

National School Curriculum  
**INSTRUCTIONAL GUIDE**  
**FOR ICT**  
**CLASSES IX & X**



Department of Curriculum and Professional Development  
Ministry of Education, Royal Government of Bhutan



“Your parents, relatives, and friends would be very proud of what you have achieved. At your age, to have completed your studies is your personal accomplishment. Your knowledge and capabilities are a great asset for the nation. I congratulate you for your achievements. Finally, your capabilities and predisposition towards hard work will invariably shape the future of Bhutan. You must work with integrity, you must keep learning, keep working hard, and you must have the audacity to dream big.”

*- His Majesty Jigme Khesar Namgyel Wangchuck*

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### Research and writing 2021

1. Amit Dahal, Teacher, Yangchenphug HSS, Thimphu
2. Dorji Thinley, Teacher, Gaupel LSS, Paro
3. Karma Phuntsho, Teacher, Yangchenphug HSS, Thimphu
4. Kumbu Dorji, Teacher, Katsho LSS, Haa
5. Norbu Sonam Lhaden, Teacher, Tshaphel LSS, Haa
6. Sangay Tempa, Teacher, Taju PS, Paro
7. Sonam Peldon, Teacher, Drukgyel LSS, Paro
8. Tenzin Dorji, Teacher, Khangkhu MSS, Paro
9. Ugyen Dendup, Teacher, Khasadrapchu MSS, Thimphu
10. Sonam Tshering, Program Officer, DCPD
11. Ugyen Dorji, Specialist, DCPD
12. Thinley, Curriculum Developer, DCPD

### Advisers

1. Mr. Tashi Namgyal, Director, DCPD, MoE
2. Mr. Kinga Dakpa, Director General, REC
3. Mr. Wangpo Tenzin, Specialist & Dean, DCPD, MoE

## Foreword

The erstwhile Royal Education Council (REC) developed an Adapted and Prioritized curriculum for schools so that students can continue learning during the disruptions caused by the COVID 19 pandemic since March 2020. With the commencement of the 2021 academic session, the new normal curriculum, later renamed as the National School Curriculum (NSC), was embraced as a paradigm shift of education from conventional knowledge-based learning to competency-based, open-source and experiential learning leveraged on digital technologies. In order to facilitate the effective implementation of the curriculum change, Instructional Guides were developed in all subjects, and the teachers were oriented through virtual and short contact modes as per the prevailing pandemic situations. The curricula were aimed at minimizing the learning loss for learners as it was designed for implementation in different situations - during school closure or during regular contact instructional hours.

While these measures served as a solution to problems brought about by the pandemic and the global changing trend in education, resilient and more dynamic curricula and instructions remain the current priority of the Government. In cognizance of some of the shortfalls in the provisional edition of Instructional Guides (IG), the Department of Curriculum and Professional Development reviewed and revised the existing Instructional Guides across all subjects with the aim of enforcing the competency-based learning, and making teaching-learning happen ‘anytime anywhere’ commensurate to inclusive education so that all learners are provided with the opportunity to learn at their pace and situation.

The revised Instructional Guides have drawn ideas and inspiration from various educational philosophies and principles, particularly the Delors Report, *Learning: The Treasure Within* (1996). The report prioritizes the development of the whole person and not just academic knowledge through the four pillars: “learning to know”, “learning to do”, “learning to be”, and “learning to live together”. Therefore, the New Curriculum and the Instructional Guide is an attempt to transform education from the teaching of “what” to learning of “how” and “why” towards empowering learners with the transversal competencies and the 21<sup>st</sup> century skills and preparing them to be lifelong learners.

It must be noted that the New Curriculum and the Instructional Guide are not just a response to the pandemic, but a culmination of the curriculum reform work for the last four years by the

Department of Curriculum and Professional Development. The school curricula are to be perceived as integrated and based on themes and problems that inspire learners to learn and to live in peace with our common humanity and our common planet. This has the potential for the development of a strong base of knowledge about one's self and about the world, finding the purpose of learning, and being able to participate in the social and political milieu. Thus, this initiative is envisaged to orient our educational process toward nurturing 'nationally rooted and globally competent citizens.

Wish all our learners and teachers life-enriching teaching and learning.

Tashi Delek

A handwritten signature in black ink, appearing to read 'Tashi Namgyal', with a horizontal line underneath it.

Tashi Namgyal

**Director**

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## Introduction

The National School Curriculum for the Information and Communication Technology (ICT) was developed for implementation in schools from the 2021 academic year. One significant change in the curriculum frameworks is the shift of focus from academic standards to competencies. Over the years, standards-based education has become a means of measuring content coverage and test readiness. The shift to competency-based education is aimed at developing and applying competencies - knowledge, skills and dispositions - to new and challenging situations. It emphasizes mastery of competencies to help our students successfully navigate their personal journeys in learning, living and working.

In school, students develop and apply ICT competencies through ICT subject-area content and learning experiences which provide opportunities for them to transfer their learning to situations and contexts even beyond the classroom. This shift permeates across the curriculum, pedagogy and assessment, and for this change to make a difference in learning, deliberate attempts must be made in all three aspects.

This instructional guide for the ICT curriculum is conceived with two objectives. The first purpose is to provide examples of how pedagogy and assessment are designed to help students develop the required ICT competencies. It also includes examples of curated online resources that can be used as reference materials for teachers, learning resources for students or assessment tools for use by teachers. The second purpose is to provide a reference for ICT teachers to facilitate the delivery of online lessons during emergencies. The guide contains distinct examples of pedagogy and assessment for non-contact online teaching.

The pedagogy, assessment and resources mentioned for every competency for all class levels are only meant to be suggestive. Teachers are encouraged to modify them, use innovative strategies or create new lessons that are relevant to their students and situations, and can help students develop and master the required competencies.

A salient feature of the guide is the conscious integration of ICT in teaching and learning. This may be in the form of blended learning during normal school settings, or fully online teaching during emergencies such as the current pandemic. The curated digital resources provided in the guide can be applied to both blended learning and online teaching depending on the instructional approach being used by the teacher.

## Purpose of the Instructional Guide

The content in the instructional guide is aligned with the competencies and topics provided in the National School Curriculum for ICT. The instructional guide comprises competencies, topics, learning experiences, assessments and resources that will facilitate teachers to successfully deliver the ICT curriculum. Using a competency and corresponding topic as the pivot, learning experiences and assessments are written towards achieving the competency.

Learning experiences provide suggestive strategies and pedagogies for the delivery of the listed competencies. It has both contact and online teaching strategies. Contact teaching refers to a situation when schools are open, and teaching and learning take place face-to-face in a classroom. Teachers can apply a blended teaching approach for meaningful ICT integration and delivery of lessons. Online teaching refers to a situation where teaching and learning happen online during school closures due to emergencies like pandemics. In such a situation, teachers need to consider relevant pedagogies that are supported by technologies such as the ones given below:

1. Choose an online learning platform such as Google Classroom, Sherig LMS (under development), WeChat, WhatsApp, Telegram, etc. considering the ease of use and appropriateness of the tool for the students. This platform is to be used as a virtual classroom for presentations, discussions, sharing resources, assigning tasks, and assessment of learning.
2. For lesson delivery by teachers, consider the use of video conferencing tools such as Zoom and Google Meet for synchronous teaching, and creation tools such as Microsoft PowerPoint and Camtasia for asynchronous teaching.
3. For assessment purposes, consider the use of tools such as Google Forms and Kahoot to create quizzes, Google Docs, Google Sheets and Google Drawings in Google Classroom to assign tasks for students.
4. For the recording of student performance, consider the use of the grading feature in Google Classroom or spreadsheets such as Google Sheets and Microsoft Excel. The scores from these sources can be transferred to the student progress report as per the assessment criteria.

Suggestive pedagogies, assessments and resources for each competency are listed below. Teachers are advised to refer to the instructions given therein for their lesson planning and effective delivery of the ICT lesson to the learners.

# Class Nine

Students will be able to:

1. produce spreadsheet documents to perform basic data analysis by applying functions and formulas.
2. resolve common networking problems in their system by following appropriate strategies explored on the Internet.
3. learn independently by enrolling in relevant online courses to upgrade their knowledge and skill.
4. deal positively with cyberbullying and other negative online behaviours and become a responsible online user by advocating cyberbullying, fake news and online crimes.
5. evaluate different types of media messages to make an informed judgement as consumers and producers of media and information.
6. adopt the practice of writing algorithms and flowcharts, and appreciate how it helps in analysing and solving the problems efficiently.
7. create graphical drawings using GUI modules to enhance coding knowledge and skills.
8. demonstrate efficient use of data type, loops, and control statement concepts to solve a problem.

## STRAND A – Technology Operation

**COMPETENCY 1:** Students will be able to produce spreadsheet documents to perform basic data analysis by applying functions and formulas.

### Overview:

Spreadsheets are productivity software that most people use to work on data and its representations. Students will learn the basic operations of Microsoft Excel and some of its essential functions. Projects such as analysing examination marks through the use of functions and formulas will help students understand the benefits of using spreadsheets for data analysis. They will further explore online tools such as Google Sheets and use the features to work collaboratively.

Through lessons under this competency, students will be able to use spreadsheets effectively, identify the benefits of using spreadsheets, and be able to switch between MS Excel and Google sheets with ease.

Topics	Key Stage Standard	Objectives	Time
<p><b>Introduction to MS Excel</b></p> <ul style="list-style-type: none"> <li>● Basic cell and data formatting</li> <li>● Data types in Excel</li> <li>● Changing cell colour</li> <li>● Text alignment</li> <li>● Inserting and deleting rows and columns</li> <li>● Merging and splitting cells</li> <li>● Applying borders</li> <li>● Cell referencing - absolute, relative, mixed referencing</li> </ul> <p><b>Functions in MS Excel</b></p> <ul style="list-style-type: none"> <li>● Entering formulas</li> <li>● Basic mathematical functions</li> <li>● Sum( ), Average( ), Count( ), Counta( ), Max( ), Min( ), if().</li> <li>● Creating Google Sheet files</li> <li>● Project - Calculation in MS-Excel/Google Sheets</li> </ul>	<p>A4.1 Perform basic data analysis using a spreadsheet.</p>	<p>9-A4.1.1 Format cells in a spreadsheet.</p> <p>9-A4.1.2 Use functions to perform basic calculations in a spreadsheet.</p>	<p>400 mins (10 periods)</p>

### Learning experiences:

- Use a projector to display an Excel sheet with sample data and demonstrate how to apply cell formatting (merge, height, width, border, etc.) and data formatting (alignment, colour, font,

direction, etc.). Then ask students to apply this formatting by doing an activity in Excel such as creating a shopping list.

