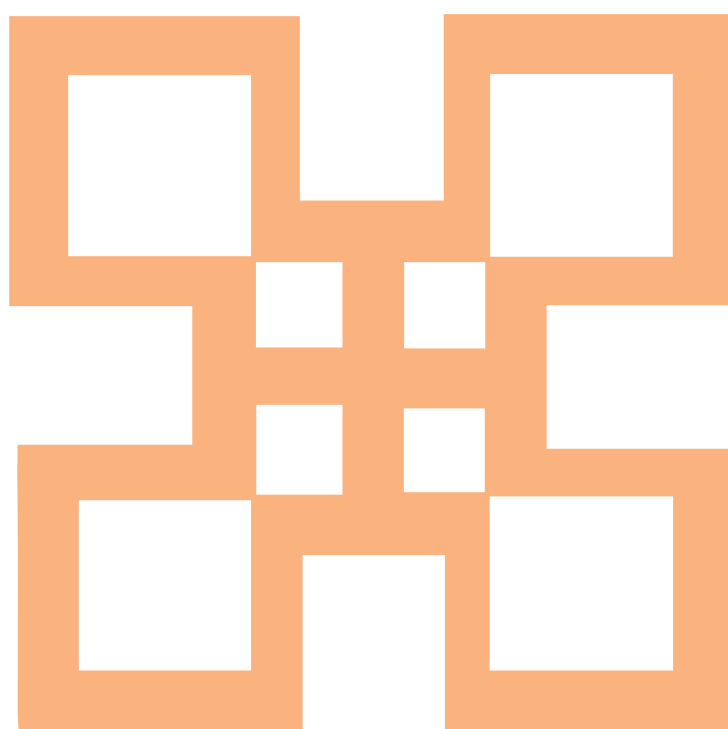


Departmental Professional Learning Community Handbook

MATHEMATICS

HANDBOOK FOR TEACHERS



Wisdom, Knowledge
and Prudence



Ghana Education
Service (GES)





GOVERNMENT OF GHANA



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**DEPARTMENTAL PROFESSIONAL LEARNING
COMMUNITY HANDBOOK**

MATHEMATICS

Teacher Version

DEPARTMENTAL PROFESSIONAL LEARNING COMMUNITY HANDBOOK

This Departmental Professional Learning Community Handbook will help teachers to familiarise themselves with the details of the new Senior High School (SHS), Senior High Technical (SHTS) and Science, Technology, Engineering and Mathematics (STEM) curriculum ahead of national roll-out in 2024/25.

Professional Learning Community (PLC) sessions were introduced across all SHS and SHTS in Ghana in June 2023 and the first two PLC Handbooks were designed to be used by teachers in mixed departmental groups.

This Departmental Professional Learning Community Handbook signals a shift in approach as we focus on providing more detailed information and guidance to teachers ahead of the roll-out of the new SHS, SHTS and STEM curriculum. This Handbook is therefore intended to be used by teachers working in departmental groupings and should be used in conjunction with subject-specific Year One Teacher Manuals.

The Handbook will guide teachers and help to familiarise them with the Weekly Learning Planner and Teacher Manuals as they develop their own Learning Plans for each subject.

The Handbook contains a total of 13 Sessions covering all 24 weeks in Year One of the new SHS, SHTS and STEM curriculum. In each Session of the Handbook teachers will be expected to collectively prepare 2 weeks of Learning Plans using the information provided in their subject-specific Teacher Manuals. The structure of this Handbook is:

Session 1: Reviewing Knowledge on previous PLC sessions

Session 2: Learning Plans for weeks 1 & 2

Session 3: Learning Plans for weeks 3 & 4

Session 4: Learning Plans for weeks 5 & 6

Session 5: Learning Plans for weeks 7 & 8

Session 6: Learning Plans for weeks 9 & 10

Session 7: Learning Plans for weeks 11 & 12

Session 8: Learning Plans for weeks 13 & 14

Session 9: Learning Plans for weeks 15 & 16

Session 10: Learning Plans for weeks 17 & 18

Session 11: Learning Plans for weeks 19 & 20

Session 12: Learning Plans for weeks 21 & 22

Session 13: Learning Plans for weeks 23 & 24

Schools must ensure that they complete all 13 Sessions within a maximum of 16 weeks so that the Handbook has been completed by the end of the 2023/24 academic year.

The Handbook will ensure that teachers continue to enhance their professional practice skills and competencies, familiarising themselves with the details of the new curriculum, enabling them to help learners develop the 21st Century skills and competencies that will prepare them for further studies, the world of work and adult life.

This Handbook also provides opportunities for peer-to-peer transfer of knowledge and encourages teachers to use their subject specialisms and unique experiences to make connections between the subjects within their departments, enhancing learning experiences.

Prof Edward Appiah

Director-General

National Council for Curriculum and Assessment (NaCCA)

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CONTENTS

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DPLC Session 1: Reviewing concepts and skills acquired in previous PLC sessions		
<i>The sections below provide the frame for what is to be done in the session</i>	Guidance Notes on Teacher Activity during the PLC Session. <i>What teachers will do during each stage of the session</i>	Time in session
1. Introduction: Review prior learning, providing opportunities for teachers to indicate how they have applied concepts learnt in the previous session(s)	1.1 Respond to a puzzle in the icebreaker for the introduction of the PLC session. 1.2 Share your expectations regarding what you hope to gain from the Departmental Professional Learning Community (DPLC) activities (NTS 1a, 1b). 1.3 Read the purpose of the DPLC Handbook (NTS 1b). Purpose: The Departmental Professional Learning Community (DPLC) Handbook is intended to serve as the ‘bridge’ between the PLC Handbook introducing the Senior High School (SHS), Senior High Technical (SHTS) and Science, Technology, Engineering and Mathematics (STEM) curriculum and the subject specific PLC Handbook supporting all teachers to plan and teach the year one subjects in the SHS, SHTS and STEM curriculum. The main purpose of DPLC is to: • Build on Session 12 on the <i>learning planner</i> of the PLC Handbook 1 on the <i>introduction to the SHS, SHTS and STEM curriculum</i> to enable teachers to consolidate their understanding and use of the learning planner. • Support teachers to use the year one teacher manuals to develop learning plans for all year one lessons in the SHS, SHTS and STEM curriculum using learning planner template. • Provide opportunities for teachers to discuss the year one learning plans and align them with the year one teacher manuals. • Equip teachers with effective and efficient ways of teaching concepts in the year one subjects in the SHS, SHTS and STEM curriculum. • Give teachers enough time to study the year one subjects in the SHS, SHTS and STEM curriculum and how these will be taught effectively and efficiently.	20 mins

	The Handbook is thus principally aimed at helping mathematics teachers to continue to enhance their professional practice, skills and competencies whilst guiding them to help learners to develop 21st century skills and competencies that will prepare them for further studies, the world of work and adult life. The Handbook will provide opportunities for peer-to-peer transfer of knowledge and mathematics teachers will be encouraged to use their subject specialism and context specific teaching experience to make connections between the teaching and learning of the related subjects in their department. The Handbook contains 13 topics which cover all the 24 weekly learning plans in year one as follows: 1. Reviewing concepts and skills acquired from previous PLC Sessions 2. Developing learning plans for Weeks 1 and 2 3. Developing learning plans for Weeks 3 and 4 4. Developing learning plans for Weeks 5 and 6 5. Developing learning plans for Weeks 7 and 8 6. Developing learning plans for Weeks 9 and 10 7. Developing learning plans for Weeks 11 and 12 8. Developing learning plans for Weeks 13 and 14 9. Developing learning plans for Weeks 15 and 16 10. Developing learning plans for Weeks 17 and 18 11. Developing learning plans for Weeks 19 and 20 12. Developing learning plans for Weeks 21 and 22 13. Developing learning plans for Weeks 23 and 24.	
2. Planning for teaching, learning and assessment activities, promoting character values, GESI, SEL, ICT and 21st century skills	2.1 Read the Purpose, Learning Outcomes (LOs) and Learning Indicators (LIs) for this session (NTS 1b). Purpose: The purpose of this session is to support mathematics teachers to review the new concepts and skills acquired through participation in previous PLC sessions to enable them to consolidate their knowledge and understanding of cross-cutting issues, resources, pedagogical and assessment strategies they have applied in their lessons. LO: Reinforce the skills and understanding of cross-cutting issues, resources and pedagogical and assessment strategies acquired from the previous PLC sessions and their application in the teaching and learning of mathematics. LI 1 Explain at least 3 cross-cutting issues discussed in previous PLC sessions that have influenced teaching and learning of mathematics.	45 mins

	LI 2 Discuss at least 2 pedagogical strategies learnt in previous PLC sessions and how they were applied in mathematics lessons. LI 3 Identify at least 4 teaching and learning resources mentioned in the previous PLC sessions and how they were used in mathematics lessons. LI 4 Discuss at least 3 assessment strategies acquired from the previous PLC sessions that enhanced teaching and learning of mathematics. 2.2 Think-pair and share with the larger group (appreciating others' views) at least 3 cross-cutting issues discussed at previous PLC sessions that influenced teaching and learning of mathematics (NTS 1a-1c, 1f, 1g, 2b-2f and 3e-3h). <i>E.g.</i> <i>GESI - Creating equal opportunities for all learners irrespective of their gender, cultural, religious, socio-economic background, etc.</i> 2.3 Participate in onion ring discussion (where applicable) on at least 2 GESI responsive pedagogical strategies which integrated cross-cutting issues you applied in the teaching and learning of mathematics (NTS 3a, 3d, 3e and 3g). <i>E.g.</i> <i>Onion ring – Engaging learners in two concentric circles to reflect on lessons, etc.</i> 2.4 Think-ink and share at least 4 teaching and learning resources (including low/no cost and ICT tools) effectively used in mathematics lessons based on previous PLC sessions (NTS 3d, 3f and 3j). <i>E.g.</i> <i>Scientific calculators for verifying computations, etc.</i> 2.5 In mixed groupings (gender, experience, etc.) describe at least 3 differentiated assessment strategies acquired from the previous PLC sessions that enhanced teaching and learning of mathematics (NTS 3k-3p). <i>E.g.</i> <i>Interviews – oral questioning used to elicit responses from learners, etc.</i>	
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3. Modelling a teaching activity, promoting character values, GESI, SEL, ICT and 21st century skills	3.1 Model a teaching activity in the sample learning plan at Appendix 1, integrating national values, cross-cutting issues, resources and pedagogical and assessment strategies which have been reinforced in this session (NTS 1b, 1f, 1g, 2c, 2e, 2f and 3c-3j). 3.2 Reflect and provide feedback on the modelled lesson (NTS 1a, 1b and 3b).	15 mins
4. Evaluation and review of session: • Noting that teachers need to identify critical friends to observe lessons and report at next session.	4.1 Reflect and share your views about the session (NTS 1a, 1b and 3b). 4.2 Remember to identify a critical friend to observe your lesson in relation to DPLC Session 1 and provide feedback (NTS 1a). 4.3 Remember to read DPLC Session 2 and bring along your teacher manual and the DPLC Handbook in preparation for the next session (NTS 1b).	10 mins

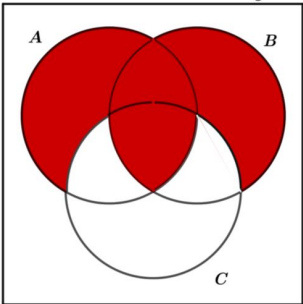
DPLC Session 2: Developing learning plans for Weeks 1 and 2

<i>The sections below provide the frame for what is to be done in the session</i>	Guidance Notes on Teacher Activity during the DPLC Session. <i>What teachers will do during each stage of the session</i>	Time in session
1. Introduction: Review of previous learning using ideas from the last DPLC session	1.1 Share two things you did differently based on DPLC Session 1, <i>reviewing concepts and skills acquired in previous PLC sessions</i>, which you think impacted learning positively (NTS 1a, 1b). 1.2 As a critical friend discuss and summarise in a single sentence why you think what a colleague did by way of application of lessons learnt in DPLC Session 1, <i>reviewing concepts and skills acquired in previous PLC sessions</i>, supported learning (NTS 1a-1c).	10 mins
2. Planning for teaching, learning and assessment activities, using the teacher manual to complete the learning planner, integrating GESI, SEL, ICT, differentiation, 21st century skills and national values (2 learning planners to be completed per session)	2.1 Read the Purpose, Learning Outcomes (LOs) and Learning Indicators (LIs) for this session (NTS 1b). Purpose: The purpose of this session is to support teachers to use the teacher manual to develop learning plans for Weeks 1 and 2 mathematics lessons. Specifically, mathematics teachers will develop learning plans for the following lessons: a) <i>Mathematics</i> i. <i>Sets of real numbers</i> ii. <i>Properties of operations and subsets</i> b) <i>Additional mathematics:</i> i. <i>Binary operations</i> ii. <i>Sets</i> LO 1: Plan mathematics lessons for Weeks 1 and 2 using the teacher manual, taking into consideration the cross-cutting issues (NTS 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3k and 3o). LI 1.1 Relate the aspects of Weeks 1 and 2 mathematics lessons in the teacher manual including content standard(s), LOs, LIs, pedagogical exemplars and	60 mins

	assessment strategies to the sections of the learning planner template. LI 1.2 Fill out the learning planner for Weeks 1 and 2 mathematics lessons with essential questions, teaching and learning activities, key notes on differentiation, assessment strategies, closure and reflection taking into consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 1 and 2 mathematics lessons (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). LI 2.1 Critique the content (essential questions, teaching and learning activities, assessment strategies, key notes on differentiation, closure and reflection) of learning plans for Weeks 1 and 2 in line with the LOs and LIs in the teacher manual. LI 2.2 Implement the recommendations made by a colleague to the learning plans for Weeks 1 and 2 in line with the LOs and LIs in the teacher manual as appropriate. 2.2 In your group, identify and share the aspects of the Weeks 1 and 2 lessons in your teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> <i>Content standards, etc.</i> 2.3 Discuss at least 2 essential questions that support the achievement the LOs and LIs of the lessons in Weeks 1 and 2 (NTS 1a, 3a). <i>E.g.</i> a) <i>Mathematics (Week 1):</i> <i>What distinguishes rational numbers from irrational numbers, and how do these different types of numbers manifest in real-world situations and mathematical concepts? etc.</i> b) <i>Additional mathematics (Week 1):</i> <i>How can I create a classroom environment that promotes collaborative learning and peer-to-peer teaching, enhancing learners' grasp of binary operations? etc.</i>	
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	c) <i>Mathematics (Week 2):</i> <i>How do the properties of closure, commutativity, associativity and distributive impact the outcomes of arithmetic operations, and how are these properties applied in solving real-world problems? etc.</i> d) <i>Additional mathematics (Week 2):</i> <i>How can I scaffold the learning process, starting with basic set concepts and gradually building up to more complex applications? etc.</i> 2.4 Ask teachers to think, pair and share key notes on differentiation in Weeks 1 and 2 mathematics lessons that cater for the diverse needs of learners (NTS 3a, 3f and 3g). Note: Refer to your teacher manual for more examples on differentiation. <i>Hint: Activities for differentiation must focus on learning tasks, pedagogical exemplars and key assessments on the different levels of proficiency.</i> <i>E.g.</i> a) <i>Mathematics (Week 1):</i> i. <i>Learning Tasks:</i> <i>Learners classify the subsets of real numbers using diagrams, flow charts, number lines, etc.</i> ii. <i>Pedagogical Approach 1: Collaborative learning.</i> <i>Provide visual aids, such as number lines or diagrams, to help learners who are struggling to visualize the subsets of the real number system, etc.</i> <i>To differentiate Provide visual aids, such as number lines or diagrams, to help learners who are struggling to visualize the subsets of the real number system, etc.</i> iii. <i>Key Assessment:</i> <i>Provide a variety of assessment tasks to cater for the varied learners.</i> <i>Assessment Level 2: Enumerate the various subsets of the real number system using a Venn diagram/flow chart or number line, etc.</i> b) <i>Mathematics (Week 2):</i> i. <i>Learning Tasks:</i> <i>Enumerating the properties of operations, commutative, associative, distributive, and</i>	
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	<i>their connections to real life as well as their inter connections, etc.</i> ii. <i>Pedagogical Approach 1: Collaborative learning.</i> <i>Learners use flowcharts/Venn diagram/number lines as well as strategies used in the class to establish the properties of operations, commutative, associative, distributive, etc.</i> <i>Differentiation:</i> <i>Use concrete examples and visual aids to help them understand the properties of operations, etc.</i> iii. <i>Key Assessment:</i> <i>Assessment Level 2: Identify the property of operation in the following</i> $4 * \frac{1}{4} = \frac{1}{4} * 4 = 1$, etc. c) <i>Additional Mathematics (Week 1):</i> i. <i>Learning tasks</i> <i>Learners review and explain the basic definition of binary operations, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Collaborative Learning</i> <i>In grouped arrangements, such as by ability, mixed ability, mixed gender, or in pairs, engage learners in various activities to enhance their understanding of binary operations guide learners to recall the four basic operations and apply them to define binary operations within specified sets, subsequently solving related problems, etc.</i> iii. <i>Key assessment</i> <i>Assessment level 1</i> <i>The operation * is defined on the set of real numbers R by $p * q = 2p + q - 2pq$. Find</i> ○ $3 * -2$ ○ $3 * 5$ ○ <i>If $p * 4 = -2$ find the value of p</i> d) <i>Additional Mathematics (Week 2):</i> i. <i>Learning tasks</i> <i>Learners review and define basic sets, understand set notation, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Collaborative Learning</i>	
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	<i>In convenient groups such as ability, mixed ability, mixed gender, or pairs, learners use Venn diagrams as tools to visually represent and verify set identities, enhancing their ability to visualize and comprehend relationships between sets, etc.</i> iii. Key assessment Assessment level 1 Write an expression for the shaded region  etc. 2.5 In your subject group or as an individual, complete learning planners for Weeks 1 and 2 with essential questions, teaching and learning activities, key notes on differentiation, assessment strategies, closure and reflection taking into consideration cross-cutting issues (NTS 1a, 1b, 2a, 2c 3a, 3g and 3h).	
3. Peer-review of learning planners. Reviewing planner to ensure alignment between course manual and learning planner based on the templates provided.	3.1 Swap one of your learning plans with a colleague in the same department (where applicable) and peer review the content of the learning plan in line with the LOs and LIs in the teacher manual (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). <i>Hint:</i> <i>Be guided by the following questions for the review:</i> <i>In what ways does the learning plan align with the teacher manual?</i> <i>How well do the pedagogical strategies and resources used address the needs of different learners?</i> <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> <i>How effective have the differentiated instruction and assessment strategies been used in the plan?</i> <i>Have the essential questions been addressed in the activities?</i>	10 mins

	<i>f) To what extent do the activities in the learning plan promote critical thinking and other 21st century skills? etc.</i> 3.2 Implement the recommendations made by a peer reviewer to your learning plan as appropriate (NTS 1a, 1b).	
4. Reflection on the session: • Reflecting on what has been learnt in the session. • Advance preparation towards next DPLC session	4.1 Share your views and feelings about the session (NTS 1a, 1b). 4.2 Complete your learning plan(s) before the session (NTS 3a, 3l). 4.3 Remember to read the contents of Weeks 3 and 4 in the teacher manual and DPLC Session 3 in preparation for the next session and bring along your DPLC Handbook and teacher manual (NTS 1a, 1b).	10 mins

