PLC context.
- Encourage collaboration between schools in developing and sharing resources and facilities.

d) *Use e-learning and ICT to deepen knowledge and understanding*

- Expand and refine the WCED ePortal.
- Learners create online accounts e.g. WCED ePortal, Telematics, Siyavula or Vodacom accounts to support and promote learners revising, consolidating and taking charge of their own learning.
- Teachers use IT available in school and integrate the various online platforms in their class and exercises given to learners to promote the use of available online resources.

- Telematics program are sent to educators quarterly.
- Virtual District initiatives (react; online tutoring).
- Support teachers in the selection of e-learning resources to deepen learners' knowledge and understanding of concepts and skills.
 - Digital resources provided on weekly lesson plans.
 - Document compiled with links to various Mathematics online resources
- Communication to be sent to parents to make them aware of available online resources that they should encourage their children to use.

4.4.4 Monitoring and Evaluation

a) Reflective practice at school level

- Establish a PLC at school which on an ongoing basis contributes to every teacher's development by implementing reflective practice for improvement.
- Each school develops a target-driven Mathematics improvement plan with collective staff input.
- Monitor teaching and learning by tracking progress and adjusting plans.
- Evaluate efficiency and impact of assessment by monitoring curriculum delivery and performance in SBAs in schools.
- Evaluate learner performance in Formal Assessment Tasks.
- Review the effectiveness of LTSM management.
- Continually improve Mathematics performance by adjusting internal SBA in the light of data from national and provincial systemic assessments.
- Schools follow an internal moderation policy and continually improve it considering subject developments and better teaching practices.
- SMTs support the subject head/DH to manage the subject team by ensuring time on task, by moderating assessment and taking responsibility to address shortcomings.
- Improve the management and monitoring competencies of SMTs.

b) Reflective practice at district level

- Ensure appointments of competent Mathematics Subject Advisers in districts.
- Recruit and develop district officials responsible for Mathematics.
- Evaluate curriculum coverage, impact and pace in accordance with national benchmarks.
- Moderate teaching plans and LTSM to gauge if gaps are addressed.

- Districts develop a Mathematics Improvement Plan within their DIP for reporting to provincial and national structures.
- Districts to reflect on whether progress is made regarding increased participation in Mathematics and to develop plans for greater impact.
- Districts (1) monitor curriculum delivery as well as time on task at schools; (2) ensure that every school has an internal assessment and moderation policy; (3) moderate and verify the SBA; (4) monitor the use and safe-keeping of resources including textbooks.
- Specialists conduct workshops to support officials and teachers to attain desired outcomes.
- Districts to reflect on whether teachers requiring support is receiving the support and is making the necessary progress.
- Districts to reflect on learner gaps being identified and addressed.

c) *Reflective practice at Head Office level*

- Develop management and monitoring competencies of head office officials.
- Research external test results to inform teaching support measures in school and district improvement plans.
- Influence the design of teacher development and leadership courses to develop strategic curriculum leadership and management.
- Include Mathematics monitoring and support in induction courses at CTLI for all in management and leadership positions.
- Review the strategy annually to ensure that the targets of the provincial strategy are met and if necessary, effect adjustments to ensure effective implementation.
- Consult with leading academics on subject improvement

d) *Monitor and reflect on implementation of Mathematics strategy*

- Refine management and monitoring strategies of head office officials.
- Research external test results to inform teaching support measures in school and district improvement plans.
- Influence the design of teacher development and leadership courses to develop strategic curriculum leadership and management.
- Review the strategy annually to ensure that the targets of the provincial strategy are met and if necessary, effect adjustments to ensure effective implementation.
- Consult with leading academics on subject improvement.