- Use a sample activity in Excel to explain cell referencing (absolute, relative, mixed). Show the use of dollar signs (\$) and colons(:) to refer to a particular cell or range. Then, allow students to practice different cell referencing in pairs or individually.
- Demonstrate the use of formulas in Excel to perform basic mathematical calculations such as addition, subtraction, division, and multiplication. Then, ask students to create a simple daily account of a shop where they have to find the total sales, discounts, and profits made for the day.
- Show how to enter functions (sum(), average(), max(), min(), rank(), count(), if(), countif(), etc.) in Excel and let students apply the functions by giving a relevant task such as calculating the result sheet for examination.
- Introduce Google Sheets to students as an online alternative tool to Excel. Demonstrate or show a video tutorial on how to access Google Sheets and perform basic calculations and data formatting in Google Sheets. After this, make students create a Google Sheet document.
- Assign a project work in Excel for students to create a monthly income and expenditure account for their family. List the sources of income (salary, bonus, allowance, etc.) and expenditures (rent, food, education, clothing, etc.) to calculate and analyse the family budget for the year. Ask students to identify whether their family is having a healthy or unhealthy budget.
- Prepare a PowerPoint presentation on cell formatting, cell referencing, formulas, and functions in Excel. Share the material on the class online platform (Google Classroom or Moodle) for students to refer to and take notes.
- Share weblinks and online resources such as video, pdf, and ppt on introduction to Excel through the class online platform. Ask students to go through the resources and complete a task.
- Conduct a video conference through Zoom or Google Meet to show how to use Excel and Google Sheets to perform basic calculations to analyse data. Provide a relevant task for students to use Excel or Google Sheets to analyse data such as finding the BMI of their family members.

### **Assessment**

- Observe and maintain a record of how students are participating and performing when they are doing activities on Excel.
- Evaluate the Excel projects submitted by students in pairs or groups by using a rubric.

- Assign a task for students to plan and work out the budget for a family trip to a new place during the summer vacation. Ask them to use Excel to prepare the trip schedule and daily expenditure to estimate the total budget for the trip. Use a rubric to evaluate students' works.
- Assign a task on Google Sheets for students to find out the value of assets owned by a family such as land, house, vehicle, jewellery, etc. Ask students to list the asset and the estimated value in the market to determine the total value of the asset owned by that family. This is to give an overview of the value of different assets in the market and how it changes over time.
- Use the class online platform to conduct an online quiz using Google Forms or Kahoot on cell formatting, cell referencing, and functions in Excel. Maintain a record of their scores.

### Questions:

1. As a student, where will you apply the data analysis skills using Excel?
2. What are the differences and similarities between charts you draw in Mathematics and MS Excel?

### Resources:

1. **Introduction to Excel:** The weblinks provide the basic information on what is MS Excel and what are some of the key features in Excel. It also gives step to step procedures to use Excel for data analysis.
  - <https://www.guru99.com/introduction-to-microsoft-excel.html>
  - <https://www.tutorialspoint.com/excel/index.htm>
  - [https://www.dit.ie/media/ittraining/msoffice/MOAC\\_Excel\\_2016\\_Core.pdf](https://www.dit.ie/media/ittraining/msoffice/MOAC_Excel_2016_Core.pdf)
  - [https://elmhurstpubliclibrary.org/lib/wpcontent/uploads/Excel\\_Basics\\_Projects\\_Handout\\_111416VH.pdf](https://elmhurstpubliclibrary.org/lib/wpcontent/uploads/Excel_Basics_Projects_Handout_111416VH.pdf)
2. **Functions in Excel:** The weblinks have videos and sample activities on how to create Excel functions such as sum(), average(), max(), min() and others. It also explains arguments in functions and gives shortcut tips in Excel.
  - <https://edu.gcfglobal.org/en/excel2016/functions/1/>
  - <https://www.guru99.com/introduction-to-formulas-and-functions-in-excel.html>
  - [https://www.youtube.com/watch?v=k1VUZEVuDJ8&ab\\_channel=Teacher%27sTech](https://www.youtube.com/watch?v=k1VUZEVuDJ8&ab_channel=Teacher%27sTech)
  - [https://www.mc.vanderbilt.edu/crc/workshop\\_files/2008-02-08.pdf](https://www.mc.vanderbilt.edu/crc/workshop_files/2008-02-08.pdf)
3. **Google Sheets:** The weblinks shows how to create Google Sheets and add data for formatting and analysing using functions. The videos and web resources have detailed information on how to manage Google Sheets.
  - <https://railsware.com/blog/google-sheets-for-beginners/>
  - <https://www.smartsheet.com/essential-google-spreadsheet-tutorial>
  - [https://www.youtube.com/watch?v=cVLXkMC8-x8&ab\\_channel=LovesData](https://www.youtube.com/watch?v=cVLXkMC8-x8&ab_channel=LovesData)

4. **Rubrics:** The weblinks provide sample rubric to evaluate projects in Excel. Teachers can modify the rubrics to make them relevant to their student's tasks.

- <https://www.rcampus.com/rubricshowc.cfm?sp=yes&code=A45BB8&>
- <https://engineering.queensu.ca/Current-Students/First-Year-Studies/files/Excel%20Word%20Assignment%20Rubric%202017.pdf>

**COMPETENCY 2:** Students will be able to resolve common networking problems in their system by following appropriate strategies explored from the Internet.

**Overview:**

Computer networks are all-pervasive. Students at this stage will learn some of the network technologies, and the procedure to configure and troubleshoot in case of problems. They would also learn to explore solutions and strategies to curtail network issues.

Learning about networks and being able to troubleshoot simple network problems will help students save time and develop an interest in computer networking. Through troubleshooting, they will be able to identify and resolve common networking problems and be able to recommend network hardware and topologies for their friends and family members..

Topics	Key Stage Standard	Objectives	Time
<p><b>Network Troubleshooting</b></p> <ul style="list-style-type: none"> <li>• Definition of computer network and its classification</li> <li>• Networking devices</li> <li>• Configurations of networking devices such as routers and switches</li> <li>• Searching online solutions to network problems.</li> <li>• Strategies to Resolve Network Problems               <ul style="list-style-type: none"> <li>o Checking physical cable connection</li> <li>o Checking the connectivity of the router</li> <li>o Verifying IP address</li> <li>o checking the connection using the ping command.</li> <li>o checking the device drivers for the network adapter</li> <li>o checking virus infections</li> </ul> </li> <li>• Project - Troubleshooting a network problem (practical)</li> </ul>	<p>A4.2 Troubleshoot simple network problems.</p>	<p>9-A4.2.1 Resolve common networking issues.</p>	<p>160 mins (4 periods)</p>

### **Learning experiences:**

- Prepare a PowerPoint presentation to explain computer networks, types of networks, benefits of the network, and some common networking devices (routers, switches, cables, servers, etc.). Show the use of the network in their computer laboratory and explain how network administrators manage the users and devices on a daily basis.
- Provide a list of common issues that users experience in a computer network such as connectivity issues, cannot get an IP address, user login problems, etc. Discuss how these issues arise (poor cable connection, double IP address, faulty devices, incomplete setting) in the computer network and their implication on resources and time. Ask students to take notes on the network issues and their impact on personal time and resources.
- Divide students into groups and distribute a common network problem for each group to understand the problem entirely and come up with a solution. Students can explore the Internet to look for appropriate solutions or strategies (checking physical cable connection, checking the connectivity of the router, verifying IP address, checking the connection using the ping command, checking the device drivers for the network adapter, checking virus infections, etc.). Then, ask each group to make a presentation to the class.
- Display a network problem related to IP address on the projector screen and demonstrate how to use ping command and ipconfig in command prompt (cmd) to show how to resolve the problem. Then, ask students to check the IP address of their system and server using the commands for possible network issues.
- Assign a project work to students where they have to practically fix a computer network issue at school or home. For example, students may show evidence of how they have resolved mobile or laptop connectivity to wi-fi networks available at home or school.
- Create a video lesson on computer network issues and strategies to resolve network problems. Share the video on the class online platform for students to understand and take notes.
- Share weblinks or online resources on network troubleshooting and the benefits (save time, money and other resources) of having skills to resolve network problems in the digital age. Ask students to list a network problem that they have experienced in the past.
- Conduct an online video conference using Zoom or Google Meet to explain network, common network issues and strategies to resolve them. Provide an opportunity for students to share their views and experiences related to network troubleshooting.

### **Assessment:**

- Observe and maintain a record of students' participation in the class or group during the lessons or activities on network troubleshooting are conducted.



- Conduct class tests having different types of questions like MCQ, fill in the blanks, matching, etc. on a computer network, network issues and troubleshooting.
- Use a rubric to evaluate students' project works on network troubleshooting that they have completed at home or school.
- Prepare an online quiz on computer network and network troubleshooting using Google Forms or Quizizz and share it on the class online platform.
- Assign an online task for students to write a short essay on the benefits of having skills to troubleshoot network issues at home. Students may explore the Internet on the network information or share their experiences related to network issues and troubleshooting. Use a rubric to evaluate their writeup.

### Questions:

1. In a typical network setup, what is the role of each device?
2. How do you troubleshoot a network problem?
3. Recommend a resilient network in your computer laboratory.

### Resources:

1. **Computer Network:** The weblinks provide information on computer networks, types of networks and common devices of the network. The video and websites give clear explanations of the fundamentals of computer networks.
  - <https://www.tutorialsmate.com/2020/05/types-of-computer-networks.html>
  - <https://cccpracticetest.com/ccc-topic-basic-of-computer-networks>
  - <https://www.slideshare.net/makyong1/basic-concepts-of-computer-networks>
  - <https://www.youtube.com/watch?v=tSodBEAJz9Y>
2. **Network Issues and Solutions:** The weblinks provide information on some of the common network issues and solutions to fix the issues. Teachers may select relevant network solutions that students can apply in school or at home.
  - <https://www.a-b-s.com/common-network-issues-solutions>
  - <https://www.computerhope.com/issues/ch000445.htm>
  - <https://www.dnsstuff.com/network-troubleshooting-steps>
  - <https://www.youtube.com/watch?v=avb8ixMs-zI>
  - <https://www.youtube.com/watch?v=gPiid3NyN6U>

## STRAND B – Communication and Collaboration

**COMPETENCY 3:** Students will be able to learn independently by enrolling in relevant online courses to upgrade their knowledge and skill.

### Overview:

Massive Open Online Courses (MOOC) has provided an alternative to traditional ways of acquiring knowledge and skills. With easy access to the Internet, MOOC has made world-class education accessible to everyone globally including students at free or at a reasonable cost. Students can now explore multiple MOOC platforms such as Coursera, edX, and Udemy, and enrol in some of the courses to enhance their skills and knowledge.