DPLC Session 3: Developing learning plans for Weeks 3 and 4

<i>The sections below provide the frame for what is to be done in the session</i>	Guidance Notes on Teacher Activity during the DPLC Session. <i>What teachers will do during each stage of the session</i>	Time in session
1. Introduction: Review of previous learning using ideas from the last DPLC session	1.1 Share two things you did differently based on DPLC Session 2, <i>developing learning plans for Weeks 1 and 2</i>, which you think impacted learning positively (NTS 1a, 1b). 1.2 As a critical friend, discuss and summarise in a single sentence why you think what a colleague did by way of application of lesson(s) learnt in DPLC Session 2, <i>developing learning plans for Weeks 1 and 2</i>, supported learning (NTS 1a-1c).	10 mins
2. Planning for teaching, learning and assessment activities, using the teacher manual to complete the learning planner, integrating GESI, SEL, ICT, differentiation, 21st century skills and national values (2 learning planners to be completed per session)	2.1 Read the Purpose, Learning Outcomes (LOs) and Learning Indicators (LIs) for this session (NTS 1b). Purpose: The purpose of this session is to support teachers to use the teacher manual to develop learning plans for mathematics lessons in Weeks 3 and 4. Specifically, mathematics teachers will develop learning plans for the following lessons: a) <i>Mathematics:</i> i. <i>Relationship among three sets of items</i> ii. <i>The concepts and existence of modulo arithmetic</i> b) <i>Additional mathematics:</i> i. <i>Binomial expansion</i> ii. <i>Surds.</i> LO 1: Plan mathematics lessons for Weeks 3 and 4 using the teacher manual taking into consideration cross-cutting issues (NTS 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3k and 3o). LI 1.1 Relate the aspects of Weeks 3 and 4 mathematics lessons in the teacher manual including content	60 mins

	standard(s), LOs, LIs, pedagogical exemplars and assessment strategies to the sections of the learning planner template. LI 1.2 Fill out the learning planner templates for Weeks 3 and 4 mathematics lessons with essential questions, teaching and learning activities, key notes on differentiation, assessment strategies, closure and reflection taking into consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 3 and 4 mathematics lessons (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). LI 2.1 Critique the content (essential questions, teaching and learning activities, assessment strategies, key notes on differentiation, closure and reflection) of the learning plans for Weeks 3 and 4 in line with the LOs and LIs in the teacher manual. LI 2.2 Implement the recommendations made by a colleague to the learning plans for Weeks 3 and 4 in line with the LOs and LIs in the teacher manual as appropriate. 2.2 In your group, identify and share the aspects of the Weeks 3 and 4 lessons in your teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> <i>Content standard, etc.</i> 2.3 Discuss at least 2 essential questions that support the achievement of the LOs and LIs of the lessons in Weeks 3 and 4 (NTS 1a, 3a). <i>E.g.</i> <i>a) Mathematics (Week 3): How does the use of Venn diagrams enhance learners' ability to compare and contrast the relationships between three sets, and how can these diagrams be utilised to illustrate complex set relationships in a clear and concise manner? etc.</i>	
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	b) <i>Additional mathematics (Week 3): How can I assist learners to use effective problem-solving strategies for solving problems involving binomial expansions? etc.</i> c) <i>Mathematics (Week 4): What strategies can be employed to assist learners to visualize fraction quantities in real-world contexts? etc.</i> d) <i>Additional mathematics (Week 4): What fundamental ideas need to be established before introducing the concept of rationalising surds? etc.</i> 2.4 Think-pair-share key notes on differentiation that cater for the needs of diverse learners in Weeks 3 and 4 mathematics lessons (NTS 3a, 3f and 3g). Note: <i>Refer to your teacher manual for more examples on differentiation.</i> <i>Hint: Activities for differentiation must focus on learning tasks, pedagogical exemplars and key assessments on the different levels of proficiency.</i> <i>E.g.</i> a) <i>Mathematics (Week 3):</i> <i>Learning Tasks: Learners state and use the vocabulary and operations of three sets, etc.</i> <i>Pedagogical Approach 1: Collaborative learning. Learners use Venn diagram organiser to solve three set problems. To differentiation: Provide examples and non-examples to help them understand the concepts, etc.</i> <i>Key Assessment: Levels 2&3 Assessment: Suppose $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$, $A = \{2, 4, 6, 8, 10\}$, and $B = \{1, 3, 5, 7, 9\}$. a) Find $(A \cup B)'$ b) Find $(A \cap B)'$ c) Verify de Morgan's laws for the sets A and B, etc.</i>	
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	b) <i>Mathematics (Week 4):</i> i. <i>Learning Tasks:</i> <i>Models the concept of fractions as part of a whole, a group or a ratio of two integers, etc.</i> ii. <i>Pedagogical Approach: Problem-Based Learning</i> <i>Learners use verbal discuss to establish concept of fractions and investigate concept of fractions with respect to part-whole, ratio and group using manipulative and modelling.</i> <i>To differentiate, consider the following to support learners who maybe struggling: Guide them through the concepts of fractions using manipulatives and models, etc.</i> iii. <i>Key Assessment:</i> <i>Assessment Level 1:</i> <i>Add the fractions $\frac{1}{4} + \frac{5}{6}$, etc.</i> c) <i>Additional mathematics (Week 3):</i> i. <i>Learning tasks:</i> <i>Learners to review and explain the basic concept of binomial expressions and expansions, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Collaborative Learning</i> <i>In convenient groups based on ability, mixed ability, mixed gender, or pairs, guide learners to establish both personal and conventional strategies for determining coefficients of terms in a binomial expansion with positive integer indices across different contexts, etc.</i> iii. <i>Key assessment:</i> <i>Assessment level 1:</i> <i>Provide appropriate responses (True or False) to the following tasks</i> ○ <i>For every positive integer n, $(3n)! = (3)!(n)!$</i> ○ <i>There are ten terms in the expression $(1 - x)^{10}$</i> ○ <i>The middle term of the expansion of $\left(1 + \frac{1}{x}\right)^8$ is 70, etc.</i> d) <i>Additional mathematics (Week 4):</i> i. <i>Learning tasks:</i>	
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	<i>Learners to review and investigate the properties of surds, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Collaborative Learning</i> <i>Learners will be working in convenient groups (ability, mixed ability, mixed gender, or pairs etc.) to explore the basic properties and operations on surds in different contexts, etc.</i> iii. <i>Key assessment:</i> <i>Assessment level 1</i> <i>Put the following surds in their simplest form where possible. For those that cannot be further simplified, state the reasons why</i> • $\sqrt{5} + \sqrt{7}$ • $3\sqrt{2} + 5\sqrt{2}$ • $\sqrt{7} - \sqrt{5}$ • $3\sqrt{2} - 5\sqrt{2}$ • $3\sqrt{2} \times 5\sqrt{2}$ 2.5 In your subject group or as an individual, complete learning planners for Weeks 3 and 4 with essential questions, key notes on differentiation, teaching and learning activities, assessment strategies, closure and reflection taking into consideration cross-cutting issues (NTS 1a, 1b, 2a, 2c, 3a, 3g and 3h).	
3. Peer-review of learning planners. • Reviewing planner to ensure alignment between course manual and learning planner based on the templates provided.	3.1 Swap one of your learning plans with a colleague in the same department (where applicable) and peer review the content of the learning plan in line with the LOs and LIs in the teacher manual (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). <i>Note:</i> <i>Be guided by the following questions for the review:</i> a) <i>In what ways does the learning plan align with the teacher manual?</i> b) <i>How well do the pedagogical strategies and resources used address the needs of different learners?</i> c) <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills?</i> d) <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i>	10 mins

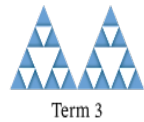
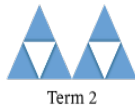
	e) <i>How effective have the differentiated instruction and assessment strategies been used in the plan?</i> f) <i>How appropriate is the closure?</i> g) <i>Have the essential questions been addressed in the activities? etc.</i> 3.2 Implement the recommendations made by a peer reviewer to your learning plan as appropriate (NTS 1a, 1b).	
4. Reflection on the session: • Reflecting on what has been learnt in the session. • Advance preparation towards next DPLC session	4.1 Share your views and feelings about the session (NTS 1a, 1b). 4.2 Complete your learning plan(s) before the next session (NTS 3a, 3l). 4.3 Remember to read the contents of Weeks 5 and 6 in the teacher manual and DPLC Session 4 in preparation for the next session and bring along your DPLC Handbook and teacher manual (NTS 1a, 1b).	10 mins

DPLC Session 4: Developing learning plans for Weeks 5 and 6		
<i>The sections below provide the frame for what is to be done in the session</i>	Guidance Notes on Teacher Activity during the DPLC Session. <i>What teachers will do during each stage of the session</i>	Time in session
Introduction: Review of previous learning using ideas from the last DPLC session	1.1 Share two things you did differently based on DPLC Session 3 on <i>developing learning plans for Weeks 3 and 4</i> which you think impacted learning positively (NTS 1a, 1b). 1.2 As a critical friend, discuss and summarise in a single sentence why you think what a colleague did by way of application of lessons learnt in DPLC Session 3 on <i>developing learning plans for Weeks 3 and 4</i> supported learning (NTS 1a-1c).	10 mins
2. Planning for teaching, learning and assessment activities, using the teacher manual to complete the learning planner, integrating GESI, SEL, ICT, differentiation, 21st century skills and national values (2 learning planners to be completed per session)	2.1 Read the Purpose, Learning Outcomes (LOs) and Learning Indicators (LIs) for this session (NTS 1b). Purpose: The purpose of this session is to support teachers to use the teacher manual to develop learning plans for mathematics lessons in Weeks 5 and 6. Specifically, mathematics teachers will develop learning plans for the following lessons: a) <i>Mathematics:</i> i. <i>Problem-solving on common fractions</i> ii. <i>Connections between and among fractions, percentages and decimal numbers</i> b) <i>Additional mathematics:</i> I. <i>Indices and logarithms</i> II. <i>Sequences and their applications in real life</i> LO 1: Develop mathematics learning plans for Weeks 5 and 6 lessons using the teacher manual, taking into consideration cross-cutting issues (NTS 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3k and 3o). LI 1.1 Relate the aspects of Weeks 5 and 6 mathematics lessons in the teacher manual including content standard(s), LOs, LIs, pedagogical exemplars and assessment strategies to the sections of the learning planner template.	60 mins

	LI 1.2 Complete learning plans for Weeks 5 and 6 mathematics lessons with essential questions, teaching and learning activities, key notes on differentiation, assessment, closure and reflection taking into consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 5 and 6 mathematics lessons (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). LI 2.1 Critique the content (essential questions, teaching and learning activities, assessment, key notes on differentiation, closure and reflection) of learning plans for Weeks 5 and 6 in line with the LOs and LIs in the teacher manual. LI 2.2 Implement the recommendations made by a colleague to the learning plans for Weeks 5 and 6 in line with the LOs and LIs in the teacher manual as appropriate. 2.2 In your groups, identify and share the aspects of Weeks 5 and 6 lessons in your teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> <i>Content standard(s), etc.</i> 2.3 Discuss at least 2 essential questions that support the achievement of the LOs and LIs of the lessons in Weeks 5 and 6 (NTS 1a, 3a). <i>E.g.</i> a) <i>Mathematics (Week 5):</i> <i>How are decimal numbers and percentages used in real-life situations to interpret and compare quantities? etc.</i> b) <i>Additional Mathematics (Week 5):</i> <i>How can recognising and classifying sequences help in solving mathematical problems and making predictions? etc.</i> c) <i>Mathematics (Week 6):</i> <i>How are percentages used in real-life scenarios such as shopping, budgeting and data analysis? etc.</i>	
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	d) <i>Additional Mathematics (Week 6):</i> <i>How can recognising and classifying sequences help in solving mathematical problems and making predictions? etc.</i> 2.4 Discuss key notes on differentiation that cater for the needs of diverse learners in Weeks 5 and 6 mathematics lessons (NTS 3a, 3f and 3g). Note: Refer to your teacher manual for more examples on differentiation. <i>Hint: Activities for differentiation must focus on learning tasks, pedagogical exemplars and key assessments on the different levels of proficiency.</i> <i>E.g.</i> a) <i>Mathematics (Week 5):</i> i. <i>Learning Tasks:</i> <i>Learners establish decimals as fractions, etc.</i> ii. <i>Pedagogical Approach 1: Problem-Based Learning</i> <i>Learners use verbal discuss to establish decimals and percentages as fractions and make conversions among decimals, fractions and percentages.</i> <i>To differentiate:</i> <i>Scaffold the concepts into simpler steps and provide concrete examples to illustrate the conversions, etc.</i> iii. <i>Key Assessment:</i> <i>Assessment Level 1: Using the expanded form, express the following decimal numbers in the form of $\frac{a}{b}$, where $b \neq 0$</i> ○ 0.75 (<i>Hint: $75 \times \frac{1}{100} = \frac{75}{100} = \frac{3}{4}$</i>) ○ 0.45, etc. b) <i>Mathematics (Week 6):</i> i. <i>Learning Tasks:</i> <i>Convert fractions to decimals and to percentages and use these representations in estimations, computations, and applications, etc.</i> ii. <i>Pedagogical Approach 1: Problem-Based Learning</i>	
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	<i>Learners use verbal discuss to establish decimals and percentages as fractions. Then establish the relationship between and among the decimals, percentages and fractions using models. They also investigate the additive and multiplicative inverses of fractions.</i> <i>To differentiate:</i> <i>Provide additional practice and support as needed to build fluency with these concepts, etc</i> iii. <i>Key Assessment:</i> <i>Assessment Level 1: What is 3 out of 5 expressed as a percentage? etc.</i> c) <i>Additional Mathematics (Week 5):</i> i. <i>Learning tasks:</i> <i>Learners review and recollect the initial laws of indices and establish other laws for negative powers and roots, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Learners will be working in convenient groups (ability, mixed ability, mixed gender, or pairs etc.) to state the initial laws of indices, etc.</i> iii. <i>Key assessment:</i> <i>Assessment level 1</i> <i>Simplify $2^2 \times 4^{-4} \div 16^{-3}$, etc.</i> d) <i>Additional Mathematics (Week 6):</i> i. <i>Learning tasks:</i> <i>Learners find terms of arithmetic and geometric sequences, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>In mixed gender groups (where appropriate) use visual aids such as Venn diagrams, tables, to demonstrate basic set operations and properties, etc.</i> iii. <i>Key assessment:</i> <i>Consider the following pattern.</i>	
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- Which of the following sequences represents the number of solid blue triangles in each successive term of the pattern?
 - 2, 8, 26, 80, ...
 - 1, 3, 9, 27, ...
 - 2, 6, 18, 54, ...
 - 2, 4, 12, 36, ...
 - 2, 4, 8, 16, ...
- Which type of sequence is found when counting the number of solid blue triangles in the above pattern? etc.

2.5 In your subject groups or as an individual, complete learning planners for Weeks 5 and 6 with essential questions, key notes on differentiation, teaching and learning activities, assessment strategies, closure and reflection taking into consideration crosscutting issues (NTS 1a, 1b, 2a, 2c, 3a, 3g and 3h).

3. Peer-review of learning planners. • Reviewing planner to ensure alignment between course manual and learning planner based on the templates provided.	3.1 Exchange one of your learning plans with a colleague in the same department (where applicable) and peer review the content of the learning plan in line with the LOs and LIs in the teacher manual (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). <i>Hint:</i> <i>Be guided by the following questions for the review:</i> <i>In what ways does the learning plan align with the teacher manual?</i> <i>How well do the pedagogical strategies and resources ensure inclusivity?</i> <i>To what extent do the activities in the learning plan promote the development of critical thinking and other 21st century skills?</i> <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> <i>Have the essential questions been addressed in the activities?</i> <i>How effective have the differentiated instruction and assessment strategies been used in the planner?</i> <i>How appropriate is the closure? etc.</i> 3.2 Implement the recommendations made by a peer reviewer to their learning plans as appropriate (NTS 1a, 1b).	10 mins
4. Reflection on the session: • Reflecting on what has been learnt in the session. • Advance preparation towards next PLC session	4.1 Share your insights and key takeaways regarding the session (NTS 1a, 1b). 4.2 Complete your learning plans before the next session (NTS 3a, 3l). 4.3 Read the contents of Weeks 7 and 8 in the teacher manual and DPLC Session 5 in preparation for the next session and bring your DPLC Handbook and teacher manual (NTS 1a, 1b).	10 mins

DPLC Session 5: Developing learning plans for Weeks 7 and 8

<i>The sections below provide the frame for what is to be done in the session</i>	Guidance Notes on Teacher Activity during the DPLC Session. <i>What teachers will do during each stage of the session</i>	Time in session
1. Introduction: Review of previous learning using ideas from the last DPLC session	1.1 Share two things you did differently based on DPLC Session 4, <i>developing learning plans for Weeks 5 and 6</i>, which you think impacted learning positively (NTS 1a, 1b). 1.2 As a critical friend, discuss and give a summary on why you think what a colleague did by way of application of lesson(s) learnt in DPLC Session 4, <i>developing learning plans for Weeks 5 and 6</i>, supported learning (NTS 1a-1c).	10 mins
2. Planning for teaching, learning and assessment activities, using the teacher manual to complete the learning planner, integrating GESI, SEL, ICT, differentiation, 21st century skills and national values (2 learning planners to be completed per session)	2.1 Read the Purpose, Learning Outcomes (LOs) and Learning Indicators (LIs) for this session (NTS 1b). Purpose: The purpose of this session is to support teachers to use the teacher manual to develop learning plans for lessons in Weeks 7 and 8. Specifically, mathematics teachers will develop learning plans for the following lessons: a) <i>Mathematics:</i> i. <i>Application of percentages</i> ii. <i>Application of percentages</i> b) <i>Additional mathematics:</i> I. <i>Functions, attributes and composite functions</i> II. <i>Graphs of linear and quadratic function</i> LO 1: Develop subject-specific learning plans for Weeks 7 and 8 lessons using the teacher manual, taking into consideration cross-cutting issues (NTS 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3k and 3o). LI 1.1 Discuss the aspects of Weeks 7 and 8 mathematics lessons in the teacher manual including content standard(s), LOs, LIs, pedagogical exemplars and assessment strategies, and relate it to the learning planner template.	60 mins

	LI 1.2 Complete learning planner templates for Weeks 7 and 8 mathematics lessons with essential questions, teaching and learning activities, key notes on differentiation, assessment strategies, closure and reflection, taking into consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 7 and 8 mathematics lessons (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). LI 2.1 Critique the content (essential questions, key notes on differentiation, teaching and learning activities, assessment, closure and reflection) of learning plans for Weeks 7 and 8 in line with the LOs and LIs in the teacher manual. LI 2.2 Implement the recommendations made by a peer reviewer to the learning plans for Weeks 7 and 8 in line with the LOs and LIs in the teacher manual as appropriate. 2.2 In groups, identify and discuss the aspects of Weeks 7 and 8 lessons in your teacher manuals that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> <i>Content standard(s), etc.</i> 2.3 Discuss at least 2 essential questions that support the achievement of the LOs and LIs of the lessons in Weeks 7 and 8 (NTS 1a, 3a). <i>E.g.</i> <i>a) Mathematics (Week 7): How are percentages used in real-life scenarios such as shopping, budgeting and data analysis? etc.</i> <i>b) Additional mathematics (Week7): How can I effectively assist learners to evaluate functions and understand their significance in real-life scenarios? etc.</i> <i>c) Mathematics (Week 8): How do simple and compound interest differ in terms of calculation methods and outcomes, and how are these concepts applied in financial transactions and investments? etc.</i>	
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	<i>d) Additional Mathematics (Week 8): What real-world scenarios can be modelled by linear functions? etc.</i> 2.4 Discuss key notes on differentiation that cater for the needs of diverse learners in Weeks 7 and 8 mathematics lessons (NTS 3a, 3f and 3g). Note: Refer to your teacher manual for more examples on differentiation. <i>Hint: Activities for differentiation must focus on learning tasks, pedagogical exemplars and key assessments on the different levels of proficiency.</i> <i>E.g.</i> <i>a) Mathematics (Week 7):</i> <i>i. Learning Tasks: Learners review fractions, percentages and decimals and apply them to percentage increase and percentage decrease of given quantities, etc.</i> <i>ii. Pedagogical Approach 1: Problem-Based Learning Learners use verbal discussions to apply their knowledge in fractions to percentage increase and percentage decrease of given quantities. To differentiate: Break down the concepts into simpler steps and provide concrete examples to illustrate the calculations, etc.</i> <i>iii. Key Assessment: Assessment Level 3: A company's sales increased by 20% this year compared to the previous year. If the sales for the previous year were GH¢250,000, what were the sales for the current year?</i> <i>b) Mathematics (Week 8):</i> <i>i. Learning Tasks: Learners calculate the simple interest earned on a fixed deposit or savings account for a given principal amount, interest rate, and time periods, etc.</i> <i>ii. Pedagogical Approach 1: Problem-Based Learning</i>	
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	<i>Learners in groups discuss to solve real-life problems involving simple and compound interest.</i> <i>To differentiate:</i> <i>Provide support and guidance as they work through the problems, focusing on building their confidence and understanding, etc.</i> iii. <i>Key Assessment:</i> <i>Assessment Level 1: conduct a mini-project by obtaining information on how to calculate any of the household utilities, etc.</i> c) <i>Additional mathematics (Week 7):</i> i. <i>Learning tasks:</i> <i>Learners create different types of functions, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Provide step-by-step instructions for learners to use in establishing and describing functions and composite function, etc.</i> iii. <i>Key assessment:</i> <i>Assessment level 1</i> <i>Evaluate $g(-3)$ if $g(x) = 2x^2 - 4x + 7$ (Level 1), etc.</i> b) <i>Additional Mathematics (Week 8):</i> i. <i>Learning tasks:</i> <i>Learners recognise and create linear and parabolic functions by hand and with technology where appropriate, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Problem-based Learning</i> <i>Learners are tasked to investigate the domain of functions such as: polynomials, radical, rational, logarithmic and exponential with the use of calculators and graphing utilities and then share their findings with the class, etc.</i> iii. <i>Key assessment:</i> <i>Assessment level 1</i> <i>Construct a linear function passing through the points (1, 4) and (3, 10), etc.</i> 2.5 In your subject group or as an individual, complete learning planner for Weeks 7 and 8 with teaching and learning activities, resources, key notes on differentiation,	
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	assessment strategies, essential questions, closure and reflection taking into consideration cross-cutting issues (NTS 1a, 1b, 2a, 2c, 3a, 3g and 3h).	
3. Peer-review of learning planners. Reviewing planner to ensure alignment between course manual and learning planner based on the templates provided.	3.1 Swap one of your learning plans with a colleague in the same department (where applicable) and peer review the content of the learning plan in line with the LOs and LIs in the teacher manual (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). <i>Hint:</i> <i>Be guided by the following questions for the review:</i> <i>In what ways does the learning plan align with the teacher manual?</i> <i>How well do the pedagogical strategies and resources used address the needs of different learners?</i> <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> <i>How effective have the differentiated instruction and assessment strategies been used in the plan?</i> <i>How appropriate is the closure?</i> <i>Have the essential questions been addressed in the activities?</i> <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills? etc.</i> 3.2 consider the peer review comments/suggestions and implement them into your learning plans (NTS 1a, 1b).	10 mins
4. Reflection on the session: - Reflecting on what has been learnt in the session. - Advance preparation towards next DPLC session	4.1 Share your views and feelings about the session (NTS 1a, 1b). 4.2 Complete your learning plan(s) before the next session (NTS 3a, 3l). 4.3 Remember to read the contents of Weeks 9 and 10 in the teacher manual and DPLC Session 6 in preparation for the next session and bring along your DPLC Handbook and teacher manual (NTS 1a, 1b).	10 mins

