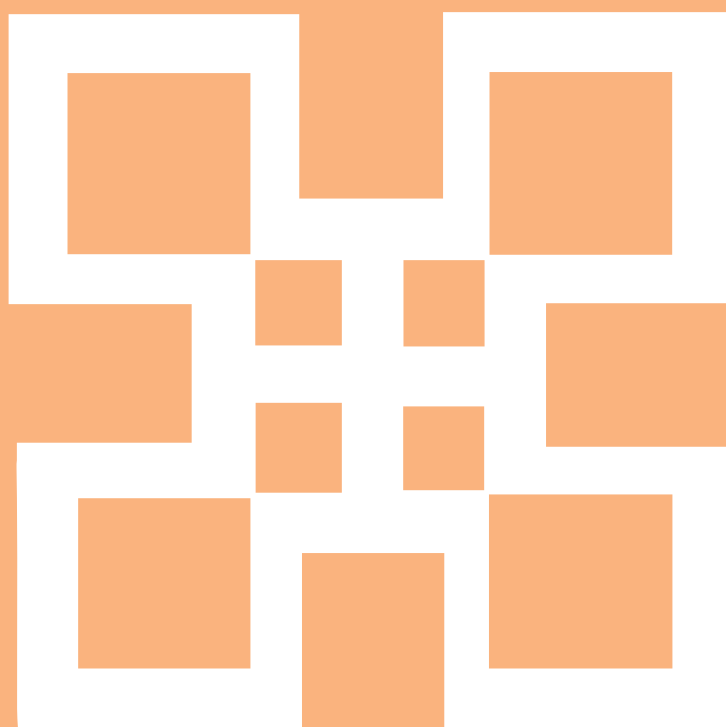


Departmental Professional Learning Community Handbook

MATHEMATICS

HANDBOOK FOR COORDINATORS



Wisdom, Knowledge
and Prudence



Ghana Education
Service (GES)



NATIONAL COUNCIL FOR
CURRICULUM & ASSESSMENT





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**DEPARTMENTAL PROFESSIONAL LEARNING
COMMUNITY HANDBOOK**

MATHEMATICS

Coordinator 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 Leading the session. <i>What the PLC Coordinator will have to say during each stage of 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 Introduce the PLC session with a puzzle as an icebreaker. 1.2 Ask teachers to share their expectations regarding what they hope to gain from the Departmental Professional Learning Community (DPLC) activities (NTS 1a, 1b). 1.3 Ask a teacher to 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	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	20 mins

	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. 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	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. 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	
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	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.	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.	
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2. Planning for teaching, learning and assessment activities, promoting character values, GESI, SEL, ICT and 21st century skills	2.1 Ask a teacher to 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 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. 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 have been used in mathematics lessons.	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 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. 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.	45 mins
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	LI 4 Discuss at least 3 assessment strategies acquired from the previous PLC sessions that enhanced teaching and learning of mathematics. 2.2 Ask teachers to 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). E.g. a) <i>Gender, Equality and Social Inclusions (GESI) - Creating equal opportunities for all learners irrespective of their gender, cultural, religious, socio-economic background, etc.</i> b) <i>SEL - Assisting learners to develop the ability to recognise their emotions and that of others (self-awareness, social-awareness, self-management, responsible decision making, relationship skills)</i> c) <i>ICT - Incorporating IT tools such as projector, computers and interactive mathematics software such as GeoGebra, Photomath, Desmos, Malmath, Microsoft Mathematics in lessons</i> d) <i>Differentiation - Acknowledging the differences in learners</i>	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). E.g. <i>GESI - Creating equal opportunities for all learners irrespective of their gender, cultural, religious, socio-economic background, etc.</i>	
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	<i>and tailoring teaching and learning activities to suit them</i> <i>e) 21st century skills- Encouraging the use of activities which ensure communication, collaboration, digital literacy, leadership, problem-solving skills, etc.</i> 2.3 Ask teachers to discuss using onion ring strategy (where applicable), at least 2 pedagogical strategies which they applied integrating cross-cutting issues in the teaching and learning of mathematics (NTS 2c, 3a-3g, 3i, 3d, 3e and 3g). <i>E.g.</i> <i>a) Onion ring – Engaging learners in two concentric circles to reflect on lessons.</i> <i>b) Fishbowl – Engaging learners in two concentric circles where learners in the inner circle discuss key concepts of the lesson and learners in the outer circle listen and take notes.</i> <i>c) Think-pair-share – brain writing the types of sets, pairing with another learner and discussing their thoughts.</i> <i>d) Individual tasks – Giving learners assignments, class exercises and projects to work on individually.</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>	
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	e) <i>Problem-Based Learning – Assigning tasks to small groups on real-life applications of percentages for learners to present their findings using varied tools including ICT tools</i> f) <i>Project-Based Learning – Tasking learners to identify a problem in their daily lives and through a hands-on approach, use mathematical concepts and skills to develop a solution to it, etc.</i> 2.4 Ask teachers to 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). E.g. a) <i>Scientific calculators for verifying computations.</i> b) <i>Number wheels for teaching and learning probability.</i> c) <i>Used cartons for modelling nets of 3 dimensional shapes.</i> d) <i>Manila cards for teaching and learning fractions, shapes, and presentation of findings</i> e) <i>Dice and coins for teaching and learning of probability</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). E.g. <i>Scientific calculators for verifying computations, etc.</i>	
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	f) <i>Geoboard for teaching and learning geometrical concepts</i> g) <i>Dynamic software such as GeoGebra for graphing, etc.</i> 2.6 Ask teachers in mixed groupings (gender, experience, etc.) to 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> a) <i>Interviews – oral questioning used to elicit responses from learners</i> b) <i>Portfolio building – gathering of artefacts as evidence of learning</i> c) <i>Riddles – riddles were posed to connect known concepts to new learning</i> d) <i>Quizzes – diagnostic tests were conducted to ascertain the strengths and weaknesses of learners</i> e) <i>Project works – end of unit project was conducted to investigate problems, etc.</i>	2.6 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>	
3. Modelling a teaching activity, promoting character values, GESI, SEL, ICT and 21st century skills	3.1 Ask a teacher to 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).	3.1 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).	15 mins

	3.2 Ask teachers to reflect and provide feedback on the modelled lesson (NTS 1a, 1b and 3b).	3.3 Reflect and provide feedback on the modelled lesson (NTS 1a, 1b and 3b).	
4. Evaluation and review of session: ▪ Noting that teachers need to identify critical friends to observe lessons and report at next session.	4.1 Ask teachers to reflect and share their views about the session (NTS 1a, 1b and 3b). 4.2 Remind teachers to, where possible, identify a critical friend to observe their lesson in relation to DPLC Session 1 and provide feedback to them (NTS 1a). 4.3 Remind teachers to read DPLC Session 2 and bring along their teacher manual and the DPLC Handbook in preparation for the next session (NTS 1b).	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 Leading the DPLC Session. <i>What the DPLC Coordinator will have to say during each stage of 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 Start the session by asking teachers to share two things they did differently based on DPLC Session 1, <i>reviewing concepts and skills acquired in previous PLC sessions</i>, which they think impacted learning positively (NTS 1a, 1b). 1.2 Ask teachers, as critical friends, to discuss and summarise in a single sentence why they 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).	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	2.1 Ask a teacher to 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:	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:	60 mins

national values (2 learning planners to be completed per session)	<i>a) Mathematics</i> <i>i. Sets of real numbers</i> <i>ii. Properties of operations and subsets</i> <i>b) Additional mathematics:</i> <i>i. Binary operations</i> <i>ii. 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 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).	<i>a) Mathematics</i> <i>i. Sets of real numbers</i> <i>ii. Properties of operations and subsets</i> <i>b) Additional mathematics:</i> <i>i. Binary operations</i> <i>ii. 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 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).	
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	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 Ask teachers in groups to identify and share the aspects of Weeks 1 and 2 lessons in their teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> a) <i>Content standards</i> b) <i>Learning outcome</i> c) <i>Learning indicator(s), etc.</i> 2.3 Ask teachers to discuss at least 2 essential questions that support the achievement of 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. <i>What distinguishes rational numbers from irrational numbers, and how do these different types of numbers manifest in real-world situations and</i>	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</i>	
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	<i>mathematical concepts?</i> <i>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?</i> <i>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.</i> <i>b) Additional mathematics (Week 1):</i> <i>i. How can I create a classroom environment that promotes collaborative learning and peer-to-peer teaching, enhancing learners' grasp of binary operations?</i> <i>ii. How can I differentiate my instruction to accommodate learners with varying levels of prior knowledge and mathematical abilities?</i> <i>iii. What GESI responsive resources can be employed to support the teaching and</i>	<i>mathematical concepts? etc.</i> <i>b) 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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	<i>learning of binary operations? etc.</i> c) <i>Mathematics (Week 2):</i> 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?</i> ii. <i>In what ways do the concepts of identity and inverse elements contribute to the understanding of addition, subtraction, multiplication and division, and how are these concepts relevant in solving real-life problems?</i> iii. <i>How can an understanding of the properties of operations enhance our ability to manipulate and simplify mathematical expressions, and how do these properties lay the foundation for more advanced mathematical concepts? etc.</i> d) <i>Additional mathematics (Week 2):</i> i. <i>How can I scaffold the learning process, starting with basic set concepts and</i>	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</i>	
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	<i>gradually building up to more complex applications?</i> ii. <i>What real-world applications can we find for set theory?</i> iii. <i>What visual aids, manipulatives, or interactive activities can enhance learners' understanding of sets and their operations? 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: Remind teachers to refer to their 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> ▪ <i>Learners differentiate rational from irrational numbers using recurring and</i>	<i>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>	
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	<i>non-recurring decimals.</i> ▪ <i>Learners investigate subsets of the real number system using visual aids.</i> ▪ <i>Learners investigate real-life application of real numbers.</i> <i>ii. Pedagogical Approach 1: Collaborative learning.</i> <i>Learners use discussions to establish the various subsets of the real number system through the closure property.</i> <i>To differentiate:</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.</i> ▪ <i>Offer additional practice problems and examples to reinforce understanding.</i> ▪ <i>Have advanced learners explore more complex subsets of the real number system, such as irrational numbers.</i> ▪ <i>Challenge them to create their own examples and non-examples to demonstrate their understanding.</i> <i>Pedagogical Approach 2: Collaborative learning.</i>	<i>ii. 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</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>	
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	<i>Learners 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: 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.</i> ▪ <i>use concrete manipulatives or visual aids to help them understand the concept of rational and irrational numbers.</i> <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.</i> ▪ <i>provide opportunities for them to present their findings to the class or create visual aids to explain their thinking.</i> <i>iii. Key Assessment: Provide a variety of assessment tasks to cater for the varied learners.</i> ▪ <i>Assessment Level 2: Enumerate the various</i>		
		<i>iii. Key Assessment: Provide a variety of assessment tasks to cater for the varied learners.</i> <i>Assessment Level 2: Enumerate the various</i>	

	<i>subsets of the real number system using a Venn diagram/flow chart or number line.</i> ▪ <i>Assessment Level 3: Investigate the closure properties of the various subsets of the real number system, under the operations $(+, -, \times, \div)$.</i> ▪ <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> <i>b) Mathematics (Week 2):</i> <i>i. Learning Tasks:</i> ▪ <i>Enumerating the properties of operations, commutative, associative, distributive, and its connections to real life as well as their inter connections.</i> ▪ <i>Extend content expectation to include classifying the properties of operations, commutative, associative,</i>	<i>subsets of the real number system using a Venn diagram/flow chart or number line, etc.</i> <i>b) Mathematics (Week 2):</i> <i>i. Learning Tasks:</i> <i>Enumerating the properties of operations, commutative, associative, distributive, and their connections to real life as well as their inter connections, etc.</i>	
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	<i>distributive, etc. and their existence with respect to the four operations.</i> ▪ <i>Extend content expectation to include applying the properties of operations, commutative, associative, distributive, etc. to real life and solving simple problems involving them.</i> <i>ii. 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>To differentiate:</i> ▪ <i>Use concrete examples and visual aids to help them understand the properties of operations.</i> ▪ <i>Break down the activity into smaller, more manageable steps, and provide scaffolding as needed.</i>	<i>ii. 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>	
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	▪ Encourage them to create their own flowcharts, Venn diagrams, or number lines to illustrate the properties of operations. ▪ Challenge them to apply the properties to solve complex problems or create their own problems for their classmates to solve. iii. Key Assessment: ▪ Assessment Level 2: Identify the property of operation in the following $4 * \frac{1}{4} = \frac{1}{4} * 4 = 1$ ▪ Assessment Level 3: Establish that for any given set of numbers a, b and c the following properties hold. ○ commutative ○ associative ○ distributive ▪ Assessment Level 3: A woman created a 2m fire belt around, but within, her 200m by 250m rice farm. She later created a circular fishpond of diameter 6m at the middle of the farm. Determine the actual land area covered by the rice farm before the creation of the fishpond	iii. Key Assessment: Assessment Level 2: Identify the property of operation in the following $4 * \frac{1}{4} = \frac{1}{4} * 4 = 1, \text{ etc.}$	
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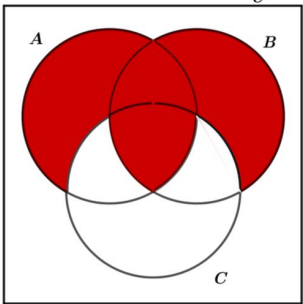
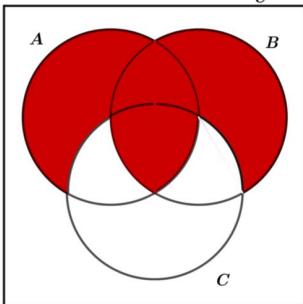
	c) <i>Additional Mathematics (Week 1):</i> i. <i>Learning tasks</i> ○ <i>Learners review and explain the basic definition of binary operations</i> ○ <i>Learners perform simple operations like addition and multiplication on integers and rational numbers.</i> ○ <i>Learners identify and prove properties like commutativity, associativity, distributivity, and verify identity elements and inverses for elements in algebraic structures.</i> ○ <i>Learners model real-world situations using abstract algebraic concepts and binary operations, etc.</i> ii. <i>Pedagogical exemplars: 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</i> ▪ <i>Guide learners to recall the four basic operations and</i>	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: 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</i>	
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	<i>apply them to define binary operations within specified sets, subsequently solving related problems</i> ▪ <i>Through think-pair-share or think-square-debate, learners discuss and determine sets suitable for defining binary operations, establishing rules governing these operations</i> ▪ <i>Assist learners in delving into investigating the properties of binary operations and practice solving problems involving identity and inverse elements within these operations</i> ○ <i>Experiential Learning</i> <i>Guide learners to actively participate in hands-on activities to</i> ▪ <i>create binary operations,</i> ▪ <i>define these operations and</i> ▪ <i>identify the inverse and identity elements associated with them</i> ○ <i>Enquiry-based learning</i> <i>Guide learners to use research</i>	<i>specified sets, subsequently solving related problems, etc.</i>	
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	resources (textbooks, electronic devices and any additional relevant resources) to discover applications of binary operations in real-life, etc. iii. Key assessment ○ Assessment level 1 ▪ The operation $*$ is defined on the set of real numbers R by $p * q = 2p + q - 2pq$. Find 1. $3 * -2$ 2. $3 * 5$ 3. If $p * 4 = -2$ find the value of p ○ Assessment level 2 ▪ A binary operation ∇ is defined on the set $S = \{2, 3, 4, 5\}$ by $p \nabla q = p + q - pq$ where p and $q \in S$ 1. Construct the table for the operation ∇ on the set S 2. Determine whether or not the operation ∇ is a. closed under S, b. commutative, c. associative and	iii. Key assessment Assessment level 1 The operation $*$ is defined on the set of real numbers R by $p * q = 2p + q - 2pq$. Find ○ $3 * -2$ ○ $3 * 5$ ○ If $p * 4 = -2$ find the value of p	
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	<i>d. distributive over * if</i> $a * b = ab - 3a, a, b \in S$ ○ <i>Assessment level 3</i> ▪ <i>Given that $m * n = 3m + 2n - mn$, investigate whether the operation * has a unique identity</i> ○ <i>Assessment level 4</i> ▪ <i>You have six shirts, two trousers and two pairs of shoes. Explain how you will use the binary operation to determine how many ways a shirt, a trouser and a pair of shoes can be worn, etc.</i> <i>d) Additional Mathematics (Week 2):</i> <i>i. Learning tasks</i> ○ <i>Learners review and define basic sets, understand set notation</i> ○ <i>Learners perform simple set operations such as union, intersection and complement.</i> ○ <i>Learners construct basic Venn diagrams involving three sets</i> ○ <i>Learners interpret the relationships between these sets using the diagrams.</i>		
		<i>d) Additional Mathematics (Week 2):</i> <i>i. Learning tasks</i> <i>Learners review and define basic sets, understand set notation, etc.</i>	

	○ <i>Learners accurately represent and analyse relationships between three sets using Venn diagrams, including identifying overlapping regions and calculating set operations based on the diagrams.</i> <i>ii. Pedagogical exemplars: Collaborative Learning</i> <i>In convenient groups such as ability, mixed ability, mixed gender, or pairs,</i> ▪ <i>learners use Venn diagrams as tools to visually represent and verify set identities, enhancing their ability to visualize and comprehend relationships between sets</i> ▪ <i>learners to create set problems collectively and apply set identities, algebraic principles, and operations to solve these problems</i> <i>Experiential Learning</i> ▪ <i>Learners establish set identities and verify their properties using elements of different sets</i> ▪ <i>Assist learners to use set algebra to verify relationships between</i>	<i>ii. Pedagogical exemplars: Collaborative Learning</i> <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>	
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	three sets, denoted as Sets A, B, and C ▪ earners are guided to apply set identities to solve problems across different contexts ▪ 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. iii. Key assessment ○ Assessment level 1 ▪ Write an expression for the shaded region  ○ Assessment level 2 ▪ 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	iii. Key assessment Assessment level 1 Write an expression for the shaded region  etc.	
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	<i>liked strawberries, 37 liked mint and 21 liked both types</i> 1. Create a Venn diagram to model the information. Level 1 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)? Level 2 ○ Assessment level 3 ▪ 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 ○ Assessment level 4 ▪ A survey asked people what alternative transportation modes they use. 30% use the bus; 20% ride a bicycle, 25% walk;		
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	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: 1. What percent of people only ride the bus? 2. How many people don't use any alternate transportation (Level 3), etc.		
	2.5 Ask teachers in their subject groups or as individuals to 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).	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	3.1 Ask teachers to swap one of their 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>Prompt teachers to be guided by the following questions for the review:</i>	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>	10 mins

templates provided.	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 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>Have the essential questions been addressed in the activities?</i> f) <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills? etc.</i> 3.2 Ask teachers to implement the recommendations made by a peer reviewer to their learning plans as appropriate (NTS 1a, 1b).	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 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>Have the essential questions been addressed in the activities?</i> f) <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 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.	4.1 Ask teachers to share their views and feelings about the session (NTS 1a, 1b). 4.2 Encourage teachers to complete their learning	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).	10 mins

▪ Advance preparation towards next DPLC session	plan(s) before the next session (NTS 3a, 3l). 4.3 Remind teachers 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 their DPLC Handbook and teacher manual (NTS 1a, 1b).	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).	
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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 Leading the DPLC Session. <i>What the DPLC Coordinator will have to say during each stage of 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 Start the session by asking teachers to share two things they did differently based on DPLC Session 2, <i>developing learning plans for Weeks 1 and 2</i>, which they think impacted learning positively (NTS 1a, 1b). 1.2 Ask teachers, as critical friends, to discuss and summarise in a single sentence why they 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).	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	2.1 Ask a teacher to 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>	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>	60 mins

planners to be completed per session)	<i>i. Relationship among three sets of items</i> <i>ii. The concepts and existence of modulo arithmetic</i> <i>b) Additional mathematics:</i> <i>i. Binomial expansion</i> <i>ii. 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 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).	<i>i. Relationship among three sets of items</i> <i>ii. The concepts and existence of modulo arithmetic</i> <i>b) Additional mathematics:</i> <i>i. Binomial expansion</i> <i>ii. 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 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).	
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	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 Ask teachers in groups to identify and share the aspects of the Weeks 3 and 4 lessons in their teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> a) <i>Content standard</i> b) <i>Learning outcome</i> c) <i>Learning indicator(s), etc.</i> 2.3 Ask teachers to 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> a) <i>Mathematics (Week 3):</i> i. <i>How does the use of Venn diagrams enhance learners' ability to compare and contrast the relationships between three sets, and how can</i>	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> a) <i>Mathematics (Week 3):</i> <i>How does the use of Venn diagrams enhance learners' ability to compare and contrast the relationships between three sets, and how can these diagrams</i>	
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	<i>these diagrams be utilised to illustrate complex set relationships in a clear and concise manner?</i> <i>ii. In what situations do the concepts of union and intersection of three sets arise in practical scenarios, and how can these operations be used to analyse and solve problems involving multiple sets?</i> <i>iii. In what ways does De Morgan's law contribute to the understanding of set theory and its applications, and how does this law extend the principles of logic to set operations involving multiple sets? etc.</i> <i>b) Additional mathematics (Week 3):</i> <i>i. How can I assist learners to use effective problem-solving strategies for solving problems involving binomial expansions?</i> <i>ii. What GESI responsive resources can be employed to support the learning of binomial expansion?</i> <i>iii. What are some open-ended problems that encourage learners to think critically and creatively about</i>	<i>be utilised to illustrate complex set relationships in a clear and concise manner? etc.</i> <i>b) Additional mathematics (Week 3):</i> <i>How can I assist learners to use effective problem-solving strategies for solving problems involving binomial expansions? etc.</i>	
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	<i>binomial expansion? etc.</i> c) <i>Mathematics (Week 4):</i> i. <i>What strategies can be employed to assist learners to visualize fraction quantities in real-world contexts?</i> ii. <i>What are the operations involved in working with fractions, and how can these operations be applied to solve problems involving measurement, comparison, and combination of fractional quantities?</i> iii. <i>How do fractions relate to other mathematical concepts, such as decimals and percentages, and what insights can be gained from exploring these relationships in various mathematical and real-life situations? etc.</i> d) <i>Additional mathematics (Week 4):</i> i. <i>What fundamental ideas need to be established before introducing the concept of rationalising surds?</i> ii. <i>What support can be given to learners in reducing surds to the basic form?</i> iii. <i>What is the relationship between surds and exponents? etc.</i>	c) <i>Mathematics (Week 4):</i> <i>What strategies can be employed to assist learners to visualize fraction quantities in real-world contexts? etc.</i> d) <i>Additional mathematics (Week 4):</i> <i>What fundamental ideas need to be established before introducing the concept of rationalising surds? etc.</i>	
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	2.4 Ask teachers to 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: Remind teachers to refer to their 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> E.g. a) Mathematics (Week 3): i. Learning Tasks: ▪ Learners state and use the vocabulary and operations of three sets. ▪ Learners investigate subsets, unions, intersections, regions of three sets Venn diagram, their properties of operations and application to real life problems. ▪ Learners to establish the de Morgan's Law and apply it to solve real-life problems involving three sets. ii. Pedagogical Approach 1: Collaborative learning.	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: 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> E.g. a) Mathematics (Week 3): i. Learning Tasks: Learners state and use the vocabulary and operations of three sets, etc. ii. Pedagogical Approach 1: Collaborative learning.	
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	Learners use Venn diagram organiser to solve three set problems. To differentiation: ▪ Provide examples and non-examples to help them understand the concepts. ▪ Provide additional practice problems and support as needed. ▪ Provide more complex three-set problems that require critical thinking and multiple steps to solve. ▪ Encourage them to analyse and compare different solution strategies, such as using the inclusion-exclusion principle. ▪ Have them create their own three-set problems for their classmates to solve. iii. 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. Level 3 ▪ Assessment Levels 2&3: A survey	Learners use Venn diagram organiser to solve three set problems. To differentiation: Provide examples and non-examples to help them understand the concepts, etc. iii. 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.	
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	conducted by learners in Yendi Secondary School revealed that, 84 learners study mathematics, 114 study ICT and 78 study Clothing. It was also realised that 48 study mathematics and ICT, 46 study mathematics and Clothing, 42 study Clothing and ICT and 34 study all the three courses. i. Draw a Venn diagram for this information. Level 2 ii. Find how many learners study: Level 3 - One course only, - Exactly two courses, - At least two courses b) Mathematics (Week 4): i. Learning Tasks: ▪ Models the concept of fractions as part of a whole, a group or a ratio of two integers ▪ Reviews, parts of fractions, types of fraction, including ▪ Initiate interactive activities that relates fractions to learners' real-life experiences ▪ Apply these experiences to		
		b) Mathematics (Week 4): i. Learning Tasks: Models the concept of fractions as part of a whole, a group or a ratio of two integers, etc.	