By taking online courses as simple as the Khan Academy courses during the ICT lesson, students will be able to gain multiple benefits in terms of cost, learning and networking. In most cases, MOOC courses are offered by renowned subject experts and this will scaffold the learning of our students in the subject of their interest. MOOC courses will facilitate students to become independent learners and develop traits of a “learning to learn” person.

Topics	Key Stage Standard	Objectives	Time
<b>Introduction to Online Course</b> <ul style="list-style-type: none"><li>● Definition of online courses</li><li>● Massive Open Online Courses (MOOC)</li><li>● Examples of different online courses</li><li>● Khan Academy, Coursera, Udemy, edX. etc.</li><li>● Benefits and limitations of online courses</li><li>● Project – Enrolling on a relevant online course</li></ul>	B4.1 Learn independently by enrolling in online courses.	9-B4.1.1 Take online courses to enhance learning.	320 min (8 periods)

### Learning experiences:

- Make students explore the Internet and find out information on online courses. Ask them to list some examples of online courses that are relevant to class IX students. Ask students to create a presentation or report based on the following questions:
  - What is an online course?
  - Give some examples of online courses.
  - What are the benefits of taking online courses?
  - What are the limitations of online courses?
  - Should students take online courses in the 21<sup>st</sup> century? Why?

- Create a PowerPoint presentation to explain Massive Open Online Course (MOOC) and some of the popular MOOC platforms (Coursera, Udemy, edX, Khan Academy, etc.). Demonstrate how to look for a relevant course in Khan Academy and enrol in the course to begin learning. Then, ask students to explore different courses on various platforms.
- Invite a guest speaker (teacher, student, parents, other civil servants) who has a good experience taking online courses to share the benefits of MOOC and how it promotes independent learning. The guest speaker must inspire students and introduce tips and best practices of online courses to be awarded certificates at the end. Encourage students to ask questions to the guest speaker and take notes.
- Assign a project work for students to look for a relevant online course and complete it after a certain duration. In the end, ask them to write a short report on why they have selected the particular course and what they have learned from the course. Make them produce the certificate or some evidence of taking the course.
- Share a weblink of an online course on Python coding (<https://www.edx.org/course/computing-in-python-i-fundamentals-and-procedural>) through the class online platform and ask students to enrol and complete the course.
- Conduct a video conference through Zoom or Google Meet on MOOC and some examples of popular MOOC courses. Explain the benefits of MOOCs and how they promote independent learning. Then, ask students to look for a relevant MOOC course and share it on the class online platform.

#### **Assessment:**

- Conduct a class test for students to share their understanding and experience of online courses. The following questions can be asked.
  - What is your experience of taking online courses?
  - List some of the benefits you have received by undertaking online courses.
  - Would you take online courses in the future? Why?
- Evaluate students' project work on taking an online course based on evidence or certificate achieved. A rubric (duration, topic, activities, certificates, reflection, etc.) may be used to assess the project work.
- Make students write a reflection on their experience of taking an online course and submit it through the class online platform. Use a rubric to evaluate the work.
- Ask students to share some evidence of taking an independent online course from home through the class online platform. Use a rubric to evaluate students' learning.

#### **Questions:**

1. What are the benefits of MOOCs?
2. What are the technologies required to deliver online courses?

3. Do you think online courses are superior to traditional ways of delivering the courses?
4. Look for a MOOC platform and enrol on a course. Explain why you choose the course and when are you planning to complete the course.

### Resources:

1. **Online Courses:** The weblinks provide information on online courses and what makes a great online course. It also provides tips for taking online courses to make the most of online learning.
  - <https://www.onlinecoursehow.com/tips/what-is-an-online-course/>
  - [https://www.youtube.com/watch?v=eF-Z1hJ67-Y&ab\\_channel=VerbaltoVisual](https://www.youtube.com/watch?v=eF-Z1hJ67-Y&ab_channel=VerbaltoVisual)
  - <https://www.northeastern.edu/graduate/blog/tips-for-taking-online-classes/>
2. **Benefits and Limitations of Online Courses:** The weblinks provide information on the advantages and disadvantages of taking online courses.
  - <https://www.montgomerycollege.edu/academics/online-learning/distance/advantages-and-disadvantages-online-courses.html>
  - <https://elearningindustry.com/advantages-and-possible-limitations-of-online-learning>
  - <https://www.easy-lms.com/knowledge-center/courses/advantages-and-disadvantages-of-online-courses/item10402>
3. **MOOC Platforms:** The following weblinks are some of the popular MOOC platforms that provide both free and paid courses in different fields. Students can select relevant courses and enrol on their own to enhance learning.
  - <https://www.khanacademy.org/>
  - <https://www.coursera.org/>
  - <https://www.udemy.com/>
  - <https://www.edx.org/>

## STRAND C – Safety and Ethics

**COMPETENCY 4:** Students will be able to deal positively with negative online behaviours such as cyberbully, cybercrime, fake news, and others. Students participate in advocacy activities on ways to overcome cyberbullying, fake news and online crimes, and become responsible netizens.

### Overview:

By going through the lessons under this competency, students will learn about cyberbullying, measures to cope with online bullying, roles one must take in a cyberbullying situation, and extend a helping hand to the cyberbullying victims. Further, they also learn about ways of dealing with fake news, scams, defamation and crimes that are prevalent in online environments.

After understanding cyberbullying and online crimes, students will be able to prepare resources and create awareness of these concepts so that everyone is prevented from becoming a victim. They can identify and alert the community in case of fake news, scam and crimes online.

Topics	Key Stage Standard	Objectives	Time
<b>Cyberbullying</b> <ul style="list-style-type: none"> <li>● Definition and examples of cyberbullying</li> <li>● Measures to cope with cyberbullying.</li> <li>● Roles of bystanders and upstanders in cyberbullying</li> <li>● Effects of cyberbullying</li> <li>● Providing support to victims of cyberbully</li> <li>● Project - Awareness on cyberbullying.</li> </ul>	C4.1 Handle unethical online behaviour in a responsible way.	9-C4.1.1 Cope with cyberbullying situations.	80 mins (2 periods)
<b>Dealing with Negative Online Experiences</b> <ul style="list-style-type: none"> <li>● Definition of fake news</li> <li>● Verifying fake news</li> <li>● Online scams, defamation, and crimes</li> <li>● Ways to fight against fake or negative online information</li> <li>● Project – Poster design on dealing with negative online experiences.</li> </ul>		9-C4.1.2 Act responsibly to negative online information or experiences.	80 mins (2 periods)

### Learning experiences:

- Make students explore the Internet to create a short presentation on cyberbullying and its psychological and physical impact on victims. Make them cover the following points in the presentation:
  - What is cyberbullying?
  - Why and how does cyberbullying happen?
  - What are the impacts of cyberbullying?
  - How should you respond to cyberbullying?
- Conduct a role-play in the class on a cyberbullying situation. Allow students to enact as cyberbullies, victims, bystanders and upstanders. The role-play must give a message on how cyberbullying affects victims, and come up with ways to fight or cope with cyberbullies.
- Generate a class discussion where students are given the opportunity to share their experiences of being bullied online by others. Allow them to share how they felt like a victim

or bully and the subsequent actions they have taken to deal with the situation. Through the discussion, make students list the characteristics of bully, victim, bystander and upstander.

- Make a short presentation on some of the negative sides of having abundant information and multiple services on the Internet such as fake news, fake accounts, online scam, online crimes, and others. Share real-life examples of how people are cheated or robbed or got into trouble through online platforms. Then, ask students to search the Internet to look for information on how to deal with such negative online situations.
- Give a project work in pairs or groups to create awareness of cyberbullying or fake news. For the project, ask them to come up with a digital poster or short videos that explain measures to fight cyberbullying and fake news. The final posters or videos can be shared through social media platforms to reach out to more people.
- Create and share a video lesson on cyberbullying and its negative impacts on the victims through the class online platform. Instruct students to identify some of the key characteristics of cyberbullying from the lesson and ask them to list some ways to fight against cyberbullying.
- Share the weblink on cyberbullying (<https://www.accreditedschoolsonline.org/resources/cyberbullying-prevention-and-support/>) through the class online platform. Ask students to go through it and come up with a list of actions they need to do if they or their friends are being bullied online.
- Conduct a video conference using Zoom or Google Meets to present negative online experiences children may come across on a daily basis. Share about fake news, defamation, impersonation, and other online crimes with examples. Then, allow students to discuss and share their opinions or experience for a better understanding of the advantages and disadvantages of using the Internet.

**Assessment:**

- Assign a task for students to come up with a poster or a video to create awareness of cyberbullying and its negative impacts on the victims. Use a rubric to evaluate students' works.
- Give a project work for students to make a PowerPoint presentation on the negative impacts of online activities. Allow students to explore the Internet for information and suggest to them to list the measures to deal with negative online experiences. Evaluate students' presentation skills and content on the subject.
- Observe and maintain a record of students' participation during group works, role play and presentations on cyberbullying and fake news.

- Make students do a simple test on cyberbullying through the website ([https://www.proprofs.com/quiz-school/story.php?title=cyber-bullying-quiz\\_4](https://www.proprofs.com/quiz-school/story.php?title=cyber-bullying-quiz_4)). Record their scores at the end.
- Create online quizzes using Google Form or Kahoot on cyberbullying, fake news and other negative online activities. Share it on the class online platform and record their quiz scores.
- Generate an online discussion using the class platform on “Why do people create fake news or information through the Internet? How do you identify fake news from real news?”. Make students share their views and experiences in the discussion. Evaluate each student based on their number and quality of comments on the subject.

### Questions:

1. What are the roles and responsibilities that you would take to prevent cyberbullying?
2. How can you build your online reputation?
3. In case you come across fake news online, what course of action will you take to inform the larger communities on the Internet?

### Resources:

1. **Cyberbullying:** The weblinks explain what is cyberbullying and how we must respond when we are bullied online. The links also mention the consequences of cyberbullying and some of the common examples of cyberbullying through simple video animation.
  - <https://kidshealth.org/en/teens/cyberbullying.html>
  - <http://onlinesense.org/cyber-bullying-bystanders-teens/>
  - <https://www.hockeycanada.ca/en-ca/hockey-programs/safety/cyberbullying/facts/examples-kids-teens-adults>
  - <http://fundforcivility.org/cyberbullying-2/>
  - <https://www.childnet.com/ufiles/Cyberbullying-guidance2.pdf>
  - <https://www.youtube.com/watch?v=0Xo8N9qIJtk>
  - <https://www.youtube.com/watch?v=5wjKb4DAhI4>
2. **Dealing with Fake News, Online Scams and Impersonation:** The weblinks provide information on the definition of fake news and ways to spot and combat fake news.
  - <https://pure.ulster.ac.uk/ws/portalfiles/portal/11623427/FAKE+NEWS+RESOURCE+ULSTER+UNIVERSITY.pdf>
  - <https://onlinedegrees.und.edu/masters-cyber-security/tips-for-students-on-how-to-identify-fake-news/>
  - <https://libguides.uwf.edu/c.php?g=609513&p=4274530>
  - <https://www.visualcapitalist.com/how-to-spot-fake-news/>
  - <https://cdn.kqed.org/wp-content/uploads/sites/26/2016/12/Fake-news-lesson-plan.pdf>

3. **Dealing with Online Scams:** The weblinks provide information on the different types of online scams carried through emails and websites. The links also provide ways to protect ourselves from such scams.