4.5. THE STRATEGY UNPACKED FOR MATHEMATICAL LITERACY

4.5.1 HUMAN RESOURCE DEVELOPMENT

a) Teacher / Officials professional development:

- Use Google Forms to conduct an annual audit at the start of each academic year and establish a database of teachers' qualifications to teach Mathematical Literacy.
- Use Google Forms at the start of each academic year to perform a needs analysis in terms of content knowledge and pedagogical needs.
- Virtual teacher support to novice teachers at the start of the academic year focusing on effective classroom and time management, important content areas and support offered by WCED.
- Virtual/physical teacher support to novice teachers at end of each term with the focus on the following term's methodology and content.
- Grow strategic curriculum leadership and management by ensuring that DH and Mathematical Literacy / Mathematics subject heads participate in regular subject strengthening forums. Lead teachers in system to keep abreast of subject developments.
- Teacher support:
 - Continuous cross district virtual targeted support for underperforming schools/struggling teachers on prioritized topics.
 - Districts: targeted teacher support with school visits and classroom support
 - Districts: targeted teacher development aligned with differential needs of teachers and learners as found in each district.
- Monitoring and developing blended learning skills needed in Mathematical Literacy teaching by Elearning Subject Adviser and Mathematical Literacy subject advisers.
- In-service training of specified short courses at certain HEIs for identified Mathematical Literacy educators.
- Lead teachers to be identified and additional PD support offered.
- Teacher development foci:
 - Teacher development and related support so that both learner and teachers' differential needs are addressed.
 - Provide a deep understanding of curriculum continuity and progression across grades.
 - Develop teachers' ability to align learning aims, teaching and assessment.
 - Support the development of realistic lesson plans and the understanding of ATPs.
 - Improve teaching competence to help learners acquire mathematical skills regarding basic calculations and questions that deal with reasoning and reflection.
 - Participation in Professional bodies e.g. AMESA.
 - Collaboration /touch base across pillars and government departments.

b) Professional Learning Communities (PLCs):

- Guide SAs, SMTs and lead teachers to start, facilitate and use PLCs at and between schools to promote and share best practices and collaboration.
- Conduct cluster work sessions, in demographic context, to address teaching gaps identified in school-based assessment, systemic testing and diagnostic report and design interventions.
- Lead teachers to be identified, developed and encouraged to lead the small clusters.
- Provincial PLC for novice teachers (dependent on numbers).

- Content for PLCs will be determined by the findings of the latest diagnostic report and findings of subject advisers in districts.

c) Recruitment, induction, and retention strategies

- Embark on a recruitment drive at HEIs and schools to appoint educators that are qualified and competent in teaching Mathematical Literacy.
- Design induction programmes at all levels, including novice educators.
- Mentoring will be provided to educators' dependent on their identified developmental needs.

d) Learner self-esteem (T2P), learner direction and learner self-regulation & psychosocial support

- Support learners in developing a positive self-esteem based on a "growth mindset" using Transform to Perform and the WCED values.
- Provide support and guidance to learners in terms of career and study opportunities using Mathematical Literacy as a subject choice (see Annexure A).
- Develop a classroom culture that ensures learners enjoy learning and understand that their learning matters.
- Encourage and sustain self-directed learning by developing and distributing resources to learners such as:
 - terminology booklets
 - exam guidelines
 - termly revision materials
 - tips for success
 - WCED lesson plans etc.
- Ensure regular interaction between SLES and schools with learners that experience personal issues or barriers to learning.

e) Parental / community involvement:

- Ensure that parents are aware of the possible career and study options that a learner has that offers this subject.
- Raise awareness to parents on available e- resources as well as how to access and effectively use these platforms and resources.
- Discuss with parents the skills their children need to develop competence in Mathematical Literacy.

f) Strategic partnerships:

- Partner and/or liaise with HEIs to keep all role players abreast with the latest developments in the subject field.
- Analyse data to determine needs for interventions.

g) Research

- Stay abreast of updates in the financial sector (income tax, exchange rates) and name changes in terms of renaming of cities etc.

h) Communication

- Establish communication platforms to encourage robust discussions amongst various stakeholders to promote the quality of Mathematical Literacy education.