DPLC Session 6: Developing learning plans for Weeks 9 and 10

<i>The sections below provide the frame for what is to be done in the session</i>	Guidance Notes on Teacher Activity during the DPLC Session. <i>What teachers will do during each stage of the session.</i>	Time in session
1. Introduction: Review of previous learning using ideas from the last DPLC session	1.1 Share two things you did differently based on DPLC Session 5, <i>developing learning plans for Weeks 7 and 8</i>, which you think impacted learning positively (NTS 1a, 1b). 1.2 As a critical friend, discuss and summarise in a single sentence why you think what a colleague did by way of application of lesson(s) learnt in DPLC Session 5, <i>developing learning plans for Weeks 7 and 8</i>, supported learning (NTS 1a-1c).	10 mins
2. Planning for teaching, learning and assessment activities, using the teacher manual to complete the learning planner, integrating GESI, SEL, ICT, differentiation, 21st century skills and national values (2 learning planners to be completed per session)	2.1 Read the Purpose, Learning Outcomes (LOs) and Learning Indicators (LIs) for this session (NTS 1b). Purpose: The purpose of this session is to support teachers to use the teacher manual to develop learning plans for mathematics lessons in Weeks 9 and 10. Specifically, mathematics teachers will develop learning plans for the following lessons: a) <i>Mathematics:</i> i. <i>Algebraic expressions & factorisation</i> ii. <i>Perfect squares</i> b) <i>Additional mathematics:</i> i. <i>Graphical and algebraic solutions to systems of three linear equations and their real-life applications</i> ii. <i>Polynomial functions and their graphs.</i> LO 1: Develop mathematics learning plans for teaching Weeks 9 and 10 lessons using the teacher manual, taking into consideration cross-cutting issues (NTS 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3k and 3o). LI 1.1 Relate the aspects of Weeks 9 and 10 mathematics lessons in the teacher manual including content standard(s),	60 mins

	LOs, LIs, pedagogical exemplars and assessment strategies to the sections of the learning planner template. LI 1.2 Fill out the learning planner templates for Weeks 9 and 10 mathematics lessons with essential questions, teaching and learning activities, key notes on differentiation, assessment strategies, closure and reflection taking into consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 9 and 10 mathematics lessons (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). LI 2.1 Critique the content (essential questions, teaching and learning activities, assessment strategies, key notes on differentiation, closure and reflection) of learning plans for Weeks 9 and 10 in line with the LOs and LIs in the teacher manual. LI 2.2 Implement the recommendations made by a colleague to the learning plans for Weeks 9 and 10 in line with the LOs and LIs in the teacher manual as appropriate. 2.2 In your group, identify and share the aspects of Weeks 9 and 10 lessons in your teacher manual that have been captured in the learning planner (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> <i>Learning indicator(s), etc.</i> 2.3 Discuss at least 2 essential questions that support the achievement of the LOs and LIs of the lessons in Weeks 9 and 10 (NTS 1a, 3a). <i>E.g.</i> a) <i>Mathematics (Week 9):</i> <i>In what ways can algebraic expressions be used to model and solve real-world problems, and how does the substitution of variables with specific values facilitate problem-solving? etc.</i> b) <i>Additional mathematics (Week 9):</i> <i>In what real-life scenarios do systems of three linear equations with three variables arise, and why are they useful for problem-solving? etc.</i> c) <i>Mathematics (Week 10):</i>	
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How can perfect squares be identified and used in mathematical operations, patterns and geometric shapes? etc.

- d) *Additional mathematics (Week 10):
How do I assist the learner to see the connection between polynomial functions and linear, quadratic, and cubic functions? etc.*

2.4 Discuss key notes on differentiation that cater for the needs of diverse learners in Weeks 9 and 10 mathematics lessons (NTS 3a, 3f and 3g).

Note: *Refer to your teacher manual for more examples on differentiation.*

Hint: Activities for differentiation must focus on learning tasks, pedagogical exemplars and key assessments on the different levels of proficiency.

E.g.

- a) *Mathematics (Week 9):*

- b) *Learning tasks:
Learners expand and simplify given algebraic expressions, etc.*

- ii. *Pedagogical Approach 1: Collaborative learning:
Make use of group and pair activities to engage learners to explore simple patterns to generate rules and write them in algebraic form. Learners formulate mathematical expressions by investigating patterns and its applications in everyday life. For example, house numbers in the street, seating in the café and church.*

To differentiate:

Ensure to include a wide range of tasks that appeal to the various groups of learners.

Particularly, make accommodations for learners who may be struggling by using advance learners to support them, etc.

- c) *Key Assessment*

Assessment Level 2: How many squares will be in the 5th pattern?



	etc. d) <i>Mathematics (Week 10):</i> i. <i>Learning Tasks:</i> <i>Learners Engage learners with perform operations on algebraic fractions including monomial and binomial denominators on all the four operations.</i> ii. <i>Pedagogical Approach 1: Problem-based learning approach:</i> <i>Learners investigate the concept of perfect square using paper cut /graph sheet and stickers out. They also brainstorm the meaning of perfect squares, identify differences of two squares, and use problem-solving strategies to apply the concepts of perfect squares.</i> <i>To differentiate:</i> <i>Offer practice problems to help them identify perfect squares and understand the concept, etc.</i> iii. <i>Key Assessment</i> <i>Assessment Level 2</i> <i>Given that $p = \frac{2x}{1-x^2}$ and $q = \frac{2x}{1+x}$, simplify $3p - 2q$</i> c) <i>Additional Mathematics (Week 9):</i> i. <i>Learning tasks:</i> <i>Learners review the concept of linear inequalities and systems of linear inequalities, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Collaborative Learning</i> <i>Pair below-average learners with peers who have a stronger grasp of the material. Assign roles within the tutoring session, such as "explainer" and "questioner," to encourage active engagement and collaboration, etc.</i> iii. <i>Key assessment:</i> <i>Assessment level 2</i> <i>Graph the solution of the following systems of inequalities, find the coordinates of all vertices and determine whether the solution set is bounded or not</i> $\begin{cases} y < x + 6 \\ 3x + 2y \geq 12, \text{ etc.} \\ x - 2y \leq 2 \end{cases}$	
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	d) <i>Additional mathematics (Week 10):</i> i. <i>Learning tasks:</i> Learners identify the degree and leading coefficient of given polynomials, etc. ii. <i>Pedagogical exemplars:</i> In groups, learners are tasked to solve unique equations or inequalities, etc. iii. <i>Key assessment:</i> Assessment level 1 Given $g(x) = 3x^2 - 5x + 2$ and $h(x) = 2x^2 + 4x - 1$ Determine the sum of $g(x)$ and $h(x)$ Find the difference between $g(x)$ and $h(x)$, etc. 2.5 In your subject group or as an individual, complete learning planners for Weeks 9 and 10 with essential questions, teaching and learning activities, key notes on differentiation, assessment strategies, closure and reflection taking into consideration cross-cutting issues (NTS 1a, 1b, 2a, 2c 3a, 3g and 3h).	
3. Peer-review of learning planners. Reviewing planner to ensure alignment between course manual and learning planner based on the templates provided.	3.1 Swap one of your learning plans with a colleague in the same department (where applicable) and peer review the content of the learning plan in line with the LOs and LIs in the teacher manual (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). <i>Hint:</i> Be guided by the following questions for the review: <i>In what ways do the learning plan align with the teacher manual?</i> <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills?</i> <i>How effective have the differentiated instruction and assessment strategies been used in the plan? etc.</i> 3.2 Implement the recommendations made by a peer reviewer to your learning plan as appropriate (NTS 1a, 1b).	10 mins

4. Reflection on the session: • Reflecting on what has been learnt in the session. • Advance preparation towards next DPLC session	4.1 Share your views and feelings about the session (NTS 1a, 1b). 4.2 Complete your learning plan(s) before the next session (NTS 3a, 3l). 4.3 Remember to read the contents of Weeks 11 and 12 in the teacher manual and DPLC Session 7 in preparation for the next session and bring along your DPLC Handbook and teacher manual (NTS 1a, 1b).	10 mins
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DPLC Session 7: Developing learning plans for Weeks 11 and 12

<i>The sections below provide the frame for what is to be done in the session</i>	Guidance Notes on Teacher Activity during the DPLC Session. <i>What teachers will do during each stage of the session</i>	Time in session
1. Introduction: Review of previous learning using ideas from the last DPLC session	1.1 Share two things you did differently based on DPLC Session 6, <i>developing learning plans for Weeks 9 and 10</i>, which you think impacted learning positively (NTS 1a, 1b). 1.2 As a critical friend, discuss and summarise in a single sentence why you think what a colleague did by way of application of lesson(s) learnt in DPLC Session 6, <i>developing learning plans for Weeks 9 and 10</i>, supported learning (NTS 1a-1c).	10 mins
2. Planning for teaching, learning and assessment activities, using the teacher manual to complete the learning planner, integrating GESI, SEL, ICT, differentiation, 21st century skills and national values (2 learning planners to be completed per session)	2.1 Read the Purpose, Learning Outcomes (LOs) and Learning Indicators (LIs) for this session (NTS 1b). Purpose: The purpose of this session is to support teachers to use the teacher manual to develop learning plans for mathematics lessons in weeks 11 and 12. Specifically, mathematics teachers will develop learning plans for the following lessons: a) <i>Mathematics:</i> i. <i>Patterns and Relationships</i> ii. <i>Relations and functions</i> b) <i>Additional mathematics:</i> i. <i>Rational functions, their properties and decomposition</i> ii. <i>Matrices, types of matrices and arithmetic operations on 2x2 matrices.</i> LO 1: Plan mathematics lessons for Weeks 11 and 12 using the teacher manual taking into consideration cross-cutting issues (NTS 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3k and 3o).	60 mins

	LI 1.1 Relate the aspects of Weeks 11 and 12 mathematics lessons in the teacher manual including content standard(s), LOs, LIs, pedagogical exemplars and assessment strategies to the sections of the learning planner template. LI 1.2 Fill out learning plans for Weeks 11 and 12 mathematics lessons with essential questions, teaching and learning activities, key notes on differentiation, assessment, closure and reflection taking into consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 11 and 12 mathematics lessons (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). LI 2.1 Critique the content (essential questions, teaching and learning activities, assessment strategies, key notes on differentiation, closure and reflection) of learning plans for Weeks 11 and 12 in line with the LOs and LIs in the teacher manual. LI 2.2 Implement the recommendations made by a colleague to the learning plans for Weeks 11 and 12 in line with the LOs and LIs in the teacher manual as appropriate. 2.2 In your groups, identify and share the aspects of Weeks 11 and 12 lessons in the teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). E.g. <i>Learning outcome(s), etc.</i> 2.3 Discuss at least 2 essential questions that support the achievement of the LOs and LIs of the lessons in Weeks 11 and 12 (NTS 1a, 3a). E.g. a) <i>Mathematics (Week 11): How do linear equations model real-world situations and how can the solutions to these equations be interpreted in the context of the problem? etc.</i> b) <i>Additional mathematics (Week 11):</i>	
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	<i>What resources will support the teaching of rational functions? etc.</i> c) <i>Mathematics (Week 12):</i> <i>What are the different types of functions, such as linear, quadratic, exponential and trigonometric functions, and how are they characterized by their graphs and equations? etc.</i> d) <i>Additional mathematics (Week 12):</i> <i>How do I integrate technology into the teaching of Matrices? etc.</i> 2.4 Discuss key notes on differentiation that cater for the needs of diverse learners in Weeks 11 and 12 mathematics lessons (NTS 3a, 3f and 3g). Note: <i>Refer to your teacher manual for more examples on differentiation.</i> <i>Hint: Activities for differentiation must focus on learning tasks, pedagogical exemplars and key assessments on the different levels of proficiency.</i> <i>E.g.</i> a) <i>Mathematics (Week 11):</i> i. <i>Learning Tasks:</i> <i>Learners review and model the concepts of solving linear equations and constructing and interpreting formulae for a given task and apply them so finding solutions involving change of subjects, etc.</i> ii. <i>Pedagogical Approach 1: Collaborative learning</i> <i>Learners to construct and interpret formulae for a given equation and apply to problems involving a change of subjects. Learners also use demonstrations and one-on-one discussions to formulate and solve linear equations in one and two variables and those involving brackets and fractions. To differentiate:</i> <i>Make sure that enough examples of varying difficulty are provided to cater for the different group of learners to grasp the concept well, etc.</i>	
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	iii. Key Assessment Assessment Level 2: Solve for y in the following equations: $6 + y - 2 = 12$, etc. b) Mathematics (Week 12): i. Learning Tasks: Learners review and model the concepts and types of relations and functions, etc. ii. Pedagogical Approach 1: Collaborative learning Learners use models to explain examples and types of relations. Learners identify functions out of the relations and establish the meaning of a function as a relation which derives one output for each given input and give the types of function as one-to-one and one-to-many function. To differentiate: Use diagrams (e.g., Venn diagrams, graphs) to represent relations and ask learners to interpret the relationships shown, etc. iii. Key Assessment Assessment Level 2: Which of the following relations defined on the set of real numbers are functions? $A = (x, y): y = 3x + 1$, etc. c) Additional mathematics (Week 11): i. Learning tasks: Learners identify basic characteristics of rational functions (e.g., vertical and horizontal asymptotes, domain, and range), etc. ii. Pedagogical exemplars: Collaborative Learning Learners examine and explore graphically and by algebraic means the set of values for which a given rational function will exist (domain of the function). Ensure that you attend to learners with low and medium learning abilities as well as high ability learners, etc. iii. Key assessment: Assessment level 1	
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	<i>What is the restriction on the domain of the rational function $f(x) = \frac{2x+1}{x-3}$?, etc.</i> d) <i>Additional mathematics (Week 12):</i> i. <i>Learning tasks:</i> <i>Learners find the determinants of 2×2 matrices, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Collaborative Learning</i> <i>Learners will be working in convenient groups (ability, mixed ability, mixed gender, or pairs etc.) to recognize the condition necessary for matrix addition and subtraction, etc.</i> iii. <i>Key assessment:</i> <i>Assessment level 1</i> <i>Given that $\begin{bmatrix} 3y+1 & 7 \\ 2y+x & 3 \end{bmatrix} = \begin{bmatrix} 10 & 3y-x \\ 8 & 3 \end{bmatrix}$ find the values of x and y, etc.</i> 2.5 In your subject group or as an individual, complete learning planners for Weeks 11 and 12 with essential question, key notes on differentiation, teaching and learning activities, assessment strategies, closure and reflection taking into consideration cross-cutting issues (NTS 1a, 1b, 2a, 2c, 3a, 3g and 3h).	
3. Peer-review of learning planners. Reviewing planner to ensure alignment between course manual and learning plan based on the templates provided.	3.1 Swap one of your learning plans with a colleague in the same department (where applicable) and peer review the content of the learning plan in line with the LOs and LIs in the teacher manual (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). <i>Hint:</i> <i>Be guided by the following questions for the review:</i> a) <i>In what ways does the learning plan align with the teacher manual?</i> b) <i>How well do the pedagogical strategies and resources ensure inclusivity?</i> c) <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills?</i> d) <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i>	10 mins

	<i>e) How effective have the differentiated instruction and assessment strategies been used in the plan? etc.</i> 3.2 Implement the recommendations made by a peer reviewer to your learning plan as appropriate (NTS 1a, 1b).	
4. Reflection on the session: • Reflecting on what has been learnt in the session. • Advance preparation towards next DPLC session	4.1 Share your views about the session (NTS 1a, 1b). 4.2 Complete your learning plan(s) before the next session (NTS 3a, 3l). 4.3 Remember to read the contents of Weeks 13 and 14 in the teacher manual and DPLC Session 8 in preparation for the next session and bring along their DPLC Handbook and teacher manual (NTS 1a, 1b).	10 mins

DPLC Session 8: Developing learning plans for Weeks 13 and 14

<i>The sections below provide the frame for what is to be done in the session</i>	Guidance Notes on Teacher Activity during the DPLC Session. <i>What teachers will do during each stage of the session</i>	Time in session
1. Introduction: Review of previous learning using ideas from the last DPLC session	1.1 Share two things you did differently based on DPLC Session 7, <i>developing learning plans for Weeks 11 and 12</i>, which you think impacted learning positively (NTS 1a, 1b). 1.2 As a critical friend, discuss and summarise in a single sentence why you think what a colleague did by way of application of lesson(s) learnt in DPLC Session 7, <i>developing learning plans for Weeks 11 and 12</i> supported learning (NTS 1a -1c).	10 mins
2. Planning for teaching, learning and assessment activities, using the teacher manual to complete the learning planner, integrating GESI, SEL, ICT, differentiation, 21st century skills and national values (2 learning planners to be completed per session)	2.1 Read the Purpose, Learning Outcomes (LOs) and Learning Indicators (LIs) for this session (NTS 1b). Purpose: The purpose of this session is to support teachers to use the teacher manual to develop learning plans for lessons in Weeks 13 and 14. Specifically, mathematics teachers will develop learning plans for the following lessons: a) <i>Mathematics:</i> i. <i>Gradient and equation of straight line and magnitude of line segments</i> ii. <i>Angles</i> b) <i>Additional mathematics:</i> i. <i>Gradient, equations of straight lines and acute angles between two intersecting lines</i> ii. <i>Vectors in a plane</i> LO 1: Plan mathematics lessons for Weeks 13 and 14 using the teacher manual, taking into account the cross-cutting issues (NTS 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3k and 3o).	60 mins