- <https://www.nidirect.gov.uk/sites/default/files/publications/LittleBookBigScams201.pdf>
- <https://www.scamwatch.gov.au/get-help/protect-yourself-from-scams>
- <https://www.nidirect.gov.uk/articles/online-scams>
- <https://www.esafety.gov.au/key-issues/staying-safe/online-scams-identity-theft>

**COMPETENCY 5:** Students will be able to evaluate different types of media messages to make an informed judgement as consumers of information and media.

**Overview:**

Media literacy is the ability to critically analyze and evaluate the messages conveyed through media. In the digital age where we are surrounded by media on daily basis, it is important that students are informed about media literacy. Through the lessons under this competency, students will be informed about media types, and learn skills related to deconstructing media, and five key questions. They will learn to evaluate the credibility of information/media from various sources.

Media literacy benefit students to become critical consumers of media and save them from becoming unnecessary sources or channel of unreliable media content. Students will develop skills to analyse the content of online media using the five key questions. And share the analysis with their communities both offline and online for information and awareness.

Topics	Key Stage Standard	Objectives	Time
<p><b>Media Literacy</b></p> <ul style="list-style-type: none"> <li>• Definition of media literacy</li> <li>• Importance of media literacy</li> <li>• Types of media (print, broadcast, online, etc.)</li> <li>• Deconstruction of media</li> <li>• Five key questions (authorship, format, audience, content, purpose).</li> <li>• Project - construction or deconstruction of a media text</li> </ul>	<p>C4.3 Evaluate the credibility of information from various media.</p>	<p>9-C4.3.1 Analyse the content of online media.</p>	<p>160 mins (4 periods)</p>



### **Learning experiences:**

- Make students visit the link (<https://medialiteracynow.org/what-is-media-literacy/>) on media literacy and ask them to read and watch the video given on the website. Discuss and explain the following contents on media literacy in the class. Make students take notes.
  - Definition of media literacy.
  - Importance of media literacy.
  - How to become a media literate person?
- Make a PowerPoint presentation on different types of media (print, broadcast, online) and how they communicate information and reach different audiences. Show examples of different media like newspapers, posters, videos, audio, etc. Then, ask students to share which media they prefer most of the time and why.
- Select a media (<http://indiater.com/bhutan-packages-free-psd-banners/>) and display it to students for them to deconstruct it. Ask them to use the five keywords (authorship, format, audience, content, purpose) and questions as given in the link ([http://www.medialit.org/sites/default/files/QTIPS%20CHART\\_0.pdf](http://www.medialit.org/sites/default/files/QTIPS%20CHART_0.pdf)) to deconstruct the media. Make students share their findings with the class.
- Share two different types (print and online) of media on the same topic/message and for the same target audience. Make students compare the message they get from the two media and ask them to share which media is better for the target audience.
- Create a PowerPoint Presentation on the importance of media literacy and share it on the class online platform. Ask students to list at least five media they have recently used/referred for information and share how these media have helped them to remain informed.
- Conduct a video conference using Zoom or Google Meet to explain the 5 key words (authorship, format, audience, content, purpose) and key questions on media deconstruction. Make students deconstruct an online media they came across recently.

### **Assessment:**

- Frame questions (MCQ, fill in the blanks, short answer questions, etc.) and conduct a class test to check students' understanding of media literacy and types of media.
- Give a group project work for students to construct or deconstruct a media (poster, video, audio, book, blog post, image, etc.) based on the five key questions. Ask each group to come up with a short report and make a presentation of their project work. Evaluate the presentation and report using a rubric.
- Assess students' understanding of media literacy by conducting online quizzes using Google Form or Quizizz.
- Assign a task for students to share the information on media literacy and tips to deconstruct the media with their parents and siblings. Instruct them to maintain a record of their family

awareness program on media literacy in the form of video or pictures. Ask them to share the evidence of their program on the class online platform for grading.

- Make students explore the Internet to write a short report on the importance of social media literacy in the digital age. Ask them to submit the report through the class online platform for evaluation. Students may consider the following points in the report:
  - What is social media?
  - Advantages and disadvantages of social media.
  - How to deconstruct media/information shared on social media?
  - How to become a responsible social media user?

### Questions:

1. How did media literacy help you?
2. What are some of the ways to validate online materials?
3. Think of ways to share what you have learned about media literacy with your community.
4. How do you behave on social media after being informed about media literacy?

### Resources:

1. **Media Literacy:** The weblinks provide information on media literacy, types of media and the importance of media literacy in the media and information age.
  - <https://www.commonsense.org/education/articles/media-literacy-resources-for-classrooms>
  - <https://www.slideshare.net/markjhonoxillo/types-of-media-78381986>
  - <https://medium.com/inspired-ideas-prek-12/media-literacy-starts-with-students-1acfd67ae769>
  - <http://www.bmf.bt/wp-content/uploads/2020/01/Media-Literacy-Training-Module-2019-Intermediate-online.pdf>
  - <https://bbamantra.com/media-types-characteristics/>
  - <https://www.youtube.com/watch?v=AD9jhj6tM50>
2. **Deconstruction of Media:** The weblinks have information on ways to break down media messages to get a better understanding of who, how, and why the media is created.
  - <https://www.sophia.org/tutorials/deconstruct-media-messages>
  - [https://www.21stcenturyschools.com/uploads/2/1/5/4/21542794/deconstructing\\_media\\_messages.pdf](https://www.21stcenturyschools.com/uploads/2/1/5/4/21542794/deconstructing_media_messages.pdf)
  - <https://www.youtube.com/watch?v=4b8HaTN8XPk>

## STRAND D – Coding

**COMPETENCY 6:** Students will be able to adopt the practice of writing algorithm and flowchart, and appreciate how it helps to analyse and solve problems efficiently.

### Overview:

As students get introduced to the world of computer science, they need to learn about algorithms and flowcharts as a foundation for computer science. These techniques are essential elements in the software development cycle. In preparation for coding animations and games, students will learn to design algorithms and construct flowcharts.

Algorithms and flowcharts are methods that would help students in understanding the problem statement. These intermediary components assist in transferring the business logic from abstract concepts to code.

Topics	Key Stage Standard	Objectives	Time
<b>Algorithm and Flowchart</b> <ul style="list-style-type: none"><li>• Definition of algorithm and flowchart</li><li>• Characteristics of an algorithm</li><li>• Examples of algorithm and flowcharts</li><li>• Designing algorithm and flowcharts</li></ul>	D4.1 Develop a text-based application by applying procedural programming concepts.	9-D4.1.2 Follow good programming practices.	120 mins (3 periods)

### Learning experiences:

- Prepare a PowerPoint presentation to explain algorithms and show how to write good algorithms (has a set of inputs, steps are uniquely defined, have a finite number of steps, produce desired output) for a program such as a process of preparing a tea or adding two whole numbers. Then, make students write an algorithm to multiply two numbers.

Algorithm for multiplying two numbers

- o Step 1: Start
  - o Step 2: Read the first number.
  - o Step 3: Read the second number.
  - o Step 4: Multiply the first number and second number.
  - o Step 5: Display the result.
  - o Step 6: End
- Instruct students to explore the Internet to look for information on flowcharts and come up with the key concepts of flowcharts. Ask them to list down the different shapes (oval, rhombus, rectangle, arrow, parallelogram, etc.) and their function in the flowchart. Then, ask

students to write a flowchart for the algorithms they created earlier. This link (<https://www.edrawsoft.com/algorithm-flowchart-examples.html>) on the sample algorithm and flowchart may be given to students for reference.

- Divide students into groups of three or four and assign each group with a task to create an algorithm and flowchart for different programs such as finding the area of a rectangle, verifying a number as even or odd, comparing two numbers, etc. Ask each group to make a presentation of their work and share what they have learned from doing it.
- Use a video or website to explain why we need to learn about algorithms and flowcharts in programming (enables analysis of the problem at hand, promotes effective communication between team members, acts as a blueprint for coding, assists in debugging, documentation for future reference during maintenance phase). Make students discuss and take notes on the benefits of algorithms and flowcharts.
- Share online resources (video, ppt, pdf, website) on creating algorithms and flowcharts in programming through the class online platform for students to learn and take notes. The resources must include steps to create algorithms and different shapes that are used to create flowcharts for a program.
- Arrange a video conferencing lesson using Zoom or Google Meet to explain the benefits of algorithms and flowcharts to solve a programming problem. During the lesson, the teacher can also demonstrate how to create an algorithm and flowchart for a program such as finding the largest of the three numbers.

#### **Assessment:**

- Evaluate the algorithms and flowcharts on different programs written by students in their notebooks during the classwork.
- Ask groups to make a presentation of their algorithm and flowchart for different programs and evaluate the content and delivery using a rubric.
- Provide worksheets on flowcharts and algorithms for students to complete within a given time. A sample quiz is given here (<https://quizizz.com/admin/quiz/58ff47663635b511003f6de7/algorithms-pseudocode-flowchart>). Divide points for flowchart and algorithms in the worksheet for awarding scores in the end.
- Conduct online quizzes using Google Form or other online platforms ([https://www.proprofs.com/quiz-school/story.php?title=algorithms\\_1](https://www.proprofs.com/quiz-school/story.php?title=algorithms_1)) to test understanding of algorithms and flowcharts in programming.
- Assign students to write notes on algorithms and flowcharts after exploring the Internet at home. Ask them to share their notes through the class online platform for grading.

## Questions:

1. How is an algorithm helpful in solving a problem?
2. Contrast between an algorithm and flowchart?
3. Why do programmers start with either flowchart or an algorithm before they actually start coding?