4.5.2. USE OF PRODUCTIVE PEDAGOGIES:

a) Strengthened, competency-based curriculum

The WCED will strive to incorporate the following elements in teaching and learning of Mathematical Literacy

○ Conceptual understanding

Conceptual understanding enables learners to see Mathematical Literacy as a connected web of concepts. Learners should be able to explain the relationships between different concepts and make links between concepts and related procedures. Conceptual knowledge and understanding enable learners to apply ideas and justify their thinking.

○ Procedural fluency

These are the processes through which Mathematical Literacy is done. Learners need to perform mathematical procedures accurately and efficiently. They also need to know when to use a relevant procedure.

○ Strategic competence

Learners should be able to identify and use appropriate strategies and to devise their own strategies to solve mathematical problems in the context of Mathematical Literacy.

○ Reasoning

Learners need to interpret the mathematical context and perform mathematical calculations, to draw a conclusion and provide a justification based on their findings.

○ Learning-centered classroom

A learning-centered classroom focuses on learning – where the teacher designs learning experiences to help learners explore and understand Mathematical Literacy, using teaching and learning strategies he/she thinks are most suitable for the specific lesson that will be taught.

b) Focus on intellectual quality

Teaching and learning to focus on:

➤ Develop deep concept knowledge and understanding.

Lessons as well as formal and informal assessment should include questions from all cognitive levels.

➤ Develop problematic knowledge

Expose learners to as many context-based problems as possible in lessons and assessments.

➤ Develop higher order thinking:

Use questioning and examples that span the range of cognitive levels.

➤ **Substantive communication:**

Teaching should include substantive conversations about Mathematical concepts and topics and how they help learners to understand and mediate their world better.

c) Language in the Mathematical Literacy classroom

- Use correct terminology in class. Limit code switching to a minimum. Progressively decrease the amount of code switching used to 0% in Grade 12 lessons.
- Proof reading of formal assessment tasks by language specialists to minimise issues on interpretation of questions.
- Use mathematical literacy terminology booklets as part of teaching to ensure learners can understand and define important concepts.
- Emphasise the instructional verbs in questions and what is expected of each.
- Establish the practice of learners discussing their thinking and reasoning.

d) Quality assessment to enhance teaching and learning

- Informal assessment plays a pivotal role in increasing learners' mathematical knowledge and understanding of the concept. This can include a baseline assessment as well as a consolidation activity.
- Only assess what has been done in class.
- Design assessment activities using current data and statistics.
- Formal assessment must reflect the proportions of the different cognitive levels as per the abridged CAPS document (Section 4.).
- Provide learners with prompt *feedback* and *feed-forward* aimed at closing the gap between the actual and desired learner achievement.
- Analyse and use evidence from assessments to draft plans for improving teaching and learner support.

e) A quality classroom environment

- Construct a welcoming classroom and school environment that is supportive, encouraging and focused on learning so that learners can achieve their full potential.
- Encourage discussion on given contexts to develop a better contextual understanding.
- Learners and teachers should be encouraged to bring real life examples of financial documents and advertisements to class to help conceptual development and practising calculations.
- Learners respect each other, work individually, in pairs and groups to develop a deeper understanding and take responsibility for their own learning and support peer learning.
- Create a Mathematical Literacy classroom that is resource-rich to support productive teaching and learning (including posters and models [measurement]).
- Encourage self-regulation and lead by example.
- Teaching and learning interactions should be orderly and well planned.

- Establish routine learner structures to enhance classroom order.

f) Interpret policy in context

- Principals, DHs and teachers interpret the stated Mathematical Literacy curriculum correctly in terms of teaching and assessment requirements as well as timetabling including the correct notional time.
- Where DH are not Mathematical Literacy educators, they will need to attend standard setting meetings and developmental workshops to equip them with the necessary skills to moderate competently.
- Teachers understand continuity and progression of prescribed content/skills between grades and how the teaching and consolidation of prescribed content/skills in one grade forms the basis for mathematical learning in the next grade.