	LI 1.1 Relate the aspects of Weeks 13 and 14 mathematics lessons in the teacher manual including content standard(s), LOs, LIs, pedagogical exemplars and assessment strategies to the sections of the learning planner. LI 1.2 Fill out the learning planner templates for Weeks 13 and 14 mathematics lessons with essential questions, teaching and learning activities, key notes on differentiation, assessment, closure and reflection taking into consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 13 and 14 mathematics lessons (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). LI 2.1 Critique the content (essential questions, teaching and learning activities, key notes on differentiation, assessment strategies, closure and reflection) of learning plans for Weeks 13 and 14 in line with the LOs and LIs in the teacher manual. LI 2.2 Implement the recommendations made by a colleague to the learning plans for Weeks 13 and 14 in line with the LOs and LIs in the teacher manual as appropriate. 2.2 In your group, identify and share the aspects of Weeks 13 and 14 lessons in your teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> <i>Content standard(s), etc.</i> 2.3 Discuss at least 2 essential questions that support the achievement of the LOs and LIs of the lessons in Weeks 13 and 14 (NTS 1a, 3a). <i>E.g.</i> a) <i>Mathematics (Week 13): In what ways can the concept of distance be applied to solve problems involving measurements, travel and spatial relationships in mathematics and other fields? etc.</i> b) <i>Additional mathematics (Week 13):</i>	
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	<i>How can learners differentiate between the different types of straight lines? etc.</i> c) <i>Mathematics (Week 14):</i> <i>How are referents used to describe angles in geometric figures and real-world contexts? etc.</i> d) <i>Additional Mathematics (Week 14):</i> <i>What is the significance of direction and magnitude in vectors? etc.</i> 2.4 Discuss key notes on differentiation that cater for the needs of diverse learners in Weeks 13 and 14 mathematics lessons (NTS 3a, 3f and 3g). Note: <i>Refer to their teacher manual for more examples on differentiation.</i> <i>Hint: Activities for differentiation must focus on learning tasks, pedagogical exemplars and key assessments on the different levels of proficiency.</i> <i>E.g.</i> a) <i>Mathematics (Week 13):</i> i. <i>Learning Tasks:</i> <i>Learners review and draw linear graphs using linear functions. etc.</i> ii. <i>Pedagogical Approach 1: Experiential learning:</i> <i>Learners research, using any of the available IT tools, to come out with an explanation why the graph of a linear function is a straight line.</i> <i>To differentiate:</i> <i>Provide learners with a guided instruction on using graphing software (e.g., Desmos, GeoGebra) to plot linear functions and observe the resulting lines. Explain the concept of a linear function and how it relates to a straight-line graph, etc.</i> iii. <i>Key Assessment</i> <i>Assessment Level 2:</i> <i>Suppose A is the point (3, 4) and B is the point (8, 14). What is the gradient/straight line joining these points?</i>	
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	b) <i>Mathematics (Week 14):</i> i. <i>Learning Tasks:</i> <i>Learners construct given angles, etc.</i> ii. <i>Pedagogical Approach 1: Experiential learning:</i> <i>Learners to explore the immediate school and classroom environment to investigate referents for angles. They are to free-hand sketch some angles they know from JHS. They then estimate, then measure the angles with protractor to compare the results with their estimates.</i> <i>To differentiate:</i> <i>Ensure to offer opportunity for a variety of ways of presentation of findings and assigned tasks, etc.</i> iii. <i>Key Assessment</i> <i>Assessment Level 2:</i> <i>Make a free hand sketch of the following angles: 30°, 45°, 60°, 75°, 90° and 180°, etc.</i> c) <i>Additional mathematics (Week 13):</i> i. <i>Learning tasks:</i> <i>Learners measure distances between points using rulers, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Experiential Learning: Begin with real-world examples, like measuring distances on a map, etc.</i> iii. <i>Key Assessment:</i> <i>Assessment level 1</i> <i>Find the midpoint of A(2, 6) and B(4, 8), etc.</i> d) <i>Additional mathematics (Week 14):</i> i. <i>Learning tasks:</i> <i>Learners identify vector and scalar quantities from a list of quantities, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Experiential Learning: Use physical objects like arrows or toy cars to represent vectors, etc.</i> iii. <i>Key Assessment:</i> iv. <i>Assessment level 1</i>	
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	Express vectors $\overrightarrow{AB}$ and $\overrightarrow{BA}$ from $A = (3, 1)$ and $B = (-3, 6)$ in column $\begin{pmatrix} x \\ y \end{pmatrix}$, or $x_i + y_i$, etc. 2.5 In your subject group or as an individual, complete learning planner for Weeks 13 and 14 with teaching and learning activities, resources, key notes on differentiation, assessment strategies, essential questions, closure and reflection taking into consideration cross-cutting issues (NTS 1a, 1b, 2a, 2c, 3a, 3g and 3h)	
3. Peer-review of learning planners. Reviewing planner to ensure alignment between course manual and learning planner based on the templates provided.	3.1 Swap one of your learning plans with a colleague in the same department (where applicable) and peer review the content of the learning plan in line with the LOs and LIs in the teacher manual (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). <i>Hint:</i> <i>Be guided by the following questions for the review:</i> <i>In what ways do the learning plan align with the teacher manual?</i> <i>How well do the pedagogical strategies and resources used address the needs of the learners?</i> <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> <i>How effective have the differentiated instruction and assessment strategies been used in the plan?</i> <i>Have the essential questions been addressed in the activities?</i> <i>How appropriate is the closure?</i> <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills? etc.</i> 3.2 Implement the recommendations made by a colleague to your learning plans as appropriate (NTS 1a, 1b).	10 mins

4. Reflection on the session: • Reflecting on what has been learnt in the session. • Advance preparation towards next DPLC session	4.1 Share your insights and key takeaways regarding the session (NTS 1a, 1b). 4.2 Complete your learning plan(s) session (NTS 3a, 3l). 4.3 Remember to read the contents of Weeks 15 and 16 in the teacher manual and DPLC Session 9 in preparation for the next session and bring along your DPLC Handbook and teacher manual (NTS 1a, 1b).	10 mins
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DPLC Session 9: Developing learning plans for Weeks 15 and 16

<i>The sections below provide the frame for what is to be done in the session</i>	Guidance Notes on Teacher Activity during the PLC Session. <i>What teachers will do during each stage of the session</i>	Time in session
Introduction: Start with an icebreaker activity to foster a collaborative atmosphere.	1.1 Share two things you did differently based on DPLC Session 8 on <i>developing learning plans for Weeks 13 and 14</i> which you think impacted learning positively (NTS 1a, 1b). 1.2 As a critical friend, discuss and summarise in a single sentence why you think what a colleague did by way of application of lessons learnt in DPLC Session 8, <i>developing learning plans for Weeks 13 and 14</i>, supported learning (NTS 1a-1c).	10 mins
2. Planning for teaching, learning and assessment activities, using the teacher manual to complete the learning planner, integrating GESI, SEL, ICT, differentiation, 21st century skills and national values (2 learning planners to be completed per session)	2.1 Read the Purpose, Learning Outcomes (LOs) and Learning Indicators (LIs) for this session (NTS 1b). Purpose: The purpose of this session is to support teachers to use the teacher manual to develop learning plans for lessons in Weeks 15 and 16. Specifically, mathematics teachers will develop learning plans for the following lessons: a) <i>Mathematics:</i> i. <i>Exterior Angle Theorem of a triangle</i> ii. <i>The Pythagorean theorem</i> b) <i>Additional mathematics:</i> i. <i>Trigonometric functions, their applications, radian measure and special angles</i> ii. <i>Limits of functions, properties of limits and continuity of functions.</i> LO 1: Develop mathematics learning plans for Weeks 15 and 16 lessons using the teacher manual, taking into consideration cross-cutting issues (NTS 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3k and 3o). LI 1.1 Relate the aspects of Weeks 15 and 16 mathematics lessons in the teacher manual including content standard(s), LOs, LIs, pedagogical exemplars and assessment strategies to the sections of the learning planner template.	60 mins

	LI 1.2 Complete learning plans for Weeks 15 and 16 mathematics lessons in the teacher manual with essential questions, teaching and learning activities, key notes on differentiation, assessment strategies, closure and reflection taking into consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 15 and 16 mathematics lessons (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). LI 2.1 Critique the content (essential questions, teaching and learning activities, assessment strategies, key notes on differentiation, closure and reflection) of learning plans for Weeks 15 and 16 in line with the LOs and LIs in the teacher manual. LI 2.2 Implement the recommendations made by a colleague to the learning plans for Weeks 15 and 16 in line with the LOs and LIs in the teaching manual as appropriate. 2.2 In your groups, identify and share the aspects of Weeks 15 and 16 lessons in their teacher manual that have been captured in the learning planner (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> <i>Content standard(s), etc.</i> 2.3 Discuss at least 2 essential questions that support the achievement of the LOs and LIs of the lessons in Weeks 15 and 16 (NTS 1a, 3a). <i>E.g.</i> a) <i>Mathematics (Week 15):</i> <i>In what ways can the Exterior Angle Theorem be applied to solve problems involving triangles, polygons, and geometric constructions? etc.</i> b) <i>Additional Mathematics (Week 15):</i> <i>What connections can learners make between angles measured in degrees and radians? etc.</i> c) <i>Mathematics (Week 16):</i> <i>How is the Pythagorean theorem applied in real-life situations, such as in construction, architecture, navigation and sports to solve problems involving distances, measurements and spatial relationships? etc.</i>	
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- d) *Additional Mathematics (Week 16):*
How can learners relate the concept of continuity to limits? etc.

2.4 Discuss key notes on differentiation that cater for the needs of diverse learners in Weeks 15 and 16 mathematics lessons (NTS 3a, 3f and 3g).

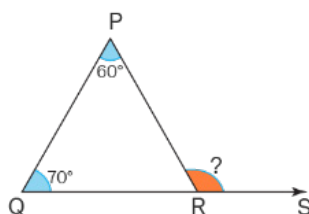
Note: *Refer to your teacher manual for more examples on differentiation.*

Hint: Activities for differentiation must focus on learning tasks, pedagogical exemplars and key assessments on the different levels of proficiency.

E.g.

- a) *Mathematics (Week 15):*

- i. *Learning Tasks:*
Learners use the exterior angle theorem to find missing angles a given triangle, etc.
- ii. *Pedagogical Approach 1: Group & pair activities:*
Learners find the exterior angle of a triangle. Learners also discuss and come out with the formula for determining the sum of the interior angles of polygons.
To differentiate:
Ensure the problems are of varying difficulty and allow learners to make use of strategies used in class as well as encouraging those who are capable of using their personal strategies to solve problems, etc.
Assessment Level 2:
Find the value of the exterior angle in the triangle.



- b) *Mathematics (Week 16):*

- i. *Learning Tasks:*
Learners to solve problems using Pythagorean theorem, etc.

	ii. <i>Pedagogical Approach 1: Group & pair activities;</i> <i>Learners to discuss the theorem of Pythagoras and use any model of the choice to proof the theory. Learners also discuss and make presentations on the real-life uses of the Pythagoras theorem.</i> <i>To differentiate:</i> <i>Offer learners the opportunity to make presentations and summarize the main ideas as well as deal with what lacked, etc.</i> iii. <i>Key Assessment</i> <i>Assessment Level 3</i> <i>Explain the Theorem of Pythagoras and give reasons why it only applies to the right triangle, etc.</i> c) <i>Mathematics (Week 16):</i> i. <i>Learning tasks:</i> <i>Learners use the exterior angle theorem to find missing angles a given triangle, etc.</i> ii. <i>Pedagogical Approach 1: Group & pair activities:</i> <i>Learners find the exterior angle of a triangle. Learners also discuss and come out with the formula for determining the sum of the interior angles of polygons.</i> <i>To differentiate:</i> <i>Ensure the problems are of varying difficulty and allow learners to make use of strategies used in class as well as encouraging those who are capable of using their personal strategies to solve problems, etc.</i> iii. <i>Key Assessment</i> <i>Assessment Level 2:</i> <i>Find the value of the exterior angle in the triangle.</i> The diagram shows a triangle with vertices P, Q, and R. Vertex P is at the top, Q is at the bottom left, and R is at the bottom right. The interior angle at vertex P is marked with a blue arc and labeled 60°. The interior angle at vertex Q is marked with a blue arc and labeled 70°. The exterior angle at vertex R is formed by extending the side QR to a point S. This exterior angle is marked with a red arc and labeled with a question mark '?'. d) <i>Additional mathematics (Week 15):</i> i. <i>Learning Tasks:</i>	
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	<i>Learners match angles with their corresponding trigonometric ratios (sine, cosine, tangent), etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Experiential / Exploratory Learning: Utilize visual aids such as diagrams, illustrations, and real-world examples to introduce trigonometric concepts, etc.</i> iii. <i>Key Assessment</i> <i>Assessment level 2:</i> <i>A sector of a circle has a central angle of 1200 and a radius of 8m. What is the length of the arc formed by this sector? etc.</i> e) <i>Additional mathematics (Week 16):</i> i. <i>Learning tasks:</i> <i>Individual learners state the value of the limit of a constant function, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Collaborative Learning:</i> <i>In mixed ability groups, learners work to consolidate and foster their understanding of concepts of limits in mathematics and in daily life using both algebraic and graphical means. To differentiate:</i> <i>Based on their past knowledge and learning requirements, learners should be divided into groups. For example, individuals who need additional scaffolding ought to be placed in the same group while others who are up for a challenge are also grouped separately, etc.</i> iii. <i>Key Assessment</i> <i>Assessment Level 1</i> <i>Evaluate $\lim_{x \rightarrow 2} \left(\frac{x^3 + 8}{x^2 - 4} \right)$, etc.</i> 2.5 In your subject group or as an individual, complete learning planners for Weeks 15 and 16 with essential questions, key notes on differentiation, teaching and learning activities, assessment strategies, closure and reflection taking into consideration crosscutting issues (NTS 1a, 1b, 2a, 2c, 3a, 3g and 3h).	
3. Peer-review of learning planners.	3.1 Exchange one of your learning plans with a colleague in the same department (where applicable) and peer review the content of the learning plan in line with the LOs and LIs	10 mins

• Reviewing planner to ensure alignment between course manual and learning planner based on the templates provided.	in the teacher manual (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). <i>Hint:</i> <i>Be guided by the following areas for the review:</i> <i>In what ways does the learning plan align with the teacher manual?</i> <i>How well do the pedagogical strategies and resources ensure inclusivity?</i> <i>To what extent do the activities in the learning plan promote the development of critical thinking and other 21st century skills?</i> <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> <i>Have the essential questions been addressed in the activities?</i> <i>How effective have the differentiated instruction and assessment strategies been used in the planner?</i> <i>How appropriate is the closure? etc.</i> 3.2 Implement the recommendations made by a peer reviewer to your learning plan as appropriate (NTS 1a, 1b).	
4. Reflection on the session: • Reflecting on what has been learnt in the session. • Advance preparation towards next PLC session	4.1 Share your insights and key takeaways regarding the session (NTS 1a, 1b). 4.2 Complete your unfinished learning plans before the next session (NTS 3a, 3l). 4.3 Remember to read the contents of Weeks 17 and 18 in the teacher manual and DPLC Session 10 in preparation for the next session and bring your DPLC Handbook and teacher manual (NTS 1a, 1b).	10 mins

DPLC Session 10: Developing learning plans for Weeks 17 and 18

<i>The sections below provide the frame for what is to be done in the session</i>	Guidance Notes on Teacher Activity during the DPLC Session. <i>What teachers will do during each stage of the session</i>	Time in session
1. Introduction: Review of previous learning using ideas from the last DPLC session	1.1 Share two things you did differently based on DPLC Session 9, <i>developing learning plans for Weeks 15 and 16</i>, which you think impacted learning positively (NTS 1a, 1b). 1.2 As a critical friend, discuss and summarise in a single sentence why you think what a colleague did by way of application of lesson(s) learnt in DPLC Session 9, <i>developing learning plans for Weeks 15 and 16</i>, supported learning (NTS 1a -1c).	10 mins
2. Planning for teaching, learning and assessment activities, using the teacher manual to complete the learning planner, integrating GESI, SEL, ICT, differentiation, 21st century skills and national values (2 learning planners to be completed per session)	2.1 Read the Purpose, Learning Outcomes (LOs) and Learning Indicators (LIs) for this session (NTS 1b). Purpose: The purpose of this session is to support teachers to use the teacher manual to develop learning plans for lessons in Weeks 17 and 18. Specifically, mathematics teachers will develop learning plans for the following lessons: a) <i>Mathematics:</i> i. <i>Vectors</i> ii. <i>Trigonometry</i> b) <i>Additional mathematics:</i> i. <i>Differentiation from 1st principles and the power rule</i> ii. <i>Applications of differentiation</i> LO 1: Plan mathematics lessons for Weeks 17 and 18 using the teacher manual taking into consideration cross-cutting issues (NTS 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3k and 3o). LI 1.1 Relate the aspects of Weeks 17 and 18 mathematics lessons in the teacher manual including content standard(s), LOs, LIs, pedagogical exemplars and	60 mins

	assessment strategies to the sections of the learning planner. LI 1.2 Fill out the learning planner templates for Weeks 17 and 18 mathematics lessons with essential questions, teaching and learning activities, key notes on differentiation, assessment, closure and reflection taking into consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 17 and 18 mathematics lessons (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). LI 2.1 Critique the content (essential questions, teaching and learning activities, key notes on differentiation, assessment strategies, closure and reflection) of learning plans for Weeks 17 and 18 in line with the LOs and LIs in the teacher manual. LI 2.2 Implement the recommendations made by a colleague to the learning plans for Weeks 17 and 18 in line with the LOs and LIs in the teacher manual as appropriate. 2.2 In your group, identify and share the aspects of Weeks 13 and 14 lessons in your teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> <i>Learning indicator(s), etc.</i> 2.3 Discuss at least 2 essential questions that support the achievement of the LOs and LIs of the lessons in Weeks 17 and 18 (NTS 1a, 3a). <i>E.g.</i> <i>a) Mathematics (Week 17): How do vectors describe physical quantities such as displacement, velocity, force and acceleration, and how are these vector quantities applied in solving problems and analysing motion in various contexts? etc.</i> <i>b) Additional mathematics (Week 17): What are the advantages and limitations of using the power rule compared to first principles in finding derivatives of polynomial functions? etc.</i>	
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	c) <i>Mathematics (Week 18):</i> <i>How will learners analyse the significance of referents in measurement, covering natural, artificial, and relative referents? etc.</i> d) <i>Additional Mathematics (Week 18):</i> <i>What does the derivative of a polynomial function represent graphically and conceptually? etc.</i> 2.4 Discuss key notes on differentiation that cater for the needs of diverse learners in Weeks 13 and 14 mathematics lessons (NTS 3a, 3f and 3g). Note: <i>Refer to your teacher manual for more examples on differentiation.</i> <i>Hint: Activities for differentiation must focus on learning tasks, pedagogical exemplars and key assessments on the different levels of proficiency.</i> <i>E.g.</i> a) <i>Mathematics (Week 17):</i> i. <i>Learning Tasks:</i> <i>Learners explain why parallel vectors are also considered collinear vectors, etc.</i> ii. <i>Pedagogical Approach 1: Problem-based learning;</i> <i>Learners discuss and represent graphically 2D vectors. They also show graphically when two vectors are considered equal. Learners solve problems on equal vectors.</i> <i>To differentiate:</i> <i>Create task sheets with varying levels of difficulty or complexity. For example, provide simpler problems for learners who may struggle with the concept of equal vectors, while offering more challenging problems for those who grasp the concept quickly. This allows each group to work at a level appropriate for their abilities, etc.</i> iii. <i>Key Assessment</i> <i>Assessment Level 3:</i> <i>Determine if the vectors $\vec{a} = (3, -4)$ and $\vec{b} = (-6, 8)$ are equal, etc.</i>	
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	b) <i>Mathematics (Week 18):</i> i. <i>Learning Tasks:</i> Learners compute for the various trig ratios. ii. <i>Pedagogical Approach 1: Group & pair activities;</i> Learners investigate and discuss the three basic trig ratios and use the knowledge to solve problems. They also discuss and present on the application of the three primary trigonometric ratios to solving real-life problems. To differentiate; Monitor each pair/group's progress closely and provide personalized feedback to address specific misconceptions or difficulties that arise, etc. iii. <i>Pedagogical Approach 1: Problem-based group learning;</i> Learners complete task sheets on trig ratios, including their word/real-life problems. To differentiate: Use concrete examples and visuals to demonstrate how to calculate sine, cosine, and tangent for simple angles. Use manipulatives or drawings to help visualize triangles. Start with straightforward problems involving angles from 0° to 90°. Provide guided practice and use real-life examples to make the concepts more relatable, etc. iv. <i>Key Assessment</i> Assessment Level 3: Sakumonor Skating Club has a beginner ski slope which makes a 150° angle with the ground. How far does a skier travel over a horizontal distance of 120 meters? etc. c) <i>Additional mathematics (Week 17):</i> i. <i>Learning tasks:</i> Learners are provided with worksheets with basic polynomial functions and with some guidance, are tasked to differentiate them, etc. ii. <i>Pedagogical exemplars:</i> Problem-based Learning Learners work in groups and individually on tasks to differentiate polynomial functions of	
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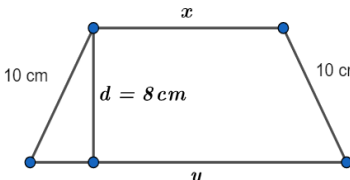
	varying degrees from first principles and with the power rule. To differentiate, Create a series of tasks that range in difficulty, similar to different routes through a polynomial garden. Based on their degree of readiness, learners select one of three pathways: "Advanced Lane," "Intermediate Avenue," or "Beginner's Boulevard." Every path includes tasks and challenges catered to the relevant degree of difficulty, etc. iii. Key Assessment: Assessment level 2 Find the derivative, $\frac{dy}{dx}$ of $3x^2 + 4x - y = 4$, etc. d) Additional mathematics (Week 18): i. Learning tasks: Learners solve real-world scenarios or advanced mathematical problems that require applying polynomial differentiation in context, etc. ii. Pedagogical exemplars: Individualised learning: Learners engage in tasks specifically tailored to suit them. Offer learners a menu of learning tasks or assignments related to polynomial functions and derivatives. Allow them to choose tasks based on their interests, learning preferences, or proficiency levels. Tasks can include problem-solving activities, investigations, presentations, or creative projects, etc. iii. Key Assessment: Assessment level 1 State the conditions that are true for a given function as: • it increases • decreases • it is momentarily at rest, etc. 2.5 In your subject group or as an individual, complete learning planners for Weeks 17 and 18 with teaching and learning activities, resources, key notes on differentiation, assessment strategies, essential questions, closure and	
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	reflection taking into consideration cross-cutting issues (NTS 1a, 1b, 2a, 2c, 3a, 3g and 3h).	
3. Peer-review of learning planners. • Reviewing planner to ensure alignment between course manual and learning planner based on the templates provided.	3.1 Swap one of your completed learning plans with a colleague in the same department (where applicable) and peer review the content of the learning plan in line with the LOs and LIs in the teacher manual (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). <i>Hint:</i> <i>Be guided by the following questions for the review:</i> <i>In what ways do the learning plan align with the teacher manual?</i> <i>How well do the pedagogical strategies and resources used address the needs of the learners?</i> <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills?</i> <i>Have the essential questions been addressed in the activities?</i> <i>How appropriate is the closure?</i> <i>How effective have the differentiated instruction and assessment strategies been used in the plan? etc.</i> 3.2 Implement the recommendations made by a colleague to your learning plan(s) as appropriate (NTS 1a, 1b).	10 mins
4. Reflection on the session: • Reflecting on what has been learnt in the session. • Advance preparation towards next DPLC session	4.1 Share your insights and key takeaways regarding the session (NTS 1a, 1b). 4.2 Complete your learning plan(s) before the next session (NTS 3a, 3l). 4.3 Remember to read the contents of Weeks 19 and 20 in the teacher manual and DPLC Session 11 in preparation for the next session and bring along your DPLC Handbook and teacher manual (NTS 1a, 1b).	10 mins