## Resources:

1. **Algorithm and Flowchart:** The weblinks explains what algorithms and flowchart are and how they help to solve programming problems. Videos, charts and examples are given to explain the concepts.
  - <https://faradars.org/wp-content/uploads/2015/07/Algorithm-and-Flow-Chart.pdf>
  - <https://www.youtube.com/watch?v=XVGggCc-d4k>
  - <https://www.programiz.com/dsa/algorithm>
  - <https://www.geeksforgeeks.org/difference-between-algorithm-and-flowchart/>
  - [https://www.ikbooks.com/home/samplechapter?filename=134\\_Sample\\_Chapter.pdf](https://www.ikbooks.com/home/samplechapter?filename=134_Sample_Chapter.pdf)
2. **Rubrics:** The weblinks have sample rubrics that can be used to assess students' projects on algorithms and flowchart.
  - [http://www.tex22.info/rm/english/robotics5/vex/student/Content/Curriculum%20-%200Robotics/Robo%205/Mod%2006/035\\_XAI\\_Flowchart%20Rubric.htm](http://www.tex22.info/rm/english/robotics5/vex/student/Content/Curriculum%20-%200Robotics/Robo%205/Mod%2006/035_XAI_Flowchart%20Rubric.htm)
  - <https://cs.carleton.edu/faculty/jadrian/cs252/2014.0/rubric.html>

**COMPETENCY 7:** Students will be able to create graphical drawings using GUI modules to enhance coding knowledge and skills.

## Overview:

Python programming for students at this stage is introduced through the Turtle module. This module is designed beginner's friendly and helps students learn coding through graphics. Using Turtle, students will learn how to draw shapes, move objects, control pen features, and get introduced to basic concepts of loops.

Learning to code in Python using the Turtle module helps students not only to understand the coding concepts but also makes coding fun. Turtle is mainly used to introduce children to the world of coding and help new programmers get a feel of programming with Python. Using Turtle, students will be able to code simple GUI applications.

Topics	Key Stage Standard	Objectives	Time
<b>Introduction to Turtle Graphics</b> <ul style="list-style-type: none"> <li>● Turtle module</li> <li>● Importing the Turtle module</li> <li>● Drawing with Turtle</li> <li>● Turtle motion <ul style="list-style-type: none"> <li>○ Move and draw</li> </ul> </li> <li>● Pen control <ul style="list-style-type: none"> <li>○ Drawing state</li> <li>○ Color control</li> <li>○ Filling</li> <li>○ Drawing control</li> </ul> </li> <li>● Text, window control, variable, input, loops</li> </ul>	D4.1 Develop a text-based application by applying procedural programming concepts.	9-D4.1.1 Import GUI module to draw objects.	800 mins (20 periods)

### Learning experiences:

- Create a PowerPoint presentation to introduce Turtle Graphics in Python. After the explanation, demonstrate how to import the Turtle library in Python, and use move and draw methods such as forward(), backward(), left(), right() to draw simple shapes (square, rectangle, triangle). Then make students draw a shape using Turtle.
- Demonstrate a drawing project such as a house or chorten by using different methods (pen, motion, colour, size, window, etc.) in Turtle programming. Then ask students to come up with their own drawings.
- Divide students into groups to come up with a project on Turtle Graphics. Allow them to explore the Internet for ideas and information. Ask them to use variables, loops and user inputs in their project. Make each group present their work at the end for comments and feedback.
- Use the class online platform to share weblinks and online tutorials (video, pdf, ppt) on Turtle Graphics for students to refer to and practice Turtle programming at home. Make students share their experiences of independent learning on Turtle programming with other students.
- Conduct a video conference through Zoom or Google Meet to demonstrate how to draw shapes and objects using the Turtle library in Python. Then, ask students to draw a car or a bus using Turtle to practice.

### Assessment:

- Observe and maintain a record of students' participation during lessons and tasks on Turtle programming. Give feedback based on the observation for improvement.
- Assign group projects on Turtle graphics and make the groups present their work after a certain duration. Evaluate the project's content and delivery using a rubric.

- Provide worksheets having debugging questions on Turtle programming for students to solve without using the computer. Grade the worksheets and then allow them to test the program on the computer.
- Use the class online platform to assign a Turtle drawing task that uses different methods (motion, pen, variables, loops). Once they have finished, ask students to share their drawings on the class online platform for other students to view and give comments. Award scores are based on the quality of drawing and comments from peers.
- Conduct an online test on concepts related to Turtle programming (pen, motion, colour, size, window, etc.) using Google Forms, Quizzes or Kahoot.

### Questions:

1. What can we do with the Turtle module?
2. Why do you need to import a Turtle module?
3. What do you like most in coding with Turtle?
4. List some of the interesting projects you created with Turtle and reflect on what you have learned from creating them.

### Resources:

1. **Turtle Programming in Python:** The weblinks provide a beginner's guide for Python Turtle, methods in Turtle, and some examples of creating drawings in Turtle.
  - <https://turtle-tutorial.readthedocs.io/en/latest/index.html>
  - <https://realpython.com/beginners-guide-python-turtle/>
  - <http://www.bu.edu/lernet/artemis/lessons/Week3/Python%20with%20Turtle2020.pdf>
  - [https://www.cs.auckland.ac.nz/courses/compsci111ssc/lectures/LectureSlides/L25\\_Python3.pdf](https://www.cs.auckland.ac.nz/courses/compsci111ssc/lectures/LectureSlides/L25_Python3.pdf)
  - <https://www.geeksforgeeks.org/turtle-programming-python/>
  - <https://www.tutorialspoint.com/turtle-programming-in-python>

**COMPETENCY 8:** Students will be able to apply coding skills and knowledge to create a computer program that solves a simple problem.

**Overview:**

After learning block codings in previous classes, students, at this stage, will learn the standard python programming and coding concepts. The concepts include variables, operators, data types, control statements, and loops. These concepts are good enough for students to develop simple text-based applications.

Using the Python coding concepts, students will be able to develop text-based applications such as BMI calculators, random password generators, average marks or height calculator, and others. They can also code using the concepts of variables, control statements, and loops.

Topics	Key Stage Standard	Objectives	Time
<p><b>Introduction to Python</b></p> <ul style="list-style-type: none"> <li>● Python introduction</li> <li>● Print and input</li> <li>● Variables and comments</li> <li>● Comments</li> <li>● Data types - Text, number, boolean, type casting</li> <li>● Operators               <ul style="list-style-type: none"> <li>○ Arithmetic operators</li> <li>○ Assignment operators</li> <li>○ Comparison operators</li> <li>○ Logical operators</li> </ul> </li> <li>● Good programming practices               <ul style="list-style-type: none"> <li>○ Debugging</li> <li>○ Commenting</li> <li>○ Code optimization</li> </ul> </li> </ul> <p><b>Control Statements in Python</b></p> <ul style="list-style-type: none"> <li>● If, Elif, Else, Nested if</li> <li>● Conditional statements using logical operators</li> <li>● Project on conditions with algorithm and flowcharts</li> </ul> <p><b>Loops in Python</b></p> <ul style="list-style-type: none"> <li>● Importance of loops</li> <li>● For and while loops</li> <li>● Range() function in loops</li> <li>● Project on loops with algorithm and flowcharts</li> </ul>	<p>D4.1 Develop a text-based application by applying procedural programming concepts.</p>	<p>9-D4.1.2 Use variables to store and modify data.</p> <p>9-D4.1.3 Use control statements and loops to create a program.</p>	<p>1480 mins (37 periods)</p>



## Learning experiences:

- Make a PowerPoint presentation on introduction to Python programming (background, benefits, examples, application) and demonstrate how to run the first code in Python such as `print("Hello World")`. Show and explain Python IDLE and syntax to understand the basic requirements for coding in Python. Then, make students write their first code in Python.
- Use PowerPoint to explain the concepts of input, variables, comments, data types, and operators followed by a demonstration of these concepts as an example. After this, allow students to take notes and practice by doing a task on these concepts. A simple program/task would be more appropriate for students to understand the skill. Some suggested activities are given below:
  - Program that gives complete information after asking name, age, gender and Dzongkhag.
  - Program to calculate and display multiples of any number.
  - Program to find the simple interest of a given principal, rate and time.
  - Program to calculate the average height of four students.
  - Program to calculate the volume and surface area of a 3D shape.
- Make students explore the Internet to look for information on good programming practices (commenting, debugging, code optimization, algorithms and flowchart). Ask them to make a list and prepare a presentation for the class. Teachers may randomly select a student for presentation and initiate discussion for clarity.
- Explain and demonstrate control statements (if, elif, else, nested if) and loops (for, while) in Python coding through simple projects. Instruct students to make notes in their book and allow them to practice these concepts by doing tasks such as:
  - Program to calculate the BMI of a person and categorise as underweight, normal, overweight and obesity.
  - Program to generate a multiplication table using loops.
  - Program to check the eligibility to vote based on age and nationality.
  - Program to calculate the percentage of students' marks and remark as pass or fail.
  - Program to verify password using conditions.
- Provide the weblink (<https://pynative.com/python-if-else-and-for-loop-exercise-with-solutions/>) for students to understand and practice loops in Python programming. Instruct them to go through the 18 exercises given in the link and check the solutions to get a clear understanding of loops. Explain range functions and increments and decrements in loops based on the given exercises. Then, allow students to discuss their observations and understanding of loops with their friends.

- Share the following weblinks on online courses to learn Python programming through the class online platform. Instruct students to go through the course and learn Python coding on their own at home.
  - <https://www.w3schools.com/python/>
  - <https://www.learnpython.org/>
  - <https://www.sololearn.com/learning/1073>

- Share resources (video, pdf and ppt) through the class online platform and arrange video conferencing lessons on Python programming followed by simple tasks for students to practice and check their learning in Python programming.

During online lessons, teachers may instruct students to use the following online Python interpreters in case of failure to install the Python on their computers.

- Repl.it: <https://repl.it/~>
- Google Colab: [colab.research.google.com](https://colab.research.google.com)
- Programiz: <https://www.programiz.com/python-programming/online-compiler>
- GDB Online: <https://www.onlinegdb.com/>

### **Assessment:**

- Observe and maintain a record of students' participation during lessons on Python programming and when they are doing activities in groups or pairs.
- Conduct class tests (both practical and theory) on Python concepts such as input, data type, operators, variable, control statement and loops to check students' learning progress.
- Evaluate the students' Python projects which they did in pairs or groups using a rubric.
- Provide worksheets having wrong Python codes in programs for students to check and fix the errors. This will help to develop debugging skills. Evaluate the worksheets and award grades.
- Share the following links to an online quiz on Python coding. Ask students to do the quiz and share the screenshot of their performance through the class online platform.
  - <https://pynative.com/python-if-else-and-for-loop-quiz/>
  - <https://realpython.com/quizzes/>
  - [https://www.w3schools.com/python/python\\_quiz.asp](https://www.w3schools.com/python/python_quiz.asp)
- Ask students to explore an online Python course and complete the course independently. Ask the students to produce evidence of taking the course and award grades accordingly. For example, a certificate of MOOC Python course or screenshots of progress in an online Python course indicates that students are learning Python independently.

### **Questions:**

1. List three importance of a variable in programming?
2. Why do we require a loop in Python programming?

3. Humans make decisions all the time. How would you implement a code that lets the computer make decisions?
4. Look for online tutorials on Python programming and list down some of the key components in Python for beginners to learn.
5. Complete some online MOOC courses on Python coding and share your experience with the class.