	<i>operations on fractions.</i> <i>ii. 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:</i> ▪ <i>Guide them through the concepts of fractions using manipulatives and models.</i> ▪ <i>Provide opportunities for them to practice using fractions in different contexts, such as sharing objects, comparing quantities, and solving problems.</i> <i>For learners who you identify as advanced:</i> ▪ <i>Encourage them to analyze relationships between fractions, decimals, and percentages.</i> ▪ <i>Challenge them to apply their understanding of fractions to real-world problems and mathematical reasoning tasks.</i>	<i>ii. 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:</i> <i>Guide them through the concepts of fractions using manipulatives and models, etc.</i>	
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	iii. Key Assessment: - Assessment Level 1: Add the fractions $\frac{1}{4} + \frac{5}{6}$. - Assessment Level 2: Solve the problem $1\frac{1}{2} \times \frac{2}{5} + 2\frac{3}{4} \div \frac{3}{7}$ - Assessment Level 3: A library has a collection of 90 books, and $\frac{3}{5}$ of them are fiction books. How many fiction books are in the collection? c) Additional mathematics (Week 3): i. Learning tasks: - Learners to review and explain the basic concept of binomial expressions and expansions. - Learners identify terms like coefficients, variables, and exponents within binomial expansions. - Learners apply binomial expansions to solve basic mathematical problems, such as finding coefficients or simplifying expressions with binomial terms. - Learners evaluate powers of decimal numbers using binomial expansions, etc. ii. Pedagogical exemplars: Collaborative Learning In convenient groups based on ability, mixed	iii. Key Assessment: Assessment Level 1: Add the fractions $\frac{1}{4} + \frac{5}{6}$, etc. c) Additional mathematics (Week 3): i. Learning tasks: Learners to review and explain the basic concept of binomial expressions and expansions, etc. ii. Pedagogical exemplars: Collaborative Learning In convenient groups based on ability, mixed	
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	<i>ability, mixed gender, or pairs</i> ▪ <i>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</i> ▪ <i>Assist learners to explore combination strategies for determining various terms of a binomial expansion with positive integer indices, enhancing their understanding and application of binomial expansions in diverse mathematical scenarios</i> <i>Experiential Learning</i> ▪ <i>Guide learners to collaboratively engage in hands-on activities, focusing on learning through practical experience, to create binomial expressions with positive integer indices</i> ▪ <i>Assist learners to apply both personal and conventional strategies to determine the coefficients of the</i>	<i>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>	
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	<i>terms in their expansions, etc.</i> iii. <i>Key assessment:</i> ▪ <i>Assessment level 1: 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.</i> ▪ <i>Assessment level 2: Find the coefficient of the term $(x)^{10}$ in the binomial expansion of the expression: $(1 + x)^{25}$</i> ▪ <i>Assessment level 3:</i> ○ <i>Find the expansion of $(a + b)^6$</i> ○ <i>If $a = \frac{1}{x}$ and $b = -2\sqrt{x}$, find the expression involving x^0</i> ▪ <i>Assessment level 4: Write down the binomial expansion of $(a + b)^4$ and use your expansion to evaluate $(2.01)^4$, etc.</i> d) <i>Additional mathematics (Week 4):</i> i. <i>Learning tasks:</i> ▪ <i>Learners to review and investigate the properties of surds</i>	iii. <i>Key assessment:</i> <i>Assessment level 1: 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> <i>Learners to review and investigate the properties of surds, etc.</i>	
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	▪ <i>Learners perform basic arithmetic operations on surds</i> ▪ <i>Learners rationalise surds with binomial denominators, etc.</i> ii. <i>Pedagogical exemplars: Collaborative Learning</i> <i>Learners will be working in convenient groups (ability, mixed ability, mixed gender, or pairs etc.) to:</i> ▪ <i>explore the basic properties and operations on surds in different contexts</i> ▪ <i>discuss the various properties of surds using participatory activities</i> ▪ <i>create surds problems involving basic operations, properties and types of surds using participatory activities such as think-pair-share/square and debate</i> ▪ <i>solve problems involving rationalization</i> <i>Experiential Learning: Learners engage in hands-on activity (learning by doing) to</i> ▪ <i>create surds problems involving basic operations, properties and types of surds</i> ▪ <i>discuss when and how to rationalise surds</i>	ii. <i>Pedagogical exemplars: 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>	
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	<i>Enquiry based learning: Learners use research resources (textbooks, electronic devices and any additional relevant resources) to deepen their understanding of operations, properties and types of surds as well as rationalisation of surds, etc.</i> iii. Key assessment: ○ Assessment level 1 <i>Put the following surds in their simplest form where possible. For those that cannot be further simplified, state the reasons why</i> ▪ $\sqrt{5} + \sqrt{7}$ ▪ $3\sqrt{2} + 5\sqrt{2}$ ▪ $\sqrt{7} - \sqrt{5}$ ▪ $3\sqrt{2} - 5\sqrt{2}$ ▪ $3\sqrt{2} \times 5\sqrt{2}$ ○ Assessment level 2 <i>Find the exact value $\sqrt{0.9}$, your answer in surd form</i> ○ Assessment level 3 <i>If $(3 + 2\sqrt{5})^2 = 29 + k\sqrt{5}$, find the value of k</i> ○ Assessment level 4 <i>Show that $\frac{x - 25}{\sqrt{x} + 5} = \sqrt{x} - 5$ (Level 2)</i> 2.5 Ask teachers in their subject groups or as individuals to complete learning planners for Weeks 3 and 4 with essential questions, key notes on differentiation, teaching and learning activities, assessment strategies,	iii. Key assessment: Assessment level 1 <i>Put the following surds in their simplest form where possible. For those that cannot be further simplified, state the reasons why</i> ○ $\sqrt{5} + \sqrt{7}$ ○ $3\sqrt{2} + 5\sqrt{2}$ ○ $\sqrt{7} - \sqrt{5}$ ○ $3\sqrt{2} - 5\sqrt{2}$ ○ $3\sqrt{2} \times 5\sqrt{2}$	
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	closure and reflection taking into consideration cross-cutting issues (NTS 1a, 1b, 2a, 2c, 3a, 3g and 3h).	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 Ask teachers to swap one of their 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>Prompt teachers to 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> e) <i>How effective have the differentiated instruction and assessment</i>	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> e) <i>How effective have the differentiated instruction and assessment</i>	10 mins

	<i>strategies been used in the plan?</i> <i>f) How appropriate is the closure?</i> <i>g) Have the essential questions been addressed in the activities? etc.</i> 3.2 Ask teachers to implement the recommendations made by a peer reviewer to their learning plans as appropriate (NTS 1a, 1b).	<i>strategies been used in the plan?</i> <i>f) How appropriate is the closure?</i> <i>g) 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 Ask teachers to share their views and feelings about the session (NTS 1a, 1b). 4.2 Encourage teachers to complete their learning plans before the next session (NTS 3a, 3l). 4.3 Remind teachers 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 their DPLC Handbook and teacher manual (NTS 1a, 1b).	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 Leading the session. <i>What the DPLC Coordinator will have to say during each stage of 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 Start the session by asking teachers to share two things they did differently based on DPLC Session 3 on <i>developing learning plans for Weeks 3 and 4</i> which they think impacted learning positively (NTS 1a, 1b). 1.2 Ask teachers, as critical friends, to discuss and summarise in a single sentence why they 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).	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	2.1 Ask a teacher to 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:	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:	60 mins

(2 learning planners to be completed per session)	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. 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,	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. 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,	
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	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 Ask teachers in groups to identify and share the aspects of Weeks 5 and 6 lessons in their teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> a) <i>Content standard(s)</i> b) <i>Learning outcome(s)</i> c) <i>Learning indicator(s), etc.</i> 2.3 Ask teachers to 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. <i>How are decimal numbers and percentages used in real-life situations to</i>	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</i>	
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	<i>interpret and compare quantities?</i> <i>ii. What operations can be performed with decimal numbers and percentages and how are these operations applied in solving problems involving measurement, data analysis and probability?</i> <i>iii. How do decimal numbers and percentages relate to each other and how can understanding their relationship help in converting between these representations and solve problems that involve both types of numbers? etc.</i> <i>b) Additional Mathematics (Week 5):</i> <i>i. What are the historical origins and cultural influences behind the development of indices and logarithms?</i> <i>ii. How do indicial and logarithmic equations model various real-life phenomena?</i> <i>iii. What are the real-world applications of indicial and logarithmic equations? etc.</i>	<i>and compare quantities? etc.</i> <i>b) Additional Mathematics (Week 5):</i> <i>How can recognising and classifying sequences help in solving mathematical problems and making predictions? etc.</i>	
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	c) <i>Mathematics (Week 6):</i> i. <i>How are percentages used in real-life scenarios such as shopping, budgeting and data analysis?</i> ii. <i>In what ways do concepts such as percentage increase, decrease and change help in making informed decisions and analysing trends in various fields such as finance, economics and demographics?</i> iii. <i>How can percentages be applied to solve problems involving discounts, taxes, insurance and other practical situations, and how do these applications enhance our understanding of percentages in everyday life? etc.</i> d) <i>Additional Mathematics (Week 6):</i> i. <i>How can recognising and classifying sequences help in solving mathematical problems and making predictions?</i> ii. <i>How can learners be engaged in exploring real-life applications of sequences?</i> iii. <i>What strategies can be employed to enhance learners' ability to analyse the relationship between</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> d) <i>Additional Mathematics (Week 6):</i> <i>How can recognising and classifying sequences help in solving mathematical problems and making predictions? etc.</i>	
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	<i>the types of sequences? etc.</i> 2.4 Ask teachers to 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: Remind teachers to refer to their 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> E.g. a) Mathematics (Week 5): i. Learning Tasks: ▪ Learners establish decimals as fractions. ▪ Learners convert the different types of fractions into decimals and vice versa. ▪ Learners establish percentages as a fraction and/or a decimal. ▪ Learners convert the different types of fractions into percentages and vice versa. ▪ Learners converting the Decimal Number into Decimal Fraction. ii. Pedagogical Approach 1: Problem-Based Learning Learners use verbal discuss to establish	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> E.g. a) Mathematics (Week 5): i. Learning Tasks: Learners establish decimals as fractions, etc. ii. Pedagogical Approach 1: Problem-Based Learning Learners use verbal discuss to establish	
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	<i>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.</i> ▪ <i>Use visual aids, such as number lines and grids, to help them visualize the relationships between decimals, fractions, and percentages.</i> ▪ <i>Provide more complex conversions involving repeating decimals, mixed numbers, and percentages greater than 100%.</i> ▪ <i>Encourage them to explore patterns and relationships between decimals, fractions, and percentages.</i> ▪ <i>Challenge them to apply their understanding to solve real-world problems and explain their reasoning.</i> <i>iii. 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> ○ <i>0.75 (Hint: $75 \times \frac{1}{100} = \frac{75}{100} = \frac{3}{4}$)</i> ○ <i>0.45</i> ▪ <i>Assessment Level 3: A fraction of learners in a</i>	<i>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> <i>iii. 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> ○ <i>0.75 (Hint: $75 \times \frac{1}{100} = \frac{75}{100} = \frac{3}{4}$)</i> ○ <i>0.45, etc.</i>	
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	<i>class have access to online learning resources. If 15 out of 32 learners can access these resources, convert the fraction to a decimal simplify it to show the ratio of learners with online access.</i> ▪ <i>Assessment Level 3: A line manager is calculating the percentage of progress for a school project, and has completed 5 out of the 8 planned tasks. How will you help him to represent the completion rate as a decimal rounded to two decimal places?</i> <i>b) 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.</i> ▪ <i>Play mental mathematics games: - learners use simple mental strategies to perform the following: addition, subtraction, multiplication and division of fractions using appropriate words and make connections.</i> ▪ <i>Models additive and multiplicative inverses of fractions using multi-purpose model charts.</i>	<i>b) 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>	
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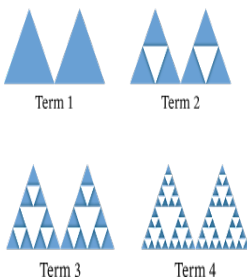
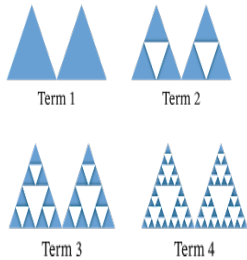
	▪ <i>Model additive and multiplicative inverses of fractions using multi-purpose model charts.</i> ▪ <i>Convert fractions from one form into other forms.</i> <i>ii. Pedagogical Approach 1: Problem-Based Learning</i> <i>Learners use verbal discuss to establish decimals and percentages as fractions. Then 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.</i> ▪ <i>Provide opportunities for them to practice making conversions and comparing fractions, decimals, and percentages.</i> ▪ <i>Encourage them to explain their thinking and strategies for working with these concepts.</i> ▪ <i>Challenge them to explore the relationship between fractions, decimals, and percentages in more depth, possibly including conversions between mixed</i>	<i>ii. Pedagogical Approach 1: Problem-Based Learning</i> <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>	
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	<i>numbers and improper fractions.</i> ▪ <i>Encourage them to investigate more advanced concepts related to the additive and multiplicative inverses of fractions.</i> iii. <i>Key Assessment:</i> ▪ <i>Assessment Level 1: What is 3 out of 5 expressed as a percentage?</i> ▪ <i>Assessment Level 2: If 18 out of 30 learners prefer gablee, what percentage of the learners prefer gablee?</i> ▪ <i>Assessment Level 3: A recipe calls for $\frac{5}{6}$ cup of sugar. However, you want to make only half of the recipe. How much sugar should you use in the reduced recipe?</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</i> ▪ <i>Learners recognise the relationship between surds and indices and apply laws of indices to simplify expressions</i> ▪ <i>Learners solve simple equations involving indices</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>	
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	▪ <i>Learners establish the relationship between indices and logarithms</i> ▪ <i>Learners use the properties of logarithms to solve related problems in one base</i> ii. <i>Pedagogical exemplars: Collaborative Learning</i> <i>Learners will be working in convenient groups (ability, mixed ability, mixed gender, or pairs etc.) to:</i> ▪ <i>state the initial laws of indices</i> ▪ <i>solve simple indicial equations using problem-based and talk-for-learning approaches</i> ▪ <i>apply the exponential equation to model phenomenon involving growths and decays</i> ▪ <i>explore the relationship between indices and logarithms</i> ▪ <i>solve related problems in one base</i> <i>Experiential Learning:</i> ▪ <i>Learners explore the laws of indices</i> ▪ <i>Learners explore indices with negative exponents</i> ▪ <i>Learners apply the exponential equation to real-life problems of growth, decay and</i>	ii. <i>Pedagogical exemplars: Learners will be working in convenient groups (ability, mixed ability, mixed gender, or pairs etc.) to state the initial laws of indices, etc.</i>	
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	compound interests, etc. iii. Key assessment: - Assessment level 1 Simplify $2^2 \times 4^{-4} \div 16^{-3}$ - Assessment level 2 $\left(2x^{-\frac{2}{5}}\right)^5 = \frac{32}{x^2}$ - Assessment level 3 Given that $y = 5x$ and $3^{x+y} = 81$, Find x - Assessment level 4 Complete the table of values if $y = 3^t$ <table border="1"><tr><td>t</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>y</td><td></td><td></td><td></td><td></td></tr></table> - Plot the graph of y against t. - Find the value y, correct to 2 decimal places, when: $t = 0.5$ $t = 2.5$ $t = 2$, etc. d) Additional Mathematics (Week 6): i. Learning tasks: - Learners find terms of arithmetic and geometric sequences - Learners find terms of sequences which may not be arithmetic nor geometric - Learners find the Nth term of a pattern and solve real-world situations involving sequences. - Learners find terms of sequences that require solutions to systems of equations and solving	t	0	1	2	3	y					iii. Key assessment: Assessment level 1 Simplify $2^2 \times 4^{-4} \div 16^{-3}$, etc. d) Additional Mathematics (Week 6): i. Learning tasks: Learners find terms of arithmetic and geometric sequences, etc.	
t	0	1	2	3									
y													

	<i>real-life problems involving sequences</i> ii. <i>Pedagogical exemplars:</i> <i>Project-Based Learning</i> ▪ <i>Learners come up with sequences that are relevant and applicable to real life and make presentations</i> ▪ <i>Learners undertake a research inquiry into what happens when terms of sequence are summed up</i> ▪ <i>Learners model sequences (numerical and non-numerical - using of colours, cut-out shapes, objects, fabrics, sound, actions, etc.) and talk about the pattern rule</i> <i>Collaborative Learning:</i> <i>In convenient groups (ability, mixed ability, mixed gender, or pairs etc.), learners</i> ▪ <i>create sequences using objects, symbols and numerals and discuss pattern rules</i> ▪ <i>investigate, identify and discuss real-life patterns in their environment and talk about the pattern rule</i> <i>Experiential Learning</i> <i>Learners (in pairs or groups) work with sequence of numbers to establish the general rule for arithmetic and</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>	
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	<i>geometric sequence (by using the first terms and relationship between consecutive terms (simple recursions)) and the notations of sequences, and determine if a sequence is arithmetic or geometric and identify key terms of the sequence such as the first, the common difference and/or ratios, and the nth-term</i> ▪ <i>Enquiry based learning Learners use research resources (textbooks, electronic devices and any additional relevant resources) to discover applications of sequences in real life, etc.</i> iii. <i>Key assessment:</i> ▪ <i>Assessment level 1 Consider the following pattern.</i>  Term 1 Term 2 Term 3 Term 4 ▪ <i>Which of the following sequences represents the number of solid blue triangles in each successive term of the pattern?</i>		
	iii. <i>Key assessment:</i> ▪ <i>Consider the following pattern.</i>  Term 1 Term 2 Term 3 Term 4 ▪ <i>Which of the following sequences represents the number of solid blue triangles in each successive term of the pattern?</i>		

	a) 2,8,26,80, ... b) 1,3,9,27, ... c) 2,6,18,54, ... d) 2,4,12,36, ... e) 2,4,8,16, ... - Which type of sequence is found when counting the number of solid blue triangles in the above pattern? - Assessment level 2 For the geometric sequence: 4, 12, 36, 108, ... Find the formula for the nth term of the sequence. - Assessment level 3 Complete the table for the sequence given by the formula $u_n = 13(2)^{n-1}; n > 0$ <table><tr><td>n</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>$U_n = 13(2)^{n-1}$</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> - Assessment level 4 The set of whole numbers is partitioned into subsets with the first number in the first subset, the next two numbers in the second subset, and the next three numbers in the third subset and so on. Find in terms of n a formula for the first member of the nth subset., etc.	n	1	2	3	4	5	6	$U_n = 13(2)^{n-1}$							a) 2,8,26,80, ... b) 1,3,9,27, ... c) 2,6,18,54, ... d) 2,4,12,36, ... e) 2,4,8,16, ... Which type of sequence is found when counting the number of solid blue triangles in the above pattern? etc.	
n	1	2	3	4	5	6											
$U_n = 13(2)^{n-1}$																	
2.5 Ask teachers in their subject groups or as		2.5 In your subject groups or as an individual, complete learning planners for Weeks 5															

	individuals to 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).	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 Ask teachers to exchange one of their 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>Prompt teachers to be guided by the following areas 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 the development of 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> e) <i>Have the essential questions been addressed in the activities?</i>	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> 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 the development of 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> e) <i>Have the essential questions been addressed in the activities?</i>	10 mins

	f) <i>How effective have the differentiated instruction and assessment strategies been used in the planner?</i> g) <i>How appropriate is the closure? etc.</i> 3.2 Ask teachers to implement the recommendations made by a peer reviewer to their learning plans as appropriate (NTS 1a, 1b).	f) <i>How effective have the differentiated instruction and assessment strategies been used in the planner?</i> g) <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).	
4. Reflection on the session: ▪ Reflecting on what has been learnt in the session. ▪ Advance preparation towards next PLC session	4.1 Ask teachers to share their insights and key takeaways regarding the session (NTS 1a, 1b). 4.2 Encourage teachers to complete their learning plans before the next session (NTS 3a, 3l). 4.3 Remind teachers to read the contents of Weeks 7 and 8 in the teacher manual and DPLC Session 5 in preparation for the next session and bring their DPLC Handbook and teacher manual (NTS 1a, 1b).	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 Leading the DPLC Session. <i>What the DPLC Coordinator will have to say during each stage of 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 Start the session by asking teachers to share two things they did differently based on DPLC Session 4, <i>developing learning plans for Weeks 5 and 6</i>, which they think impacted learning positively (NTS 1a, 1b). 1.2 Ask teachers, as critical friends, to discuss and give a summary on why they 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).	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	2.1 Ask a teacher to 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 7 and 8. Specifically, mathematics teachers will develop learning plans for the a) <i>Mathematics:</i> i. <i>Application of percentages</i>	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>	60 mins

planners to be completed per session)	<i>ii. Application of percentages</i> <i>b) Additional mathematics:</i> <i>I. Functions, attributes and composite functions</i> <i>II. 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. 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).	<i>ii. Application of percentages</i> <i>b) Additional mathematics:</i> <i>I. Functions, attributes and composite functions</i> <i>II. 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. 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).	
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	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 Ask teachers in groups to identify and discuss the aspects of Weeks 7 and 8 lessons in their teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> a) <i>Content standard(s)</i> b) <i>Learning outcome(s)</i> c) <i>Learning indicator(s), etc.</i> 2.3 Ask teachers to 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> a) <i>Mathematics (Week 7):</i> i. <i>How are percentages used in real-life scenarios such as shopping, budgeting and data analysis?</i> ii. <i>In what ways do concepts such as</i>	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> a) <i>Mathematics (Week 7):</i> <i>How are percentages used in real-life scenarios such as shopping, budgeting and data analysis? etc.</i>	
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	<i>percentage increase, decrease and change help in making informed decisions and analysing trends in various fields such as finance, economics and demographics?</i> <i>iii. How can percentages be applied to solve problems involving discounts, taxes, insurance and other practical situations, and how do these applications enhance our understanding of percentages in everyday, etc.</i> <i>b) Additional mathematics (Week 7):</i> <i>i. How can I effectively assist learners to evaluate functions and understand their significance in real-life scenarios?</i> <i>ii. How will the learning activities cater for all the various sub-groups in the class?</i> <i>iii. What resources can help learners have some interactive engagements with the concepts?</i> <i>iv. How will the understanding of the concept of inverse function assist learners to identify and interpret real life situations that connote inverse? etc.</i>	<i>b) Additional mathematics (Week7):</i> <i>How can I effectively assist learners to evaluate functions and understand their significance in real-life scenarios? etc.</i>	
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	c) <i>Mathematics (Week 8):</i> i. <i>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?</i> ii. <i>What factors influence the amount of interest earned or paid in simple and compound interest calculations, and how can these factors be manipulated to optimize financial outcomes?</i> iii. <i>How does understanding the concepts of principal, interest rate and time affect decision-making in borrowing, lending and investment scenarios involving simple and compound interest? etc.</i> d) <i>Additional Mathematics (Week 8):</i> i. <i>What real-world scenarios can be modelled with linear functions?</i> ii. <i>How do transformations such as translations, reflections, and dilations affect quadratic functions?</i> iii. <i>What practical activities and resources can be employed to support learners apply</i>	c) <i>Mathematics (Week 8):</i> <i>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> d) <i>Additional Mathematics (Week 8):</i> <i>What real-world scenarios can be modelled by linear functions? etc.</i>	
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	<i>the concepts on graphs of linear and quadratic function to real life situations? etc.</i> 2.4 Ask teachers to 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: Remind teachers to refer to their 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) Mathematics (Week 7): i. Learning Tasks: ▪ Learners review fractions, percentages and decimals and apply them to percentage increase and percentage decrease of given quantities. ▪ Learners model real-life examples of percentage increase and percentage decrease. ▪ Learners extend the ideas to calculating other concepts such as discount, commission, utility bills, exchange rates,	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> a) Mathematics (Week 7): i. Learning Tasks: Learners review fractions, percentages and decimals and apply them to percentage increase and percentage decrease of given quantities, etc.	
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	<i>project budgeting, etc.</i> ii. <i>Pedagogical Approach 1: Problem-Based Learning</i> <i>Learners use verbal discussions to apply their knowledge in fractions to percentage increase and percentage decrease of given quantities.</i> <i>To differentiate:</i> ▪ <i>Break down the concepts into simpler steps and provide concrete examples to illustrate the calculations.</i> ▪ <i>Use visual aids, such as diagrams or pictures, to help them understand the concept of percentage change.</i> ▪ <i>Guide learners through the process of calculating percentage increase and decrease using fractions and decimals.</i> ▪ <i>Encourage them to explain their reasoning and justify their answers.</i> iii. <i>Key Assessment:</i> ▪ <i>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</i>	ii. <i>Pedagogical Approach 1: Problem-Based Learning</i> <i>Learners use verbal discussions to apply their knowledge in fractions to percentage increase and percentage decrease of given quantities.</i> <i>To differentiate:</i> <i>Break down the concepts into simpler steps and provide concrete examples to illustrate the calculations, etc.</i> iii. <i>Key Assessment:</i> <i>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>	
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	were the sales for the current year? ▪ Assessment Level 3: A retail store purchases a television set for GH¢800 and plans to sell it with a mark-up of 30%. If the VAT rate is 12.5%, what will be the final selling price of the television set, including VAT? ▪ Assessment Level 3: A small business has to pay a monthly Internet service fee of GH¢120 and a usage charge based on the amount of data consumed. If the usage rate is GH¢0.10 per gigabyte (GB) and the business consumed 250 GB of data in a month, calculate the total Internet bill for that month. b) Mathematics (Week 8): 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. ▪ Learners solve word problems involving simple interest calculations in various contexts, such as loan repayments or rental income.		
		b) Mathematics (Week 8): 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.	