DPLC Session 11: Developing learning plans for Weeks 19 and 20

<i>The sections below provide the frame for what is to be done in the session.</i>	Guidance Notes on Teacher Activity during the DPLC Session. <i>What teachers will do during each stage of the session</i>	Time in session
1. Introduction: Review of previous learning using ideas from the last DPLC session	1.1 Share two things you did differently based on DPLC Session 10, <i>developing learning plans for Weeks 17 and 18</i>, which you think impacted learning positively (NTS 1a, 1b). 1.2 As a critical friend, discuss and summarise in a single sentence why you think what a colleague did by way of application of lessons learnt in DPLC Session 10, <i>developing learning plans for Weeks 17 and 18</i>, supported learning (NTS 1a - 1c).	10 mins
2. Planning for teaching, learning and assessment activities, using the teacher manual to complete the learning planner, integrating GESI, SEL, ICT, differentiation, 21st century skills and national values (2 learning planners to be completed per session)	2.1 Read the Purpose, Learning Outcomes (LOs) and Learning Indicators (LIs) for this session. Purpose: The purpose of this session is to support mathematics teachers to use the teacher manual to develop learning plans for mathematics lessons in Weeks 19 and 20. Specifically, mathematics teachers will develop learning plans for the following lessons: a) <i>Mathematics:</i> i. <i>Area and Perimeter of shapes</i> ii. <i>Volume of prisms</i> b) <i>Additional mathematics:</i> i. Collection, categorisation and representation of data (Categorical data) ii. Graphical representation (Continuous data) of data, LO 1: Plan mathematics lessons for Weeks 19 and 20 in the teacher manual taking into consideration cross-cutting issues (NTS 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3k and 3o). LI 1.1 Relate the aspects of Weeks 19 and 20 mathematics lessons in the teacher manual including content standard(s),	60 mins

	LOs, LIs, pedagogical exemplars and assessment strategies to the sections of the learning planner template. LI 1.2 Fill out learning plans for Weeks 19 and 20 mathematics lessons with essential questions, teaching and learning activities, key notes on differentiation, assessment, closure and reflection taking into consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 19 and 20 mathematics lessons (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). LI 2.1 Critique the content (essential questions, teaching and learning activities, assessment strategies, key notes on differentiation, closure and reflection) of the learning plans for Weeks 19 and 20 in line with the LOs and LIs in the teacher manual. LI 2.2 Implement the recommendations made by a colleague to the learning plans for Weeks 19 and 20 in line with the LOs and LIs in the teacher manual as appropriate. 2.2 In your group, identify and share the aspects of Weeks 19 and 20 lessons in your teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> <i>Learning outcome, etc.</i> 2.3 Discuss at least 2 essential questions that support the achievement of the LOs and LIs of the lessons in Weeks 19 and 20 (NTS 1a, 3a). <i>E.g.</i> a) <i>Mathematics (Week 19):</i> <i>How are referents for measuring used as benchmarks for comparing and quantifying lengths, distances and other quantities? etc.</i> b) <i>Additional mathematics (Week 19):</i> <i>What is categorical data, and how does it differ from numerical data? etc.</i> c) <i>Mathematics (Week 20):</i> <i>How can the concept of volume be extended to different types of prisms, such as rectangular prisms, triangular prisms and trapezoidal</i>	
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	<i>prisms, and how are the volume formulae derived for these shapes? etc.</i> d) <i>Additional Mathematics (Week 20): What is the fundamental difference between continuous and discrete data? etc.</i> 2.4 Think, pair and share key notes on differentiation that cater for the needs of diverse learners in Weeks 19 and 20 mathematics lessons (NTS 3a, 3f and 3g). E.g. a. <i>Mathematics (Weeks 19):</i> i. <i>Learning Tasks:</i> <i>Learners solve problems on finding the perimeter and area of kites, rhombus, parallelogram and trapezium, etc.</i> ii. <i>Pedagogical Approach 1: Experiential learning:</i> <i>Learners to explore the immediate school environment to investigate referents for the measuring various items.</i> <i>To differentiate:</i> <i>Encourage shy learners to share their findings from the investigations, etc.</i> iii. <i>Key assessment</i> <i>Assessment Level 2</i> <i>The perimeter of the given trapezium is 104 cm. Find its area.</i>  etc. b. <i>Mathematics (Week 20):</i> i. <i>Learning Tasks:</i> <i>Learners identify various prisms and indicate the type of face, number of faces, edges and vertices, etc.</i> ii. <i>Pedagogical Approach 1: Group & pair activities;</i> <i>Learners discuss and provide justification for given formulae of prisms. Learners also solve problems, using formulae for determining</i>	
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	<i>the volume of the prisms with given dimensions.</i> <i>To differentiate;</i> <i>Offer different modes of instruction to cater to diverse learning styles. Some learners may benefit from direct instruction, while others may prefer hands-on activities or collaborative learning experiences, etc.</i> iii. Key assessment Assessment Level 2 <i>What is the volume of a triangular prism with dimensions of 12 m, 16 m and 20 m? etc.</i> c. Additional mathematics (Week 19): i. Learning tasks: <i>Task learners to conduct a simple survey within the school to collect data on learners' favourite subjects. Provide a structured survey template with clear instructions. Offer support in formulating questions and conducting interviews if needed, etc.</i> ii. Pedagogical exemplars: <i>Problem-based Learning</i> <i>To differentiate, provide a structured template for conducting a simple survey within the school to collect data on learners' favourite subjects. Offer guidance in formulating questions and conducting interviews if needed. Scaffold the process by breaking it down into manageable steps, such as drafting questions together as a class and practicing survey techniques in pairs, etc.</i> iii. Key Assessment: Assessment level 1: <i>Determine the level of measurement. (Nominal, Ordinal, Interval, Ratio)</i> <i>Cars described as compact, midsize, and full-size.</i> <i>Colours of M&M candies.</i> <i>Weights of M&M candies</i> <i>Types of markers (washable, permanent, etc.)</i> <i>Time it takes to sing the National Anthem</i> <i>Total annual income for statistics learners</i> <i>Body temperatures of bears in the north pole</i>	
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	- Teachers being rated as superior, above average, average, below average, or poor, etc. d) Additional mathematics (Week 20): - Learning tasks: Given a set of data, learners match each data point to its corresponding position on a pre-drawn graph, etc. - Pedagogical exemplars: Problem-based learning: Use pre-made sets of data points and corresponding graphs on cards. Learners match each data point to its corresponding position on the graph. Provide visual aids and guided practice sessions to reinforce understanding, etc. - Key Assessment: Assessment level 2 A group of learners were asked to say the 15-times table as fast as possible. The time taken by each student was recorded. The results are shown in the table below: <table border="1"><thead><tr><th>Time / s</th><th>Number of learners</th></tr></thead><tbody><tr><td>$0 < t \leq 10$</td><td>1</td></tr><tr><td>$10 < t \leq 20$</td><td>2</td></tr><tr><td>$20 < t \leq 30$</td><td>8</td></tr><tr><td>$30 < t \leq 40$</td><td>12</td></tr><tr><td>$40 < t \leq 50$</td><td>6</td></tr><tr><td>$50 < t \leq 60$</td><td>3</td></tr></tbody></table> Draw a histogram for the data, etc. 2.5 In your subject group or as an individual, complete learning planners for Weeks 19 and 20 with essential questions, key notes on differentiation, teaching and learning activities, resources, assessment, closure and reflection taking into consideration cross-cutting issues to cater for all learners (NTS 1a, 1b, 2a, 2c, 3a, 3g and 3h).	Time / s	Number of learners	$0 < t \leq 10$	1	$10 < t \leq 20$	2	$20 < t \leq 30$	8	$30 < t \leq 40$	12	$40 < t \leq 50$	6	$50 < t \leq 60$	3	
Time / s	Number of learners															
$0 < t \leq 10$	1															
$10 < t \leq 20$	2															
$20 < t \leq 30$	8															
$30 < t \leq 40$	12															
$40 < t \leq 50$	6															
$50 < t \leq 60$	3															

3. Peer-review of learning planners. • Reviewing planner to ensure alignment between course manual and learning planner based on the templates provided.	3.1 Swap one of your learning plans with a colleague in the same department (where applicable) and peer review the content of the learning plan in line with the LOs and LIs in the teacher manual (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). <i>Note:</i> <i>Be guided by the following questions for the review:</i> <i>In what ways does the learning plan align with the teacher manual?</i> <i>How well do the pedagogical strategies and resources used address the needs of different learners?</i> <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills?</i> <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> <i>How effective have the differentiated instruction and assessment strategies been used in the plan?</i> <i>How appropriate is the closure?</i> <i>Have the essential questions crafted been addressed in the activities? etc.</i> 3.2 Implement the recommendations made by a peer reviewer to your learning plans as appropriate (NTS 1a, 1b).	10 mins
4. Reflection on the session: • Reflecting on what has been learnt in the session. • Advance preparation towards next DPLC session	4.1 Share your views and feelings about the session (NTS 1a, 1b). 4.2 Complete your learning plan(s) before the next session (NTS 3a, 3l). 4.3 Remember to read the contents of Weeks 21 and 22 in the teacher manual and DPLC Session 12 in preparation for the next session and bring along your DPLC Handbook and teacher manual (NTS 1a, 1b).	10 mins

DPLC Session 12: Developing learning plans for Weeks 21 and 22

<i>The sections below provide the frame for what is to be done in the session</i>	Guidance Notes on Teacher Activity during the DPLC Session. <i>What teachers will do during each stage of the session</i>	Time in session
1. Introduction: Review of previous learning using ideas from the last DPLC session	1.1 Share two things you did differently based on PLC Session 11, <i>developing learning plans for Weeks 19 and 20</i>, which you think impacted learning positively (NTS 1a, 1b). 1.2 As a critical friend, discuss and give a summary on why you think what a colleague did by way of application of lesson learnt in PLC Session 11, <i>developing learning plans for Weeks 19 and 20</i>, supported learning (NTS 1a-1c).	10 mins
2. Planning for teaching, learning and assessment activities, using the teacher manual to complete the learning planner, integrating GESI, SEL, ICT, differentiation, 21st century skills and national values (2 learning planners to be completed per session)	2.1 Read the Purpose, Learning Outcomes (LOs) and Learning Indicators (LIs) for this session (NTS 1b). Purpose: The purpose of this session is to support teachers to use the teacher manual to develop learning plans for lessons in Weeks 21 and 22. Specifically, mathematics teachers will develop learning plans for the following lessons: a) <i>Mathematics:</i> i. <i>Types of data</i> ii. <i>Data organisation & presentation</i> b) <i>Additional mathematics:</i> i. <i>Measures of central tendencies and dispersion</i> ii. <i>Counting rules, concept of permutations and combinations</i> LO 1: Develop subject-specific learning plans for teaching Weeks 21 and 22 lessons using the teacher manual, taking into account GESI, ICT, SEL, National Values and other cross-cutting issues (NTS 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3k and 3o).	60 mins

	LI 1.1 Discuss the aspects of Weeks 21 and 22 mathematics lessons in the teacher manual including content standard(s), LOs, LIs, key concepts, GESI, pedagogical exemplars and assessment strategies, and relate it to the learning planner template. LI 1.2 Complete learning planner templates for Weeks 21 and 22 mathematics lessons with essential questions, teaching and learning activities, key notes on differentiation, assessment strategies, closure and reflection taking into consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 21 and 22 mathematics lessons (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). LI 2.1 Critique the content (essential questions, key notes on differentiation, teaching and learning activities, assessment, closure and reflection) of learning plans for Weeks 21 and 22 in line with the LOs and LIs in the teacher manual. LI 2.2 Implement the recommendations made by a colleague to the learning plans for Weeks 21 and 22 in line with the Los and LIs in the teacher manual as appropriate. 2.2 In groups, identify and discuss the aspects of Weeks 21 and 22 lessons in your teacher manuals that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). E.g. <i>Content standard(s), etc.</i> 2.3 Discuss at least 2 essential questions that support the achievement of the LOs and LIs of the lessons in Weeks 21 and 22 (NTS 1a, 3a). E.g. <i>a) Mathematics (Week 21): How are the different types of data, including qualitative (categorical) data and quantitative (numerical) data, distinguished based on their characteristics and measurement scales? etc.</i>	
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	b) <i>Additional mathematics (Week 21):</i> <i>How can measures of central tendency and dispersion be used together to gain a comprehensive understanding of a dataset? etc.</i> c) <i>Mathematics (Week 22):</i> <i>What are the best practices for organizing and presenting data to ensure clarity, accuracy and relevance to the audience or users of the data? etc.</i> d) <i>Additional Mathematics (Week 22):</i> <i>How can I use real-life scenarios to introduce learners to the concept of counting, making it more relatable and engaging? etc.</i> 2.4 Discuss key notes on differentiation that cater for the needs for diverse learners in weeks 11 and 12 mathematics lessons (NTS 3a, 3f and 3g). Note: <i>Refer to your teacher manual for more examples on differentiation.</i> <i>Hint: Activities for differentiation must focus on learning tasks, pedagogical exemplars and key assessments on the different levels of proficiency.</i> <i>E.g.</i> a) <i>Mathematics (Week 21)</i> i. <i>Learning Tasks:</i> <i>Learners differentiate among the different types of data, etc.</i> ii. <i>Pedagogical Approach: Experiential learning;</i> <i>Learners to embark on a mini-project within the school environment by researching and selecting an existing survey questionnaire, interview guide, observation guide, etc., then discuss its features, validate its usefulness and collect quantitative/qualitative data with it.</i> <i>To differentiate:</i> <i>You may have to support some learners in researching and obtaining the research tool. Where learners are capable, provide</i>	
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	<i>support for them to construct the tool themselves and help them validate it.</i> iii. <i>Key assessment</i> Assessment Level 2 The data below are the scores of 21 learners in a creative arts test. Organise it into a frequency distribution table by grouping them. 59, 65, 61, 62, 53, 55, 60, 70, 64, 56, 58, 58, 62, 62, 68, 65, 56, 59, 68, 61, 67, etc. b) <i>Mathematics (Week 22):</i> i. <i>Learning Tasks:</i> Learners organise data in frequency tables, bar charts, pie charts, line graphs, etc. ii. <i>Pedagogical Approach: Group & pair activities;</i> Learners are assigned a variety of data to organise them into, frequency tables, pie charts, line graphs, bar charts, etc. To ensure a differentiated class you may consider the following varied activities; Provide step-by-step guidance on how to organize data into frequency tables and create basic graphs (e.g., bar graphs, line graphs). iii. <i>Key assessment</i> Assessment Level 2 Suppose we conduct a survey in which we ask 15 households how many pets they have in their home. The results are as follows: 1, 1, 1, 1, 2, 2, 2, 3, 3, 4, 5, 5, 6, 7, 8. Construct both a grouped and an ungrouped frequency tables for the data. c) <i>Additional Mathematics (Week 21):</i> i. <i>Learning tasks:</i> Learners calculate mean, median, and mode for simple data sets, etc. ii. <i>Pedagogical exemplars:</i> Problem-based / Project-based Learning: To differentiate, begin with a pre-assessment to gauge learners' prior knowledge and identify any misconceptions, etc.	
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	iii. <i>Key Assessment:</i> <i>Assessment level 1</i> <i>Find the median of the following numbers: 47, 30, 56, 31, 55, 43 and 44Cars described as compact, midsize, and full-size, etc.</i> d) <i>Additional Mathematics (Week 22)</i> i. <i>Learning tasks:</i> <i>Learners determine the number of possible outcomes in simple scenarios, etc.</i> ii. <i>Pedagogical exemplar:</i> <i>Experiential Learning</i> <i>Begin with concrete examples using objects like marbles, coins, or coloured blocks to demonstrate basic counting principles, etc.</i> iii. <i>Key Assessment:</i> <i>Assessment level 1</i> <i>A restaurant offers a menu with 3 appetizers, 5 main courses and 4 desserts. How many different meal combinations can be created by choosing one appetizer, one main course and one dessert., etc.</i> 2.5 In your subject groups or as individuals complete learning planners for Weeks 21 and 22 with essential questions, teaching and learning activities, assessment strategies, differentiation, closure and reflection taking into consideration cross-cutting issues (NTS 1a, 1b, 2a, 2c, 3a, 3g and 3h).	
3. Peer-review of learning planners. Reviewing planner to ensure alignment between course manual and learning planner based on the	3.1 Swap one of your learning plans with a colleague in the same department (where applicable) and peer review the content of the learning plan in line with the LOs and LIs in the teacher manual (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). <i>Hint:</i> <i>Be guided by the following questions for the review:</i> a) <i>In what ways does the learning plan align with the teacher manual?</i> b) <i>How well do the pedagogical strategies and resources used address the needs of different learners?</i>	10 mins

templates provided.	c) <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> d) <i>How effective have the differentiated instruction and assessment strategies been used in the plan?</i> e) <i>How appropriate is the closure?</i> f) <i>Have the essential questions crafted been addressed in the activities?</i> g) <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills?</i> h) <i>What is your view and feeling about the learning plan you reviewed? etc.</i> 3.2 Implement the recommendations made by a peer reviewer to your learning plan as appropriate (NTS 1a, 1b).	
4. Reflection on the session: • Reflecting on what has been learnt in the session. • Advance preparation towards next PLC session	4.1 Share your views and feelings about the session (NTS 1a, 1b). 4.2 Complete your learning plan(s) before the next session (NTS 3a, 3l). 4.3 Remember to read the contents of Weeks 22 and 23 in the teacher manual and DPLC Session 13 in preparation for the next session and bring along your DPLC Handbook and teacher manual (NTS 1a, 1b).	10 mins

DPLC Session 13: Developing learning plans for Weeks 23 and 24

<i>The sections below provide the frame for what is to be done in the session</i>	Guidance Notes on Teacher Activity during the DPLC Session. <i>What teachers will do during each stage of the session</i>	Time in session
1. Introduction: Review of previous learning using ideas from the last DPLC session	1.1 Share two things you did differently based on DPLC Session 12, <i>developing learning plans for Weeks 21 and 22</i>, which you think impacted learning positively (NTS 1a, 1b). 1.2 As a critical friend, discuss and summarise in a single sentence why you think what a colleague did by way of application of lesson learnt in DPLC Session 12, <i>developing learning plans for Weeks 21 and 22</i>, supported learning (NTS 1a-1c).	10 mins
2. Planning for teaching, learning and assessment activities, using the teacher manual to complete the learning planner, integrating GESI, SEL, ICT, differentiation, 21st century skills and national values (2 learning planners to be completed per session)	2.1 Read the Purpose, Learning Outcomes (LOs) and Learning Indicators (LIs) for this session (NTS 1b). Purpose: The purpose of this session is to support teachers to use the teacher manual to develop learning plans for mathematics lessons in Weeks 23 and 24. Specifically, mathematics teachers will develop learning plans for the following lessons: a. <i>Mathematics:</i> i. <i>Simple and compound probability experiments</i> ii. <i>Probability of independent events</i> b. <i>Additional mathematics:</i> i. <i>Simplifying permutation and combination expressions</i> ii. <i>Theoretical probability of events.</i> LO 1: Plan mathematics lessons for Weeks 23 and 24 using the teacher manual, taking into consideration cross-cutting issues (NTS 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3k and 3o).	60 mins