4.5.3 Resource/facility provision and use

a) Adapt to “new normal” Covid context

- Explore new strategies e.g., Blended learning,
- Improve online learning possibilities / models.
- Increase the participation rate of students using online resources and materials.

b) Acquire and use facilities/resources appropriately

- Schools do a baseline asset assessment and progressively procure necessary textbooks.
- Ensure that all learners have access to learning and teaching support material (LTSM).
- Manage asset registers to monitor the use and retrieval of resources, use allocated funds and other means to supplement equipment/facilities as required to implement the SIP of Mathematical Literacy (e.g., calculators supplied to schools by WCED, visualisers supplied to schools by WCED.)
- Increase awareness around the importance of a learner having a scientific calculator from grade 10.

c) Use resources effectively

- Educators use grade appropriate teaching and learning resources and materials.
- Teachers plan per term for resources required for teaching.
- Schools that have access to computer labs need to plan for the use of the computer labs during lesson time.
- Teachers need to be up skilled on the latest developments in mathematical literacy to proofread the textbooks and make the necessary adjustments by providing supplementary material.
- Share ideas about effective use of accessible resources to help mediate key concepts in Mathematical Literacy.
- Encourage collaboration between schools in developing and sharing resources and facilities. (Community of practice).

d) Use e-learning and ICT to deepen knowledge and understanding

- Create, edit, and upload material on WCED ePortal
 - Weekly lessons per topic
 - Termly revision packages
 - Mind the Gap
 - Terminology booklets

- Tips for success
- Content created by educators
- Past papers for revisions purposes
- Teachers use IT available in school and selected teaching sources on the Internet.
 - Telematics programme sent to educators termly
 - Virtual District initiatives (react; online tutoring)
- Support teachers in the selection of e-learning resources to deepen learners' knowledge and understanding of concepts and skills.
 - Digital resources provided on weekly lesson plans
- Advocacy to parents about resources available on the ePortal to support and enhance Mathematical Literacy learning.
- Encourage parents to acquire and use free software programmes.

4.5.4 Monitoring and Evaluation

The improvement of practices that will sustain better Mathematical Literacy teaching and learning depends on reflection at different levels of the education system. These reflections should suggest changes to the Mathematics Strategy and how we advocate it.

a) *Reflective practice at school level*

- Each school develops a target-driven Mathematical Literacy improvement plan with subject team input.
- DH / Subject head to monitor teaching and learning by tracking progress and adjusting plans.
- Evaluate learner performance in Formal Assessment Tasks by means of per question analysis.
- Continually improve Mathematical Literacy performance by aligning internal SBA to the data from national reports.
- Schools follow an internal moderation policy and continually improve it considering subject developments and better teaching practices.
- Subject Head/DH to manage the subject team by ensuring time on task, by moderating assessments and taking responsibility to address shortcomings.
- Improve the management and monitoring strategies of SMTs by putting systems in place to monitor compliance on a regular basis.
- Quarterly mark verification to ensure marks are accurately transcribed.

b) *Reflective practice at district level*

- Ensure competent appointments of district officials to strengthen district support.
- Develop teachers responsible for Mathematical Literacy.
- Evaluate curriculum coverage, impact and pace in accordance with national benchmarks.
- Moderate SBA at school level to ensure compliance in terms of content covered as well as cognitive levels assessed.
- Districts develop a Mathematical Literacy Improvement Plan within their DIP for reporting to provincial and national structures.
 - Districts :
 - (1) monitor curriculum delivery as well as time on task at schools.
 - (2) ensure that every school has an internal assessment and moderation policy.

- (3) moderate and verify the SBA.
- (4) monitor the use and safe keeping of resources including textbooks.
- Officials conduct workshops to support teachers to attain desired outcomes and develop content and pedagogical knowledge.

c) *Reflective practice at Head Office level*

- Refine management and monitoring strategies of head office officials.
- Research external test results to inform teaching support measures in school and district improvement plans.
- Influence the design of teacher development and leadership courses in order to develop strategic curriculum leadership and management.
- Review the strategy annually to ensure that the targets of the provincial strategy are met and if necessary, effect adjustments to ensure effective implementation.
- Consult with leading academics on subject improvement.

d) *Monitor and reflect on the implementation of the Mathematics strategy*

- Evaluate the understanding and implementation of the provincial Mathematics strategy at districts, at schools, and within communities.
- Ensure all role players understand the importance of this strategy.
- Substantiate changes to the planned strategy where needed.
- Advocate the importance of being numerate and being able to choose Mathematical Literacy as a subject from Grade 10 that will allow all learners to apply to tertiary institutions for certain qualifications.