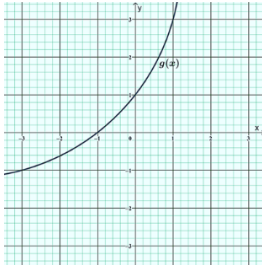
	▪ <i>Learners calculate the future value of an investment after a certain period, considering the principal amount, compound interest rate, and compounding frequency (annually, semi-annually, quarterly, etc.).</i> ▪ <i>Learners analyze the difference between simple interest and compound interest calculations for long-term investments and understand the impact of compounding.</i> <i>ii. Pedagogical Approach 1: Problem-Based Learning</i> <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</i> ▪ <i>Encourage them to apply their knowledge to different situations and explain their reasoning.</i> ▪ <i>Provide examples that require them to compare and contrast simple and compound interest in different contexts.</i> ▪ <i>Provide opportunities for them to explore</i>		
		<i>ii. Pedagogical Approach 1: Problem-Based Learning</i> <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>	

	<i>advanced concepts related to interest calculations, such as continuous compounding and the impact of inflation on investment returns.</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</i> ▪ <i>Assessment Level 2: conduct a mini-project by obtaining information on how to calculate any of the household utilities and record their findings</i> ▪ <i>Assessment Level 3: conduct a mini-project by obtaining information on how to calculate any of the household utilities and record their findings and apply to solve every day problems.</i> ▪ <i>Assessment Level 4: conduct a mini-project by obtaining information on how to calculate any of the household utilities and record their findings and apply to solve every day problems and design similar mini projects.</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>	
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	c) <i>Additional mathematics (Week 7):</i> i. <i>Learning tasks:</i> ▪ <i>Learners create different types of functions</i> ▪ <i>Learners use mappings diagram and algebraic proofs to show whether or not a given function is one-to-one or onto or both</i> ▪ <i>Learners explore increasing and decreasing functions by verifying graphically and algebraically</i> ▪ <i>Learners create a graph by hand and by appropriate technology to illustrate a function</i> ▪ <i>determine the domain, intercepts, formula for the function and maximum and minimum values of the graph, etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Problem-based Learning</i> ▪ <i>learners use Venn diagrams as tools to visually represent and</i> ▪ <i>learners to create set problems collectively</i> <i>Problem-based Learning</i> <i>In convenient groups (ability, mixed ability,</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>	
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	<i>mixed gender, or pairs etc.),</i> ▪ <i>learners evaluate functions, determine their domains and ranges, and find the composite of functions</i> ▪ <i>learners determine bijective functions and find the inverse of such functions (learners must find the inverse function by using graphic illustrations and through algebraic means)</i> ▪ <i>learners debate and discuss the types and features of functions and relations</i> ▪ <i>Exploratory Learning Learners construct graphs of given functions by hand in graph books or by use of EdTech tools such graphic calculators GeoGebra, Demos, PhET Simulations, Geometer's Sketch Pad etc. then identify and interpret key points such as the intercepts, turning points, maximum values, minimum values</i> ▪ <i>Experiential Learning Learners will collaboratively be engaged in hands-on activity (learning by doing) to create a graph by hand and by</i>		
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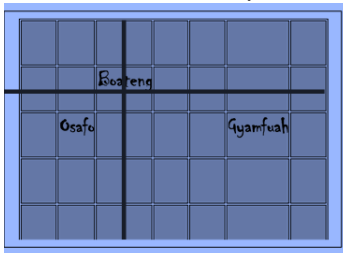
	<i>appropriate technology to illustrate a function, (creators must know the intercepts, maximum and or minimum values that define the graph). Then, have them swap with a different group/pair. The new pair should determine the domain, intercepts, formula for the function and maximum and minimum values of the graph. Then, they should swap back for creators to assess the accuracy or otherwise with justification), etc.</i> iii. Key assessment: ▪ Assessment level 1 Evaluate $g(-3)$ if $g(x) = 2x^2 - 4x + 7$ (Level 1) ▪ Assessment level 12 If an astronaut weighs 65 kg on the surface of the earth, then her weight when she is d miles from the earth is given by $w(d)$ $= 65 \left(\frac{3960}{3960 + d} \right)^2$ 1. Determine her weight when she is 150 miles above the earth. 2. Construct a table of values for the function w that		
		iii. Key assessment: Assessment level 1 Evaluate $g(-3)$ if $g(x) = 2x^2 - 4x + 7$ (Level 1), etc.	

	gives her weight at heights in the interval: $[0, 300]$ using 50 miles for the increment. 3. From your table, describe the nature of the function, $w(d)$, (increasing or decreasing, injective, surjective and bijective) - Construct the graph of the inverse function of the function whose graph is shown in Figure 1  Figure 2 d) Additional Mathematics (Week 8): i. Learning tasks: - Learners recognise and create linear and parabolic functions by hand and with technology where appropriate - Learners use algebraic notions, properties of linear and non-linear functions, linear and non-linear equations and solve linear and non-linear		
		d) Additional Mathematics (Week 8): i. Learning tasks: Learners recognise and create linear and parabolic functions by hand and with technology where appropriate, etc.	

	<i>simultaneous systems</i> ▪ <i>Learners solve linear equations in two variables find the solution using the graph and determine the area enclosed by the graphs</i> ▪ <i>Learners model statements into linear mathematical equations and solve simultaneously, etc.</i> ii. <i>Pedagogical exemplars: 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</i> ▪ <i>learners are assisted to undertake an inquiry into domain and range of functions in real life</i> <i>Collaborative Learning</i> ▪ <i>learners through demonstrations and discussions to recognise linear equations in two variables and draw its graph by hand and by using the</i>	ii. <i>Pedagogical exemplars: 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>	
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	<i>appropriate technology (e.g., GeoGebra, Demos, PhET Simulations, Geometer's Sketch Pad), Give learners the opportunity to make group presentations (oral and written) with each member of the pair/group taking their turn to help in solving assigned task</i> ▪ <i>learners work in harmonised mixed-abilities groups to extend the idea of linear and parabolic functions to find solution using the graph and determine the area enclosed by the graphs to develop conceptual understanding. Give learners the platform to work out enough examples whiles you also address challenges faced by learners through one-on-one discussions</i> <i>Exploratory Learning</i> <i>Learners construct graphs of given functions by hand in graph books or by use of EdTech tools such as graphic calculators GeoGebra, Demos, PhET Simulations, Geometer's Sketch Pad etc. then identify and interpret key points</i>		
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	<i>such as the intercepts, turning points, maximum values, minimum values</i> <i>Experiential Learning</i> <i>Guide learners to construct linear and parabolic functions by hand and with the aid of technology. Make sure that enough examples of varying difficulty are provided to cater for the different group of learners to grasp the concept well</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)</i> ▪ <i>Assessment level 2</i> <i>Draw graphs of the following functions, stating the y-intercepts, the minimum and maximum values, and the values for which the graph is increasing and decreasing</i> ▪ $y = 3 - 2x$, ▪ $y = 2x^2 + 3x - 1, -2 \leq x \leq 2$ ▪ <i>Assessment level 3</i> <i>Determine the turning point of the parabolic function $y = -2x^2 + 4x + 1$, state whether it is a maximum of</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>	
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	minimum and describe the nature of its graph Assessment level 3 In an office, the allocation of a pigeon holes in a cabinet to Mr. Osafo, Ms. Gyamfuah and Mrs. Boateng is such that the spaces allocated to Mr. Osafo and Ms. Gyamfuah are located along the line that separates the upper section and the lower section while Mrs. Boateng's hole is located on the line that divides the cabinet into left and right sides as indicated in the picture below. Find a quadratic function that describes the curve that passes through Mr. Osafo's and Ms. Gyamfuah's holes and has a maximum point 		
	2.5 Ask teachers in their subject groups or as individuals to complete learning planners for Weeks 7 and 8 with teaching and learning activities, resources, key notes on differentiation,	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, assessment strategies,	

	assessment strategies, essential questions, closure and reflection taking into consideration cross-cutting issues (NTS 1a, 1b, 2a, 2c, 3a, 3g and 3h).	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 Ask teachers to swap one of their 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>Prompt teachers to 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 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 been addressed in the activities?</i> g) <i>To what extent do the activities in the learning</i>	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> 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 been addressed in the activities?</i> g) <i>To what extent do the activities in the learning</i>	10 mins

	<i>plan promote critical thinking and other 21st century skills? etc.</i> 3.2 Ask teachers to consider the peer review comments/suggestions and implement them into their learning plans (NTS 1a, 1b).	<i>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).	
4. Reflection on the session: ▪ Reflecting on what has been learnt in the session. ▪ Advance preparation towards next DPLC session	4.1 Ask teachers to share their views and feelings about the session (NTS 1a, 1b). 4.2 Encourage teachers to complete their learning plans before the next session (NTS 3a, 3l). 4.3 Remind teachers 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 their DPLC Handbook and teacher manual (NTS 1a, 1b).	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 Leading the DPLC Session. <i>What the DPLC Coordinator will have to say during each stage of 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 Start the session by asking teachers to share two things they did differently based on DPLC Session 5, <i>developing learning plans for Weeks 7 and 8</i>, which they think impacted learning positively (NTS 1a, 1b). 1.2 Ask teachers, as critical friends, to discuss and summarise in a single sentence why they 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).	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,	2.1 Ask a teacher to 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	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	60 mins

21st century skills and national values (2 learning planners to be completed per session)	develop learning plans for the following lessons: <i>a) Mathematics:</i> <i>i. Algebraic expressions & factorisation</i> <i>ii. Perfect squares</i> <i>b) Additional mathematics:</i> <i>i. Graphical and algebraic solutions to systems of three linear equations and their real-life applications</i> <i>ii. 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), 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	develop learning plans for the following lessons: <i>a) Mathematics:</i> <i>i. Algebraic expressions & factorisation</i> <i>ii. Perfect squares</i> <i>b) Additional mathematics:</i> <i>i. Graphical and algebraic solutions to systems of three linear equations and their real-life applications</i> <i>ii. 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), 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	
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	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 Ask teachers in groups to identify and share the aspects of Weeks 9 and 10 lessons in their teacher manual that have been captured in the learning planner (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> <i>a) Learning indicator(s)</i> <i>b) Learning outcome(s)</i> <i>c) Content standard, etc.</i>	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>	
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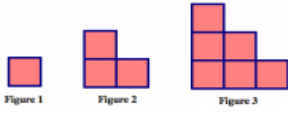
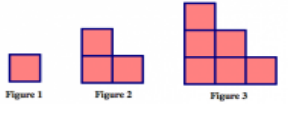
	2.3 Ask teachers to discuss at least 2 essential questions that support the achievement of the LOs and LIs of the lessons in Weeks 9 and 10 (NTS 1a, 3a). E.g. a) <i>Mathematics (Week 9):</i> <i>In what ways can algebraic expressions be used to model and solve real-world problems, and how does the substitution of variables with specific values facilitate problem-solving?</i> <i>How do patterns and relationships between numbers and variables help in identifying and applying the correct operations to simplify and solve complex mathematical expressions?</i> <i>In what ways does understanding factorization contribute to the manipulation and simplification of algebraic expressions, and how is factorization relevant in solving quadratic equations and polynomial expressions? etc.</i> b) <i>Additional mathematics (Week 9):</i> <i>In what real-life scenarios do systems of three linear</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). E.g. 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</i>	
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	<i>equations with three variables arise, and why are they useful for problem-solving?</i> <i>ii. How can learners translate real-world problems into systems of three linear equations and which method is most suitable for solving them?</i> <i>iii. In what scenarios would learners use systems of three linear equations to model and solve problems in economics? etc.</i> <i>c) Mathematics (Week 10):</i> <i>i. How can perfect squares be identified and used in mathematical operations, patterns and geometric shapes?</i> <i>ii. In what ways are perfect squares applied in real-life situations such as in measurements, area calculations and number patterns?</i> <i>iii. How do algebraic fractions appear in real-world contexts, and how are they used in problem-solving and mathematical modelling? etc.</i> <i>d) Additional mathematics (Week 10):</i> <i>i. How do I assist the learner to see the connection between</i>	<i>variables arise, and why are they useful for problem-solving? etc.</i> <i>c) Mathematics (Week 10):</i> <i>How can perfect squares be identified and used in mathematical operations, patterns and geometric shapes? etc.</i> <i>d) Additional mathematics (Week 10):</i> <i>How do I assist the learner to see the connection between polynomial</i>	
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	<i>polynomial functions and linear, quadratic, and cubic functions?</i> <i>ii. What role do the coefficients and constants play in shaping the graph of a polynomial function?</i> <i>iii. How can learners apply technology, such as graphing calculators or software to aid in graphing and analysing polynomial functions? etc.</i> 2.4 Ask teachers to 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: Remind teachers to refer to their 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> E.g. a) Mathematics (Week 9): i. Learning tasks: ▪ Learners expand and simplify given algebraic expressions. ▪ Factorise expressions using algebraic tiles; and regrouping of terms.	<i>functions and linear, quadratic, and cubic functions? etc.</i> 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. <i>Hint: Activities for differentiation must focus on learning tasks, pedagogical exemplars and key assessments on the different levels of proficiency.</i> E.g. a) Mathematics (Week 9): i. Learning tasks: ▪ Learners expand and simplify given algebraic expressions, etc.	
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	- Factorise quadratic trinomials using standard identities. - Factorise quadratic equation using formula approach; splitting the middle term and quadratic formula. ii. <i>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.</i> <i>To differentiate:</i> - 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. - Ensure to include simple, intermediate as well as advanced tasks to cater for all groups of learners. <i>Pedagogical Approach 2: Problem-based learning</i>	ii. <i>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.</i> <i>To differentiate:</i> <i>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.</i>	
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	<i>Learners to simplify the addition, subtraction, multiplication and division of algebraic expressions. Then investigate the concept of factorisation by reviewing expansion of algebraic expressions and apply the idea to factorise expressions. They are also learners to explore how to factorise algebraic expressions using the common factor approach. To differentiate:</i> ▪ <i>Please ensure to include tasks for beginning learners, intermediate learners as well as advance learners.</i> ▪ <i>Break down the concepts into simpler steps, providing clear explanations and using concrete examples to illustrate the process.</i> ▪ <i>Use visual aids and manipulatives to help them understand the concepts of simplification and factorization.</i> ▪ <i>Present them with complex algebraic expressions containing multiple variables and terms of higher degrees.</i>		
	iii. <i>Key Assessment</i> ▪ <i>Assessment Level 2: How many squares will be in the 5th pattern?</i>	iii. <i>Key Assessment</i> <i>Assessment Level 2: How many squares will be in the 5th pattern?</i>	

	 Figure 1 Figure 2 Figure 3 ▪ <i>Assessment Level 2: The length of a rectangular garden is 4 meters longer than its width. Write an expression to find the area of the garden.</i> ▪ <i>Assessment Level 3: Ama is collecting seashells on the beach. On her first day, she collected 1 seashell. Each day after that she collected 2 more seashells than the previous day. How many seashells will she have on the fifth day? Generate a pattern and use it to formulate mathematical expression.</i> b) <i>Mathematics (Week 10):</i> i. <i>Learning Tasks:</i> Learners Engage learners with perform operations on algebraic fractions including monomial and binomial denominators on all the four operations. ii. <i>Pedagogical Approach 1: Problem-based learning approach:</i> Learners investigate the concept of perfect square using paper cut /graph sheet and stickers out. They also	 Figure 1 Figure 2 Figure 3 etc. b) <i>Mathematics (Week 10):</i> i. <i>Learning Tasks:</i> Learners Engage learners with perform operations on algebraic fractions including monomial and binomial denominators on all the four operations. ii. <i>Pedagogical Approach 1: Problem-based learning approach:</i> Learners investigate the concept of perfect square using paper cut /graph sheet and stickers out. They also	
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	<i>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</i> ▪ <i>Use manipulatives and visuals to demonstrate perfect squares and the difference of two squares.</i> ▪ <i>Provide complex problem-solving tasks that require the use of perfect squares in unique ways.</i> <i>Pedagogical Approach 1: Collaborative learning: Learners discuss and explain what an algebraic fraction is and apply operations on simple algebraic fractions. They also identify and explain the condition under which an algebraic fraction is zero or undefined and simplify algebraic fractions which involves monomial</i>	<i>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>	
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	<i>and binomial denominators.</i> <i>To differentiate:</i> ▪ <i>Provide a clear definition of algebraic fractions and use concrete examples with visuals.</i> ▪ <i>Encourage learners to explain algebraic fractions in their own words and discuss examples with peers.</i> ▪ <i>Assign learners to create their own examples of algebraic fractions and explain the concept to the class.</i> ▪ <i>Provide a list of conditions under which an algebraic fraction is zero or undefined, and ask learners to match them with examples.</i> ▪ <i>Discuss the importance of avoiding division by zero and provide examples for learners to identify when an algebraic fraction is undefined.</i> ▪ <i>Present complex algebraic expressions and ask learners to determine the conditions under which each expression is zero or undefined.</i>		
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	iii. Key Assessment - Assessment Level 2 Given that $p = \frac{2x}{1-x^2}$ and $q = \frac{2x}{1+x}$, simplify $3p - 2q$ - Assessment Level 3: Identify with reasons which of the following fractions have monomial or binomial denominators. $\frac{2}{5x}, \frac{y}{x+1}, \frac{x-3}{x+6},$ $\frac{7y-1}{x^2-4}, \frac{3z+4}{z^2}$ - Assessment Level 3: Find the values for the following unknown using the idea of perfect squares a. $3z + 132 = 162$ c) Additional mathematics (Week 9): i. Learning tasks: - Learners review the concept of linear inequalities and systems of linear inequalities - Learners find graphically, solutions to linear inequalities involving one and two variables - Learners find graphical solution to systems of linear inequalities - Learners find optimal solutions	iii. Key Assessment Assessment Level 2 Given that $p = \frac{2x}{1-x^2}$ and $q = \frac{2x}{1+x}$, simplify $3p - 2q$ c) Additional Mathematics (Week 9): i. Learning tasks: Learners review the concept of linear inequalities and systems of linear inequalities, etc.	
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	<i>to real-world problems using linear programming., etc.</i> <i>ii. Pedagogical exemplars: 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</i> ▪ <i>Demonstrate the process of solving systems of linear inequalities in a visually engaging manner. Encourage learners to participate by manipulating equations and discussing problem-solving strategies</i> ▪ <i>Pose open-ended questions related to solving systems of linear inequalities and have average learners participate in think-pair-share discussions. This allows them to articulate their understanding and learn from their peers' perspectives</i> ○ <i>Problem-based learning:</i> ▪ <i>Pair struggling learners with peers who have a stronger grasp of the material. Assign roles</i>	<i>ii. Pedagogical exemplars: 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>	
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	<i>within the tutoring session, such as "explainer" and "questioner," to encourage active engagement and collaboration</i> ▪ <i>Divide average learners into small groups and provide them with sets of problems to solve collaboratively. Encourage discussion and peer support as they work through the solutions together</i> ▪ <i>Challenge advanced learners to complete extended problem-solving projects that require them to apply their knowledge of systems of linear inequalities in real-world contexts. Provide opportunities for creativity and exploration.</i> ▪ <i>Enquiry-Based learning Assign advanced learners to conduct independent research on advanced topics related to systems of linear inequalities, such as optimization problems or systems with three variables. Have them present their findings to the class, etc.</i>		
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	iii. Key assessment: - Assessment level 2 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 $\begin{cases} y < x + 6 \\ 3x + 2y \geq 12 \\ x - 2y \leq 2 \end{cases}$ - Assessment level 3 Suppose you are asked to solve a system of two linear equations in two variables. - Would you prefer to use the substitution method or the elimination method? - How many solutions are possible? Draw diagrams to illustrate the possibilities? - Assessment level 4 A cat food manufacturer uses fish and beef by-products. The fish contains 12 g of protein and 3 g of fat per ounce. The beef contains 6 g of protein and 9 g of fat per ounce. Each can of cat food must contain at least 60 g of protein and 45 g of fat. Find a system of inequalities that describes the possible number of ounces of fish and beef that can be used in each	iii. Key assessment: Assessment level 2 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 $\begin{cases} y < x + 6 \\ 3x + 2y \geq 12, \\ x - 2y \leq 2 \end{cases}$ etc.	
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	<i>can to satisfy these minimum requirements. Graph the solution set, etc.</i> <i>d) Additional mathematics (Week 10):</i> <i>i. Learning tasks:</i> ▪ <i>Learners identify the degree and leading coefficient of given polynomials</i> ▪ <i>Learners solve basic polynomial equations by applying one operation at a time (e.g., addition or subtraction)</i> ▪ <i>Learners graph simple polynomial functions on a coordinate plane and identify key features such as roots and turning points</i> ▪ <i>Learners investigate the behaviour of polynomial functions with different degrees and leading coefficients, noting patterns and making conjectures</i> ▪ <i>Learners draw graphs of polynomial function by hand and by using ICT tools</i> ▪ <i>Learners analyse and critique polynomial models used in scientific research or engineering applications, proposing improvements or</i>	<i>d) Additional mathematics (Week 10):</i> <i>i. Learning tasks:</i> <i>Learners identify the degree and leading coefficient of given polynomials, etc.</i>	
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	<i>alternative approaches, etc.</i> <i>ii. Pedagogical exemplars:</i> <i>Collaborative Learning</i> ▪ <i>Learners in their groups explore relationship between the constants a, b and c of the general quadratic equation $ax^2 + bx + c = 0$ and α and β, and use these relations to write other quadratic equations with given roots</i> ▪ <i>Assign advanced learners to work in groups to investigate and present on topics like polynomial long division, polynomial regression analysis, or polynomial root-finding algorithms, promoting peer learning and teamwork</i> <i>Enquiry-Based learning:</i> ▪ <i>Present inquiry tasks with scaffolded support, such as guiding questions and partial solutions, to help average learners investigate polynomial concepts independently while receiving necessary guidance</i>	<i>ii. Pedagogical exemplars:</i> <i>In groups, learners are tasked to solve unique equations or inequalities, etc.</i>	
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	- Assign advanced learners to conduct independent research on advanced topics related to systems of linear inequalities, such as optimization problems or systems with three variables. Have them present their findings to the class. - Concrete modelling Demonstrate addition and subtraction of polynomials using algebra tiles, providing hands-on experience for struggling learners to grasp foundational concepts, etc. iii. Key assessment: - 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 $h(x)$ - Assessment level 2 Given the polynomial $f(x) = x^3 - 2x^2 + 3x - 1$, use the Remainder Theorem to find the remainder when $f(x)$ is divided by $x - 2$ - Would you prefer to use the substitution method or the	iii. Key assessment: 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.	
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	<i>elimination method?</i> ▪ <i>How many solutions are possible? Draw diagrams to illustrate the possibilities?</i> ▪ <i>Assessment level 3</i> <i>A local farmer wants to build a rectangular pen for his animals. He plans to use one side of his barn as one side of the pen, and he has 200 feet of fencing material to complete the other three sides. What dimensions should the farmer use to maximize the area of the pen? etc.</i>		
	2.5 Ask teachers in their subject groups or as individuals to 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).	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	3.1 Ask teachers to swap one of their 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	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	10 mins