	LI 1.1 Relate the aspects of Weeks 23 and 24 mathematics lessons of the teacher manual including content standard(s), LOs, LIs, pedagogical exemplars and assessment strategies to the sections of the learning planner template. LI 1.2 Fill out the learning planner templates for Weeks 23 and 24 mathematics lessons with essential questions, teaching and learning activities, key notes on differentiation, assessment strategies, closure and reflection taking into consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 23 and 24 mathematics lessons (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). LI 2.1 Critique the content (essential questions, teaching and learning activities, assessment strategies, key notes on differentiation, closure and reflection) of learning plans for Weeks 23 and 24 in line with the LOs and LIs in the teacher manual. LI 2.2 Implement the recommendations made by a colleague to the learning plans for Weeks 23 and 24 in line with the LOs and LIs in the teacher manual as appropriate. 2.2 In your group, identify and share the aspects of Weeks 23 and 24 lessons in your teacher manual that have been captured in the learning planner (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> <i>Learning indicator(s), etc.</i> 2.3 Discuss at least 2 essential questions that support the achievement of the LOs and LIs of the lessons in Weeks 23 and 24 (NTS 1a, 3a). <i>E.g.</i> <i>a) Mathematics (Week 23): How can data collection methods be selected and applied to gather relevant and reliable data for a specific real-life project, and what considerations should be made to ensure the ethical and legal aspects of data collection are addressed? etc.</i>	
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	b) <i>Additional mathematics (Week 23):</i> <i>How can I make abstract mathematical concepts like permutations and combinations more concrete and relatable to learners' everyday experiences? etc.</i> c) <i>Mathematics (Week 24):</i> <i>How do compound probability experiments differ from simple experiments, and how are they used to calculate the probability of multiple events occurring together? etc.</i> d) <i>Additional mathematics (Week 24):</i> <i>What is the fundamental difference between theoretical and experimental probability, and why is it important to distinguish between the two? etc.</i> 2.4 Discuss key notes on differentiation that cater for the needs of diverse learners in Weeks 23 and 24 mathematics lessons (NTS 3a, 3f and 3g). <i>E.g.</i> a) <i>Mathematics (Week 23):</i> i. <i>Learning Tasks:</i> <i>Learners use mathematical language to make inferences of data.</i> ii. <i>Pedagogical Approach: Experiential learning;</i> <i>Learners design a mini-project by collecting a real-life data, organise it, make presentations on it and publish the results.</i> <i>To differentiate:</i> <i>Provide guided practice in using basic mathematical reasoning to support personal choices and assess data, etc.</i> iii. <i>Key assessment</i> <i>Assessment Level 4</i> <i>Collect analyse and present a real-life data (WASCE Result, Sports Records, etc.) from within the school environment, etc.</i> b) <i>Additional mathematics (Week 23):</i> i. <i>Learning tasks:</i>	
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	<i>Given a permutation or combination expression, learners identify the total number of elements and the number of elements to be selected or arranged, etc.</i> <i>ii. Pedagogical exemplars:</i> <i>Use physical objects like beads or coloured tokens to represent the elements in permutation and combination expressions, etc.</i> <i>iii. Key Assessment:</i> <i>Assessment level 3</i> <i>Given that ${}^nP_r = 90$ and ${}^nP_r = 15$, find the value of r, etc.</i> <i>c) Mathematics (Week 24):</i> <i>i. Learning Tasks:</i> <i>Learners determine whether given experiments are independent events or not, etc.</i> <i>ii. Pedagogical Approach: Group & pair activities;</i> <i>Learners solve problems on probability of independent events including real-life problems.</i> <i>To differentiate:</i> <i>Please make accommodations for the various ability groups in the class as you carry out this activity, etc.</i> <i>iii. Key assessment</i> <i>Assessment Level 2</i> <i>Two coins are tossed once. List the sample space for the experiment, etc.</i> <i>d) Additional mathematics (Week 24):</i> <i>i. Learning tasks:</i> <i>Learners identify possible outcomes and calculate basic probabilities, etc.</i> <i>ii. Pedagogical exemplars:</i> <i>Experiential Learning: Provide hands-on activities using dice, spinners, and cards to demonstrate probability concepts, etc.</i> <i>iii. Key Assessment:</i> <i>Assessment level 1</i>	
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	<i>A fair die is tossed twice. What is the sample size? etc.</i> 2.5 In your subject groups or as individuals, complete learning planners for Weeks 23 and 24 with essential questions, teaching and learning activities, key notes on differentiation, assessment strategies, closure and reflection taking into consideration cross-cutting issues (NTS 1a, 1b, 2a, 2c 3a, 3g and 3h).	
3. Peer-review of learning planners. Reviewing planner to ensure alignment between course manual and learning planner based on the templates provided.	3.1 Swap one of your learning plans with a colleague in the same department (where applicable) and peer review the content of the learning plan in line with the LOs, LIs and key concepts in the mathematics teacher manual (NTS 1a, 1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). <i>Hint:</i> <i>Prompt teachers to be guided by the following questions for the review:</i> <i>In what ways do the learning plan align with the teacher manual?</i> <i>How well do the pedagogical strategies and resources ensure inclusivity?</i> <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills?</i> <i>How effective have the differentiated instruction and assessment strategies been used in the plan? etc.</i> 3.2 Implement the recommendations made by a peer reviewer to your learning plan as appropriate (NTS 1a, 1b).	10 mins

4. Reflection on the session: • Reflecting on what has been learnt in the session. • Advance preparation towards next DPLC session	4.1 Share your views and feelings about the session (NTS 1a, 1b). 4.2 Complete your learning plan which was not completed during the session (NTS 3a, 3l). 4.3 Remember to keep yourself abreast with the curriculum, teacher manual and the content of the learning plan to enhance teaching and learning (NTS 1b, 2c).	10 mins
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Appendix 1: Mathematics

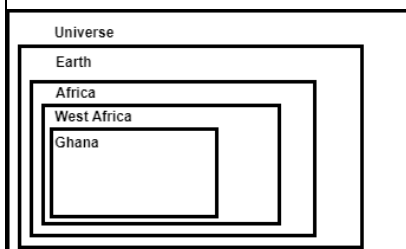
Learning Plan							
Subject	Mathematics	Week	1	Duration	4 hrs.	Form	1
Strand	Numbers for everyday life	Sub-Strand	Real number and numeration system				
Content Standard	Demonstrate knowledge and understanding of real number system and the operations of the various subsets.						
Learning Outcome(s)	Apply the relationships and differences between the set of rational and irrational numbers and use them to solve problems.						
Learning Indicator(s)	a) Develop the real number system using the closure property. b) Distinguish between rational and irrational numbers using conversion of common to decimal fractions and solve related problems.						
Essential Question(s)	i. What distinguishes rational numbers from irrational numbers, and how do these different types of numbers manifest in real-world situations and mathematical concepts? ii. What are some examples of real-life situations where irrational numbers play a crucial role, and how can its significance be illustrated to learners? iii. How can understanding the visual representation of real numbers on the number line help us in ordering and comparing quantities in real-world contexts? etc.						
Pedagogical Strategies	Collaborative learning: Small group and large group discussions, mixed-ability groups, mixed-gender group, think-pair-share, "Know, Want-to-know, and Learned (KWL)", Individualized practice, etc.						
Teaching & Learning Resources	Mathematical sets, computer with organising software like Excel, A4, A3 papers, manila cards, flip charts, markers, colour pens, projector, etc.						
Key Notes on Differentiation							
a) Learning Tasks: - Learners classify the subsets of real numbers using diagrams, flow charts, number lines, etc. - Learners differentiate rational from irrational numbers using recurring and non-recurring decimals. - Learners investigate subsets of the real number system using visual aids. - Learners investigate real-life application of real numbers.							
b) Pedagogical Approach 1: Collaborative learning. Students use discussions to establish the various subsets of the real number system through the closure property. To differentiate; - Provide visual aids, such as number lines or diagrams, to help learners who are struggling to visualize the subsets of the real number system. - Offer additional practice problems and examples to reinforce understanding.							

iii. Have advanced learners explore more complex subsets of the real number system, such as irrational numbers. iv. Challenge them to create their own examples and non-examples to demonstrate their understanding. c) <i>Pedagogical Approach 2: Collaborative learning</i> <i>Students use discussions as well as visual aids/diagrams to differentiate rational from irrational numbers then investigate subsets of the real number system and its real-life applications.</i> <i>To differentiate:</i> <i>For learners who are struggling to grasp the concepts:</i> i. break down the activity into smaller, more manageable steps, and provide clear explanations and examples. ii. use concrete manipulatives or visual aids to help them understand the concept of rational and irrational numbers. <i>For advanced learners:</i> i. challenge them to apply their understanding to solve complex problems or real-life scenarios involving rational and irrational numbers. ii. provide opportunities for them to present their findings to the class or create visual aids to explain their thinking. d) <i>Key Assessment:</i> Provide a variety of assessment tasks to cater for the varied learners. i. <i>Assessment Level 2: Enumerate the various subsets of the real number system using a Venn diagram/flow chart or number line.</i> ii. <i>Assessment Level 3: Investigate the closure properties of the various subsets of the real number system, under the operations (+, −, ×, ÷).</i> iii. <i>Assessment Level 4: Write down the steps by which a python can swallow a grain of corn, a chick and a hawk at different places, in a single meal. If a hunter kills the python after this and put it into his bag containing a bottle of water, use Venn diagram to illustrate the content in the hunters' bag. Relate these within the real number system.</i>	
Keywords	<i>Union, intersection, complements, surveys, sets, etc.</i>
Lesson 1: Establishing the set of real numbers using the closure property	
Main Lesson drawing on Concepts, Skills and Competencies to reinforce as in the Subject Teacher Manual	
Teacher Activity	Learner Activity

Starter Activity (10 minutes)

Review learners' previous knowledge on the real number system using real life models for learners to consolidate their ideas on the concept. Encourage the use of the concept "Subset" in order to link it to the new learning for this lesson.

Study the diagram carefully.



- In mixed-ability/gender groups, learners should answer questions such as;
- If someone is from Ho, can you assume they are also from Ghana?
- If someone lives in China, list all the possible subsets that you can place him or her.

Introduction (e.g. 30 minutes)

- I. In a whole class activity, lead the class to play the "Closure Exploration Game".

Game

- Distribute index cards with various numbers to the students. Include both integers and fractions.
- Ask students to pair up and perform addition, subtraction, multiplication, and division operations on their numbers. Encourage them to discuss and analyze the results.
- Have each pair write their results on the whiteboard or jotter.

- II. Facilitate a class discussion based on the results. Ask questions such as:

- What patterns or trends do you observe in the results?
- Were there any instances where the closure property did not hold?
- How does this exploration relate to the development of the real number system?

- III. Connect the activity to the concept of developing the real number system. Emphasize that the closure property ensures that performing basic operations on real numbers will always result in a real number.

Introduction (e.g. 30minutes)

In a whole class, learners play the "Closure Exploration Game".

Game

- Study the index cards with various numbers.
- With a partner, perform addition, subtraction, multiplication, and division operations on the numbers. Please discuss and analyze the results.
- Each pair should write their results on the whiteboard or in their jotters.

- II. Learners contribute to a class discussion. Answer questions such as:

- What patterns or trends do you observe in the results?
- Were there any instances where the closure property did not hold?
- How does this exploration relate to the development of the real number system?

Discuss with a partner how the activity connects to the concept of developing the real number system.

IV. In mixed-ability groups, task learners to discuss how this property is foundational for building the real number system. <u>Activity 1 (e.g. 30 minutes)</u> I. Help learners to organise themselves into mixed-ability groups, then task them to discuss the various subsets under the real number system then use a model [including using a computer application software] of their choice to depict it. II. Call groups to make presentations of their models to the class. Offer other learners the opportunity to contribute to the presentations. <u>Activity 2 (e.g. 30 minutes)</u> a) In mixed-groups, task learners to discuss and come out with various real-life uses of the various subsets of the real number system. b) Call groups to make presentations to the class.	IV. In mixed-ability groups, discuss how this property is foundational for building the real number system. <u>Activity 1 (e.g. 30 minutes)</u> I. In your mixed-ability groups, discuss the various subsets under the real number system then use a model [including using a computer application software] of your choice to depict it. II. Take turns to make presentations of your models to the class. You have the opportunity to contribute to the presentations. But be circumspect with your comments. III. <u>Activity 2 (e.g. 30 minutes)</u> I. In mixed-groups, discuss and come out with various real-life uses of the various subsets of the real number system. II. Groups take turns to make presentations to the class.
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Assessment DoK aligned to the Curriculum and Subject Teacher Manual

Level 2

Answer at least 2 of the following questions:

1. Enumerate the various subsets of the real number system using a Venn diagram
2. investigate the closure properties of the various subsets of the real number system, under the operations $(+, -, \times, \div)$.
3. Investigate, where possible, application of the various subsets of the real number system in at least two of the following sectors:
 - a) Daily transactions,
 - b) Computing,
 - c) technology,
 - d) medicine,
 - e) agriculture,
 - f) food and garment production
 - g) energy sector,
 - h) others.
4. Write down the steps by which a python can swallow a grain of corn, a chick and a hawk at different places, in a single act. If a hunter kills the python after this and put it

into his bag containing a bottle of water, use Venn diagram to illustrate the content in the hunters' bag. Relate these the real number system.

Lesson Closure

In completing this part, refer to the Essential Questions to check that learning has taken place.

Activity (10 minutes)

- Make a seamless transition to plenary by making reference to the first **Essential Question**, and engage learners to brainstorm ideas on them.
Hint: Link the concept of subset by bringing up a conversation on the need to appreciate the uniqueness of different subgroups in our society coexisting as Ghanaians. (GESI).
- Using the last part of our WWH strategy, wrap up the lesson by summarising learners' ideas for them to write in their notes. (Offer learners the opportunity to ask questions for further clarification and address any misconceptions if any)
- Have a general class voting to aid reflection.

Reflection & Remarks

- What was my best moment in today's lesson and how can I create more of such situations?
- What did the learners find difficult to understand, and what activities did learners complete with ease and accuracy?
- Which materials best supported the delivery of the lesson and how did learners find its use in aiding their understanding of the concept taught?
- Were the different subgroups in the class catered?
- Were the learners enthusiastic about the activities and resources employed in the delivery of the lesson?

Lesson 2: Distinguishing between rational and irrational numbers and their applications to the real world

Main Lesson drawing on Concepts, Skills and Competencies to reinforce as in the Subject Teacher Manual

Teacher Activity

Learner Activity

Activity (e.g. 30 minutes)

In a whole class play the game: "Real Number Relay".

Instructions

- Prepare large sheets of paper with categories written on them, such as "Whole Numbers," "Integers," "Rational Numbers," "Irrational Numbers," and "Real Numbers." Place these sheets at different locations in the classroom or outdoor area.
- Write various numbers on the index cards, including integers, fractions, decimals, and irrational numbers. Ensure that there is a mix of different types of numbers.
Divide the class into teams, and assign each team a starting point.
Each team will send one member at a time to pick a number card, identify the type of number it represents, and place it on the correct category sheet.
- Emphasize that the team members must be accurate and quick, as the goal is to complete the relay in the shortest time.
- After the relay race, gather the students and review the placement of numbers on each category sheet.
- Discuss any challenging numbers and clarify any misconceptions.

h) Score the teams based on accuracy and speed. Celebrate the winning team and acknowledge individual efforts.

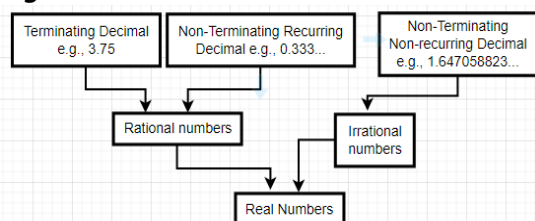
Introduction (e.g. 25 minutes)

- I. In mixed-ability groups, present learners with a model of the real number system and tasked them to identify numbers that are rational and those that are irrational. Encourage learners to show respect for individual views, beliefs, religions, and cultures as they interact and collaborate in their groups and make presentations of their work.
- II. Call groups to make presentations of their notes to the class.

Activity 1 (e.g. 30 minutes)

- I. In an all-inclusive group discussion, task learners to discuss, with examples, the differences between rational and irrational numbers.
- II. Task groups to use a model to distinguish between rational and irrational numbers.

E.g.



Activity 2 (e.g. 25 minutes)

- I. In their groups, task them to discuss with examples the concept and establish recurring and non-recurring decimals using simple fractions. Also, task them to investigate their applications to real life problems.

Introduction (e.g. 25 minutes)

- I. In mixed-ability groups, use the model of the real number system given and identify numbers that are rational and those that are irrational. Encourage learners to show respect for individual views, beliefs, religions, and cultures as they interact and collaborate in their groups and make presentations of their work.
- II. Call groups to make presentations of their notes to the class.

Activity 1 (e.g. 30 minutes)

- I. In an all-inclusive group discussion, learners discuss, with examples, the differences between rational and irrational numbers.
- II. Use a model to distinguish between rational and irrational numbers.

Activity 2 (e.g. 25 minutes)

- I. In groups, discuss with examples the concept and establish recurring and non-recurring decimals using simple fractions.
- II. Also, investigate the applications of recurring and non-recurring decimals to real life problems.

Example:

- I. A recipe calls for $\frac{1}{3}$ cup of a certain ingredient. If you want to make a larger batch of the recipe and need to measure out 5 times the original amount, calculate the total quantity of the

	ingredient needed in decimal form. Determine whether the result is a recurring or non-recurring decimal.
Assessment DoK aligned to the Curriculum and Subject Teacher Manual	
Level 3 Answer at least two of the following questions. - Establish at least two real life applications or uses of rational and irrational numbers. - Investigate and classified each of the following as either rational or irrational number. 75% 0.7142857142857143... $\frac{125}{11050}$ $\sqrt{8}$ 3.14159265358979... $2\sqrt{7}$ - Convert the following decimals into fractions $0.\dot{5}$ $0.\dot{6}\dot{2}$ $1.\dot{6}$ $2.\dot{8}\dot{1}$	
Lesson Closure In completing this part, refer to the Essential Questions to check that learning has taken place.	
Activity (10 minutes) - Make a seamless transition to plenary by making reference to the second and third “Essential Question”, and engage learners to brainstorm ideas on them. - Lead the class to summarise the main ideas in the lesson for learners to write in their notes. (Offer learners the opportunity to ask questions for further clarification and address any misconceptions if any) - Have a general class voting to aid reflection.	
Reflection & Remarks	
- What was my best moment in today’s lesson and how can I create more of such situations? - What did the learners find difficult to understand, and what activities did learners complete with ease and accuracy? - Which materials best supported the delivery of the lesson and how did learners find its use in aiding their understanding of the concept taught? - Were the different subgroups in the class catered? - Were the learners enthusiastic about the activities and resources employed in the delivery of the lesson?	