### **Resources:**

1. **Python for Beginners:** The weblinks provide video and text tutorials on Python coding for beginners. These links will support teachers and students to independently learn Python coding with its step-by-step lessons and activities.
  - <https://python.land/python-tutorial>
  - <https://www.w3schools.com/python/default.asp>
  - <https://www.programiz.com/python-programming/first-program>
  - <https://www.guru99.com/python-tutorials.html>
  - [https://bugs.python.org/file47781/Tutorial\\_EDIT.pdf](https://bugs.python.org/file47781/Tutorial_EDIT.pdf)
  - <https://www.youtube.com/watch?v=kqtD5dpn9C8>

# Class Ten

Students will be able to:

1. produce graphical reports by performing data analysis in spreadsheets for making informed decisions.
2. solve problems collaboratively by using cloud services and appreciate the value added by such technology in terms of flexibility, resources, and efficiency.
3. cite sources of online materials to acknowledge the ownership and avoid plagiarism, piracy and copyright infringement.
4. create a text-based application by applying loops, functions, and data structures to solve a problem.
5. demonstrate the acquisition of coding knowledge, skills and good practices by creating projects to solve a problem.

## STRAND A – Technology Operation

**COMPETENCY 1:** Students will be able to produce graphical reports by performing data analysis in spreadsheets for making informed decisions.

### Overview:

A spreadsheet is a tool that is used to store, manipulate and analyse data. Data in a spreadsheet is organized in a series of rows and columns and can be searched, sorted, calculated and used in a variety of charts and graphs. Through the lessons under this competency, students will learn to analyse datasets and create visualisations using spreadsheets such as MS Excel or Google Sheets. Specifically, they will learn conditional formatting, sort and filter, data representation in charts and graphs. They will learn to use both MS Excel and Google Sheets.

Students will be able to analyse a dataset and create intuitive charts to visualise the data analysis. Such experiences on using computers to analyse and represent data will make students comfortable with data management and encourage them to take careers in data science.

Topics	Key Stage Standard	Objectives	Time
<b>Data Analysis and Visualisation - Excel</b> <ul style="list-style-type: none"><li>● Conditional formatting</li><li>● Sort and filter, validation</li><li>● Advanced functions - logical, statistical</li><li>● Data representation in charts</li><li>● types and elements</li><li>● Project on data analysis in Excel or Google Sheets</li></ul>	A4.1 Perform basic data analysis using a spreadsheet.	10-A4.1.1 Analyse data in a spreadsheet. 10-A4.1.2 Create charts to visualise data.	600 mins (15 periods)

### Learning experiences:

- Use projectors to demonstrate how to apply simple data arrangement and formatting (conditional formatting, sort and filter, data validation, find and replace, comment) in Excel to make students understand the importance of data cleaning and validation before performing data analysis and visualisation. Then, give sample data for students to practice data arrangement and formatting.
- Show a list of Excel functions (sumif, countif, averageif, vlookup, hlookup, concatenate, trim, rank ) to the students and demonstrate how to use these functions to process and analyse a set of data. After the data has been processed, show how to create charts to represent the data in graphical formats. Explain how charts help to communicate messages effectively and quickly. Then, allow students to take notes and practice individually. Some of the projects on data analysis in Excel are:

- Preparing result sheets and creating charts to display students' performance in different subjects, and the overall percentage or rank of each student in the class.
- Maintaining a record of family income and expenditure for several months and analysing the data to find out where the family is spending the most of their income and what needs to be done to make more savings.
- Visiting a nearby shop and collecting the data of daily sales for a week to find out which product is most sold and how much profit is made out of selling the product for a week.
- Divide students into groups and provide each group with a data set for analysis and representation. Ask them to explore the Internet to complete their task. Then, instruct students to make a presentation of their data analysis and representation. Teachers may print the charts created by the students and display them in the class for other students to view and give comments.
- Display a chart (bar or pie) of a set of data and generate a class discussion to teach students how to analyse a chart. Ask the following questions for discussion:
  - What message do you get from the chart?
  - What is recommended by the chart to get a positive result?
  - What is missing in the chart?
  - How can the chart be created differently to communicate the same message?
- Give project work for students in Excel where they have to (1) collect data, (2) arrange and format data, (3) analyse data, and (4) represent the data using charts. Make students also come up with a report in MS Word that explains all the steps and experiences involved in completing their project work. Students may use Google Forms for data collection, analysis and representation.
- Share online resources on data analysis and representation (conditional formatting, sort and filter, advanced functions and charts) in Excel through the class online platform (Google Classroom or Moodle LMS). Make students take notes and practice data analysis on their own.
- Conduct a video conference through Google Meet or Zoom to demonstrate how to analyse data and create charts in Excel or Google Sheets. Ask students to take notes and explore the Internet for more information on data analysis and representation in Excel.

**Assessment:**

- Evaluate students' projects (report) on data collection, arrangement, analysis and representation based on a rubric. Award marks and give feedback.
- Conduct a practical class test on data analysis in Excel where students are provided with a set of data and instructions to analyse them within a given time.
- Ask the following questions through the class online platform for students to explore the Internet and share their understandings.
  - Why do we need to analyse data?

- o What steps are involved to analyse and represent data?
- o Mention two reasons why charts are used to represent data.
- o Where can you apply the skill of data analysis and representation?
- Assign a project work in Google Sheets for students to create a monthly income and expenditure account for their family. Ask students to list the sources of income (salary, bonus, allowance, etc.) and expenditures (rent, food, education, clothing, etc.) to calculate and analyse their family budget for a year. Tell them to represent the information in charts and find out the status of their family budget. Then, ask them to share on a class online platform for evaluation and feedback.

### Questions:

1. Where do you use conditional formatting?
2. Why do you think representing data in charts is important?
3. Contrast sort and filter.

### Resources:

1. **Data Analysis and Representation:** The weblinks provide information on how to use different functions and charts to analyse and visualise data using Excel. There are explanations of some of the common functions(countif, sumif, averageif, vlookup, etc.) with examples. The YouTube videos show how to create Excel charts and modify them to make them look better.
  - <https://www.excel-easy.com/data-analysis.html>
  - [https://www.tutorialspoint.com/excel\\_data\\_analysis/excel\\_data\\_analysis\\_tutorial.pdf](https://www.tutorialspoint.com/excel_data_analysis/excel_data_analysis_tutorial.pdf)
  - <https://www.optimizesmart.com/how-to-select-best-excel-charts-for-your-data-analysis-reporting/>
  - <https://trumpexcel.com/learn-excel/>
  - <https://www.youtube.com/watch?v=TfkNkrKMF5c>
  - [https://www.youtube.com/watch?v=DAU0qqh\\_I-A](https://www.youtube.com/watch?v=DAU0qqh_I-A)
2. **Advanced Excel Functions for Data Analysis:** The weblinks provide information on some of the advanced Excel functions that can be used for data analysis.
  - <https://excelwithbusiness.com/blog/15-excel-data-analysis-functions-need/>
  - <https://www.eapl.org/sites/default/files/docs/Advanced%20Excel%201.pdf>
  - <https://www.youtube.com/watch?v=ShBTJrdioLo>
  - [https://www.slideshare.net/emetelka/advanced-microsoft-excel-52508274?next\\_slideshow=1](https://www.slideshare.net/emetelka/advanced-microsoft-excel-52508274?next_slideshow=1)

## STRAND B – Communication and Collaboration

**COMPETENCY 2:** Students will be able to solve problems collaboratively through cloud services and recognise the value added by such technology in terms of flexibility, resources, and efficiency.

### Overview:

Communication and collaboration tools like Google Workspace have become ever important in the current situation. Using cloud services facilitates users to collaborate and communicate anywhere and anytime. Under this competency, students will learn and explore cloud services and their features. Google Workspace for Education will be introduced to them as one of the key online collaboration tools.

As a part of the learning experience, students will be able to use cloud services to collaborate and communicate amongst themselves while doing assignments and projects. They will even be able to recommend tools and cloud services to their communities.

Topics	Key Stage Standard	Objectives	Time
<b>Cloud Services</b> <ul style="list-style-type: none"><li>● Definition and examples of cloud services</li><li>● Features of cloud services</li><li>● Advantages and disadvantages of cloud services</li></ul> <b>Collaboration using Google Workspace</b> <ul style="list-style-type: none"><li>● Google Workspace for Education</li><li>● Google Workspace for Education apps</li><li>● Benefits of using Google Workspace for Education</li><li>● Google Docs for collaboration</li><li>● Project on Google Docs</li></ul>	B4.2 Work collaboratively using cloud services.	10-B4.2.1 Explain cloud services.  10-B4.2.2 Collaborate using G Suite for Education apps.	400 mins (10 periods)

### Learning experiences:

- Divide students into groups and ask them to create a presentation on Cloud Services. Allow students to explore the Internet for information on cloud services and use PowerPoint to prepare the presentation. The presentation must cover the following points.

Definition of cloud services

Types of cloud services with examples

Features of cloud services

Some benefits and limitations of cloud services



- Prepare a PowerPoint presentation on Google Workspace for Education. Explain its benefits and how students can use some of the Google Workspace for Education apps (Docs, Slides, Sheets, Drive, Forms, Meet, Chat) to collaborate online with friends and teachers. Then, demonstrate how to create and use Google Docs using a projector. Make some of the students join the Google Docs and show how to use the features (formatting, commenting, suggesting, sharing) to create a document.
- Divide students into six groups and assign each group with a Google Workspace for Education app such as Google Drive, Google Forms, Google Chat, Google Slides, Google Meet, Google Docs for them to explore and make a presentation to the class after a few days. Instruct each group to find the information on the following points.
  - Name of the G Suite app
  - Main function of the app
  - Key feature of the app
  - Use of the app by students for online collaboration with examples.
- Create a Google Docs and invite all the students with editing rights. Ask each one of them to write a paragraph about their experience during the first national lockdown in 2020 due to the COVID-19 pandemic. Encourage them to share relevant pictures or links to express their experiences. Then, appoint a few students to review the work and print the final document as the “Lockdown Experience of Class X Students”.
- Share weblinks or online resources on cloud services (definition, features, types, benefits and examples) through the class online platform for students to refer to and learn more about cloud services. Ask them to share their understanding of cloud service in the class online platform for others to comment and give feedback.
- Create a presentation on Google Drive and share online resources ([https://docs.google.com/presentation/d/1ugfCwI3qGhL2fY0EKw\\_aqAWHL5REIDTqh-AIsZU58xg/htmlpresent](https://docs.google.com/presentation/d/1ugfCwI3qGhL2fY0EKw_aqAWHL5REIDTqh-AIsZU58xg/htmlpresent) ) related to Google Drive through the class online platform. Instruct students to create a folder named “Class X English” in Google Drive and store some relevant files and documents. Ask them to share the folder with some of their friends.
- Conduct an online video conference using Zoom or Google Meet to demonstrate how to access and use G Suite apps (Docs, Slides, Sheets, Drive, Forms). Then, ask students to create a G Suite app and share it with their friends to practice online collaboration.