course manual and learning planner based on the templates provided.	(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> a) <i>In what ways do the learning plan align with the teacher manual?</i> b) <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> c) <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills?</i> d) <i>How effective have the differentiated instruction and assessment strategies been used in the plan? etc.</i> 3.2 Ask teachers to implement the recommendations made by a peer reviewer to their learning plans as appropriate (NTS 1a, 1b).	(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 do the learning plan align with the teacher manual?</i> b) <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> c) <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills?</i> d) <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).	
4. Reflection on the session: ▪ Reflecting on what has been learnt in the session. ▪ Advance preparation towards	4.1 Ask teachers to share their views and feelings about the session (NTS 1a, 1b). 4.2 Encourage teachers to complete their learning plans before the next session (NTS 3a, 3l).	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).	10 mins

next DPLC session	4.3 Remind teachers 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 their DPLC Handbook and teacher manual (NTS 1a, 1b).	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).	
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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 Leading the DPLC Session. <i>What the DPLC Coordinator will have to say during each stage of 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 Start the session by asking teachers to share two things they did differently based on DPLC Session 6, <i>developing learning plans for Weeks 9 and 10</i>, which they think impacted learning positively (NTS 1a, 1b). 1.2 Ask teachers, as critical friends, to discuss and summarise in a single sentence why they 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).	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	2.1 Ask a teacher to 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	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	60 mins

and national values (2 learning planners to be completed per session)	teachers will develop learning plans for the following lessons: <i>a) Mathematics:</i> <i>i. Patterns and Relationships</i> <i>ii. Relations and functions</i> <i>b) Additional mathematics:</i> <i>i. Rational functions, their properties and decomposition</i> <i>ii. 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). 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	teachers will develop learning plans for the following lessons: <i>a) Mathematics:</i> <i>i. Patterns and Relationships</i> <i>ii. Relations and functions</i> <i>b) Additional mathematics:</i> <i>i. Rational functions, their properties and decomposition</i> <i>ii. 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). 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	
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	consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 11 and 12 mathematics lessons (NTS 1a, 1b, 2b, 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 Ask teachers in groups to 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). <i>E.g.</i> <i>a) Learning outcome(s)</i> <i>b) Content standard(s)</i> <i>c) Learning indicator(s), etc.</i>	consideration cross-cutting issues. LO 2: Review the learning plans for Weeks 11 and 12 mathematics lessons (NTS 1a, 1b, 2b, 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). <i>E.g.</i> <i>Learning outcome(s), etc.</i>	
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	2.3 Ask teachers to 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):</i> i. <i>How do linear equations model real-world situations and how can the solutions to these equations be interpreted in the context of the problem?</i> ii. <i>In what ways can formulae be manipulated to express one variable in terms of another, and how are these manipulations used in practical scenarios such as physics, engineering and finance?</i> iii. <i>How are linear inequalities used to represent constraints and conditions in real-world problems, and how can their solution sets be used to make decisions and draw conclusions? etc.</i> b) <i>Additional mathematics (Week 11):</i> i. <i>What resources will support the teaching of rational functions?</i> ii. <i>How can I incorporate</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):</i> <i>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> <i>What resources will support the teaching of rational functions? etc.</i>	
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	<i>technology and graphing calculators to enhance learners' understanding of rational functions?</i> <i>iii. How do I help learners to identify the vertical and horizontal asymptotes of a rational function? etc.</i> <i>c) Mathematics (Week 12):</i> <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?</i> <i>ii. How can the rule of a given mapping be determined from a table of values, a graph, or a verbal description, and how is this rule expressed algebraically?</i> <i>iii. In what ways can the concept of mapping be applied to represent relationships between sets, and how are these mappings used to analyse patterns and make predictions? etc.</i>	<i>c) 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>	
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	d) <i>Additional mathematics (Week 12):</i> i. <i>How do I integrate technology into the teaching of Matrices?</i> ii. <i>How will learners perform basic matrix operations (addition, subtraction, and scalar multiplication)?</i> iii. <i>What is the role of matrices in solving systems of linear equations? etc.</i> 2.4 Ask teachers to 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>Remind teachers to 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> E.g. 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</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> E.g. 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</i>	
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	<i>solutions involving change of subjects.</i> ▪ <i>Learners solve linear equations involving One and Two variable(s), brackets and fractions.</i> ▪ <i>Learners develop and solve real-world situations involving linear equations in One variable.</i> ▪ <i>Learners find the solution or truth set of linear inequalities and illustrate on number lines.</i> <i>ii. 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.</i> <i>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.</i> ▪ <i>Give learners the opportunity to make group presentations</i>	<i>involving change of subjects, etc.</i> <i>ii. 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.</i> <i>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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	<i>(oral and written) with each member of the pair/group taking their turn to help in solving assigned task.</i> ▪ <i>Give learners the platform to work out enough examples whilst you also address challenges faced by learners through one-on-one discussions.</i> <i>Pedagogical Approach 2: Collaborative learning</i> <i>Learners to solve word problems involving linear equations and inequalities and translate them into mathematical statements and solve. Learners also find solution set or truth set of linear inequalities and illustrate them on the number line and solve real-world/life problems involving linear equations in one variable.</i> <i>To differentiate:</i> ▪ <i>Encourage learners to share solutions to the whole class whiles you provide feedback which promotes further explanations on the strategies they used and how they</i>		
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	<i>arrived at their answers.</i> ▪ <i>Equal opportunities should be given to all groups to present their findings/solutions to the class whiles those struggling to grasp the concepts are supported.</i> iii. <i>Key Assessment</i> ▪ <i>Assessment Level 2: Solve for y in the following equations; $6 + y - 2 = 12$</i> ▪ <i>Assessment Level 3: Find the solution set of the following equations and illustrate your answer on the number line;</i> $x - \frac{2}{3}(x + 1) \leq \frac{1}{2}(4 - x) - 5$ ▪ <i>Assessment Level 3: The perimeter of a football field in a rectangular form of a certain school is 296m. If the breadth is $\frac{2}{3}$ of the length, find the length.</i> b) <i>Mathematics (Week 12):</i> i. <i>Learning Tasks:</i> ▪ <i>Learners review and model the concepts and types of relations and functions.</i> ▪ <i>Learners develop the concept of mapping</i>	iii. <i>Key Assessment</i> <i>Assessment Level 2: Solve for y in the following equations; $6 + y - 2 = 12$, etc.</i> b) <i>Mathematics (Week 12):</i> i. <i>Learning Tasks:</i> <i>Learners review and model the concepts and types of relations and functions, etc.</i>	
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	<i>and make investigations of the relationships between two number sets and determine the rules of given mappings or functions.</i> ▪ <i>Learners develop and solve real-world situations involving the concepts of relations, functions and mappings.</i> ▪ <i>Learners draw graphs of linear functions and interpret them.</i> <i>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.</i> <i>To differentiate:</i> ▪ <i>Use diagrams (e.g., Venn diagrams, graphs) to represent relations and ask learners to interpret the relationships shown.</i> ▪ <i>Introduce mathematical notation and symbols (e.g., ordered pairs,</i>	<i>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.</i> <i>To differentiate:</i> <i>Use diagrams (e.g., Venn diagrams, graphs) to represent relations and ask learners to interpret the relationships shown, etc.</i>	
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	mappings) to represent relations and explain their meaning. ▪ Provide examples of relations and ask learners to identify which ones are functions and which are not. ▪ Engage learners in a discussion about why functions are useful in mathematics and real-life situations. ▪ Ask learners to create their own examples of one-to-one and one-to-many functions and explain their choices. <i>Pedagogical Approach 2: Experiential and Problem-Based Learning Approaches: Learners develop and solve real-world situations involving the concepts of relations, functions and mappings.</i> <i>To differentiate:</i> ▪ Offer the opportunity for learners to make oral and written presentations to the class for discussion and also ensuring that every learner in the group makes a presentation.		
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	▪ Also, as part of activities to perform at home, task learners each to develop and solve at least two real-world situations involving relations, functions and mapping and submit for scoring and continuous assessment. ▪ Present more complex scenarios (e.g., mapping of customers to their purchases) and ask learners to create diagrams or tables to represent the relations. ▪ Challenge learners with open-ended scenarios (e.g., mapping of social media users to their interactions) and ask them to develop functions to model the relationships. iii. Key Assessment ▪ Assessment Level 2: Which of the following relations defined on the set of real numbers are functions? $A=(x, y): y = 3x + 1$ ▪ Assessment Level 3: Draw mapping diagrams to represent the following $y = 2x^2 - 1$ ▪ Assessment Level 3:	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.	
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	<i>Draw the following linear graphs and interpret them</i> $y = 2x + 1$ c) <i>Additional mathematics (Week 11):</i> i. <i>Learning tasks:</i> ▪ <i>Learners identify basic characteristics of rational functions (e.g., vertical and horizontal asymptotes, domain, and range)</i> ▪ <i>Learners solve basic arithmetic operations on rational functions</i> ▪ <i>Learners find the domain, range and zeros of rational functions</i> ▪ <i>Learners solve for values of constants of functions.</i> ▪ <i>Learners split and simplify complex rational functions into sums of simpler partial fractions, etc.</i> ii. <i>Pedagogical exemplars:</i> ▪ <i>Collaborative Learning</i> ▪ <i>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</i>	c) <i>Additional mathematics (Week 11):</i> i. <i>Learning tasks:</i> <i>Learners identify basic characteristics of rational functions (e.g., vertical and horizontal asymptotes, domain, and range), etc.</i> ii. <i>Pedagogical exemplars:</i> <i>Collaborative Learning</i> <i>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.</i>	
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	<i>abilities as well as high ability learners</i> ▪ <i>Learners will be working in convenient groups (ability, mixed ability, mixed gender, or pairs etc.) to explore factorization and expansion of denominators and numerators to simplify rational functions</i> ▪ <i>Learners will be working in convenient groups (ability, mixed ability, mixed gender, or pairs etc.) to apply knowledge of equivalence to determine values of constants of functions</i> ▪ <i>Learners will be working in convenient groups (ability, mixed ability, mixed gender, or pairs etc.) to split rational functions into partial fractions</i> ▪ <i>Divide learners into expert groups to solve different types of rational function problems, then have them regroup to share their expertise with classmates</i> ▪ <i>Experiential Learning</i>		
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	▪ <i>Learners examine and explore graphically and by algebraic means the values of x of a function for which the function is zero</i> ▪ <i>Learners perform basic operations on rational functions</i> ▪ <i>Problem-Based learning</i> <i>Provide worksheets with step-by-step instructions and plenty of space for learners to show their work. Include examples with visuals to reinforce understanding, etc.</i> iii. <i>Key assessment:</i> ▪ <i>Assessment level 1</i> <i>What is the restriction on the domain of the rational function</i> $f(x) = \frac{2x+1}{x-3}$? ▪ <i>Assessment level 2</i> <i>Why is the function</i> $k(x) = \frac{x^2+1}{x-2}$ <i>defined for all real numbers except</i> $x = 2$. ▪ <i>Assessment level 3</i> <i>Resolve each of the following into partial fractions</i> ▪ $\frac{3x^3+5x^2-7x+3}{(x^2-1)^2}$ ▪ $\frac{5x^3+13x-1}{(x^2+4)^2}$, <i>etc.</i> ▪ <i>Assessment level 4</i> <i>A chemical reaction in a manufacturing</i>		
		iii. <i>Key assessment:</i> <i>Assessment level 1</i> <i>What is the restriction on the domain of the rational function</i> $f(x) = \frac{2x+1}{x-3}$?, etc.	

	<i>process is described by the following rational function:</i> $R(t) = \frac{3t + 2}{t^2 + 5t + 6}$ <i>where R(t) represents the rate of the chemical reaction at time t. Perform partial fraction decomposition to analyse the behaviour of the reaction over time.</i> <i>d) Additional mathematics (Week 12):</i> <i>i. Learning tasks:</i> ▪ <i>Learners find the determinants of 2×2 matrices</i> ▪ <i>Learners perform basic arithmetic operations of matrices</i> ▪ <i>Learners multiply two or more 2 × 2 of matrices, etc.</i> <i>ii. Pedagogical exemplars:</i> ▪ <i>Collaborative Learning</i> <i>Learners will be working in convenient groups (ability, mixed ability, mixed gender, or pairs etc.) to:</i> ▪ <i>recognize the condition necessary for matrix addition and subtraction</i> ▪ <i>investigate matrix addition and subtraction</i> ▪ <i>explore commutative and associative</i>		
		<i>d) Additional mathematics (Week 12):</i> <i>i. Learning tasks:</i> <i>Learners find the determinants of 2×2 matrices, etc.</i> <i>ii. 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>	

	<i>properties of addition</i> ▪ <i>Experiential Learning</i> <i>Learners engage in hands-on activity (learning by doing) to</i> ▪ <i>create matrices</i> ▪ <i>define matrices</i> ▪ <i>determine the order of matrices</i> ▪ <i>Enquiry based learning</i> <i>Learners use research resources (textbooks, electronic devices and any additional relevant resources) to discover matrices in real life, etc.</i> iii. <i>Key assessment:</i> ▪ <i>Assessment level 1</i> <i>Given that</i> $\begin{bmatrix} 3y + 1 & 7 \\ 2y + x & 3 \end{bmatrix} = \begin{bmatrix} 10 & 3y - x \\ 8 & 3 \end{bmatrix}$ <i>find the values of x and y</i> ▪ <i>Assessment level 2</i> <i>Given that</i> $X = \begin{pmatrix} 4 & 0 \\ 2 & -1 \end{pmatrix}$ <i>and</i> $Y = \begin{pmatrix} 1 & -2 \\ 5 & 3 \end{pmatrix}$, <i>find</i> ▪ <i>XY</i> ▪ <i>YX</i> ▪ <i>What do your answers in 1 and 2 show you about multiplication of matrix?</i> ▪ <i>Assessment level 3</i> <i>Two 2×2 matrices, A and B, have the same determinant. If we multiply matrix A by a constant k, how does the determinant of the</i>	iii. <i>Key assessment:</i> <i>Assessment level 1</i> <i>Given that</i> $\begin{bmatrix} 3y + 1 & 7 \\ 2y + x & 3 \end{bmatrix} = \begin{bmatrix} 10 & 3y - x \\ 8 & 3 \end{bmatrix}$ <i>find the values of x and y, etc.</i>	
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	<i>resulting matrix (kA) compare to the determinant of B?, etc.</i> 2.5 Ask teachers in their subject groups or as individuals to 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).	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 Ask teachers to swap one of their 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> Prompt teachers to be guided by the following questions for the review: <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</i>	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 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 critical thinking and</i>	10 mins

	<i>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> e) <i>How effective have the differentiated instruction and assessment strategies been used in the plan? etc.</i> 3.2 Ask teachers to implement the recommendations made by a peer reviewer to their learning plans as appropriate (NTS 1a, 1b).	<i>other 21st century skills?</i> d) <i>To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> e) <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).	
4. Reflection on the session: ▪ Reflecting on what has been learnt in the session. ▪ Advance preparation towards next DPLC session	4.1 Ask teachers to share their views about the session (NTS 1a, 1b). 4.2 Encourage teachers to complete their learning plans before the next session (NTS 3a, 3l). 4.3 Remind teachers 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).	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 Leading the session. <i>What the DPLC Coordinator will have to say during each stage of 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 Start the session by asking teachers to share two things they did differently based on DPLC Session 7, <i>developing learning plans for Weeks 11 and 12</i>, which they think impacted learning positively (NTS 1a, 1b). 1.2 Ask teachers, as critical friends, to discuss and summarise in a single sentence why they 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).	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,	2.1 Ask a teacher to 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	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	60 mins

differentiation, 21st century skills and national values (2 learning planners to be completed per session)	lessons in Weeks 13 and 14. Specifically, mathematics teachers will develop learning plans for the following lessons: <i>a) Mathematics:</i> <i>i. Gradient and equation of straight line and magnitude of line segments</i> <i>ii. Angles</i> <i>b) Additional mathematics:</i> <i>i. Gradient and equations of straight lines and acute angles between two intersecting lines</i> <i>ii. 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). 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	lessons in Weeks 13 and 14. Specifically, mathematics teachers will develop learning plans for the following lessons: <i>a) Mathematics:</i> <i>i. Gradient and equation of straight line and magnitude of line segments</i> <i>ii. Angles</i> <i>b) Additional mathematics:</i> <i>i. Gradient, equations of straight lines and acute angles between two intersecting lines</i> <i>ii. 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). 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	
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	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 Ask teachers in groups to identify and share the aspects of Weeks 13 and 14 lessons in their teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> <i>a) Content standard(s)</i> <i>b) Learning outcome(s)</i>	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>	
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	c) <i>Learning indicator(s), etc.</i> 2.3 Ask teachers to 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):</i> i. <i>In what ways can the concept of distance be applied to solve problems involving measurements, travel and spatial relationships in mathematics and other fields?</i> ii. <i>In what ways can the gradient and equation of a straight line be used to analyse patterns, make predictions, and solve problems in various mathematical and real-world contexts?</i> iii. <i>How can values be read from a line graph and how can the information presented in these graphs be used to make comparisons, identify trends and draw conclusions? 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):</i> <i>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>	
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	<i>b) Additional mathematics (Week 13):</i> <i>i. How can learners differentiate between the different types of straight lines?</i> <i>ii. How will learners apply the knowledge of ratio to divide a line segment in a given ratio either internally or externally?</i> <i>iii. How will learners find the distance between given points?</i> <i>iv. How can learners explore the concept of gradient and equation of straight lines?</i> <i>v. How will learners apply the concept of shortest distance between a point and a line in real-life?</i> <i>vi. How can learners write equations for parallel and perpendicular lines? etc.</i> <i>c) Mathematics (Week 14):</i> <i>i. How are referents used to describe angles in geometric figures and real-world contexts?</i> <i>ii. What methods are used to replicate and bisect angles, and how are these techniques applied in constructing geometric figures</i>	<i>b) Additional mathematics (Week 13):</i> <i>How can learners differentiate between the different types of straight lines? etc.</i> <i>c) Mathematics (Week 14):</i> <i>How are referents used to describe angles in geometric figures and real-world contexts? etc.</i>	
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	<i>and solving problems involving angles?</i> iii. <i>How do angles arise in real-life problems and situations, and how can the concepts of angle measurement and classification be applied to solve practical problems involving angles? etc.</i> d) <i>Additional Mathematics (Week 14):</i> i. <i>What is the significance of direction and magnitude in vectors?</i> ii. <i>What is the relationship between vectors and coordinates in the Cartesian plane?</i> iii. <i>How can I use technology, such as graphing calculators or software, to visualize and manipulate vectors effectively?</i> iv. <i>What pedagogical strategies can I employ to help learners develop a deep understanding of vectors, such as inquiry-based learning, problem-solving approaches, and interactive demonstrations?</i>	d) <i>Additional Mathematics (Week 14):</i> <i>What is the significance of direction and magnitude in vectors? etc.</i>	
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	v. <i>How can I differentiate instruction to meet the needs of diverse learners, including visual, auditory, and kinaesthetic learners? etc.</i> 2.4 Ask teachers to 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>Remind teachers to 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> E.g. a) <i>Mathematics (Week 13):</i> i. <i>Learning Tasks:</i> ▪ <i>Learners review and draw linear graphs using linear functions.</i> ▪ <i>Find solutions to equations involving gradient and equations of the straight line and its real-world applications.</i> ▪ <i>Determine the equation of perpendicular and parallel lines.</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> E.g. a) <i>Mathematics (Week 13):</i> i. <i>Learning Tasks:</i> <i>Learners review and draw linear graphs using linear functions. etc.</i>	
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	▪ <i>Determine the magnitude and midpoint of a straight line.</i> <i>ii. Pedagogical Approach 1: Experiential learning: 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.</i> ▪ <i>Ask learners to research online resources (videos, articles, interactive simulations) that explain the relationship between linear functions and straight line graphs. Have them summarize their findings and present to the class using presentation software (e.g., PowerPoint, Google Slides).</i> ▪ <i>Challenge learners to use graphing software to plot various linear functions with different slopes and y-</i>	<i>ii. Pedagogical Approach 1: Experiential learning: 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>	
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	<i>intercepts. Ask them to analyze the patterns and relationships they observe, and then create a multimedia presentation (e.g., video, website) explaining why the graph of a linear function is always a straight line.</i> <i>Pedagogical Approach 2: Collaborative learning/Talk for learning Approaches: Learners to draw a straight line for given gradient by ensuring that the lesson is tailored-measured for learners taking into consideration the different ability learners in the class.</i> <i>To differentiate:</i> ▪ <i>Begin with a simple explanation of gradient as the steepness of a line. Demonstrate how to draw a line with a specific gradient using a ruler and graph paper. Provide worksheets with grids and gradients for learners to practice drawing lines. Offer extra practice for learners who need it and provide additional guidance.</i> ▪ <i>Guide learners through drawing lines with different gradients, providing tips on using</i>		
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	<i>the ruler effectively. Assign exercises where learners draw lines independently, checking for accuracy. Challenge learners to draw lines with specific gradients accurately without using a ruler for measurement.</i> ▪ <i>Provide real-world examples where understanding gradient and drawing lines accurately are important (e.g., construction, engineering).</i> <i>iii. Key Assessment</i> ▪ <i>Assessment Level 2: Suppose A is the point (3, 4) and B is the point (8, 14). What is the gradient/straight line joining these points?</i> ▪ <i>Assessment Level 3: Find the midpoint of the line joining the points or with end points of (1,3) and (5,6). Show that the line segment joining the points (1, 4) and (3, 10) is parallel to the line segment joining the points (-5, -10) and (-2, -1).</i> <i>b) Mathematics (Week 14):</i> <i>i. Learning Tasks:</i> ▪ <i>Learners construct given angles</i>	<i>iii. Key Assessment</i> <i>Assessment Level 2: Suppose A is the point (3, 4) and B is the point (8, 14). What is the gradient/straight line joining these points?</i> <i>b) Mathematics (Week 14):</i> <i>i. Learning Tasks:</i> <i>Learners construct given angles, etc.</i>	
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	▪ <i>Learners solve for missing angles</i> ▪ <i>Learners find values of angles formed by parallel lines intersected by a transversal</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.</i> ▪ <i>Allow for oral as well as written presentations.</i> <i>Pedagogical Approach 2: Problem-based learning;</i> <i>Learners to bisect given angles. Then discuss in groups the types of angles. Learners are also to solve problems on pairs of angles.</i> <i>To differentiate:</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>	
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	▪ <i>Ensure to offer support to struggling learners by giving one-on-one support or tasking advanced learners to support the groups.</i> ▪ <i>Ensure to differentiate the tasks by including tasks of different difficulty to cater for the different ability groups.</i> <i>iii. Key Assessment</i> ○ <i>Assessment Level 2: Make a free hand sketch of the following angles: 30°, 45°, 60°, 75°, 90° and 180°. Draw, analyse and name pairs of angles formed by parallel lines and a transversal by identifying corresponding angles, alternate interior angles, alternate exterior angles, and vertically opposite angles.</i> ○ <i>Assessment Level 3: Two angles are supplementary. The measure of the larger angle is 10 degrees more than the product of 4 and the measure of the smaller angle. What is the measure of the</i>	<i>iii. Key Assessment</i> <i>Assessment Level 2: Make a free hand sketch of the following angles: 30°, 45°, 60°, 75°, 90° and 180°, etc.</i>	
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	<i>larger angle in degrees?</i> c) <i>Additional mathematics (Week 13):</i> i. <i>Learning tasks:</i> ▪ <i>Learners measure distances between points using rulers</i> ▪ <i>Learners solve problems involving distances and division of lines in different contexts</i> ▪ <i>Learners relate the concept of proportionality to division of line segments</i> ▪ <i>Learners find the equation of straight lines, etc.</i> ii. <i>Pedagogical exemplars:</i> ▪ <i>Experiential Learning</i> ▪ <i>Begin with real-world examples, like measuring distances on a map</i> ▪ <i>Use visual aids such as diagrams and rulers to demonstrate concepts</i> ▪ <i>Break down steps into smaller, manageable parts</i> ▪ <i>Use interactive tools or software for virtual demonstrations, etc.</i> iii. <i>Key Assessment:</i> ▪ <i>Assessment level 1</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>	
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	<i>Find the midpoint of $A(2, 6)$ and $B(4, 8)$</i> ▪ <i>Assessment level 2</i> ▪ <i>$P(4, 6)$ and $Q(12, 6)$ are points on the cartesian plane. A point $M(x, y)$ moves in the plane such that $MP = MQ$</i> ▪ <i>An engineer is designing a suspension bridge that spans two river banks. The coordinates of the feet of the bridge on the river banks are $A(3, 5)$ and $B(9, 5)$. Predict the coordinates of the midpoint of the river where the main support pillar will be anchored, etc.</i> <i>d) Additional mathematics (Week 14):</i> <i>i. Learning tasks:</i> ▪ <i>Learners identify vector and scalar quantities from a list of quantities</i> ▪ <i>Learners perform addition and subtraction of vectors</i> ▪ <i>Learners relate the concept of proportionality to division of line segments</i> ▪ <i>Learners find the magnitude of vectors in a plane</i> ▪ <i>Learners prove properties of</i>	<i>Find the midpoint of $A(2, 6)$ and $B(4, 8)$, etc.</i> <i>d) Additional mathematics (Week 14):</i> <i>i. Learning tasks:</i> <i>Learners identify vector and scalar quantities from a list of quantities, etc.</i>	
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	vectors such as the commutative and associative laws of addition, etc. ii. Pedagogical exemplars: Experiential Learning - Use physical objects like arrows or toy cars to represent vectors - Have learners physically move objects to demonstrate vector addition and subtraction Use visual aids such as diagrams and rulers to demonstrate concepts - Utilize diagrams, graphs, and animations to illustrate vector operations - Incorporate interactive simulations or online tools for vector manipulation. - Encourage peer collaboration through group problem-solving activities - Provide worksheets with varying levels of difficulty to cater to different learning paces, etc. iii. Key Assessment: - Assessment level 1 Express vectors $\overrightarrow{AB}$ and $\overrightarrow{BA}$ from $A =$	ii. Pedagogical exemplars: Experiential Learning: Use physical objects like arrows or toy cars to represent vectors, etc. iii. Key Assessment: Assessment level 1 Express vectors $\overrightarrow{AB}$ and $\overrightarrow{BA}$ from $A = (3, 1)$ and	
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	$(3, 1)$ and $B = (-3, 6)$ in column $\begin{pmatrix} x \\ y \end{pmatrix}$, or $x_i + y_i$ ▪ Assessment level 2 ○ Given that $m = \begin{pmatrix} 3 \\ -4 \end{pmatrix}$ and $n = \begin{pmatrix} 5 \\ 0 \end{pmatrix}$, $p = \frac{1}{4}(m + n)$ and $q = \frac{1}{2}(m - n)$ Show that $p + q = p - q$ ○ Given that $a = \begin{pmatrix} 2 \\ -2 \end{pmatrix}$ and $b = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$ find r such that $\frac{1}{2}a - b + r = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$, etc. 2.5 Ask teachers in their subject groups or as individuals to complete learning planners 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).	$B = (-3, 6)$ 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	3.1 Ask teachers to swap one of their 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).	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).	10 mins