Learning Plan							
Subject	Additional Mathematics	Week	2	Duration	4 hrs.	Form	1
Strand	Modelling with Algebra	Sub-Strand	Number and Algebraic Patterns				
Content Standard	Demonstrate knowledge and understanding binary operations, sets and binomial theorem and solve related problems in real life situations						
Learning Outcome(s)	Model and solve real life problems on sets						
Learning Indicator(s)	Establish the properties of operations on set, including commutative, associative, and distributive, sets algebra and apply them to solve problems						
Essential Question(s)	i. What is the essential knowledge and skills that learners need to learn based on sets and its application in real-life? ii. How will learners' prior knowledge help them understand the concepts? iii. How can I create a classroom culture that values diversity and inclusivity? iv. How can learners apply their knowledge of sets solving real-life problems? v. What pedagogies and assessment strategies can I employ to meet all learners' needs? etc.						
Pedagogical Strategies	Collaborative learning, Talk-for-learning, enquiry-based learning, experiential learning and problem-based learning, etc.						
Teaching & Learning Resources	Cut out shapes of different colours and orientation, Maths Technology learning apps, tools, Chalkboard illustrations, Worksheets, Cut out geometrical shapes of different colours and orientation, etc.						
Key Notes on Differentiation							
a. Learning tasks: i. Learners review and define basic sets, understand set notation ii. Learners perform simple set operations such as union, intersection and complement. iii. Learners construct basic Venn diagrams involving three sets iv. Learners interpret the relationships between these sets using the diagrams. v. Learners accurately represent and analyse relationships between three sets using Venn diagrams, including identifying overlapping regions and calculating set operations based on the diagrams b. Pedagogical exemplars: i. Collaborative Learning: In convenient groups such as ability, mixed ability, mixed gender, or pairs, to engage in various activities							

- ii. Learners to use Venn diagrams as tools to visually represent and verify set identities, enhancing their ability to visualize and comprehend relationships between sets
- iii. Learners to create set problems collectively and apply set identities, algebraic principles, and operations to solve these problems
- iv. Experiential Learning:
 - v. Learners establish set identities and verify their properties using elements of different sets
 - vi. Assist learners to use set algebra to verify relationships between three sets, denoted as Sets A, B, and C.
 - vii. Learners are guided to apply set identities to solve problems across different contexts
 - viii. Learners are guided to create real-life scenarios involving up to three sets and apply set algebra, operations, and identities to solve problems generated by their peers, fostering a deeper understanding of set theory and its practical applications.
- c. Key assessment
 - i. Assessment level 1: Recall:

Write an expression for the shaded region.
 - ii. Assessment level 2: Skills of conceptual understanding

A pharmaceutical company is considering manufacturing new toothpaste. They are considering two charcoal flavours, strawberry and mint. In a sample of 74 people, it was found that 45 liked strawberries, 37 liked mint and 21 liked both types

 - Create a Venn diagram to model the information. Level 1
 - How many liked only strawberries?
 - How many liked only mints?
 - How many liked exactly one of the two (that is they liked one but not the other)?
 - iii. Assessment level 3: Strategic reasoning:

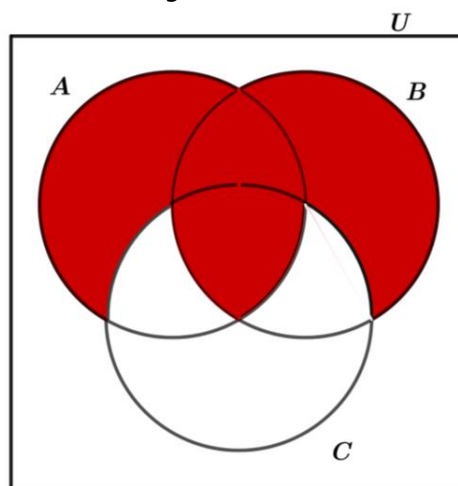
A survey asks: "Which online social media have you used in the last month: WhatsApp, Facebook, Both". The results show 42% of those surveyed have used WhatsApp, 70% have used Facebook, and 20% have used both. How many people have used neither WhatsApp nor Facebook? Level 3
 - iv. Assessment level 4 Extended critical thinking and reasoning:

A survey asked people what alternative transportation modes they use. 30% use the bus; 20% ride a bicycle, 25% walk; 5% use the bus and ride a bicycle 10% ride a bicycle and walk; 12% use the bus and walk; 2% use all three. Use the data to complete a Venn diagram, then determine:

 - What percent of people only ride the bus
 - How many people don't use any alternate transportation

Keywords	Commutative, Associative, Distributive and Venn diagrams, etc.		
Lesson 1: Review of definition, types and properties of sets and visual representations of sets			
Main Lesson drawing on Concepts, Skills and Competencies to reinforce as in the Subject Teacher Manual			
Teacher Activity		Learner Activity	
Starter Activity (5 minutes) Review learners’ previous knowledge by asking them in convenient groups to share ideas on the definition and types of set for whole-class discussion Encourage learners to show respect for individual diverse views as they interact and collaborate in their groups			
Introduction (e.g. 30 minutes) I. Task representatives of groups to share with the larger group their findings on the description, types and characteristics of sets. Encourage learners to show respect for one another and accept constructive critiquing II. Summarise learners’ presentations and correct their misconceptions on the description, types and characteristics of sets		Introduction (e.g. 30minutes) Group representatives share their findings on the description, types and characteristics of sets with the larger group. Respect for one another and accept constructive critiquing Encourage learners to listen attentively and take notes	
Activity 1 (e.g. 45 minutes) Using problem-based and experiential approaches task learners to investigate the commutative, associative and distributive properties of set by both algebraic and graphic approaches		Activity 1 (e.g. 45 minutes) Investigate the commutative, associative and distributive properties of set by both algebraic and graphic approaches	
Activity 2 (e.g. 30 minutes) Using discovery and experiential learning approaches, guide learners to explore the regions of a three-set Venn diagram		Activity 2 (e.g. 30 minutes) In your groups explore the regions of a three-set Venn diagram	
Assessment DoK aligned to the Curriculum and Subject Teacher Manual			
Assessment level 1: Recall 1. Consider the sets: A = {red, green, blue}, B = {red, yellow, orange}, C = {red, orange, yellow, green, blue, purple} D = {yellow, white} and the universal set, $U = A \cup B \cup C \cup D$ a. find $A' \cap C$ b. find $A \cup C$ and $B' \cap A$.			

2. Let $U = \{1, 2, 3, \dots, 8, 9, 10\}$ be the universal set. Consider the sets: $A = \{3, 5, 8, 10\}$, $B = \{1, 3, 4, 7, 8, 9, 10\}$ and $C = \{2, 5, 6\}$. Find each of the following:
- $A \cup C$
 - $B \cap C$
 - $A \cap B$
 - $\overline{(A \cup C)}$
 - $\overline{(A \cap B)} \cup C$
3. Write an expression for the shaded region.



4. Suppose the universal set is $U = \{\text{all odd numbers from 1 to 15}\}$ and $A = \{1, 3, 9, 11\}$, then list the elements of A'
5. A, B and C are three intersecting subsets of the universal set ξ . Draw a Venn diagram and shade the following regions:
- A
 - C
 - B
 - $A \cap C$
 - $B \cup C$
 - $(B \cap C) \cup A$

Assessment level 2: Skills of conceptual understanding

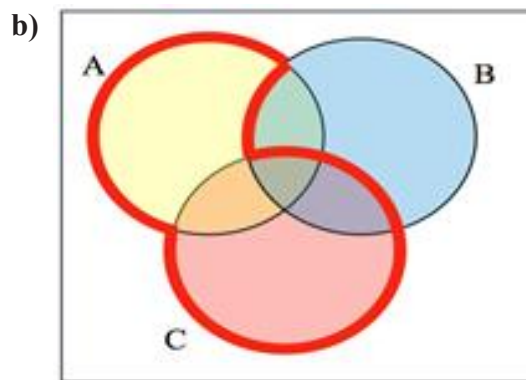
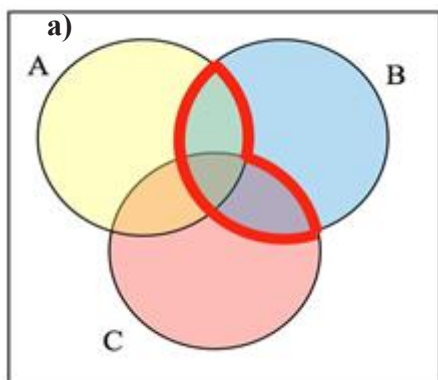
- The set $A = \{1, 3, 5\}$. What is a larger set that this might be a subset of?
- Draw a Venn Diagram to represent that set G is a proper subset of set P .

Assessment level 3: Strategic reasoning

- Find $(A \cup B)'$ if $n(A) = 42$, $n(B) = 70$ and $n(A \cap B) = 20$
- In a survey of 115 pet owners, 26 said they own a dog, and 64 said they own a cat. 5 said they own both a dog and a cat. Use a Venn diagram to determine how many of the pet owners surveyed owned neither a cat nor a dog?

Level 4 Extended critical thinking and reasoning:

- Write an expression for the regions outlined in red



2. A survey asked people what alternative transportation modes they use. 30% use the bus; 20% ride a bicycle, 25% walk; 5% use the bus and ride a bicycle 10% ride a bicycle and walk; 12% use the bus and walk; 2% use all three. Use the data to complete a Venn diagram, then determine:
- What percent of people only ride the bus
 - How many people don't use any alternate transportation

Lesson Closure

In completing this part, refer to the Essential Questions to check that learning has taken place.

Activity (10 minutes)

- Make a seamless transition to plenary by referring to the first **Essential Question**, and engage learners to brainstorm ideas on them.
Hint: Link the concept of subset by bringing up a conversation on the need to appreciate the uniqueness of different subgroups in our society coexisting as Ghanaians. (GESI).
- Using the last part of our WWH strategy, wrap up the lesson by summarising learners' ideas for them to write in their notes. (Offer learners the opportunity to ask questions for further clarification and address any misconceptions if any)
- Have a general class voting to aid reflection

Reflection & Remarks

- What was my best moment in today's lesson and how can I create more of such situations?
- What did the learners find difficult to understand, and what activities did learners complete with ease and accuracy?
- Which materials best supported the delivery of the lesson and how did learners find its use in aiding their understanding of the concept taught?
- Were the different subgroups in the class catered?
- Were the learners enthusiastic about the activities and resources employed in the delivery of the lesson?

Lesson 2: Solving three-set and real-life problems involving three sets

Main Lesson drawing on Concepts, Skills and Competencies to reinforce as in the Subject Teacher Manual

Teacher Activity

Learner Activity

Starter Activity (5 minutes)

Review learners' previous knowledge by tasking them in convenient groups or as individuals to identify the regions of a three-set Venn diagram as described using set notation and operations i.e., intersection, union and complement. Encourage learners to show respect for individual diverse views as they interact and collaborate in their groups

Activity 1 (e.g. 45 minutes)

Using discovery and experiential learning approaches, guide learners to explore the solutions of set problems through Venn diagram and set algebra

Activity 2 (e.g. 60 minutes)

- I. Using problem-based and collaborative learning task learners in groups to solve problems in real-life using Venn diagrams by applying their understanding of properties of set
- II. Encourage learners to work together, respect each other's views and contributions to find the solutions to the problems

Activity 1 (e.g. 45 minutes)

In your groups explore the solutions of set problems through Venn Diagram and set algebra

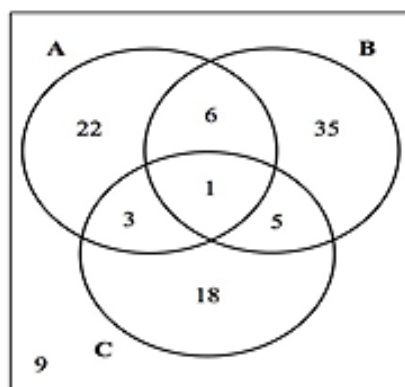
Activity 2 (e.g. 60 minutes)

- I. In your groups solve problems in real-life using Venn diagrams by applying your understanding of properties of sets
- II. In your groups, work together, respect each other's views and contributions to find the solutions to the problems

Assessment DoK aligned to the Curriculum and Subject Teacher Manual

Assessment level 1: Recall

Consider the Venn diagram below. The numbers indicate the number of elements in the regions



Determine the following

1. $n(A)$
2. $n(C)$
3. $n(B)$
4. $n(A \cap C)$
5. $n(B \cup C)$
6. $n((B \cap C) \cup A)$

Assessment level 2: Skills of conceptual understanding

A pharmaceutical company is considering manufacturing new toothpaste. They are considering two charcoal flavours, strawberry and mint. In a sample of 74 people, it was found that 45 liked strawberries, 37 liked mint and 21 liked both types

1. Create a Venn diagram to model the information.
2. How many liked only strawberries?
3. How many liked only mints?
4. How many liked exactly one of the two (that is they liked one but not the other)?

Assessment level 3: Strategic reasoning

A survey asks: "Which online social media have you used in the last month: WhatsApp, Facebook, Both". The results show 42% of those surveyed have used WhatsApp, 70% have used Facebook, and 20% have used both. How many people have used neither WhatsApp nor Facebook?

Lesson Closure

In completing this part, refer to the Essential Questions to check that learning has taken place.

Activity (10 minutes)

- a) Make a seamless transition to plenary by referring to the fourth **Essential Question** and recap the focal areas of the lesson.
- b) Lead the class to summarise the main ideas in the lesson for learners to write in their notes. (Offer learners the opportunity to ask questions for further clarification and address any misconceptions if any)
- c) Have a general class voting to aid reflection.

Reflection & Remarks

- f) What was my best moment in today's lesson and how can I create more of such situations?
- g) What did the learners find difficult to understand, and what activities did learners complete with ease and accuracy?
- h) Which materials best supported the delivery of the lesson and how did learners find its use in aiding their understanding of the concept taught?
- i) Were the different subgroups in the class catered?
- j) Were the learners enthusiastic about the activities and resources employed in the delivery of the lesson?

Teacher Lesson Observation Form

Name of School

Subject being observed

Class

☐ Year 1

☐ Year 2

☐ Year 3

Sex of the teacher

☐ Male

☐ Female

1. Is the purpose of the lesson clearly stated in the lesson plan and focused on learners achieving the lesson learning outcomes?

- ☐ Yes
☐ In Part
☐ No
☐ NA

b1. Please provide an explanation to your answer in Q1 above

2. Are the unique needs of female learners, male learners, and learners with special education needs adequately catered for in the lesson plan? For example, the choice of teaching methods and learning activities reflects/does not reflect the learning needs of all learners.

For example, the choice of teaching methods, and learning activities.

- ☐ Yes
☐ In Part
☐ No
☐ NA

2b. Please provide an explanation to your answer in Q2 above

3. Does the teacher manage behavior well, maintaining a positive and non-threatening learning environment throughout the lesson?

- ☐ Yes
☐ In Part
☐ No
☐ NA

3b. Please provide an explanation to your answer in Q3 above

4. Are appropriate teaching and learning materials and other resources (including ICT, books, desks) available, accessible and being used to support learning of all females, males and learners with special education needs?

- ☐ Yes
☐ In Part
☐ No
☐ NA

4b. Please provide an explanation to your answer in Q4 above

5. Are learners engaged on tasks that challenge them in line with the content standards?

Does the teacher take into consideration the uniqueness of learners?

- ☐ Yes
☐ In Part
☐ No
☐ NA

5b. Please provide an explanation to your answer in Q5 above

6. Is there evidence that students are learning?

- ☐ Yes
☐ In Part
☐ No
☐ NA

6b. Please provide an explanation to your answer in Q6 above

7. Is teaching differentiated to cater for the varied needs of all learners (i.e., male learners, female learners, learners with special education needs) and those with poor literacy and/ or numeracy proficiency?

- ☐ Yes
☐ In Part
☐ No
☐ NA

7b. Please provide an explanation to your answer in Q7 above

8. Does the teacher use real life examples which are familiar to learners to explain concepts?

- ☐ Yes
☐ In Part
☐ No
☐ NA

8b. Please provide an explanation to your answer in Q8 above

9. Does the teacher point out or question traditional gender roles when they come up during the lessons as appropriate?

- ☐ Yes
☐ In Part
☐ No
☐ NA

9b. Please provide an explanation to your answer in Q9 above

10. Does the lesson include appropriate interactive and creative approaches e.g., group work, role play, storytelling to support learners achieving the learning outcomes?

If yes, give examples of the issues and skills that have been so integrated.

- ☐ Yes
☐ In Part
☐ No
☐ NA

10b. Please provide an explanation to your answer in Q10 above

11. Have cross-cutting issues and /or 21st century skills been integrated into the lesson to support learners in achieving the learning outcomes e.g., problem-solving, critical thinking, communication? If yes, give examples of the issues and skills that have been so integrated.

- ☐ Yes
☐ In Part
☐ No
☐ NA

11b. If yes, give examples of the issues and skills that have been so integrated.

12. Does the teacher incorporate ICT into their practice to support learning?

- ☐ Yes
☐ In Part
☐ No
☐ NA

12b. Please provide an explanation to your answer in Q12 above

13. Does the teacher encourage all female male and male learners (including those who may be shy or afraid to speak) to ask questions, answer questions, participate in group work, etc. during the lesson?

- ☐ Yes
☐ In Part
☐ No
☐ NA

13b. Please provide an explanation to your answer in Q13 above

14. Is assessment evident in the lesson? If yes, does it include assessment as, for or of learning and go beyond recall?

If yes, did it include assessment of, for or as learning and go beyond recall?

- ☐ Yes
☐ In Part
☐ No
☐ NA

14b. Please provide an explanation to your answer in Q14 above

15. Do learners make use of feedback from teacher and peers?

- ☐ Yes
☐ In Part
☐ No
☐ NA

15b. Please provide an explanation to your answer in Q15 above

16. Does the teacher sum up the lesson and evaluate the lesson against the learning outcomes with the learners?

- ☐ Yes
☐ In Part
☐ No
☐ NA

16b. Please provide an explanation to your answer in Q16 above

17. Does the teachers' planning of lessons taught before the one observed show how they plan for learning over time, considering individual and group needs?

- ☐ Yes
☐ In Part
☐ No
☐ NA

17b. Please provide an explanation to your answer in Q17 above

18. Does the teacher pay attention to the composition of females and males during group work and assigns females leadership roles.

- ☐ Yes
☐ In Part
☐ No
☐ NA

18b. Please provide an explanation to your answer in Q18 above

19. Does the teacher provide constructive verbal feedback to both females and males and learners with special education needs?

- ☐ Yes
☐ In Part
☐ No
☐ NA

19b. Please provide an explanation to your answer in Q19 above

20. Does the teacher provide constructive written feedback to both females and males and learners with special education needs in their exercise book?

- ☐ Yes
☐ In Part
☐ No
☐ NA

20b. Please provide an explanation to your answer in Q20 above

21. Key strengths in the lesson

22. Areas for development

23. Next steps for teacher

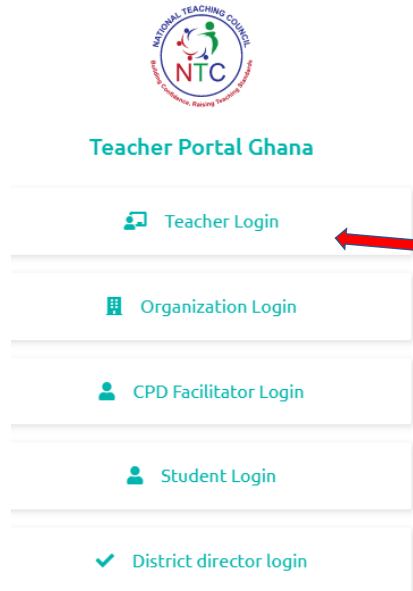
24. Additional Notes (on teacher's actions, the flow of activities, etc.)

HOW TO AWARD CPD POINTS TO DESERVING TEACHERS

1. Visit tpg.ntc.gov.gh and click Login



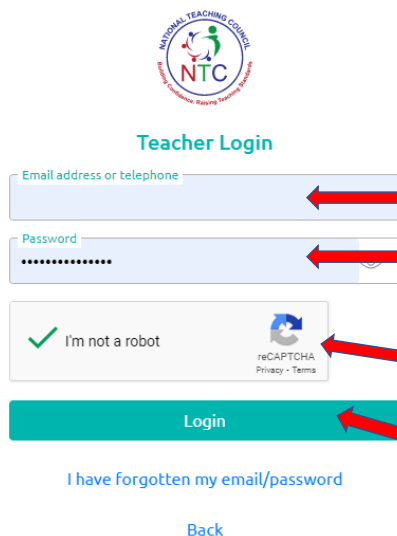
2. On the Login page, click Teacher Login



The image shows the 'Teacher Portal Ghana' login page. At the top is the NTC logo with the text 'NATIONAL TEACHING COUNCIL' and 'NTC' in the center. Below the logo is the title 'Teacher Portal Ghana'. There are five login options listed in a vertical stack: 'Teacher Login' (with a laptop icon), 'Organization Login' (with a building icon), 'CPD Facilitator Login' (with a person icon), 'Student Login' (with a person icon), and 'District director login' (with a checkmark icon). A red arrow points from a text box to the 'Teacher Login' button.

Click Teacher Login

3. On the Teacher Login page enter your email address and password and then click Login



The image shows the 'Teacher Login' page. At the top is the NTC logo. Below the logo is the title 'Teacher Login'. There are four input fields: 'Email address or telephone', 'Password', 'I'm not a robot' (with a green checkmark icon), and a 'Login' button (with a blue arrow icon). A red arrow points from a text box to the 'Email address or telephone' field. Another red arrow points from a text box to the 'Password' field. A third red arrow points from a text box to the 'I'm not a robot' checkbox. A fourth red arrow points from a text box to the 'Login' button. Below the 'Login' button is a link that says 'I have forgotten my email/password' and a 'Back' link.