### **Assessment:**

- Assign a group project work to make a presentation on cloud services and different Google Workspace for Education apps (Docs, Slides, Sheets, Drive, Forms, Chat). Evaluate both the content and delivery using a rubric.
- Give the following questions in the class for students to check their understanding of cloud services and G Suite for Education apps.

- o What are the benefits and limitations of cloud services?
  - o Mention two Google Workspace for Education apps that students can use to enhance their learning.
  - o Why should we use online collaboration tools? Give examples to support your answer.
- Make students create Google Docs on relevant topics(Coding for students, Impacts of social media on students, Online learning during the COVID-19 pandemic) and ask them to share them with others to collaborate online. Evaluate the Google Docs based on the content, formatting, inputs from different users and frequency of online collaboration. Teachers can open the history of Google Docs to check how each student has made changes to the document.
  - Conduct an online quiz using Google Forms on cloud services and G Suite for Education. Maintain records of the quiz.
  - Ask students to select a Google Workspace for Education app and write a short report using Google Docs. Instruct them to share the report with teachers for assessment. The report must have the following points.
    - o Main function of the app
    - o Key feature of the app
    - o Advantages of using the app
    - o Some examples of how the app can be used by students or teachers to facilitate learning.

### Questions:

1. What are some of the Google Workspace for Education apps?
2. How can you use Google docs as a collaboration tool?
3. Why do most people use cloud services these days?
4. Compare the elements of collaboration in Google Workspace with other tools?
5. Why do you think Google Workspace is more popular than other online collaboration tools? Justify your answers with examples.

### Resources:

1. **Cloud Services:** The weblinks provide information on the definition of cloud services, types of cloud services (SaaS, IaaS, PaaS, FaaS), benefits of cloud services, and how cloud services (private and public) are delivered.
  - <https://www.citrix.com/glossary/what-is-a-cloud-service.html>
  - <https://www.esds.co.in/blog/cloud-computing-types-cloud/#sthash.Ri8yOCXw.dpbs>
  - <https://www.youtube.com/watch?v=1ERdeg8Sfv4>
  - <https://www.youtube.com/watch?v=27vJg3v9AqM>

2. **Google Workspace for Education:** The weblinks provide information on G Suite for Education and some of its apps (Sheets, Docs, Drive, Slides, Forms) that provide an opportunity for online collaboration and learning.

- <https://www.aeseducation.com/computer-applications/how-and-why-to-teach-g-suite-in-middle-school>
- <https://www.aeseducation.com/blog/2016/02/google-apps-lesson-plans>
- <https://teachlearn.leedsbeckett.ac.uk/guides/mybeckett-and-digital-learning-guides/g-suite/google-docs-sheets-slides-forms/>
- <https://www.youtube.com/watch?v=oEHOLw6v-2c>

## STRAND C – Safety and Ethics

**COMPETENCY 3:** Students will be able to cite sources of online materials to acknowledge ownership and avoid plagiarism, piracy and copyright infringements.

### Overview:

The value of acknowledging the sources of information or materials used for learning or other purposes is critical. Acknowledging the owner of the material lifted online or offline is an ethical practice. Through the lessons under this competency, students will learn to identify sources/owners, copyright and creative commons, and citation rules. They will explore online resources on fair and responsible use of the online materials.

As a part of the learning experience, students will be able to reference the ownership of online materials in their works. They will be able to further create awareness of acknowledging ownership within their friends or community both online and offline.

Topics	Key Stage Standard	Objectives	Time
<b>Acknowledging Ownership</b> <ul style="list-style-type: none"> <li>• Identifying the source or owners of online resources</li> <li>• Importance of fair and responsible use</li> <li>• Introduction to copyright and creative commons</li> <li>• Ways of ensuring fair and responsible use</li> <li>• citation rule of online materials (text, video, image, website)</li> </ul>	C4.2 Exhibit fair and responsible use of online materials.	10-C4.2.1 Reference the ownership of online materials.  10-C4.2.2 Explain the consequences of the unethical use of online materials.	200 mins (5 periods)

## **Learning experiences:**

- Make students create a one-page Word document on a relevant topic (My favourite sports person, celebrity, movie, or book). Ask them to explore the Internet to gather information and images on the topic to be used in the document. Then, instruct students to cite the sources of the information or images they have used at the end of the page. Explain why the sources of information need to be cited and what are the consequences of not acknowledging the sources.
- Divide students into groups and assign the groups to explore the Internet to find out how different online materials are cited. For example, a group can work on APA citations for images while others look for citations on text, videos, journals, books, etc. Ask them to display their work on a chart paper and instruct other groups to walk around for observations and comments.
- Make a PowerPoint presentation with examples on the citation of online resources. Include the following points in the presentation and encourage students to ask questions.
  - Definition and examples of online citations.
  - Benefits of citing online resources that are used in personal works.
  - APA citation for websites, images and videos.
- Divide students into two groups to look for information on copyright (<https://www.whoishostingthis.com/resources/student-copyright/> ) and creative commons (<https://copyrightforcontentcreators.press.plymouth.edu/chapter/week-3-lecture-notes-creative-commons-basics/> ). Ask them to find symbols, restrictions, and benefits related to the topics. Then, arrange a class discussion where each group will share their findings on the two topics. Finally, summarise the discussion by highlighting the key points on copyright and creative commons.
- Share online resources on acknowledging ownership (copyright, creative commons, citations) through the class online platform and ask students to share their understanding by creating a short video.
- Conduct an online video conference using Zoom or Google Meet to demonstrate how to write APA format citations when using online materials for their project works. For example, mention the author, date and website of an image used by the student. Then, ask students to send a citation of a material they have used recently.

## **Assessment:**

- Conduct a class test incorporating different types of questions (MCQ, fill in the blanks, matching) on acknowledging ownership (citation, copyright and creative commons).
- Ask students to submit a write up on a topic related to other subjects (English, Science, History). Instruct them to explore the Internet for additional information and give proper

citations of the materials used. Evaluate their work based on the content and citations reflected correctly in the document.

- Provide a list of websites (news, pictures, videos, pdf) to the students and ask them to write the citations if they were to use the images and information from the given websites. Grade them on the correctness of the citation.
- Prepare an online quiz using Google Forms or Quizizz on acknowledging ownership and share it on the class online platform for students to check their understanding of the concepts.
- Post the following questions on the class online platform for the students to check their understanding of the importance of citation.
  - Why do we have to cite the sources of information used in our works?
  - What is copyright and why it is important?
  - What are the consequences of not acknowledging the sources of information or materials used in our works?
- Make students explore the Internet and ask them to write the correct APA citation format for different materials (book, website, video, image) with examples. Instruct them to write in Google Docs and share it with the teacher for evaluation.

### Questions:

1. What are Creative Commons?
2. Why do we need to acknowledge the ownership of the material that you use?
3. How can you champion fair and responsible use of online materials?

### Resources:

1. **Acknowledging Sources:** The weblinks explain the meaning of acknowledging sources and how to write citations using APA format. There is also a short quiz to check the understanding of the topics.
  - <https://educationstandards.nsw.edu.au/wps/portal/nesa/11-12/hsc/hsc-all-my-own-work/acknowledging-sources/why-acknowledge-sources>
  - <https://courses.lumenlearning.com/englishcomp21xmaster/chapter/read-acknowledging-sources-and-avoiding-plagiarism/>
  - <https://www.mendeley.com/guides/apa-citation-guide>
2. **Copyright and Creative Commons:** The weblinks provide information on copyright and creative commons with examples. The online resources also contain the differences between copyright and creative commons.
  - <https://www.commoncraft.com/video/copyright-and-creative-commons>
  - <https://copyrightforcontentcreators.press.plymouth.edu/chapter/week-3-lecture-notes-creative-commons-basics/>
  - <https://www.youtube.com/watch?v=cpZYDa03VMg>
  - <https://www.youtube.com/watch?v=srVPLrmlBJY>

- <https://www.workmadeforhire.net/the-rest/whats-the-difference-between-copyright-and-creative-commons/>

## STRAND D – Coding

**COMPETENCY 4:** Students will be able to create text-based applications by applying loops, functions, and data structures to solve a problem.

### Overview:

Coding ignites algorithmic and logical thinking in young minds in creating text-based applications. Through the lessons under this competency, students will delve deeper into loops in Python programming. Concepts like continue and break used in loops will be introduced. They will also learn about the while loop; another type of loop.

As a part of learning experiences on Python coding, students will be able to code a text-based application with a focus on loops. Students will also make a judgement on the use of while and for loop in their applications.

Topics	Key Stage Standard	Objectives	Time
<b>Loops in Python (Continued from class IX)</b> <ul style="list-style-type: none"> <li>• Loops in Turtle</li> <li>• For and while loops- break and continue, pass</li> <li>• Project on loops with algorithm and flowcharts</li> </ul>	D4.1 Develop text-based applications by applying procedural programming concepts.	10-D4.1.3 Apply loops to repeat a statement in a program.	120 mins (3 periods)

**Note:** This content will be taught to recapitulate the coding concepts taught in class IX in order to maintain continuity in Python programming.

### Learning experiences:

- Display a Turtle drawing (house, snowman, car, cartoon character) that has methods and loops which students have learned in class IX. Then, ask them to recreate it. Once they have finished, pick a student to explain how he/she has created the drawing to the class.
- Make a PowerPoint presentation on for and while loops in Python. Demonstrate the use of loops with a sample program such as multiplication tables, patterns, and regular shapes.
- Provide the YouTube video (<https://www.youtube.com/watch?v=WiShwgtWWHI>) on using a for loop to create a pattern in Turtle to the students. Ask them to watch the video and create a similar pattern. Make students share their patterns with the class.

- Assign a project work for students to create a Python program such as a quiz where they have to use loops. Ask them to write the algorithm and flowchart for their program.
- Make students apply the “Dry Run” (manually working through their code to trace the value of variables without using computers) strategy to understand and execute programs on loops. Ask them to compare their work with friends before beginning to code on the computer.
- Provide the following free course on Python basics and Turtle Graphics through the class online platform for students to enrol and take the online classes independently.
  - <https://www.udemy.com/course/python-turtle-art/>
  - <https://www.coursera.org/lecture/python-basics/our-first-turtle-program-TOxha>
- Share the website (<https://www.geeksforgeeks.org/turtle-programming-python/>) with the students. Instruct them to go through the information and create the different shapes given in the website using Turtle programming.