learning planner based on the templates provided.	<i>Hint:</i> <i>Prompt teachers to be guided by the following questions for the review:</i> <i>a) In what ways do the learning plan align with the teacher manual?</i> <i>b) How well do the pedagogical strategies and resources used address the needs of the learners?</i> <i>c) To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> <i>d) How effective have the differentiated instruction and assessment strategies been used in the plan?</i> <i>e) Have the essential questions been addressed in the activities?</i> <i>f) How appropriate is the closure?</i> <i>g) To what extent do the activities in the learning plan promote critical thinking and other 21st century skills? etc.</i> 3.2 Ask teachers to implement the recommendations made by a colleague to their learning plans as appropriate (NTS 1a, 1b).	<i>Hint:</i> <i>Be guided by the following questions for the review:</i> <i>a) In what ways do the learning plan align with the teacher manual?</i> <i>b) How well do the pedagogical strategies and resources used address the needs of the learners?</i> <i>c) To what extent has GESI and other cross-cutting issues been integrated in the plan?</i> <i>d) How effective have the differentiated instruction and assessment strategies been used in the plan?</i> <i>e) Have the essential questions been addressed in the activities?</i> <i>f) How appropriate is the closure?</i> <i>g) 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).	
4. Reflection on the session:	4.1 Ask teachers to share their insights and key	4.1 Share your insights and key takeaways regarding the session (NTS 1a, 1b).	10 mins

▪ Reflecting on what has been learnt in the session. ▪ Advance preparation towards next DPLC session	takeaways regarding the session (NTS 1a, 1b). 4.2 Encourage teachers to complete their learning plans before the next session (NTS 3a, 3l). 4.3 Remind teachers 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 their DPLC Handbook and teacher manual (NTS 1a, 1b).	4.2 Complete your learning plan(s) session (NTS 3a, 3l). 4.2 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).	
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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 Leading the session. <i>What the DPLC Coordinator will have to say during each stage of 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 Start the session by asking teachers to share two things they did differently based on the DPLC Session 8 on <i>developing learning plans for Weeks 13 and 14</i> which they think impacted learning positively (NTS 1a, 1b). 1.2 Ask teachers, as critical friends, to discuss and summarise in a single sentence why they 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).	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,	2.1 Ask a teacher to 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	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	60 mins

21st century skills and national values (2 learning planners to be completed per session)	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. 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	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. 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	
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	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 Ask teachers in groups to 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> a) <i>Content standard(s)</i> b) <i>Learning outcome(s)</i> c) <i>Learning indicator(s), etc.</i>	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>	
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	2.3 Ask teachers to 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). E.g. 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?</i> ▪ <i>How is the formula for finding the sum of the interior angles of a polygon derived and applied to polygons of different types and sizes?</i> ▪ <i>How does the number of sides of a polygon relate to the sum of its interior angles, and how can this relationship be used to classify polygons and solve problems involving their interior angles? etc.</i> b) <i>Additional Mathematics (Week 15):</i> i. <i>What connections can learners make between angles measured in degrees and radians?</i> ii. <i>What role does phase shift play in altering the graph of</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). E.g. 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>	
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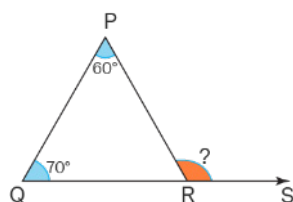
	<i>trigonometric functions?</i> <i>iii. How will learners relate trigonometric functions to real-life situations?</i> <i>iv. What opportunities exist for learners to reflect on their learning and identify areas for growth? etc.</i> c) <i>Mathematics (Week 16):</i> ▪ <i>How is the Pythagorean theorem applied in real-life situations, such as in construction, architecture, navigation and sports to solve problems involving distances, measurements and spatial relationships?</i> ▪ <i>How can the Pythagorean theorem be used to determine if a triangle is a right triangle and what are the criteria for applying the theorem in this context?</i> ▪ <i>In what ways can the Pythagorean theorem be used as a tool for geometric reasoning and problem-solving, particularly in situations where the right angle of a triangle is not explicitly given? 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) <i>Additional Mathematics (Week 16):</i> i. <i>How can learners relate the concept of continuity to limits?</i> ii. <i>How can learners analyse the implications of continuity for function behaviour?</i> iii. <i>How can limits help learners understand the behaviour of functions near a specific point, including identifying asymptotes and determining continuity? etc.</i> 2.4 Ask teachers to 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: <i>Remind teachers to 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> E.g. a) <i>Mathematics (Week 15):</i> i. <i>Learning Tasks:</i> <i>Learners use the exterior angle theorem to find missing angles a given triangle</i>	d) <i>Additional Mathematics (Week 16):</i> <i>How can learners relate the concept of continuity to limits? etc.</i> 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: <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> E.g. a) <i>Mathematics (Week 15):</i> i. <i>Learning Tasks:</i> <i>Learners use the exterior angle theorem to find missing angles a given triangle, etc.</i>	
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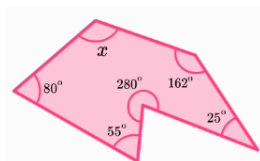
	▪ <i>Learners find the interior angle and sum of the interior angles of polygons</i> ii. <i>Pedagogical Approach 1: Group & pair activities: Learners find the exterior angle of a triangle. Learners also discuss and come out with the formula for determining the sum of the interior angles of polygons. To differentiate:</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.</i> ▪ <i>Ensure to blend the activities by using paper folding to show number of triangles in given polygon as well as drawing to show the same concept before using symbols to generate the formula.</i> <i>Pedagogical Approach 2: Problem-based group learning; Learners solve problems on finding the sum of the interior angles of polygons. To differentiate:</i>	ii. <i>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:</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>	
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Include a variety of questions and offer learners the opportunity to choose as many as they can answer.

- iii. Key Assessment
Assessment Level 2:
Find the value of the exterior angle in the triangle.



Work out the size of the angle labelled x.



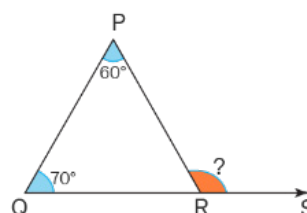
Assessment Level 3
A regular polygon's interior and exterior angles are in the ratio 9:1. How many sides does the polygon have?

- b) Mathematics (Week 16):

i. Learning Tasks:

- Learners to solve problems using Pythagorean theorem.
- Learners to use the Pythagorean theorem to determine if a given triangle is a right triangle

- iii. Key Assessment
Assessment Level 2:
Find the value of the exterior angle in the triangle.



- b) Mathematics (Week 16):

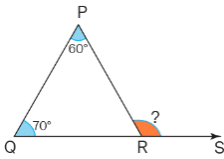
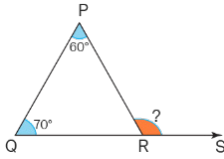
i. Learning Tasks:

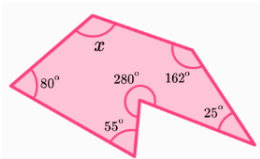
Learners to solve problems using Pythagorean theorem, etc.

	<i>ii. Pedagogical Approach 1: Group & pair activities; 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.</i> ▪ <i>Allow learners to make oral presentation as well as written presentations and including the use of any applicable computer application.</i> <i>Pedagogical Approach 1: Problem-based group learning; Learners complete task sheets of varying difficulty using the Pythagorean theorem to determine if a given triangle, is a right triangle. Learners also solve problems on real life application of Pythagorean theorem.</i> <i>To differentiate: Consider doing these for learners who are struggling:</i>	<i>ii. Pedagogical Approach 1: Group & pair activities; 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: Offer learners the opportunity to make presentations and summarize the main ideas as well as deal with what lacked, etc.</i>	
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	▪ <i>Given the lengths of the two shorter sides of a triangle, learners determine if it's a right triangle using the Pythagorean theorem.</i> ▪ <i>Simple word problems involving finding the missing side of a right triangle using the Pythagorean theorem. For learners who have grasped the concepts;</i> ▪ <i>Determine if a triangle is a right triangle with one side length given and find the missing side.</i> ▪ <i>Word problems involving finding the distance between two points on a coordinate plane using the Pythagorean theorem.</i> <i>For advance learners:</i> ▪ <i>Determine if a triangle is a right triangle with two side lengths given and find the missing side.</i> ▪ <i>Real-life applications such as finding the diagonal of a rectangular field or the height of a ladder leaning against a wall using the Pythagorean theorem.</i>		
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	iii. Key Assessment Assessment Level 3 ▪ Explain the Theorem of Pythagoras and give reasons why it only applies to the right triangle. ▪ Use a model to verify the Pythagoras theorem. ▪ An army captain is on a hunt for a criminal. Her GPS tells her that she is 50m away from the criminal. She walks 34m due west. The GPS compass now tells her that the criminal is due south from where she is standing. How far south does she need to go to find the criminal? b) Mathematics (Week 16): i. Learning tasks: ▪ Learners use the exterior angle theorem to find missing angles a given triangle ▪ Learners find the interior angle and sum of the interior angles of polygons 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:	iii. Key Assessment Assessment Level 3 Explain the Theorem of Pythagoras and give reasons why it only applies to the right triangle, etc. b) Mathematics (Week 16): 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:	
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	▪ 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. ▪ Ensure to blend the activities by using paper folding to show number of triangles in given polygon as well as drawing to show the same concept before using symbols to generate the formula. <i>Pedagogical Approach 2: Problem-based group learning;</i> <i>Learners solve problems on finding the sum of the interior angles of polygons.</i> <i>To differentiate:</i> <i>Include a variety of questions and offer learners the opportunity to choose as many as they can answer.</i> iii. Key Assessment ▪ Assessment Level 2: Find the value of the exterior angle in the triangle. 	<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. Key Assessment <i>Assessment Level 2:</i> <i>Find the value of the exterior angle in the triangle.</i> 	
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	Work out the size of the angle labelled x.  - Assessment Level 3 A regular polygon's interior and exterior angles are in the ratio 9:1. How many sides does the polygon have? c) Additional mathematics (Week 15): i. Learning tasks: - Learners match angles with their corresponding trigonometric ratios (sine, cosine, tangent) - Learners calculate missing side lengths or angle measures in basic right triangles using trigonometric functions - Learners solve basic problems involving angles of elevation/depression or distance calculations - Learners are to solve simple trigonometric equations involving sine, cosine, and tangent functions, etc. ii. Pedagogical exemplars: - Experiential / Exploratory Learning - Utilize visual aids such as diagrams, illustrations, and real-	c) Additional mathematics (Week 15): i. Learning Tasks: Learners match angles with their corresponding trigonometric ratios (sine, cosine, tangent), etc. ii. Pedagogical exemplars: Experiential / Exploratory Learning: Utilize visual aids such as diagrams, illustrations, and real-world examples to	
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	<i>world examples to introduce trigonometric concepts</i> ▪ <i>Break down concepts into smaller, manageable steps, providing clear explanations and ample opportunities for practice</i> ▪ <i>Provide guided practice sessions where learners work through problems with teacher support, gradually increasing independence</i> ▪ <i>Conduct interactive demonstrations using technology or manipulatives to illustrate trigonometric principles</i> ▪ <i>Offer problem-solving challenges or puzzles that require application of trigonometric concepts in novel contexts</i> ▪ <i>Encourage exploratory learning experiences where learners investigate trigonometric functions independently or in small groups, etc.</i> <i>iii. Key Assessment</i> ▪ <i>Assessment level 2 A sector of a circle has a central angle of 120° and a radius of 8m. What is the length of the arc formed by this sector? A ladder is leaning against a wall. The</i>	<i>introduce trigonometric concepts, etc.</i> <i>iii. Key Assessment</i> <i>Assessment level 2: A sector of a circle has a central angle of 120° and a radius of 8m. What is the length of the arc formed by this sector? etc.</i>	
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	<i>angle of elevation from the ground to the top is 60° and the ladder is 5 meters long. How far is the base of the ladder from the wall, etc.</i> d) <i>Additional mathematics (Week 16):</i> i. <i>Learning tasks:</i> ▪ <i>Individual learners state the value of the limit of a constant function</i> ▪ <i>Learners individually mention the conditions for the continuity of a function</i> ▪ <i>Learners calculate the limits of given functions using the properties of limits</i> ▪ <i>Learners are tasked in groups to determine the continuity of given polynomial and rational functions at given points and in some intervals</i> ▪ <i>Learners in pairs, use the limit of a function at a point, the nature of continuity of the function in an interval and its behaviour to sketch rational functions</i> ▪ <i>Learners use the conditions of continuity, the properties of limits a, the graph of function and any relevant</i>	d) <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>	
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	concepts to justify the prediction of the continuity or discontinuity of a function in a given interval to the larger group ▪ Learners working in mixed ability groups investigate and classify various functions into continuous and discontinuous functions and relate them real-life situations ▪ Learners investigate and identify the points of discontinuity, etc. ii. Pedagogical exemplars: ▪ Collaborative Learning 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 ▪ 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	ii. Pedagogical exemplars: Collaborative Learning: 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: 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.	
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	<i>a challenge are also grouped separately</i> ▪ <i>Learners work in groups with different tasks to investigate the behaviour of a function for different intervals for the input values and share their observations. This will promote critical thinking and communication skills</i> ▪ <i>Pair learners with different levels to encourage peer teaching, allowing stronger learners to reinforce their knowledge while supporting their peers.</i> ▪ <i>Learners in their mixed ability groups are to initiate a discussion on the meaning of approaching a number on a real number line from the left or from the right of the number</i> ▪ <i>Experiential Learning Learners find functional values and the limits of functions around given points to investigate continuity of functions at the given points</i> ▪ <i>Enquiry-based learning: Learners research about the applications of limits in their home settings</i>		
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	and other subject areas and industries ▪ <i>Exploratory learning: Learners use dynamic tools and calculators to explore the limits and behaviour of the graphs of functions at a point</i> iii. <i>Key Assessment</i> ▪ <i>Assessment level 1</i> <i>Evaluate $\lim_{x \rightarrow 2} \left(\frac{x^3+8}{x^2-4} \right)$</i> ▪ <i>Assessment level 2</i> <i>Evaluate $\lim_{x \rightarrow \infty} (2x^4 - x^2 - 8x)$</i> ▪ <i>Assessment level 3</i> <i>Given $f(x) = 1$, $g(x) = 10$ and $h(x) = -7$. Use the limit properties to compute each of the following limits. If it is not possible to compute any of the limits clearly explain why.</i> ▪ <i>$\lim_{x \rightarrow -4} [f(x)g(x)h(x)]$</i> ▪ <i>$\lim_{x \rightarrow -4} \left[\frac{1}{h(x)} + \frac{3-f(x)}{g(x)+h(x)} \right]$</i> 2.5 Ask teachers in their subject groups or as individuals to 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	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	
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	crosscutting issues (NTS 1a, 1b, 2a, 2c, 3a, 3g and 3h).	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 Ask teachers to exchange one of their 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>Prompt teachers to 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>	3.1 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 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>	10 mins

	3.2 Ask teachers to implement the recommendations made by a peer reviewer to their learning plans as appropriate (NTS 1a, 1b).	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 Ask teachers to share their insights and key takeaways regarding the session (NTS 1a, 1b). 4.2 Encourage teachers to complete their learning plans before the next session (NTS 3a, 3l). 4.3 Remind teachers 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 their DPLC Handbook and teacher manual (NTS 1a, 1b).	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 Leading the session. <i>What the DPLC Coordinator will have to say during each stage of 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 Start the session by asking teachers to share two things they did differently based on DPLC Session 9, <i>developing learning plans for Weeks 15 and 16</i>, which they think impacted learning positively (NTS 1a, 1b). 1.2 Ask teachers, as critical friends, to discuss and summarise in a single sentence why they 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).	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	2.1 Ask a teacher to 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	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	60 mins