ANNEXURE A to MATHEMATICAL LITERACY

University	Faculty	Course
Wits	LAW	LLB – 4-year program BA Law
	EDUCATION	B.Ed
	HEALTH	Oral Health Science
	ARTS	Bachelor of Arts Bachelor of Arts in Digital Arts Bachelor of Arts in Theatre and Performance Bachelor of Arts in Film and Television Bachelor of Arts in Fine Arts Bachelor of Music
UWC	ARTS	BA Sports Science BA General Courses
	COMMUNITY & HEALTH SCIENCES	B. Social Work BSc Dietetics & Nutrition Oral Health Physiotherapy BA Sport, Recreation and Exercise Science BSc Occupational Therapy B Nursing
	ECONOMIC AND MANAGEMENT SCIENCES	BAdmin BCom
	LAW	All law degrees

	EDUCATION	B.Ed (FP, IP, SP & FET)
UCT	HEALTH SCIENCES	Oral Health
	HUMANITIES	BA; B.Ed
	LAW	LLB 4-year extended course
SU	AGRISCIENCES	Agricultural Production and Management
	ARTS AND SOCIAL SCIENCES	BA in Humanities BA in Development and the Environment BA in Sport Science
	Education	B.Ed (FP, IP, SP & FET)
	LAW	LLB (four-year) BA (Law)
	MILITARY SCIENCE	BMil in Organisation and Resource Management BMil in Security and Africa Studies
	THEOLOGY	BTh (Bachelor of Theology)
	ARTS	BA in Visual Arts

4.6 THE STRATEGY UNPACKED FOR TECHNICAL MATHEMATICS

4.6.1 HUMAN RESOURCE DEVELOPMENT

a) Teacher / Officials professional development:

- To conduct an annual audit at the start of each academic year and establish a database of teachers' qualifications to teach Technical mathematics.
- Teacher support to novice teachers at the start of the academic year focusing on effective classroom and time management, important content areas and support offered by WCED.
- Teacher support to novice teachers at end of each term with the focus on the following term's methodology and content.
- Teacher support:
 - All districts – district virtual targeted support for all schools/ teachers on prioritized topics.
 - All districts – targeted teacher support with school visits and classroom support.
 - All districts – targeted teacher development aligned with differential needs of teachers and learners as found in each district.
- Lead teachers to be identified and additional PD support offered.
- Teacher development foci:
 - Teacher development and related support so that both learner and teachers' differential needs are addressed.
 - Provide a deep understanding of curriculum continuity and progression across grades.
 - Develop teachers' ability to align learning aims, teaching and assessment.
 - Support the development of realistic lesson plans and the understanding of ATPs.
 - Improve teaching competence to help learners acquire mathematical skills regarding basic calculations and questions that deal with reasoning and reflection.
 - Collaboration /touch base across pillars and government departments.

b) Professional Learning Communities (PLCs):

- Conduct cluster work sessions, in demographic context, to address teaching gaps identified in school-based assessment, systemic testing and diagnostic report and design interventions.
- Lead teachers to be identified, developed and encouraged to lead the small clusters.
- Moderation of SBA and sharing of best practice will be done in these forums.

c) Recruitment, induction, and retention strategies

- Embark on a recruitment drive at schools to appoint educators that are qualified and competent in teaching the subject.
- Mentoring will be provided to educators' dependent on their identified developmental needs.

d) Learner self-esteem (T2P), learner direction and learner self-regulation & psychosocial support

- Support learners in developing a positive self-esteem based on the WCED values.
- Develop and monitor a Technical Mathematics club at all schools.