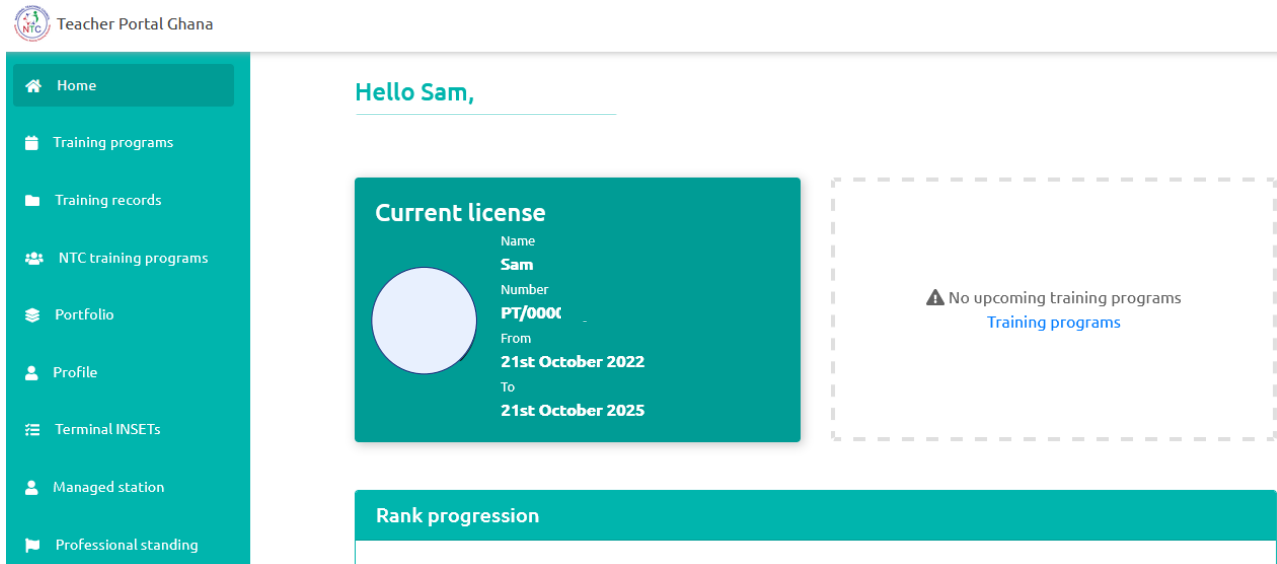
Enter your email address

Enter your password

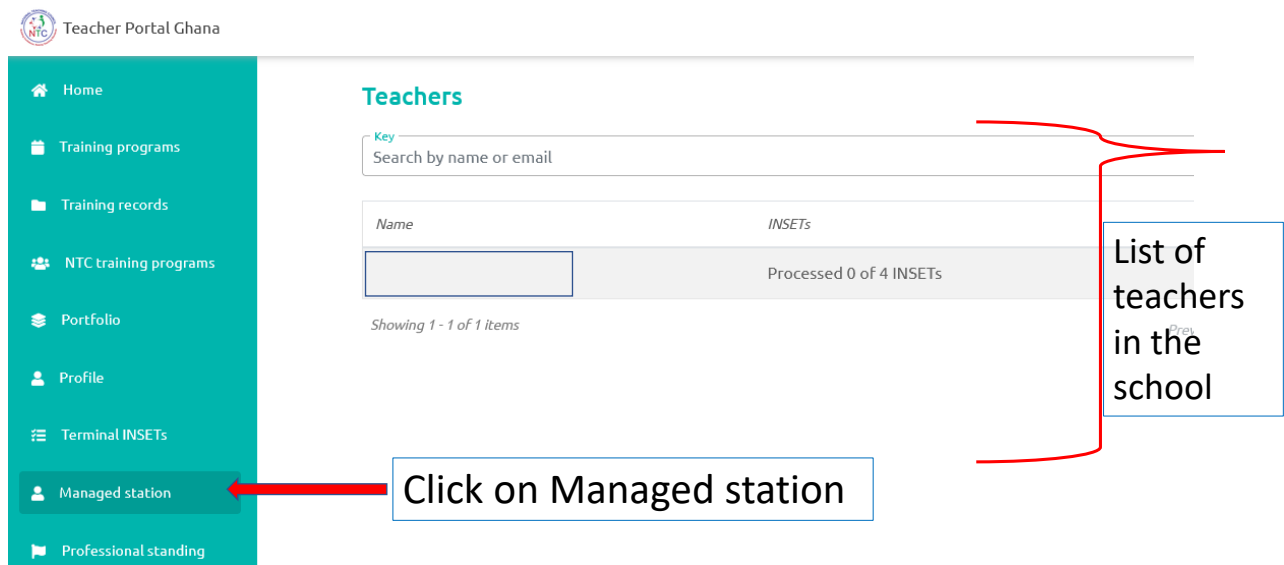
Check I'm not a robot

Click Login

4. After a successful login you will get access to your TPG account (Check image below)



5. To award CPD points, from the side menu tap on **Managed station** to display list of teachers



6. Click on the name of the teacher to display the page for awarding CPD points (Check image below)

Teachers /

Type	Year	Term	Processed	Processed by	Processed on	Credits	
School Based Inset (SBI)	2022/2023	1	No	---	---	---	...
Cluster Based Inset (CBI)	2022/2023	1	No	---	---	---	...
School Based Inset (SBI)	2022/2023	1	No	---	---	---	...
Department Based Inset (DBI)	2022/2023	1	No	---	---	---	...

7. Click on the 3 dots after the Credits column at the extreme right side to process (Check image below)

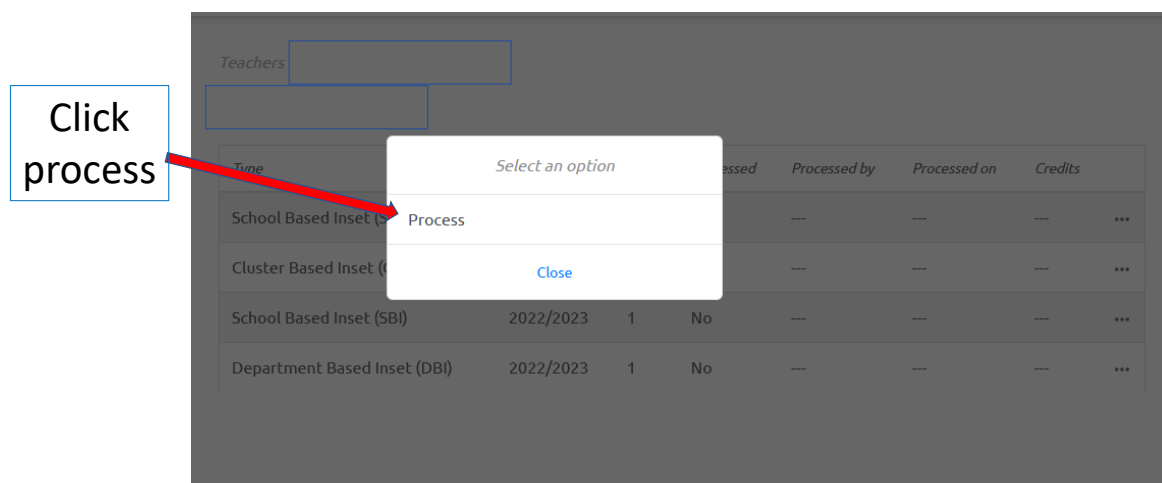
Teachers /

Click here to process

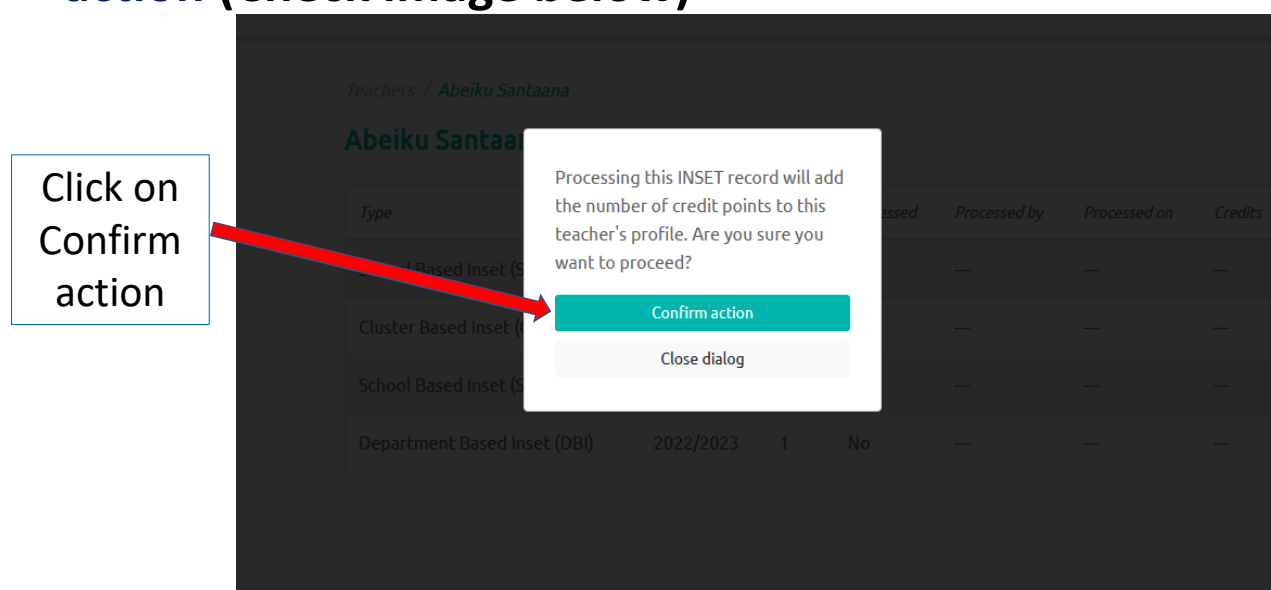
Type	Year	Term	Processed	Processed by	Processed on	Credits	
School Based Inset (SBI)	2022/2023	1	No	---	---	---	...
Cluster Based Inset (CBI)	2022/2023	1	No	---	---	---	...
School Based Inset (SBI)	2022/2023	1	No	---	---	---	...
Department Based Inset (DBI)	2022/2023	1	No	---	---	---	...

Note: You will repeat same actions for all the INSET/PLC types

8. On the new page that appears click on **Process** (Check image below)



8. On the new page that appears click on **Confirm action** (Check image below)



9. The points for the teacher will then be processed (Check image below)

Teachers /

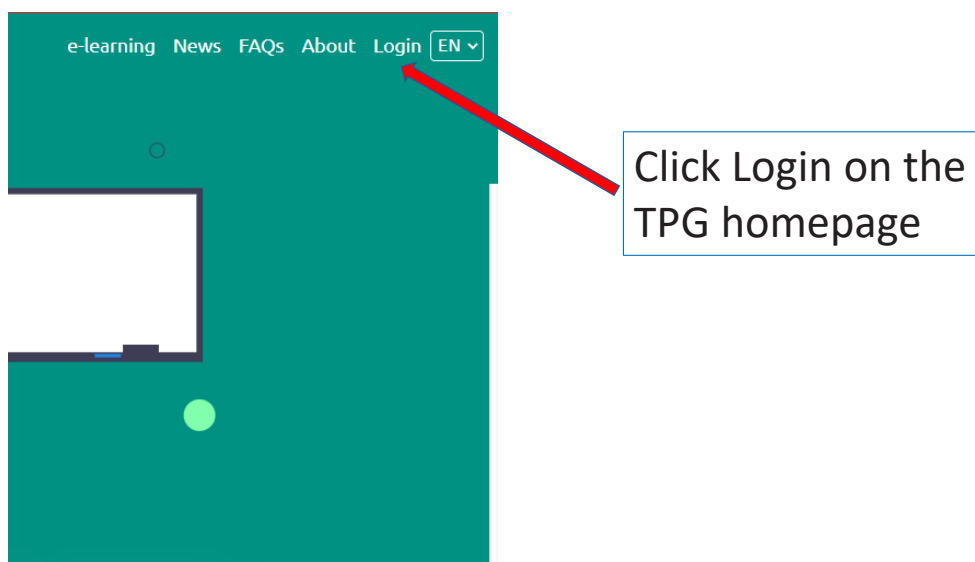
Points processed

Type	Year	Term	Processed	Processed by	Processed on	Credits	
School Based Inset (SBI)	2022/2023	1	Yes	(Teacher)	Saturday, 15th April, 2023	1	...
Cluster Based Inset (CBI)	2022/2023	1	Yes	(Teacher)	Saturday, 15th April, 2023	1	...
School Based Inset (SBI)	2022/2023	1	No	---	---	---	...
Department Based Inset (DBI)	2022/2023	1	No	---	---	---	...

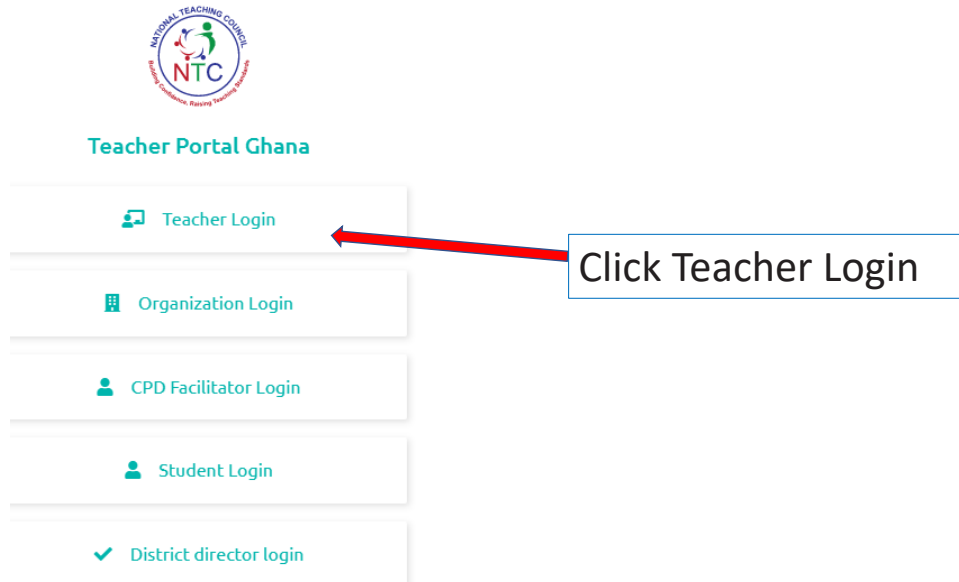
THANK YOU

HOW TO CHECK CPD POINTS AND TRAINING RECORDS ON TEACHER PORTAL GHANA

1. Visit tpg.ntc.gov.gh and click Login

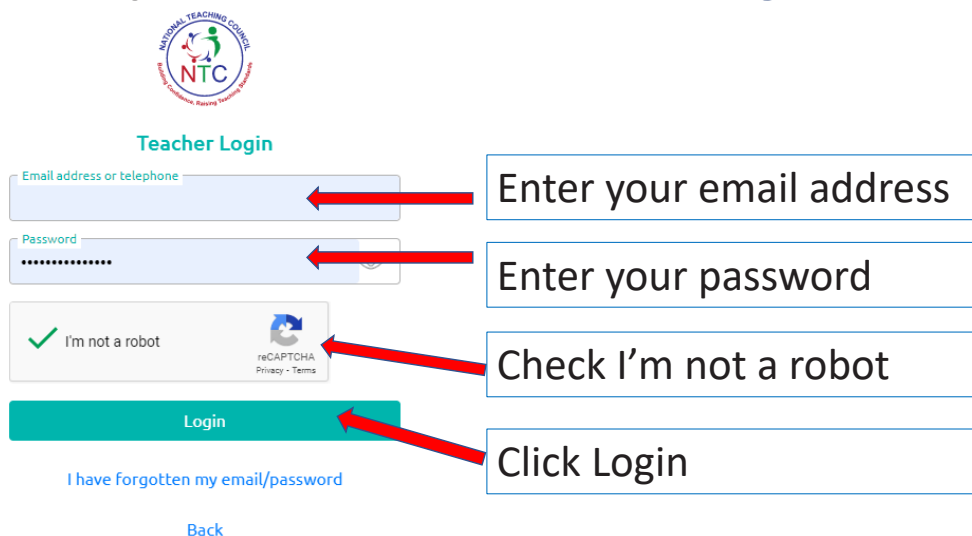


2. On the Login page, click Teacher Login



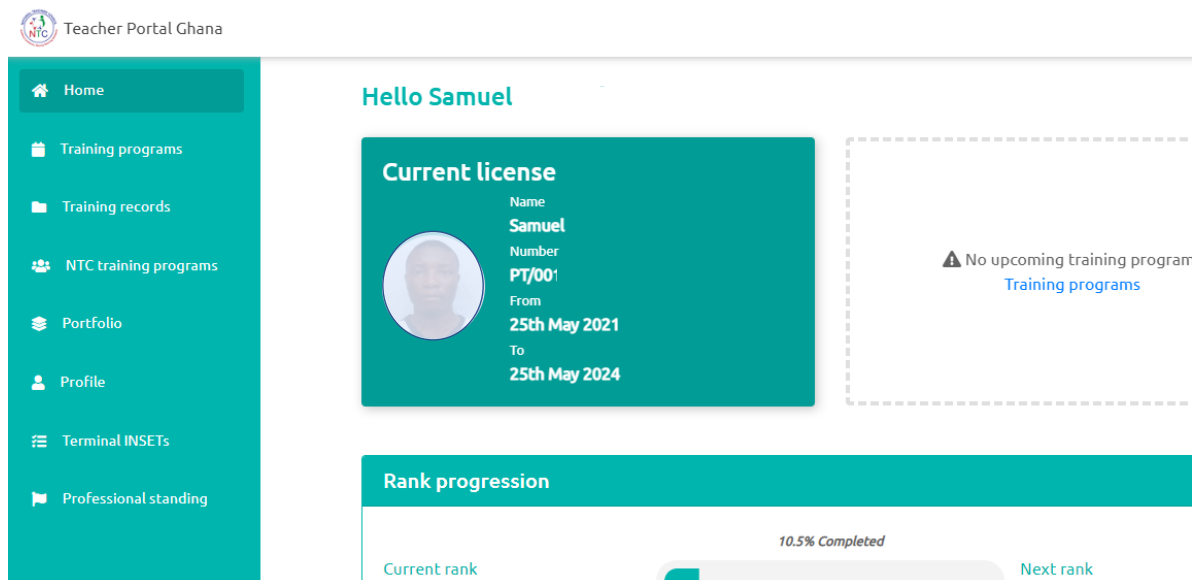
The image shows the 'Teacher Portal Ghana' login page. At the top is the NTC logo with the text 'NATIONAL TEACHING COUNCIL' and 'NTC' in the center. Below the logo is the title 'Teacher Portal Ghana'. There are five login options listed in a vertical stack: 'Teacher Login' (with a person icon), 'Organization Login' (with a building icon), 'CPD Facilitator Login' (with a person icon), 'Student Login' (with a person icon), and 'District director login' (with a checkmark icon). A red arrow points from a text box 'Click Teacher Login' to the 'Teacher Login' button.

3. On the Teacher Login page enter your email address and password and then click Login



The image shows the 'Teacher Login' page. At the top is the NTC logo. Below the logo is the title 'Teacher Login'. There are four input fields: 'Email address or telephone' (with a red arrow pointing to it from a text box 'Enter your email address'), 'Password' (with a red arrow pointing to it from a text box 'Enter your password'), and a reCAPTCHA box (with a red arrow pointing to it from a text box 'Check I'm not a robot'). Below the input fields is a green 'Login' button (with a red arrow pointing to it from a text box 'Click Login'). Below the 'Login' button is a link 'I have forgotten my email/password' and a link 'Back'.

4. After a successful login you will get access to your **TPG account** (Check image below)



5. To check CPD points, scroll down to **Rank progression**. You will see the CPD points progress bar and actual points accrued (Check image below)



6. To view training records, from the side menu tap on **Training records** (Check image below)

The screenshot shows the Teacher Portal Ghana interface. On the left is a teal side menu with options: Home, Training programs, Training records, NTC training programs, Portfolio, Profile, Terminal INSETs, and Professional standing. A red arrow points to 'Training records'. The main content area is titled 'Training records' with the subtitle 'Records for training programs registered and/or attended'. It shows 'Total points: 1.8988'. Below this is a list of training programs:

Training Program	Status
Sensitization on Education Policies	⚠ Marked as absent
Differentiated Learning	✓ Processed Credits: 1.32
Advanced Mobile Learning with Multimedia (AMLM)	✓ Processed Credits: 0.5788

A red bracket on the right side of the list is labeled 'List of training programs'. A callout box at the bottom left says 'Click to view training records' with an arrow pointing to the 'Training records' menu item.

THANK YOU