and national values (2 learning planners to be completed per session)	plans for the following lessons: <i>a) Mathematics:</i> <i>i. Vectors</i> <i>ii. Trigonometry</i> <i>b) Additional mathematics:</i> <i>i. Differentiation from 1st principles and the power rule</i> <i>ii. 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 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.	plans for the following lessons: <i>a) Mathematics:</i> <i>i. Vectors</i> <i>ii. Trigonometry</i> <i>b) Additional mathematics:</i> <i>i. Differentiation from 1st principles and the power rule</i> <i>ii. 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 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.	
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	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 Ask teachers in groups to identify and share the aspects of Weeks 17 and 18 lessons in their teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> a) <i>Learning indicator(s)</i> b) <i>Content standard(s)</i> c) <i>Learning outcome(s), etc.</i> 2.3 Ask teachers to 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).	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).	
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	<i>E.g.</i> a) <i>Mathematics (Week 17):</i> ▪ <i>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?</i> ▪ <i>How do the properties of vectors, such as addition, subtraction, scalar multiplication, and the dot product, vary depending on the type of vector and its application?</i> ▪ <i>In what ways can vectors in two dimensions be applied to solve problems involving position, displacement, velocity and force in physics and other fields? etc.</i> b) <i>Additional mathematics (Week 17):</i> ▪ <i>What are the advantages and limitations of using the power rule compared to first principles in finding derivatives of polynomial functions?</i> ▪ <i>How can we use derivatives to analyse the behaviour of polynomial functions at critical points?</i>	<i>E.g.</i> a) <i>Mathematics (Week 17):</i> <i>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> b) <i>Additional mathematics (Week 17):</i> <i>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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	▪ <i>What differentiated planning approaches can be used to accommodate the diverse needs of learners in applications of differentiation?</i> ▪ <i>What are some common mistake that learners might make when differentiating polynomial functions, and how can we address them? etc.</i> c) <i>Mathematics (Week 18):</i> ▪ <i>How are trigonometric concepts such as sine, cosine, tangent and their inverses used to model and solve problems involving angles and sides of triangles?</i> ▪ <i>How are the trigonometric ratios used to find unknown angles and side lengths in right triangles, and what relationships exist between these ratios?</i> ▪ <i>How are the trigonometric ratios of 30°, 45°, and 60° degrees related to the side lengths of special right triangles, and how are these ratios used to solve problems involving these angles? etc.</i>	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>	
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	d) <i>Additional Mathematics (Week 18):</i> i. <i>What does the derivative of a polynomial function represent graphically and conceptually?</i> ii. <i>What role do derivatives play in curve sketching and analysis?</i> iii. <i>How can I incorporate technology to explore graphical representations of polynomial functions and their derivatives?</i> iv. <i>How do outliers impact the interpretation of a graph, and how should they be handled?</i> v. <i>How can visualisations be used to help understand and communicate measures of dispersion?</i> vi. <i>What are the limitations of measures of dispersion, and how might they be addressed in practice? etc.</i> 2.4 Ask teachers to discuss key notes on differentiation that cater for the needs of diverse learners in Weeks 17 and 18 mathematics lessons (NTS 3a, 3f and 3g).	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).	
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	Note: Remind teachers to refer to their 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) Mathematics (Week 17): i. Learning Tasks: ▪ Learners explain why parallel vectors are also considered collinear vectors. ▪ Learners calculate the magnitude of a given vector ▪ Learners determine that given vectors are equal ii. Pedagogical Approach 1: Problem-based learning; Learners discuss and represent graphically 2D vectors. They also show graphically when two vectors are considered equal. Learners solve problems on equal vectors. To differentiate: 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	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) Mathematics (Week 17): i. Learning Tasks: Learners explain why parallel vectors are also considered collinear vectors, etc. ii. Pedagogical Approach 1: Problem-based learning; Learners discuss and represent graphically 2D vectors. They also show graphically when two vectors are considered equal. Learners solve problems on equal vectors. To differentiate: 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	
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	<i>more challenging problems for those who grasp the concept quickly. This allows each group to work at a level appropriate for their abilities.</i> ii. <i>Provide additional resources such as visual aids, manipulatives, or reference materials to assist learners who may require extra support in understanding the concept of equal vectors. This can help make the task more accessible to all learners regardless of their ability level.</i> iii. <i>Key Assessment</i> <i>Assessment Level 3:</i> a. <i>Determine if the vectors $\vec{a} = (3, -4)$ and $\vec{b} = (-6, 8)$ are equal.</i> b. <i>Determine whether given pairs of vectors are equal or not. Justify your answer.</i> c. <i>The vector u has an initial point at $(-2, 0, 1)$ and an endpoint at $(4, -2, 3)$. What is the vector's length?</i> b) <i>Mathematics (Week 18):</i> i. <i>Learning Tasks:</i> <i>Learners compute for the various trig ratios. Learners apply the three primary trigonometric ratios to solve real-life problems</i>	<i>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> b) <i>Mathematics (Week 18):</i> i. <i>Learning Tasks:</i> <i>Learners compute for the various trig ratios.</i>	
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	<i>ii. Pedagogical Approach 1: Group & pair activities; 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.</i> <i>To differentiate;</i> ▪ <i>Monitor each pair/group's progress closely and provide personalized feedback to address specific misconceptions or difficulties that arise.</i> ▪ <i>Encourage peer teaching within the groups so that learners can learn from one another and clarify any misunderstandings together.</i> ▪ <i>For learners who grasp the concept quickly and need additional challenge, offer extension activities or open-ended tasks that allow them to apply their understanding in new and creative ways. This keeps them engaged and motivated while providing opportunities for deeper exploration of the topic.</i>	<i>ii. Pedagogical Approach 1: Group & pair activities; 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.</i> <i>To differentiate;</i> <i>Monitor each pair/group's progress closely and provide personalized feedback to address specific misconceptions or difficulties that arise, etc.</i>	
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	<i>ii. Pedagogical Approach 1: Problem-based group learning; Learners complete task sheets on trig ratios, including their word/real-life problems.</i> <i>To differentiate:</i> ▪ <i>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.</i> ▪ <i>Focus on memorization of the values for 30°, 45°, and 60°. Provide step-by-step guidance on using a calculator to find trigonometric ratios. Introduce more complex examples involving angles beyond 90°. Encourage learners to use the unit circle to find trigonometric ratios for any angle.</i> ▪ <i>Introduce problems with angles in standard position up to 360°. Encourage learners to use trigonometric identities and apply the</i>	<i>ii. Pedagogical Approach 1: Problem-based group learning; Learners complete task sheets on trig ratios, including their word/real-life problems.</i> <i>To differentiate:</i> <i>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.</i>	
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	<i>ratios to real-world scenarios. Emphasize understanding the patterns and relationships between the trigonometric ratios of special angles.</i> <i>iii. Key Assessment</i> <i>Assessment Level 3:</i> ▪ <i>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?</i> ▪ <i>A ramp is to be built from the ground to the back of a semi-truck. The bed of the truck is 1.3 meters above the ground. The ramp makes a 22° angle with the ground. How long will the ramp be?</i> ▪ <i>The angle of elevation from a boat to the top of a 48-meter lighthouse is 25°. How far is the boat from the base of the lighthouse?</i> <i>c) Additional mathematics (Week 17):</i> <i>i. Learning tasks:</i> ▪ <i>Learners are provided with worksheets with basic polynomial functions and with some guidance, are tasked to differentiate them</i> ▪ <i>Learners are offered a set of standard practice problems that</i>	<i>iii. Key Assessment</i> <i>Assessment Level 3:</i> <i>i. 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.</i> <i>c) Additional mathematics (Week 17):</i> <i>i. Learning tasks:</i> <i>Learners are provided with worksheets with basic polynomial functions and with some guidance, are tasked to differentiate them, etc.</i>	
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	<i>require applying the power rule to polynomial functions of varying degrees</i> ▪ <i>Learners individually to apply the 1st principle of differentiation to find the derivative of polynomial functions, etc.</i> ii. <i>Pedagogical exemplars:</i> ▪ <i>Problem-based Learning Learners work in groups and individually on tasks to differentiate polynomial functions of varying degrees from first principles and with the power rule</i> ▪ <i>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.</i> ▪ <i>Create tiered worksheets on polynomial differentiation. For struggling learners, provide step-by-step</i>	ii. <i>Pedagogical exemplars:</i> <i>Problem-based Learning</i> <i>Learners work in groups and individually on tasks to differentiate polynomial functions of 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.</i>	
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	<i>guided examples with simplified problems. For average learners, offer standard practice problems. For advanced learners, include challenging problems that require deeper critical thinking and application skills</i> <i>Collaborative Learning</i> ▪ <i>Learners working in mixed ability groups investigate how the limit of a function relates with its derivative</i> ▪ <i>Learners at varying ability levels should be paired. Assist peers in understanding topics and problem-solving techniques by having more capable learners explain them. Promote peer teaching by involving peers in peer feedback sessions and cooperative problem-solving exercises.</i> ▪ <i>Break down the process of differentiating polynomial functions into smaller, more manageable steps for learners who might need more assistance and provide ample support and guidance as learners' progress through each step</i> ▪ <i>Pair learners with different levels to encourage peer teaching, allowing</i>		
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	<i>stronger learners to reinforce their knowledge while supporting their peers.</i> <i>Experiential Learning</i> ▪ <i>Learners apply idea of limits, skills learnt in evaluating functions and any relevant skills and concepts to find the derivative of function by 1st principle or by the power rule</i> ▪ <i>Set up learning stations around the classroom with different activities. Station 1 could involve watching a video tutorial on polynomial differentiation, Station 2 could be a hands-on activity with algebra tiles to visualize differentiation, and Station 3 could be an interactive computer simulation for practicing differentiation</i> ▪ <i>Enquiry-based learning: Learners research to discover the link between limits and derivative of a function, etc.</i> <i>iii. Key Assessment:</i> ▪ <i>Assessment level 2</i> <i>Find the derivative, $\frac{dy}{dx}$ of $3x^2 + 4x - y = 4$</i> ▪ <i>Assessment level 3</i> <i>Given that $f(x) = -4x^2 + 2x$, $g(x) = 5x^3 + x$ and $h(x) = f(x) + g(x)$, find $h'(x)$ using</i>	<i>iii. Key Assessment:</i> <i>Assessment level 2</i> <i>Find the derivative, $\frac{dy}{dx}$ of $3x^2 + 4x - y = 4$, etc.</i>	
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	▪ <i>differentiation by first principles</i> ▪ <i>the power rule, etc.</i> <i>d) Additional mathematics (Week 18):</i> <i>i. Learning tasks:</i> ▪ <i>Learners solve real-world scenarios or advanced mathematical problems that require applying polynomial differentiation in context</i> ▪ <i>Task learners in pairs to use the graphing tool to draw the graph of functions and deduce the rate of rate or certain points</i> ▪ <i>Task learners in groups to create real life problems involving rates of change</i> ▪ <i>Task learners in groups to sketch cubic functions and rational functions, etc.</i> <i>ii. Pedagogical exemplars:</i> ▪ <i>Individualised learning: Learners engage in tasks specifically tailored to suit them</i> ▪ <i>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</i>	<i>d) Additional mathematics (Week 18):</i> <i>i. Learning tasks:</i> <i>Learners solve real-world scenarios or advanced mathematical problems that require applying polynomial differentiation in context, etc.</i> <i>ii. Pedagogical exemplars:</i> <i>Individualised learning: Learners engage in tasks specifically tailored to suit them</i> <i>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-</i>	
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	<i>problem-solving activities, investigations, presentations, or creative projects</i> ▪ <i>Develop learning contracts that outline specific learning objectives, tasks, and assessment criteria for each student. Learners can negotiate their learning goals and select activities that align with their strengths and areas for growth</i> ▪ <i>Collaborative Learning</i> <i>Learners working in mixed ability groups explore ways of finding the rate of change of a given function or phenomenon at certain points</i> ▪ <i>Problem-based learning: Present real-world problems or scenarios that require the application of derivative concepts. Allow learners to work collaboratively to solve these problems, encouraging critical thinking and problem-solving skills, etc.</i> <i>iii. Key Assessment:</i> ▪ <i>Assessment level 1</i> <i>State the conditions that are true for a given function as:</i> ○ <i>it increases</i> ○ <i>decreases</i>	<i>solving activities, investigations, presentations, or creative projects, etc.</i> <i>iii. Key Assessment:</i> <i>Assessment level 1</i> <i>State the conditions that are true for a given function as:</i> ▪ <i>it increases</i> ▪ <i>decreases</i>	
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	○ <i>it is momentarily at rest</i> ▪ <i>Assessment level 2</i> <i>Find the value(s) of x for which $f(x) = 2x^3 - x^2 - 2x + 1$ increases, decreases or momentarily at rest</i> <i>Find the equation of the tangent line to the curve $y = 7x^2$ at the point (1,7)</i> ▪ <i>Assessment level 3</i> <i>A water tank is being filled with water at a variable rate. The amount of water in the tank, in cubic meters, at time t minutes is given by the equation $V(t) = 2t^3 - 5t^2 - 10t$. At time $t = 4$ minutes, what is the rate of change of the water in the tank. Interpret your results, etc.</i> 2.5 Ask teachers in their subject groups or as individuals to complete learning planners for Weeks 17 and 18 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).	▪ <i>it is momentarily at rest, etc.</i> 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 reflection taking into consideration cross-cutting issues (NTS 1a, 1b, 2a, 2c, 3a, 3g and 3h).	
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3. Peer-review of learning planners. ▪ Reviewing planner to ensure alignment between course manual and learning planner based on the templates provided.	3.1 Ask teachers to swap one of their 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>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 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>	3.1 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>	10 mins
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	3.2 Ask teachers to implement the recommendations made by a colleague to their learning plan(s) as appropriate (NTS 1a, 1b).	3.2 Implement the recommendations made by a colleague to your learning plan(s) 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 Ask teachers to share their insights and key takeaways regarding the session (NTS 1a, 1b). 4.2 Encourage teachers to complete their learning plans before the next session (NTS 3a, 3l). 4.3 Remind teachers 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 their DPLC Handbook and teacher manual (NTS 1a, 1b).	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 Leading the DPLC Session. <i>What the DPLC Coordinator will have to say during each stage of 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 Start the session by asking teachers to share two things they did differently based on DPLC Session 10, <i>developing learning plans for Weeks 17 and 18</i>, which they think impacted learning positively (NTS 1a, 1b). 1.2 Ask teachers, as critical friends, to discuss and summarise in a single sentence why they 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).	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	2.1 Ask a teacher to 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	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:	60 mins

skills and national values (2 learning planners to be completed per session)	teachers will develop learning plans for the following lessons: <i>a) Mathematics:</i> <i>Area and Perimeter of shapes</i> <i>Volume of prisms</i> <i>b) Additional mathematics:</i> - Collection, categorisation and representation of data (Categorical data) - 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), 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,	<i>a) Mathematics:</i> <i>Area and Perimeter of shapes</i> <i>Volume of prisms</i> <i>b) Additional mathematics:</i> - Collection, categorisation and representation of data (Categorical data) - 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), 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,	
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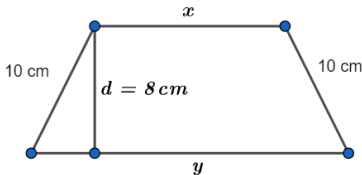
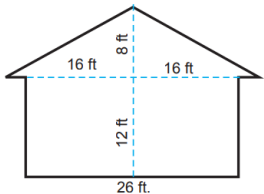
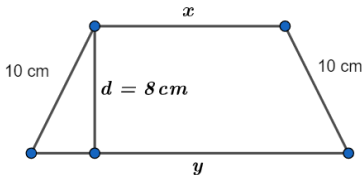
	1b, 2b, 2c, 2e, 2f, 3a, 3d, 3e, 3g-3j and 3o). LI 2.1 Critique the content (essential questions, teaching and learning activities, assessment strategies, key notes on differentiation, closure and reflection) of the learning plans for Weeks 19 and 20 in line with the LOs and LIs in the teacher manual. 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 Ask teachers in groups to identify and share the aspects of Weeks 19 and 20 lessons in their teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> a) <i>Learning outcome</i> b) <i>Content standard(s)</i> c) <i>Learning indicator, etc.</i> 2.3 Ask teachers to 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. <i>How are referents for measuring used as benchmarks for comparing and</i>	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,</i>	
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	<i>quantifying lengths, distances and other quantities?</i> <i>ii. How do different systems of measurement, such as the metric system and the imperial system, utilize referents to establish standardized units for measuring length, mass, volume and time?</i> <i>iii. How can the concept of perimeter be applied to solve problems involving the measurement, design and construction of geometric figures in real-world scenarios? etc.</i> <i>b) Additional mathematics (Week 19):</i> <i>i. What is categorical data, and how does it differ from numerical data?</i> <i>ii. How can technology be leveraged to enhance the collection, categorization, and representation of categorical data?</i> <i>iii. What are some real-world applications of categorical data analysis in various fields? etc.</i> <i>c) Mathematics (Week 20):</i> <i>i. How can the concept of volume be extended to different types of</i>	<i>distances and other quantities? etc.</i> <i>b) Additional mathematics (Week 19):</i> <i>What is categorical data, and how does it differ from numerical data? etc.</i> <i>c) Mathematics (Week 20):</i> <i>How can the concept of volume be extended to different types of prisms,</i>	
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	<i>prisms, such as rectangular prisms, triangular prisms and trapezoidal prisms, and how are the volume formulae derived for these shapes?</i> <i>ii. How are the concepts of volume of prisms applied in real-world scenarios, such as in packaging, shipping and architecture, to determine quantities and make decisions?</i> <i>iii. What strategies can be used to solve real-world problems involving the volume of prisms, and how do these problems enhance our understanding of volume measurement in practical contexts? etc.</i> <i>d) Additional Mathematics (Week 20):</i> <i>i. What is the fundamental difference between continuous and discrete data?</i> <i>ii. What are the different types of graphical representations suitable for continuous data?</i> <i>iii. How can we utilize collaborative learning strategies to deepen learners' understanding of graphical representation? etc.</i> 2.4 Ask teachers to think, pair and share key notes on differentiation that cater for the needs of diverse learners	<i>such as rectangular prisms, triangular prisms and trapezoidal prisms, and how are the volume formulae derived for these shapes? etc.</i> <i>d) Additional Mathematics (Week 20):</i> <i>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	
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	in Weeks 19 and 20 mathematics lessons (NTS 3a, 3f and 3g). <i>E.g.</i> a) <i>Mathematics (Week 19):</i> i. <i>Learning Tasks:</i> ▪ <i>Learners solve problems on finding the perimeter and area of kites, rhombus, parallelogram and trapezium</i> ▪ <i>Learners solve real-life problems on perimeter and area of 2-D shapes, etc.</i> ii. <i>Pedagogical Approach 1: Experiential learning: 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.</i> ▪ <i>Ensure full participation by differentiating the manner in which learners go about their estimations and presentation formats. Allow for oral, written as well as use of IT tools for presentations.</i> <i>Pedagogical Approach 2: Problem-based learning; Learners to investigate the perimeter and area of kites, parallelogram, rhombus and trapezoids using geodot/graphs.</i>	mathematics lessons (NTS 3a, 3f and 3g). <i>E.g.</i> 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: Learners to explore the immediate school environment to investigate referents for the measuring various items. To differentiate: Encourage shy learners to share their findings from the investigations, etc.</i>	
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	<i>Learners to solve problems, using formulae for determining the perimeter/area of kites, parallelogram, rhombus and trapezoids. Learners may use digital mathematics tools where applicable and available. To differentiate:</i> ▪ <i>Provide additional resources such as visual aids, manipulatives, or reference materials to assist learners who may require extra support in understanding the concept of equal vectors. This can help make the task more accessible to all learners regardless of their ability level.</i> ▪ <i>Instead of assigning fixed mixed-ability groups all the time, allow for flexibility in grouping based on learners' strengths and weaknesses. You can observe during class activities and then regroup learners accordingly, ensuring that each group has a mix of abilities and can support one another effectively.</i> <i>iii. Key assessment Assessment Level 2 The perimeter of the given trapezium is 104 cm. Find its area.</i>		
		<i>iii. Key assessment Assessment Level 2 The perimeter of the given trapezium is 104 cm. Find its area.</i>	

	 Assessment Level 3  Miss. Tackie wants to paint her house. To buy paint, she must know the area. What's the area of one side of Miss. Tackie's house? b) Mathematics (Week 20): - Learning tasks: - Learners identify various prisms and indicate the type of face, number of faces, edges and vertices. - Learners determine the volume of given prisms. - Learners workout the height or width or length of a prism when the volume is given. - Pedagogical Approach 1: Group & pair activities; Learners discuss and provide justification for given formulae of prisms. Learners also solve problems, using formulae for determining the	 etc. b. Mathematics (Week 20): - Learning Tasks: - Learners identify various prisms and indicate the type of face, number of faces, edges and vertices, etc. - Pedagogical Approach 1: Group & pair activities; Learners discuss and provide justification for given formulae of prisms. Learners also solve problems, using formulae for determining the volume of the prisms with given dimensions. To differentiate;	
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	<i>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.</i> ▪ <i>By incorporating a variety of instructional approaches, you can engage all learners more effectively.</i> <i>Pedagogical Approach 2: Problem-based group learning;</i> <i>Learners complete task sheets on volume, including word/real-life problems to solve.</i> <i>To differentiate;</i> ▪ <i>Monitor each group's progress closely and provide personalized feedback to address specific misconceptions or difficulties that arise.</i> ▪ <i>Encourage peer teaching within the groups so that learners can learn from one another and clarify any misunderstandings together, etc.</i> <i>iii. Key assessment</i> <i>Assessment Level 2</i> ▪ <i>What is the volume of a triangular prism with</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> <i>iii. Key assessment</i> <i>Assessment Level 2</i> <i>What is the volume of a triangular prism with</i>	
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	<i>dimensions of 12 m, 16 m and 20 m?</i> ▪ <i>A swimming pool in the shape of a cuboid has a length of 10 meters, a width of 5 meters, and a depth of 2 meters. If the pool is filled with water, how much water does it hold?</i> ▪ <i>The height of a square prism is 11 yards. The volume is 99 cubic yards. What is the length of the side of the square at the base of the prism?</i> <i>c) Additional mathematics (Week 19):</i> <i>i. Learning tasks:</i> ▪ <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</i> ▪ <i>Learners sort collected data into predefined categories (e.g., subjects) using a provided checklist. Offer visual aids and examples to help learners understand how to categorize data. Provide</i>	<i>dimensions of 12 m, 16 m and 20 m? etc.</i> <i>c. Additional mathematics (Week 19):</i> <i>i. Learning tasks:</i> <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>	
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	<i>guidance in identifying relevant categories</i> ▪ <i>Learners create a basic bar graph or pie chart to represent the survey results of favourite subjects</i> ▪ <i>Learners are provided guidelines for survey design and data collection methods design and conduct a survey on a topic of interest outside of school. Provide. Encourage learners to choose topics that resonate with their interests, etc.</i> <i>ii. Pedagogical exemplars:</i> ▪ <i>Problem-based Learning</i> ▪ <i>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</i>	<i>ii. Pedagogical exemplars:</i> <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>	
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	▪ <i>Facilitate learner-led inquiry by encouraging learners to design and conduct a survey on a topic of interest outside of school. Provide resources and guidelines for survey design, data collection methods, and analysis. Foster critical thinking skills by prompting learners to formulate research questions independently</i> ▪ <i>Challenge learners to create a comparative pie chart to visualize the distribution of survey responses among different age groups. Encourage experimentation with different chart formats and data representations. Facilitate peer feedback sessions where learners critique each other's visualizations and suggest improvements based on clarity and effectiveness</i> ▪ <i>Encourage learners to create dynamic and interactive data visualization dashboards using specialized software (e.g., Excel). Provide advanced training in data visualization principles and software functionalities. Foster creativity and</i>		
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	<i>innovation by challenging learners to design dashboards that effectively communicate insights from complex categorical data to diverse audiences</i> ▪ <i>Collaborative Learning</i> ▪ <i>Guide learners in sorting collected data into predefined categories (e.g., subjects) using a provided checklist. Utilise visual aids and examples to support understanding and offer feedback on the accuracy of categorisation. Encourage peer collaboration and provide opportunities for hands-on practice with sorting activities.</i> ▪ <i>Foster student autonomy in organizing collected data into meaningful categories based on identified themes. Encourage brainstorming and peer collaboration in proposing and refining categories. Provide opportunities for learners to justify their categorization decisions and</i>		
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	<i>engage in discussions about the significance of different groupings, etc.</i> iii. Key Assessment: ▪ Assessment level 1 Determine the level of measurement. (Nominal, Ordinal, Interval, Ratio) ○ Cars described as compact, midsize, and full-size. ○ Colours of M&M candies. ○ Weights of M&M candies ○ Types of markers (washable, permanent, etc.) ○ Time it takes to sing the National Anthem ○ Total annual income for statistics learners ○ Body temperatures of bears in the north pole ○ Teachers being rated as superior, above average, average, below average, or poor ▪ Assessment level 2 The weight of some randomly selected football players are as follows 55, 52, 51, 58, 57, 54, 51, 52, 50, 53, 54, 55, 50, 59, 56, 53, 52, 55, 54, 55, 52.	iii. Key Assessment: Assessment level 1: Determine the level of measurement. (Nominal, Ordinal, Interval, Ratio) ▪ Cars described as compact, midsize, and full-size. ▪ Colours of M&M candies. ▪ Weights of M&M candies ▪ Types of markers (washable, permanent, etc.) ▪ Time it takes to sing the National Anthem ▪ Total annual income for statistics learners ▪ Body temperatures of bears in the north pole ▪ Teachers being rated as superior, above average, average, below average, or poor, etc.	
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	<i>Make a frequency table for the data, etc.</i> <i>d) Additional mathematics (Week 20):</i> <i>i. Learning tasks:</i> ▪ <i>Given a set of data, learners match each data point to its corresponding position on a pre-drawn graph</i> ▪ <i>Learners complete partially filled graphs with missing data points provided</i> ▪ <i>Learners interpret simple line graphs and identify trends or patterns</i> ▪ <i>Learners construct histograms and cumulative frequency curves to represent the frequency distribution of ages in a population</i> ▪ <i>Learners analyse a cumulative frequency curve and make predictions based on the displayed data points</i> ▪ <i>Learners develop a mathematical model (polynomial) to predict future trends based on a given set of continuous data or a line graph</i> ▪ <i>Learners conduct a survey on a topic of interest, collect data, and create various types of continuous data representations to present findings, etc.</i>	<i>d) Additional mathematics (Week 20):</i> <i>i. Learning tasks:</i> <i>Given a set of data, learners match each data point to its corresponding position on a pre-drawn graph, etc.</i>	
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	ii. <i>Pedagogical exemplars:</i> ▪ <i>Problem-based learning:</i> ▪ <i>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</i> ▪ <i>Provide worksheets with partially filled graphs and a set of missing data points. Learners fill in the missing data points based on the provided information. Offer step-by-step instructions and check-in points to ensure learners are correctly applying the concepts</i> ▪ <i>Present real-life scenarios through stories or videos where simple line graphs are used to represent data (e.g., temperature changes over time). Guide learners through the process of interpreting the graphs and identifying trends or patterns. Provide ample opportunities for discussion and clarification</i>	ii. <i>Pedagogical exemplars:</i> <i>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.</i>	
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	▪ <i>Project-based learning:</i> ▪ <i>Assign a task where learners collect data on a topic of interest (e.g., daily temperature, population demographics). They then create line graphs or histograms to represent the data. Offer templates and guidelines for graph construction, along with feedback on their presentations</i> ▪ <i>Present word problems where learners need to interpret and analyse continuous data representations to solve real-life scenarios (e.g., predicting future sales based on sales data trends). Break down the problems into manageable steps and provide support as needed</i> ▪ <i>Encourage learners to create dynamic and interactive data visualization dashboards using specialized software (e.g., Excel). Provide advanced training in data visualization principles and software functionalities. Foster creativity and innovation by challenging learners to design dashboards that effectively communicate insights from complex</i>		
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	categorical data to diverse audiences, etc. iii. 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><tr><th>Time / s</th><th>Number of learners</th></tr><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></table> Draw a histogram for the data - Assessment level 4 <table><tr><th>Marks</th><th>Frequency</th></tr><tr><td>6-70</td><td>9</td></tr><tr><td>71-75</td><td>42</td></tr><tr><td>76-80</td><td>69</td></tr><tr><td>81-85</td><td>66</td></tr><tr><td>86-90</td><td>81</td></tr><tr><td>91-95</td><td>15</td></tr><tr><td>96-100</td><td>3</td></tr></table> - Draw a cumulative frequency curve for the distribution. - Use the curve in (a) to estimate; - the pass mark if 60% of the learners passed, - the probability of selecting a student who scored between 72% to 90%	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	Marks	Frequency	6-70	9	71-75	42	76-80	69	81-85	66	86-90	81	91-95	15	96-100	3	iii. 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><tr><th>Time / s</th><th>Number of learners</th></tr><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></table> Draw a histogram for the data, etc.	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	
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	2.5 Ask teachers in their subject groups or as individuals to 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).	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).	
3. Peer-review of learning planners. ▪ Reviewing planner to ensure alignment between course manual and learning planner based on the templates provided.	3.1 Ask teachers to swap one of their 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>Prompt teachers to 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>	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>	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 crafted been addressed in the activities? etc.</i> 3.2 Ask teachers to implement the recommendations made by a peer reviewer to their learning plans as appropriate (NTS 1a, 1b).	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 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).	
4. Reflection on the session: ▪ Reflecting on what has been learnt in the session. ▪ Advance preparation towards next DPLC session	4.1 Ask teachers to share their views and feelings about the session (NTS 1a, 1b). 4.2 Encourage teachers to complete their learning plans before the next session (NTS 3a, 3l). 4.3 Remind teachers 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 their DPLC Handbook and teacher manual (NTS 1a, 1b).	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 Leading the PLC Session. <i>What the DPLC Coordinator will have to say during each stage of 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 Start the session by asking teachers to share two things they did differently based on PLC Session 11, <i>developing learning plans for Weeks 19 and 20</i>, which they think impacted learning positively (NTS 1a, 1b). 1.2 Ask teachers, as critical friends, to discuss and give a summary on why they think what a colleague did by way of application of lessons learnt in PLC Session 11, <i>developing learning plans for Weeks 19 and 20</i>, supported learning (NTS 1a-1c).	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	2.1 Ask a teacher to 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:	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:	60 mins