- Develop a classroom culture that ensures learners enjoy learning and understand that their learning matters.
- Support schools in their curriculum interventions through online platforms.
- Encourage and sustain self-directed learning by developing and distributing resources to learners such as:
 - Recorded content videos
 - exam guidelines
 - termly revision materials
 - Past papers that are sequenced per topic
 - tips for success
 - WCED lesson plans etc.

e) Parental / community involvement:

- Ensure that parents are aware of the possible career and study options that a learner who offers Technical Mathematics has.
- Raise awareness to parents on available e-resources as well as how to access and effectively use these platforms and resources.
- Increase awareness around the importance of a learner having a scientific calculator from grade 10.
- Share assessment plan so that parents can take note of important dates and forms to assist learners to prepare adequately.

f) Strategic partnerships:

- Partner and/or Liaise with HEIs to keep all role players abreast with the latest developments in the subject field.
- Discuss provincial strategies with them.
- Allow them to assist our teachers in content trainings.

g) Research

- Staying abreast of updates especially at TVET levels so that learners are not far away from what is covered at TVET institutions.

h) Communication

- Establish communication platforms to encourage robust discussions amongst various stakeholders to promote the subject.

4.6.2. USE OF PRODUCTIVE PEDAGOGIES:

a) Strengthened, competency-based curriculum

The WCED will strive to incorporate the following elements in teaching and learning of Technical Mathematics

○ **Conceptual understanding**

Conceptual understanding enables learners to structure their knowledge acquisition in a proper manner. Learners should be able to explain the relationships between different concepts and make links between concepts and related procedures. Conceptual knowledge and understanding enable learners to apply ideas and justify their thinking.

○ **Procedural fluency**

These are the processes through which knowledge is processed. Learners need to perform procedures accurately and efficiently. They also need to know when to use a relevant procedure.

- **Strategic competence**
Learners should be able to identify and use appropriate strategies and to devise their own strategies to solve problems especially real-life applications as the nature of the subject is to apply concepts in real life.
- **Reasoning**
Learners need to interpret, arrive at conjectures, prove them, draw a conclusion and provide a justification based on their findings.
- **Learning-centered classroom**
A learning-centered classroom focuses on learning – where the teacher designs learning experiences to help learners explore and understand concepts, using whatever teaching and learning strategies he/she thinks are most suitable for the specific lesson that will be taught.

b) Focus on intellectual quality

Teaching and learning to focus on:

- **Develop deep concept knowledge and understanding.**
Lessons as well as formal and informal assessment should include questions from all cognitive levels.
- **Develop problematic knowledge**
Expose learners to as many application problems as possible in lessons and assessments.
- **Develop higher order thinking**
Use questioning and examples that span the range of cognitive levels.
Use past papers as guides as papers are already graded in different levels
- **Substantive communication**
Teaching should include substantive conversations about concepts and topics and how they help learners to understand and mediate their world better.

c) Language in the classroom

- Allow and encourage learners to participate in lessons.
- Allow them to make mistakes when they converse.
- Teachers need to use correct terminology in class.
- Limit code switching.
- Proof reading of formal assessment tasks by Language specialists, to minimise ambiguity in questions.
- Use glossary booklets as part of teaching to ensure learners can understand and define important concepts.
- Emphasise the instructional verbs in questions and what is expected of each.

d) Quality assessment to enhance teaching and learning

- Assessment must be planned by teachers and communicated to learners and parents.
- Informal assessment plays a pivotal role in increasing the learners' mathematical knowledge and understanding of the concept. This can include a baseline assessment as well as a consolidation activity.
- Only assess what has been done in class.
- Design assessment activities using current data and statistics.