national values (2 learning planners to be completed per session)	<i>a) Mathematics:</i> <i>i. Types of data</i> <i>ii. Data organisation & presentation</i> <i>b) Additional mathematics:</i> <i>i. Measures of central tendencies and dispersion</i> <i>ii. 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). 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	<i>a) Mathematics:</i> <i>i. Types of data</i> <i>ii. Data organisation & presentation</i> <i>b) Additional mathematics:</i> <i>i. Measures of central tendencies and dispersion</i> <i>ii. 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). 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	
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	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 Ask teachers in groups to identify and discuss the aspects of Weeks 21 and 22 lessons in their teacher manual that have been captured in the learning planner template (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> a) <i>Content standard(s)</i> b) <i>Learning outcome(s)</i> c) <i>Learning indicator(s), etc.</i>	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). <i>E.g.</i> <i>Content standard(s), etc.</i>	
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	2.3 Ask teachers to 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. a) <i>Mathematics (Week 21):</i> ▪ <i>How are the different types of data, including qualitative (categorical) data and quantitative (numerical) data, distinguished based on their characteristics and measurement scales?</i> ▪ <i>What are the various methods used to collect quantitative data, such as surveys, experiments, and observations, and how can these methods be validated to ensure the accuracy and reliability of the data?</i> ▪ <i>What are the different methods used to collect qualitative data, such as interviews, focus groups, and content analysis, and how can these methods be validated to ensure the credibility and trustworthiness of the data? etc.</i> b) <i>Additional mathematics (Week 21):</i> i. <i>How can measures of central tendency and dispersion be used together to gain a comprehensive</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. a) <i>Mathematics (Week 21):</i> <i>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> b) <i>Additional mathematics (Week 21):</i> <i>How can measures of central tendency and dispersion be used together to gain a comprehensive</i>	
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	<i>understanding of a dataset?</i> <i>ii. How do we ensure that collected data is relevant, unbiased, and representative of the population or phenomenon being studied?</i> <i>iii. What is the purpose of measures of central tendency (mean, median, mode) and how do they help summarize data?</i> <i>iv. How do outliers impact the interpretation of a graph, and how should they be handled?</i> <i>v. How can visualisations be used to help understand and communicate measures of dispersion?</i> <i>vi. What are the limitations of measures of dispersion, and how might they be addressed in practice? etc.</i> <i>c) 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?</i> <i>▪ How do the different types of data influence the choice of</i>	<i>understanding of a dataset? etc.</i> <i>c) 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>	
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	<i>data analysis methods and statistical techniques used to interpret and draw conclusions from the data?</i> ▪ <i>How do measures of central tendencies vary in their interpretation and applicability based on the distribution and characteristics of the data, and what insights can be gained from analysing these measures? etc.</i> d) <i>Additional Mathematics (Week 22):</i> i. <i>How can I use real-life scenarios to introduce learners to the concept of counting, making it more relatable and engaging?</i> ii. <i>What are combinations, and why are they important in mathematics and real-world scenarios?</i> iii. <i>How can learners use permutations to solve real-world problems, such as counting the number of distinct arrangements in a word or arranging objects in a sequence? 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>	
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	2.4 Ask teachers to 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: Remind teachers to refer to their 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> E.g. a) Mathematics (Week 21): - Learners differentiate among the different types of data - Learners organise given data into frequency tables - Learners research and select an existing survey questionnaire, observation guide, etc., then discuss its features, validate its usefulness and collect quantitative data with it. - Learners design a mini project where they choose a data collection method of choice and collect real-life quantitative data with it. ii. Pedagogical Approach: Experiential learning;	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: 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> E.g. a) Mathematics (Week 21) Learners differentiate among the different types of data, etc. : ii. Pedagogical Approach: Experiential learning;	
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	<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 support for them to construct the tool themselves and help them validate it.</i> <i>To ensure that all learners participate fully, you may consider the following;</i> ▪ <i>Choice of Data Collection Tool: Offer learners a range of options for data collection tools to suit different preferences and skill levels. This could include surveys, interviews or observations. Allow learners to choose the method that aligns best with their interests and strengths.</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 support for them to construct the tool themselves and help them validate it.</i>	
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	▪ <i>Flexible Grouping:</i> Allow learners to work individually, in pairs, or in small groups based on their preferences and the complexity of the project. This accommodates varying levels of collaboration and allows learners to support one another in the validation and data collection processes. ▪ <i>Provide resources and support materials at different levels of complexity to accommodate diverse learning needs. This could include step-by-step guides, video tutorials, or examples of validated data collection tools. Ensure that learners have access to the resources they need to succeed at their chosen level.</i>		
	<i>iii. Key assessment</i> <i>Assessment Level 2</i> <i>The data below are the scores of 21 learners in a creative arts test. Organise it into a frequency distribution table by grouping them.</i> <i>59, 65, 61, 62, 53, 55, 60,</i>	<i>iii. Key assessment</i> <i>Assessment Level 2</i> <i>The data below are the scores of 21 learners in a creative arts test. Organise it into a frequency distribution table by grouping them.</i> <i>59, 65, 61, 62, 53, 55, 60, 70, 64, 56, 58, 58, 62, 62,</i>	

	70, 64, 56, 58, 58, 62, 62, 68, 65, 56, 59, 68, 61, 67 Assessment Level 3 a) <i>Select an existing survey questionnaire and discuss its features.</i> b) <i>Validate the questionnaire and collect a quantitative data with it.</i> b) <i>Mathematics (Week 22):</i> i. <i>Learning Tasks:</i> ▪ <i>Learners organise data in frequency tables, bar charts, pie charts, line graphs, etc.</i> ▪ <i>Learners determine the measures of central tendencies for grouped data and justify which of the averages best represent a given data, etc.</i> ii. <i>Pedagogical Approach:</i> <i>Group & pair activities; Learners are assigned a variety of data to organise them into, frequency tables, pie charts, line graphs, bar charts, etc.</i> <i>To ensure a differentiated class you may consider the following varied activities;</i> ▪ <i>Provide step-by-step guidance on how to organize data into frequency tables and</i>	68, 65, 56, 59, 68, 61, 67, etc. b) <i>Mathematics (Week 22):</i> i. <i>Learning Tasks:</i> <i>Learners organise data in frequency tables, bar charts, pie charts, line graphs, etc.</i> ii. <i>Pedagogical Approach:</i> <i>Group & pair activities; Learners are assigned a variety of data to organise them into, frequency tables, pie charts, line graphs, bar charts, etc.</i> <i>To ensure a differentiated class you may consider the following varied activities;</i> <i>Provide step-by-step guidance on how to organize data into frequency tables and create basic graphs</i>	
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	<i>create basic graphs (e.g., bar graphs, line graphs).</i> ▪ <i>Offer simplified explanations of descriptive statistics like mean, median, and mode.</i> ▪ <i>Use concrete examples and visual aids to help learners understand the concepts.</i> ▪ <i>Allow learners to work in small groups or pairs to create simple frequency tables and graphs using provided data sets.</i> ▪ <i>Provide templates and tools (such as graphing software or apps) to assist with creating visual representations of data.</i> ▪ <i>Introduce the use of technology (e.g., spreadsheet software) for creating and analyzing data.</i> ▪ <i>Challenge learners to create advanced visualizations, such as 3D graphs, using specialized software or programming languages.</i> <i>iii. Key assessment</i> ▪ <i>Assessment Level 2</i> ○ <i>Suppose we conduct a survey in which we ask 15 households how many pets they</i>	<i>(e.g., bar graphs, line graphs).</i> <i>iii. Key assessment</i> <i>Assessment Level 2</i> <i>Suppose we conduct a survey in which we ask 15 households how many pets they have in their home. The results are as</i>	
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	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. ○ Estimate the mean, median and mode for the data set. <table><tr><th>Length (mm)</th><th>Frequency</th></tr><tr><td>150 - 154</td><td>5</td></tr><tr><td>155 - 159</td><td>2</td></tr><tr><td>160 - 164</td><td>6</td></tr><tr><td>165 - 169</td><td>8</td></tr><tr><td>170 - 174</td><td>9</td></tr><tr><td>175 - 179</td><td>11</td></tr><tr><td>180 - 184</td><td>6</td></tr><tr><td>185 - 189</td><td>3</td></tr></table> ▪ Assessment Level 3 State and explain, with practical examples two differences between mean and median. c) Additional Mathematics (Week 21): i. Learning tasks: ▪ Learners calculate mean, median, and mode for simple data sets ▪ Learners identify outliers in a data set ▪ Learners interpret the meaning of standard deviation in context ▪ Learners analyse the effect of adding or removing data	Length (mm)	Frequency	150 - 154	5	155 - 159	2	160 - 164	6	165 - 169	8	170 - 174	9	175 - 179	11	180 - 184	6	185 - 189	3	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) Additional Mathematics (Week 21): i. Learning tasks: Learners calculate mean, median, and mode for simple data sets, etc.	
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175 - 179	11																				
180 - 184	6																				
185 - 189	3																				

	<i>points on measures of central tendency</i> ▪ <i>design an experiment to investigate the relationship between two variables and analyse the results using statistical methods, etc.</i> ii. <i>Pedagogical exemplars:</i> ▪ <i>Problem-based / Project-based Learning</i> ▪ <i>Begin with a pre-assessment to gauge learners' prior knowledge and identify any misconceptions</i> ▪ <i>Break down the calculation process into smaller, manageable steps. Provide guided practice with immediate feedback</i> ▪ <i>Offer problem-solving activities with varied levels of complexity. Encourage learners to work in pairs or small groups to discuss and solve problems collaboratively</i> ▪ <i>Present challenges that require learners to apply their understanding in different contexts, such as analysing trends in stock market data or conducting surveys within the school community</i>	ii. <i>Pedagogical exemplars: Problem-based / Project-based Learning: To differentiate, begin with a pre-assessment to gauge learners' prior knowledge and identify any misconceptions, etc.</i>	
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	▪ <i>Provide challenging problems that require critical thinking and higher-order reasoning skills. Encourage learners to explore alternative methods for calculating measures of central tendency and dispersion</i> ▪ <i>Assign independent research projects where learners investigate advanced statistical techniques or applications of measures of central tendency and dispersion in specific fields like psychology or economics, etc.</i> iii. <i>Key Assessment:</i> ▪ <i>Assessment level 1 Find the median of the following numbers: 47, 30, 56, 31, 55, 43 and 44Cars described as compact, midsize, and full-size.</i> ▪ <i>Assessment level 2 The mean of 12 numbers is 18. If each of the numbers are increased by 4. What is the new mean? etc.</i> ▪ <i>Assessment level 4 Calculate the variance and standard deviation of the distribution below, given that the mean as 138 and you</i>	iii. <i>Key Assessment:</i> <i>Assessment level 1 Find the median of the following numbers: 47, 30, 56, 31, 55, 43 and 44Cars described as compact, midsize, and full-size, etc.</i>	
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	<i>assume a mean of 140, 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</i> ▪ <i>Learners list all possible arrangements of a small set of objects</i> ▪ <i>Learners solve problems involving multiple conditions and restrictions</i> ii. <i>Pedagogical exemplars: Experiential Learning</i> ▪ <i>Begin with concrete examples using objects like marbles, coins, or coloured blocks to demonstrate basic counting principles</i> ▪ <i>Introduce permutations and combinations using real-life scenarios such as arranging seats at a table or selecting items from a menu</i> ▪ <i>Provide ample opportunities for practice with guided exercises</i> ▪ <i>Introduce more complex scenarios involving multiple sets of objects or conditions</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: Experiential Learning</i> <i>Begin with concrete examples using objects like marbles, coins, or coloured blocks to demonstrate basic counting principles, etc.</i>	
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	▪ <i>Encourage learners to use systematic approaches such as tree diagrams or organized lists, etc.</i> iii. <i>Key Assessment:</i> ▪ <i>Assessment level 1 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?</i> ▪ <i>Assessment level 3 There are three bus lines between town A and B and 3 bus lines between town B and C. In how many ways</i> ▪ <i>can a person travel from town A to town C by way of town B?</i> ▪ <i>can a person travel by bus in a return trip by bus from town A to town C by way of town B.?</i> ▪ <i>can a person travel by bus on a return trip from town A to C, if this person doesn't want to use a line more than once? etc.</i> 2.5 Ask teachers in their subject groups or as individuals to complete	iii. <i>Key Assessment:</i> <i>Assessment level 1 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	
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	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).	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 templates provided.	3.1 Ask teachers to swap one of their 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>Prompt teachers to 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>	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>	10 mins

	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 Ask teachers to implement the recommendations made by a peer reviewer to their learning plans as appropriate (NTS 1a, 1b).	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 Ask teachers to share their views and feelings about the session (NTS 1a, 1b). 4.2 Encourage teachers to complete their learning plans before the next session (NTS 3a, 3l). 4.3 Remind teachers 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 their DPLC Handbook and teacher manual (NTS 1a, 1b).	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 Leading the DPLC Session. <i>What the DPLC Coordinator will have to say during each stage of 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 Start the session by asking teachers to share two things they did differently based on DPLC Session 12, <i>developing learning plans for Weeks 21 and 22</i>, which they think impacted learning positively (NTS 1a, 1b). 1.2 Ask teachers, as critical friends, to discuss and summarise in a single sentence why they think what a colleague did by way of application of lessons learnt in DPLC Session 12, <i>developing learning plans for Weeks 21 and 22</i>, supported learning (NTS 1a-1c).	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	2.1 Ask a teacher to 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.	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.	60 mins

and national values (2 learning planners to be completed per session)	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). LI 1.1 Relate the aspects of Weeks 23 and 24 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 the learning planner templates for Weeks 23 and 24 mathematics lessons with essential questions, teaching and learning activities, key notes on differentiation,	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). 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,	
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	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 Ask teachers in groups to identify and share the aspects of Weeks 23 and 24 lessons in their teacher manual that have been captured in the learning planner (NTS 1a, 1b, 2a and 2c). <i>E.g.</i> a) <i>Learning indicator(s)</i> b) <i>Learning outcome</i> c) <i>Content standard, etc.</i>	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>	
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	2.3 Ask teachers to 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> a) <i>Mathematics (Week 23):</i> i. <i>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?</i> ii. <i>What are the key steps involved in analysing data collected from a real-life project, including data cleaning, data exploration and data interpretation, and how can statistical and visual tools be used to enhance the analysis process?</i> iii. <i>How can data be effectively presented to stakeholders and decision-makers in a real-life project, including the use of tables, charts, graphs and other visualizations to communicate key findings and insights derived from the data analysis? 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> a) <i>Mathematics (Week 23):</i> <i>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. <i>How can I make abstract mathematical concepts like permutations and combinations more concrete and relatable to learners' everyday experiences?</i> ii. <i>How can I foster a sense of curiosity and excitement for mathematics in the context of teaching permutation and combination concepts among my learners?</i> iii. <i>What strategies can I use to help learners build a growth mindset and develop a positive attitude toward mathematics, specifically when working with complex concepts like permutations and combinations? etc.</i> c) <i>Mathematics (Week 24):</i> i. <i>How do compound probability experiments differ from simple experiments, and how are they used to calculate the</i>	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</i>	
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	<i>probability of multiple events occurring together?</i> <i>ii. How can the concept of independence be applied to real-life situations, and how does the probability of independent events influence decision-making and risk assessment?</i> <i>iii. How do misconceptions or biases related to independent events influence decision-making and risk assessment in various fields? etc.</i> d) <i>Additional mathematics (Week 24):</i> <i>i. What is the fundamental difference between theoretical and experimental probability, and why is it important to distinguish between the two?</i> <i>ii. In what ways can we use combinatorial techniques such as permutations and combinations to calculate theoretical probabilities?</i> <i>iii. What role does collaborative learning, peer discussion, and problem-solving activities play in enhancing</i>	<i>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>	
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	<i>understanding of theoretical probabilities? etc.</i> 2.4 Ask teachers to 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> <i>a) Mathematics (Week 23):</i> <i>i. Learning Tasks:</i> <i>Learners use mathematical language to make inferences of data</i> <i>ii. Pedagogical Approach:</i> <i>Experiential learning; 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.</i> ▪ <i>Offer structured activities where learners work in pairs or small groups to analyze simple data sets. Scaffold discussions to help learners incorporate</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> <i>a) Mathematics (Week 23):</i> <i>i. Learning Tasks:</i> <i>Learners use mathematical language to make inferences of data</i> <i>ii. Pedagogical Approach:</i> <i>Experiential learning; 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>	
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	<i>the views of others in their assessments.</i> ▪ <i>Teach learners to use more advanced mathematical reasoning, including statistical analysis, to support their choices and assess data.</i> ▪ <i>Provide opportunities for learners to collaborate in teams to plan and execute a project, including collecting and analyzing data using computer applications.</i> ▪ <i>Challenge learners to use sophisticated mathematical arguments and statistical methods to support their choices and assess complex data sets.</i> ▪ <i>Encourage learners to think critically and creatively, incorporating diverse perspectives in their assessments.</i> <i>iii. Key assessment Assessment Level 4</i> ▪ <i>Collect analyse and present a real-life data (WASCE Result, Sports Records, etc.) from within the school environment.</i> ▪ <i>From the findings, make recommendations and give reasons for such recommendations.</i>	<i>iii. Key assessment Assessment Level 4 Collect analyse and present a real-life data (WASCE Result, Sports Records, etc.) from within the school environment, etc.</i>	
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	▪ <i>Work with colleague learners to develop a mini-research project by;</i> ○ <i>Developing a questionnaire</i> ○ <i>Collecting data</i> ○ <i>Analysing the data and</i> ○ <i>Presenting the data</i> ▪ <i>Make a publication of the findings of the project on the school notice, social media platform, etc.</i> <i>b) Additional mathematics (Week 23):</i> <i>i. Learning tasks:</i> ▪ <i>Given a permutation or combination expression, learners identify the total number of elements and the number of elements to be selected or arranged</i> ▪ <i>Learners establish the connection between combinations and permutations</i> ▪ <i>Present a variety of permutation and combination problems of moderate complexity for learners to solve independently or in pairs, etc.</i> <i>ii. Pedagogical exemplars:</i> ▪ <i>Experiential Learning</i> ▪ <i>Use physical objects like beads or coloured tokens to represent</i>	<i>b) Additional mathematics (Week 23):</i> <i>i. Learning tasks:</i> <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</i>	
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	<i>the elements in permutation and combination expressions</i> ▪ <i>Guide learners through physically arranging and rearranging the objects to understand the concepts of arrangement and selection</i> ▪ <i>Break down the process of simplifying expressions into smaller, manageable steps</i> ▪ <i>Provide visual aids and cue cards to help learners remember each step</i> ▪ <i>Present real-life scenarios where permutation and combination principles are applied, such as seating arrangements or lottery probabilities, etc.</i> iii. <i>Key Assessment:</i> ▪ <i>Assessment level 3 Given that ${}^nP_r = 90$ and ${}^nC_r = 15$, find the value of r</i> ▪ <i>Assessment level 4 Given that ${}^nC_4 = 210$, find the value of n, etc.</i> c) <i>Mathematics (Week 24):</i> i. <i>Learning Tasks:</i> ▪ <i>Learners determine whether given</i>	<i>permutation and combination expressions, etc.</i> iii. <i>Key Assessment:</i> <i>Assessment level 3 Given that ${}^nP_r = 90$ and ${}^nP_r = 15$, find the value of r, etc.</i> c) <i>Mathematics (Week 24):</i> i. <i>Learning Tasks:</i> <i>Learners determine whether given experiments are</i>	
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	<i>experiments are independent events or not.</i> ▪ <i>Learners list the sample space of a given probability event. Ensure to include simple scenarios as well as intermediate and complex ones to help all the different groups of learners.</i> ▪ <i>Learners determine the probability of independent events and express the results as fractions, decimals, percentages and/or ratios.</i> ▪ <i>Learners solve real-life problems involving the probability of two-independent events.</i> <i>ii. Pedagogical Approach: Group & pair activities; 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.</i> ▪ <i>For instance; for some of the learners give</i>	<i>independent events or not, etc.</i> <i>ii. Pedagogical Approach: Group & pair activities; Learners solve problems on probability of independent events including real-life problems.</i> <i>To differentiate: Please make accommodations for the various ability groups in the class as you carry out this activity, etc.</i>	
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	<i>simple scenarios for them to identify the outcomes of two independent events and list them systematically.</i> ▪ <i>Then, other learners should analyze real-life scenarios to identify two independent events and construct the sample space for these events.</i> ▪ <i>Then for some other learners, they should evaluate complex scenarios involving multiple independent events and create sample spaces for these scenarios.</i> <i>iii. Key assessment</i> ▪ <i>Assessment Level 2</i> <i>Two coins are tossed once. List the sample space for the experiment.</i> ▪ <i>Assessment Level 3</i> ○ <i>Two (2) cards are chosen from a deck of cards. The first card is replaced before choosing the second card. What is the probability that they both will be face cards?</i> ○ <i>A dollar-bill changer on a snack machine was tested with 100 \$1 bills. Twenty-five of the bills were found to be</i>		
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iii. Key assessment
Assessment Level 2
Two coins are tossed once. List the sample space for the experiment, etc.

	<i>counterfeit, but only one was accepted by the machine. However, six of the legal bills were rejected. Draw a chart to show the number of legal and counterfeit bills that were accepted or rejected.</i> <i>1. What is the probability that a bill will be rejected given that it is legal?</i> <i>2. What is the probability that the counterfeit bill is accepted?</i> <i>d) Additional mathematics (Week 24):</i> <i>Learning tasks:</i> <i>▪ Learners identify possible outcomes and calculate basic probabilities</i> <i>▪ Learners calculate probabilities of simple events using formulas and diagrams</i> <i>▪ Solve complex probability problems involving combination, permutations and conditional probability, etc.</i> <i>Pedagogical exemplars:</i> <i>▪ Experiential Learning</i> <i>▪ Provide hands-on activities using dice,</i>	<i>d) Additional mathematics (Week 24):</i> <i>Learning tasks:</i> <i>Learners identify possible outcomes and calculate basic probabilities, etc.</i> <i>Pedagogical exemplars:</i> <i>Experiential Learning:</i> <i>Provide hands-on activities using dice,</i>	
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	<i>spinners, and cards to demonstrate probability concepts</i> ▪ <i>Break down complex concepts into smaller, more manageable parts using visual aids and real-life examples</i> ▪ <i>Scaffold learning by providing step-by-step guidance through problem-solving exercises</i> ▪ <i>Offer frequent opportunities for practice with immediate feedback to reinforce understanding, etc.</i> <i>iii. Key Assessment:</i> ▪ <i>Assessment level 1 A fair die is tossed twice. What is the sample size?</i> ▪ <i>Assessment level 2 A fair coin is tossed twice, and the result recorded. What is the probability that</i> ▪ <i>the first toss shows head</i> ▪ <i>the second toss shows a head.</i> ▪ <i>Assessment level 3 Two identical tetrahedral are tossed once. If each face of each tetrahedral is labelled in the manner 2, 3, 4, 5. What is the probability of</i>	<i>spinners, and cards to demonstrate probability concepts, etc.</i> <i>iii. Key Assessment: Assessment level 1 A fair die is tossed twice. What is the sample size? etc.</i>	
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	<i>obtaining a sum equal to 7? etc.</i> 2.5 Ask teachers in their subject groups or as individuals to 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).	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 Ask teachers to swap one of their 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>	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>	10 mins

	d) <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills?</i> e) <i>How effective have the differentiated instruction and assessment strategies been used in the plan? etc.</i> 3.2 Ask teachers to implement the recommendations made by a peer reviewer to their learning plans as appropriate (NTS 1a, 1b).	d) <i>To what extent do the activities in the learning plan promote critical thinking and other 21st century skills?</i> e) <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).	
4. Reflection on the session: ▪ Reflecting on what has been learnt in the session. ▪ Advance preparation towards next DPLC session	4.1 Ask teachers to share their views and feelings about the session (NTS 1a, 1b). 4.2 Encourage teachers to complete their learning plans which were not completed during the session (NTS 3a, 3l). 4.3 Encourage teachers to keep themselves abreast with the curriculum, teacher manual and the content of the learning plan to enhance teaching and learning (NTS 1b, 2c).	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

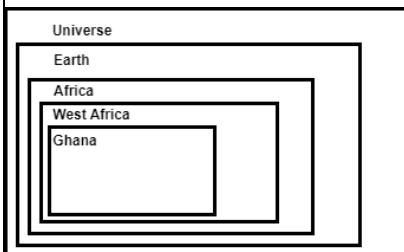
Appendix 1: Mathematics

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)	iv. What distinguishes rational numbers from irrational numbers, and how do these different types of numbers manifest in real-world situations and mathematical concepts? v. What are some examples of real-life situations where irrational numbers play a crucial role, and how can it significance be illustrated to learners? vi. 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;							

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. ii. 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) Pedagogical Approach 2: Collaborative learning 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. To differentiate: For learners who are struggling to grasp the concepts: 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. For advanced learners: 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) Key Assessment: Provide a variety of assessment tasks to cater for the varied learners. i. Assessment Level 2: Enumerate the various subsets of the real number system using a Venn diagram/flow chart or number line. ii. Assessment Level 3: Investigate the closure properties of the various subsets of the real number system, under the operations $(+, -, \times, \div)$. iii. 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.	
Keywords	Union, intersection, complements, surveys, sets, etc.
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. <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.
Assessment DoK aligned to the Curriculum and Subject Teacher Manual	
<u>Level 2</u> 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.