- Formal assessment must reflect the weightings of the different cognitive levels as per the abridged CAPS document (Section 4.).
- Provide learners with prompt *feedback* and *feed-forward* aimed at closing the gap between the actual and desired learner achievement.
- Analyse and use evidence from assessments to draft plans for improving teaching and learner support.
- Teachers need to redo concepts that learners didn't understand.

e) A quality classroom environment

- Create a welcoming classroom and school environment that is supportive, encouraging and focused on learning so that learners can achieve their full potential.
- Encourage learners to have times table, squares and square roots on posters.
- Encourage discussion on given contexts to develop a better contextual understanding.
- Learners and teachers should be encouraged to bring real life examples of documents and advertisements to class to help aid in conceptual development.
- Learners respect each other, work individually, in pairs and groups to develop a deeper understanding and take responsibility for their own learning and support peer learning.
- Create a print rich classroom that is resource-rich to support productive teaching and learning (including posters and models [measurement]).
- Encourage self-regulation and lead by example in preparation.
- Learners should be encouraged to develop their own posters.

f) Interpret policy in context

- Principals and teachers interpret the stated curriculum correctly in terms of teaching and assessment requirements
- Timetabling must have the correct notional time.
- Teachers need to understand continuity and progression of prescribed content/skills between grades and how the teaching and consolidation of prescribed content/skills in one grade forms the basis for mathematical learning in the next grade.

4.6.3 Resource/facility provision and use

a) Adapt to “new normal” Covid context

- Explore new strategies.
- Improve online learning possibilities/ models.
- Increase the participation rate of students using online resources and materials.

b) Acquire and use facilities/resources appropriately

- Ensure that all learners have access to learning and teaching support material (LTSM).
- Encourage teacher to discuss the lessons with learners.
- Manage asset registers to monitor the use of resources.

c) Use resources effectively

- Teachers plan per term for resources to use in teaching.
- Educators use grade appropriate teaching and learning resources and materials.
- Teachers need to be up skilled on the latest developments in Mathematics.
- Share ideas about effective use of accessible resources to help mediate key concepts.
- Encourage collaboration between teachers and sharing best practises.

d) Use e-learning and ICT to deepen knowledge and understanding

- Create, edit and upload material on WCED ePortal.
 - Weekly lessons per topic per grade
 - Term revision packages
 - Mind the Gap
 - Tips for success
 - Content created by educators
 - Past papers for revisions purposes
 - Recorded videos based on selected content
- Teachers use IT available in school and selected teaching sources on the Internet.
 - Virtual District initiatives (react; online tutoring)
- Support teachers in the selection of e-learning resources to deepen learners' knowledge and understanding of concepts and skills.
 - Digital resources provided on weekly lesson plans
- Advocacy to parents about resources available on the ePortal.
- Encourage teachers and parents to acquire and use free software programmes.

4.6.4 Monitoring and Evaluation

The informed reflections acquired from experiences will sustain better teaching and learning.

a) *Reflective practice at school level*

- Each school develops improvement plan with targets for the subject per grade.
- Subject head to monitor teaching and learning.
- Evaluate learner performance in Formal Assessment Tasks.
- Continually improve quality of SBA by constant comparison with past papers.
- Schools follow an internal moderation policy and continually improve it considering subject developments and better teaching practices.
- HOD to manage the subject team by ensuring time on task, by moderating assessments and taking responsibility to address shortcomings.

b) *Reflective practice at district level*

- Ensure competent appointments of teachers at schools to enhance learning.
- Develop teachers responsible for the subject and support them with resources.
- Evaluate curriculum coverage, impact and pace in accordance with national benchmarks.
- Moderate SBA at school level to ensure compliance in terms of content covered as well as cognitive levels assessed.
- Districts
 - monitor curriculum delivery as well as time on task at schools
 - ensure that every school has an internal assessment and moderation policy
 - moderate and verify the SBA
 - monitor the use and safe keeping of resources

c) *Reflective practice at Head Office level*

- Research external test results to inform teaching support measures in school and district improvement plans.
- Review the strategy annually to ensure that the targets of the provincial strategy are met and if necessary, effect adjustments to ensure effective implementation.
- Consults with stake holders on subject improvement.

d) *Monitor and reflect on implementation of the Mathematics strategy*

- Evaluate the understanding and implementation of the provincial Mathematics strategy at districts, at schools, and within communities.
- Ensure all role players understand the importance of this strategy.

- Substantiate changes to the planned strategy where needed.
- Advocate the importance of choosing the subject and the effort there after.