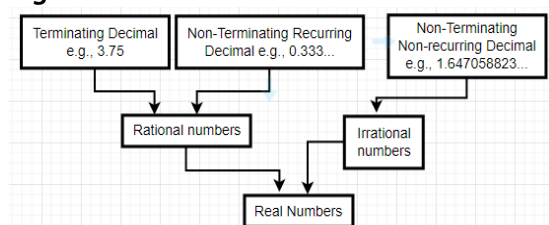
Introduction (e.g. 25 minutes)

- 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: 1. 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 <i>In completing this part, refer to the Essential Questions to check that learning has taken place.</i>	
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?

d) Were the different subgroups in the class catered?

e) 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>i. What is the essential knowledge and skills that learners need to learn based on sets and its application in real-life?</i> <i>ii. How will learners' prior knowledge help them understand the concepts?</i> <i>iii. How can I create a classroom culture that values diversity and inclusivity?</i> <i>iv. How can learners apply their knowledge of sets solving real-life problems?</i> <i>v. What pedagogies and assessment strategies can I employ to meet all learners' needs? etc.</i>						
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

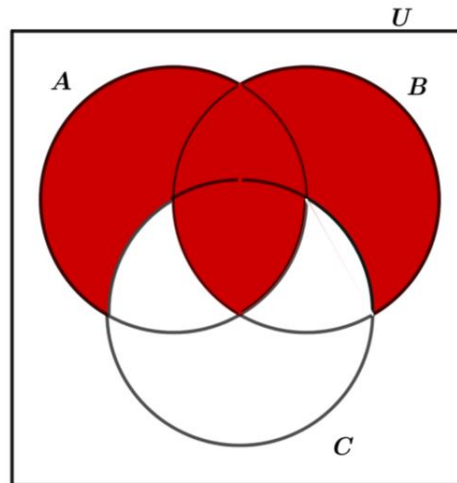
Keywords

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
<u>Starter Activity (5 minutes)</u> 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	
<u>Introduction (e.g. 30 minutes)</u> - 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 - Summarise learners' presentations and correct their misconceptions on the description, types and characteristics of sets <u>Activity 1 (e.g. 45 minutes)</u> Using problem-based and experiential approaches task learners to investigate the commutative, associative and distributive properties of set by both algebraic and graphic approaches <u>Activity 2 (e.g. 30 minutes)</u> Using discovery and experiential learning approaches, guide learners to explore the regions of a three-set Venn diagram	<u>Introduction (e.g. 30minutes)</u> 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 <u>Activity 1 (e.g. 45 minutes)</u> Investigate the commutative, associative and distributive properties of set by both algebraic and graphic approaches <u>Activity 2 (e.g. 30 minutes)</u> In your groups explore the regions of a three-set Venn diagram
Assessment DoK aligned to the Curriculum and Subject Teacher Manual	
<u>Assessment level 1: Recall</u> - Consider the sets: $A = \{\text{red, green, blue}\},$ $B = \{\text{red, yellow, orange}\},$ $C = \{\text{red, orange, yellow, green, blue, purple}\}$ $D = \{\text{yellow, white}\}$ and the universal set, $U = A \cup B \cup C \cup D$ - find $A' \cap C$ - find $A \cup C$ and $B' \cap A$. - 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. $A \cup C$
- b. $B \cap C$
- c. $A \cap B$
- d. $\overline{(A \cup C)}$
- e. $\overline{(A \cap B)} \cup C$

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. A
 - b. C
 - c. B
 - d. $A \cap C$
 - e. $B \cup C$
 - f. $(B \cap C) \cup A$

Assessment level 2: Skills of conceptual understanding

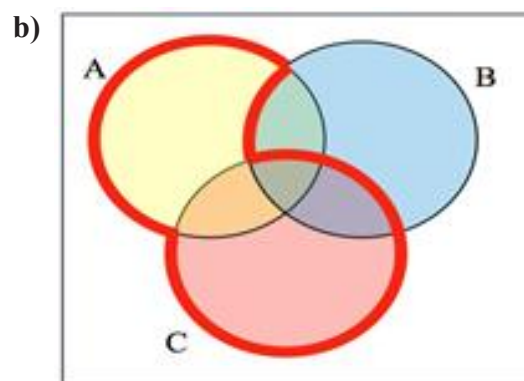
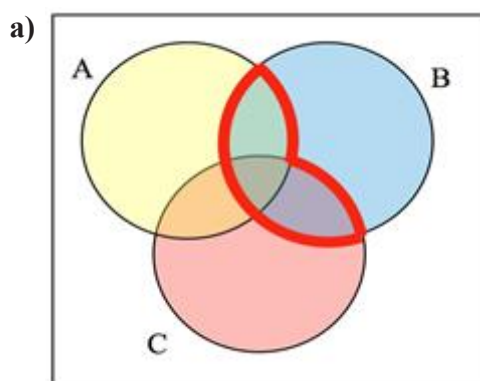
1. The set $A = \{1, 3, 5\}$. What is a larger set that this might be a subset of?
2. Draw a Venn Diagram to represent that set G is a proper subset of set P .

Assessment level 3: Strategic reasoning

1. Find $(A \cup B)'$ if $n(A) = 42$, $n(B) = 70$ and $n(A \cap B) = 20$
2. 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:

1. 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)

- c. 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).

- f) 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)
- g) 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?

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

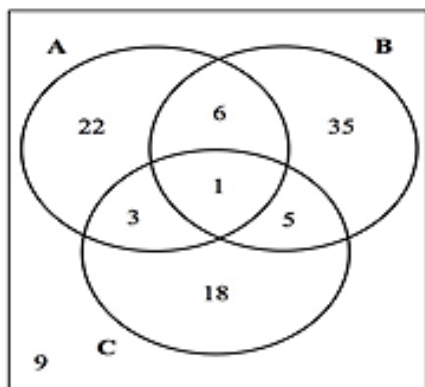
Activity 2 (e.g. 60 minutes)

- 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

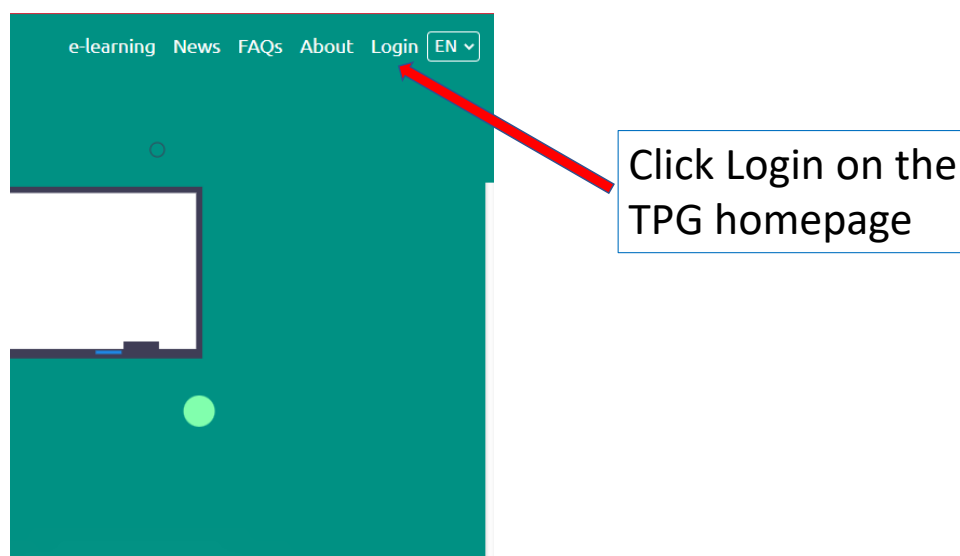
22. Areas for development

23. Next steps for teacher

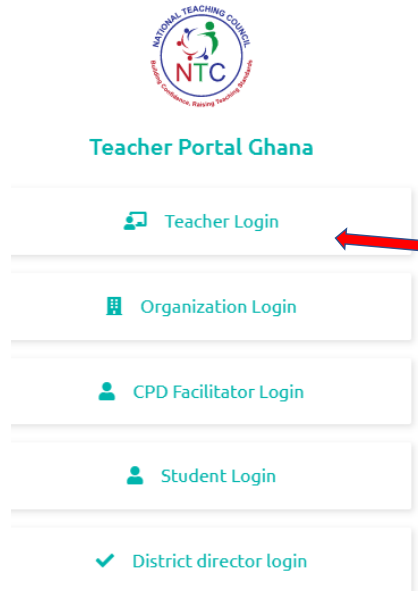
24. Additional Notes (on teacher's actions, the flow of activities, etc.)

HOW TO AWARD CPD POINTS TO DESERVING TEACHERS

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



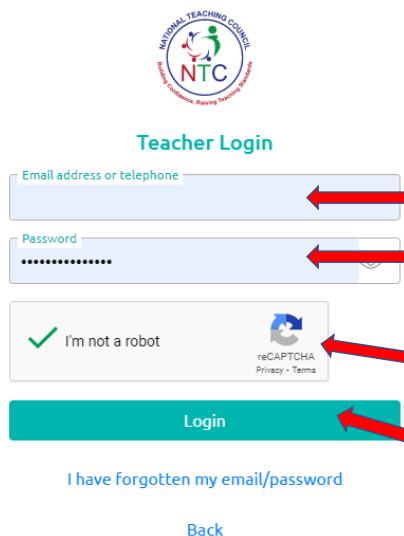
2. On the Login page, click Teacher Login



The image shows the 'Teacher Portal Ghana' login page. At the top is the NTC logo with the text 'NATIONAL TEACHING COUNCIL' and 'NTC'. 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 checkmark icon), and a 'Login' button. 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)

The screenshot shows the TPG dashboard for a user named Sam. The left sidebar contains a menu with the following items: Home, Training programs, Training records, NTC training programs, Portfolio, Profile, Terminal INSETs, Managed station, and Professional standing. The main content area displays a greeting 'Hello Sam,' followed by a 'Current license' card. The license card shows the name 'Sam', number 'PT/0001', and validity from '21st October 2022' to '21st October 2025'. To the right of the license card is a dashed box containing a warning icon and the text 'No upcoming training programs' with a link to 'Training programs'. Below these elements is a 'Rank progression' section.

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

The screenshot shows the 'Teachers' page in the TPG dashboard. The left sidebar is the same as in the previous image, with 'Managed station' highlighted. A red arrow points from the 'Managed station' menu item to a text box that says 'Click on Managed station'. The main content area is titled 'Teachers' and features a search bar with the placeholder 'Search by name or email'. Below the search bar is a table with two columns: 'Name' and 'INSETs'. The table contains one row with a placeholder for a name and the text 'Processed 0 of 4 INSETs'. Below the table, it says 'Showing 1 - 1 of 1 items'. A red bracket on the right side of the table points to a text box that says 'List of teachers in the school'.

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)

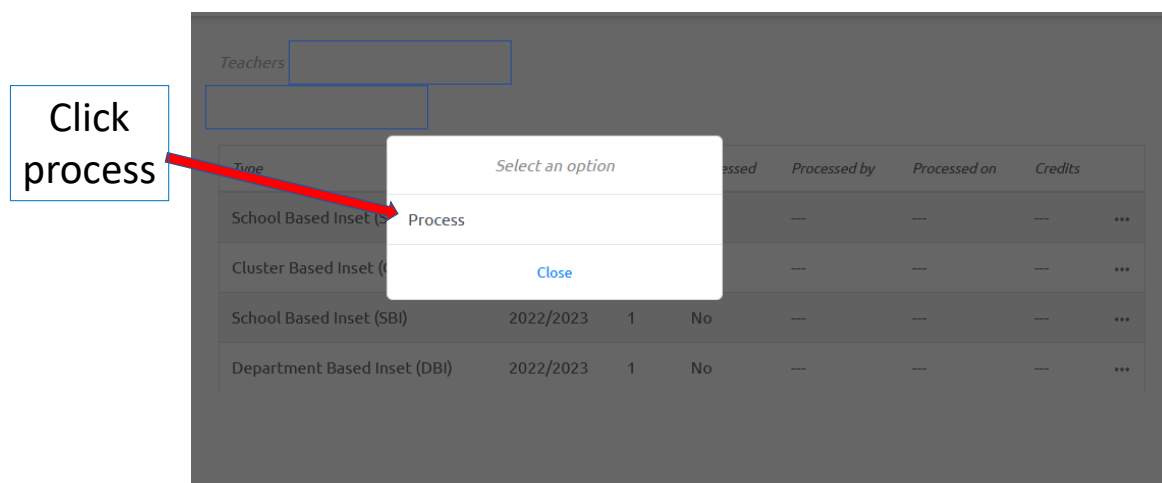
Teachers /

Click here to process

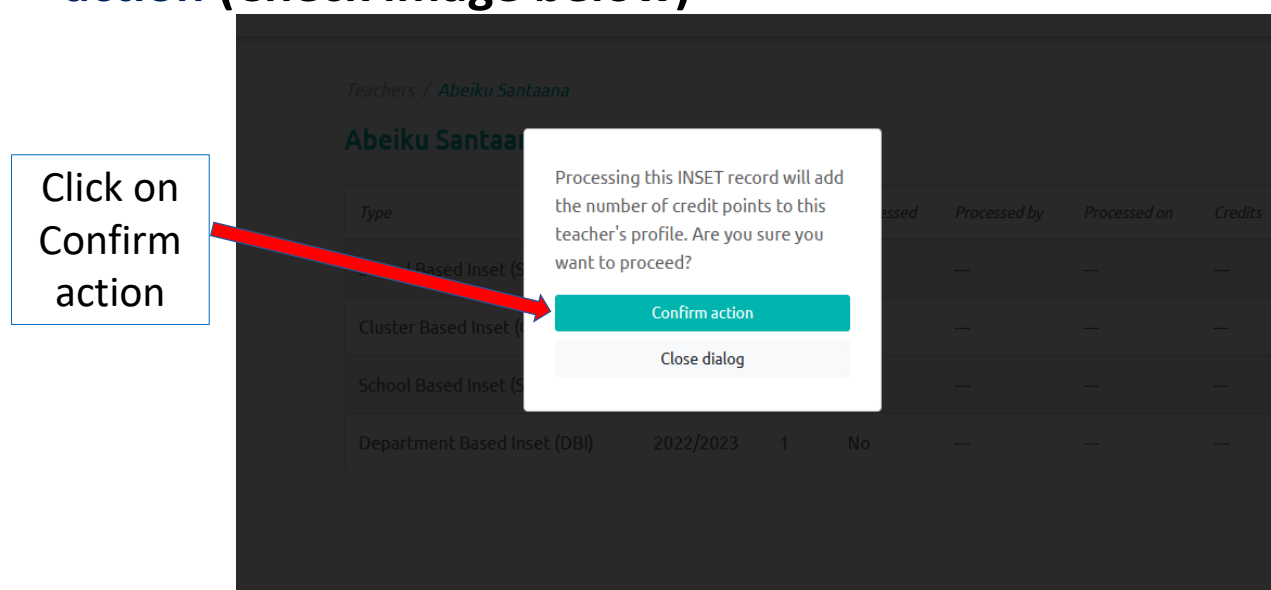
Type	Year	Term	Processed	Processed by	Processed on	Credits	
School Based Inset (SBI)	2022/2023	1	No	---	---	---	...
Cluster Based Inset (CBI)	2022/2023	1	No	---	---	---	...
School Based Inset (SBI)	2022/2023	1	No	---	---	---	...
Department Based Inset (DBI)	2022/2023	1	No	---	---	---	...

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 /

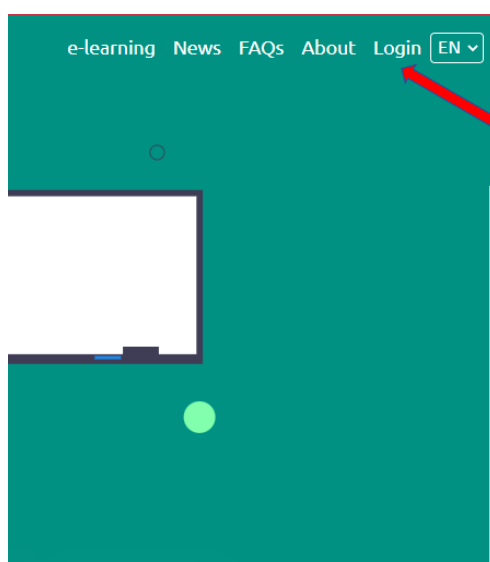
Points processed

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

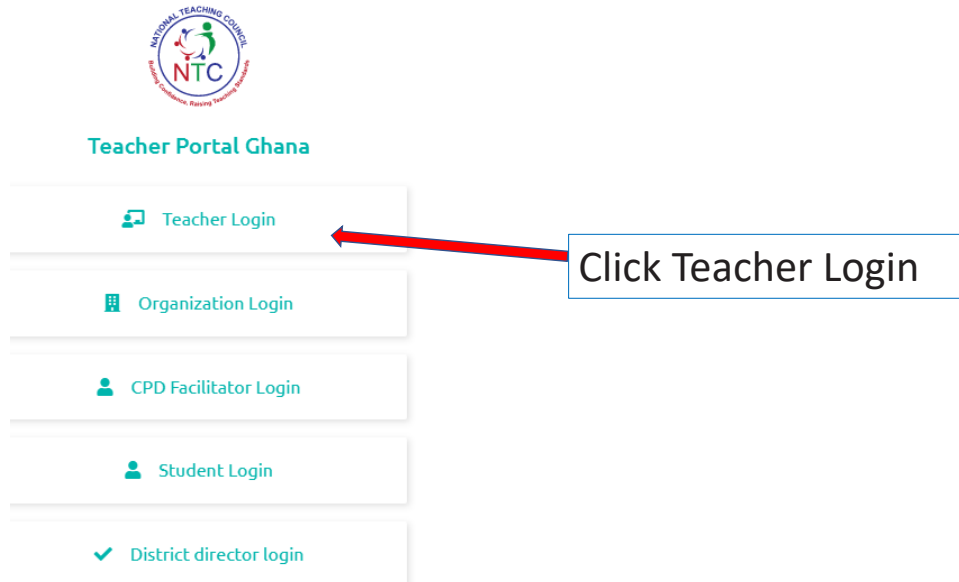
HOW TO CHECK CPD POINTS AND TRAINING RECORDS ON TEACHER PORTAL GHANA

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



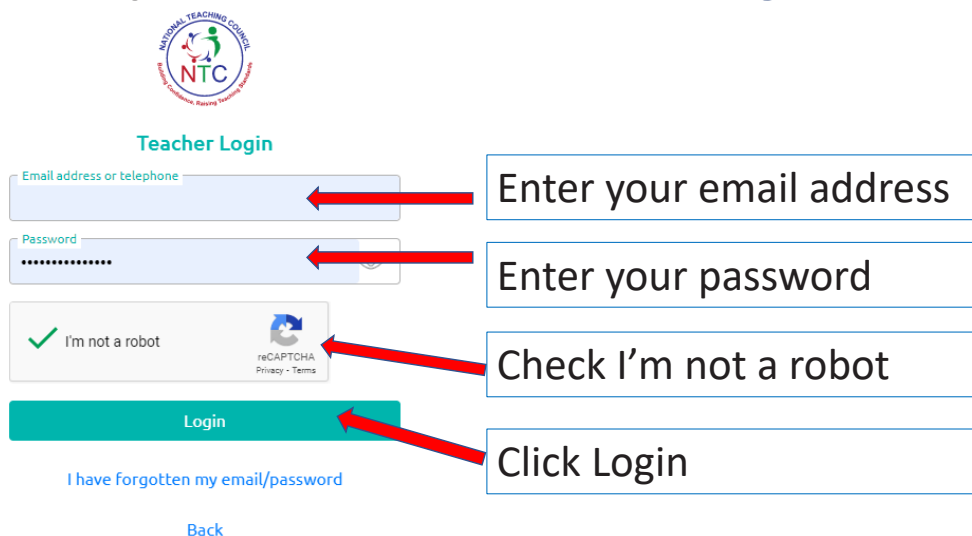
Click Login on the
TPG homepage

2. On the Login page, click Teacher Login



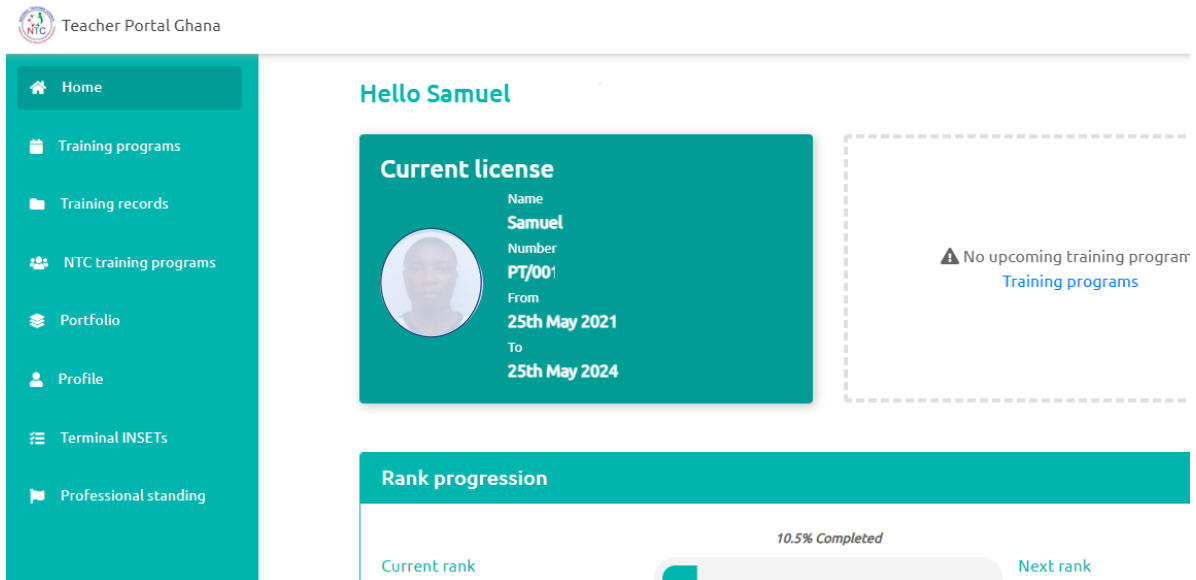
The image shows the 'Teacher Portal Ghana' login page. At the top is the NTC logo with the text 'NATIONAL TEACHING COUNCIL' and 'NTC' in the center. Below the logo is the title 'Teacher Portal Ghana'. There are five login options listed in a vertical stack: 'Teacher Login' (with a person icon), 'Organization 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 the following items: Home, Training programs, Training records, NTC training programs, Portfolio, Profile, Terminal INSETs, and Professional standing. A red arrow points to the 'Training records' item. The main content area is titled 'Training records' with the subtitle 'Records for training programs registered and/or attended'. It shows a total of 1.8988 points. 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 of training programs points to a box labeled 'List of training programs'. Below the side menu, a box labeled 'Click to view training records' has an arrow pointing to the 'Training records' menu item.

THANK YOU