### Assessment:

- Observe students during the lesson and activities on Python programming (loops) and maintain a record of their participation.
- Evaluate students’ Turtle drawings (Olympic logo, flags) and Python programs (quiz, patterns) along with a flowchart based on the rubric.
- Assign a homework task on Turtle on Python programming which requires students to use loops and ask them to share their work through the class online platform for evaluation.
- Create an online quiz on loops using Google Forms and share it through the class online platform for assessment.

### Questions:

1. Compare break and continue.
2. How is the while loop different from for loop?

### Resources:

1. **Python Turtle Tutorials:** The weblinks provide information on a beginners’ guide to Python Turtle. The tutorials cover drawing shapes, changing colours and pen size, and using loops to draw patterns in Python Turtle.
  - <https://www.tutorialspoint.com/turtle-programming-in-python>
  - <https://realpython.com/beginners-guide-python-turtle/>
  - <https://www.educba.com/python-turtle/>
  - <https://www.tutorialsandyou.com/python/how-to-draw-olympics-logo-in-python-turtle-10.html>

**COMPETENCY 4:** Students will be able to create text-based applications by applying loops, functions, and data structures to solve a problem.

**Overview:**

Function plays an important role in programming. Functions enhance the readability of a program. Breaking the code into smaller functions keeps the program organised, easy to understand and makes it reusable. Through the lessons under this competency, students will learn to define functions, call functions, parameterised functions, return and recursive functions. Besides, they will also learn advanced data structures like lists, tuples and dictionaries.

As a part of learning experiences, students will be able to write efficient code by using relevant functions and data structures. They will also be informed about the advantages of using functions and be able to use functions to make their code modular and maintainable.

Topics	Key Stage Standard	Objectives	Time
<p><b>Functions in Python (Continued from class IX)</b></p> <ul style="list-style-type: none"> <li>● Importance of function</li> <li>● Defining a function</li> <li>● Calling function</li> <li>● parameters of a function</li> <li>● return statement in a function</li> <li>● Functions in Turtle</li> <li>● Recursive function</li> <li>● Project on function with algorithm and flowcharts</li> </ul> <p><b>Data Structures in Python</b></p> <ul style="list-style-type: none"> <li>● List, Tuple, Set, Dictionary</li> <li>● Projects on data structure with algorithm and flowcharts</li> </ul>	D4.1 Develop text-based applications by applying procedural programming concepts.	<p>10-D4.1.1 Use functions to decompose problems.</p> <p>10-D4.1.2 Use data structures to enhance the efficiency of the program.</p>	1980 mins (47 periods)

**Learning experiences:**

- Create a PowerPoint presentation to explain function (definition, the importance of function, function syntax, calling function, built-in and user-defined functions) in Python programming and demonstrate a function example such as a function to find sum or multiplication. Then, allow students to practice how to create functions in Python.
- Ask students to explore the Internet to find information on how to create functions in Python programming. Ask them to find the meaning and use of parameters, arguments, and return statements in functions. Then, make them share or demonstrate some examples of functions to the class. Some of the weblinks for students to explore on functions are given below:
  - <https://www.programiz.com/python-programming/function>
  - <https://www.learnpython.org/en/Functions>



- o <https://realpython.com/defining-your-own-python-function/>
- o <https://www.javatpoint.com/python-functions>
- Explain Python recursive function with a demonstration of an example (Fibonacci sequence, factorial of a number) in the class. Use the weblink (<https://www.programiz.com/python-programming/recursion> ) to show the example and explain the advantages and disadvantages of recursion. Then, ask students to take notes and practice Python recursion individually.
- Use a projector to demonstrate and explain built-in data structure (list, tuple, set, dictionary) in Python. Give examples to show differences between list, tuple, set and dictionary, and make students practice these types of data in Python programming. The following weblinks can be used to explain Python data structure.
  - o <https://www.geeksforgeeks.org/inbuilt-data-structures-python/>
  - o <https://jakevdp.github.io/WhirlwindTourOfPython/06-built-in-data-structures.html>
  - o <https://www.edureka.co/blog/data-structures-in-python/>
- Divide students into four groups and ask each group to explore on list, tuple, set and dictionary respectively. Tell the groups to explore the Internet or refer to books to get as much information on the topic as possible and prepare a presentation for the class. During the presentation, invite discussions on the topics and instruct them to take notes.
- Show multiple examples of how to edit list, tuple, set and dictionary (remove, append, len, pop, insert, copy) in Python programming. Explain the function of each method and ask students to take notes as well as practice the codes.
- Assign a project work to students where they have to use functions and data structure to execute a Python program. Ask students to make the program user interactive and relevant to a real-world situation. Discuss the project idea with them and provide a week's duration to complete it.
- Share weblinks on functions and data structure in Python through the class online platform for students to refer to and practise the concepts. As a follow-up to the reading and practice, assign some tasks to create programs on functions and data structures.
- Conduct video conferencing lessons to demonstrate and explain functions and data structures in Python programming. Give examples and sample programs to make students understand the differences between list, tuple, set and dictionary. Encourage students to ask questions and take notes during the lesson.
- Teachers may instruct students to use the following online Python interpreters in case of failure to install the Python on their computers.
  - o **Repl.it:** <https://repl.it/~>
  - o **Google Colab:** [colab.research.google.com](https://colab.research.google.com)
  - o **Programiz:** <https://www.programiz.com/python-programming/online-compiler>
  - o **GDB Online:** <https://www.onlinegdb.com/>

## Assessment:

- Maintain a record of students participation (asking questions, discussing problems, answering questions, putting effort, completing additional tasks) in the class or groups during lessons on functions and data structures in Python. Give marks and feedback to students.
- Assign tasks to students to come up with Python programs (digital artefacts) that have functions and data structures. Compile students' work as a digital artefact in a folder and award scores accordingly.
- Conduct class tests (both practical and theory) on Python functions and data structure to check students' understanding of these concepts. Use different sets of questions (MCQ, fill in the blanks, short Q&A, true or false) in the theory test. In practical tests, make students create algorithms, apply debugging skills, and solve the problem.
- Conduct online quizzes using Google Forms or Kahoot on functions and data structure in Python programming. Maintain a record of students' scores.
- Share worksheets on data structure in Python through the class online platform for students to complete at home and submit after a few days.
- Assign tasks on Python programming on functions and data structure through the class online platform for students to complete at home individually. Ask them to submit the work after a few days for evaluation and grading. Some examples of Python projects that can be assigned to students are given below.
  - Simple Calculator  
(<https://www.programiz.com/python-programming/examples/calculator>)
  - Guess a Number Game  
(<https://djangocentral.com/creating-a-guessing-game-in-python/>)
  - Rock, Paper and Scissors Game  
(<https://thehelloworldprogram.com/python/python-game-rock-paper-scissors/>)
  - Dice Rolling Simulator  
(<https://www.geeksforgeeks.org/dice-rolling-simulator-using-python-random/>)
  - Binary Search Algorithm  
(<https://www.geeksforgeeks.org/python-program-for-binary-search/>)
  - Text-Based Adventure Games  
(<https://www.derekshidler.com/how-to-create-a-text-based-adventure-and-quiz-game-in-python/>)
  - Contact Book  
(<https://www.geeksforgeeks.org/implementing-a-contacts-directory-in-python/>)

## Questions:

1. Differentiate between list and tuple.
2. Why set, dictionary, list and tuple are called data structures?
3. How can function improve the efficiency of the code?

## Resources:

1. **Functions in Python:** The weblinks provide information on functions, user-defined functions, return statements in functions and recursive functions in Python programming.
  - [https://www.w3schools.com/python/python\\_functions.asp](https://www.w3schools.com/python/python_functions.asp)
  - <https://www.guru99.com/functions-in-python.html>
  - <https://www.tutorialsteacher.com/python/python-user-defined-function>
  - <https://www.geeksforgeeks.org/python-return-statement/>
  - <https://www.programiz.com/python-programming/recursion>
  - <https://open.cs.uwaterloo.ca/python-from-scratch/13/>
2. **Data Structures in Python:** The weblinks provide information on the meaning of data structure and its type such as list, tuple, set and dictionary.
  - <https://www.edureka.co/blog/data-structures-in-python/>
  - <https://www.slideshare.net/CelineGeorge1/basic-data-structures-in-python>
  - <https://realpython.com/python-data-structures/>
  - <https://www.geeksforgeeks.org/inbuilt-data-structures-python/>

**COMPETENCY 5:** Students will be able to demonstrate the acquisition of coding knowledge, skills and good practices by creating a program to solve problems.

## Overview:

Students will do major projects in Python using all the knowledge and skill acquired thus far. They will design flowcharts and state algorithms to solve a problem statement. They will also maintain relevant documentation related to the project.

Students will be able to develop a text-based application that is cross-curricular in nature. They will be able to write readable and maintainable code. They will also be able to maintain exhaustive documentation as per the requirements.

Topics	Key Stage Standard	Objectives	Time
<b>Major Project in Python</b> <ul style="list-style-type: none"><li>• Algorithms and flowcharts</li><li>• Good programming practices</li><li>• Project-based learning</li><li>• Cross-curricular approach</li></ul>	D4.1 Develop text-based applications by applying procedural programming concepts.	10-D4.1.4 Apply fundamental programming concepts and skills to develop a text-based application.	400 mins (10 periods)

**Note:** By this point, students would have completed procedural programming in Python. They would have learned about algorithms, flowcharts, Python syntax, data types, operators, variables, loops, conditional statements, functions, and data structure in classes IX and X. Therefore, it is

important to provide an opportunity at the end of the key stage for students to apply Python knowledge and skill by doing a major project.

**Major Project Process:** Guide and instruct students to follow the following steps to complete the major project in Python programming.

1. **Defining the problem:** Allow students to explore the Internet or refer to books to identify an idea or a problem for the Python project. Students discuss their ideas with friends and teachers for finalisation. The project has to be relevant to a real-world situation and have elements related to other subjects such as Mathematics, Science and Commerce.
2. **Planning the solution:** Instruct students to plan the project by creating the algorithm and flowcharts to solve the problem. Ask them to identify the input and output elements, and various python methods and functions that have to be used in the program.
3. **Coding the program:** Instruct students to begin coding the program for the project by following the algorithm and flowchart. Give them around two weeks to complete coding for the problem. Remind them to follow good programming practices such as adding comments and optimizing codes using loops, functions and data structures.
4. **Testing the program:** Ask students to share their program with friends and family members for testing and feedback. Make them list the bugs in the code and fix them to make it run as per the plan.
5. **Documenting the program:** Once the testing and debugging have been completed, ask students to submit their program along with a report in Word. The report must have a brief description of the program, logic tools such as flowcharts and algorithms, program listings, and testing results.

#### **Assessment:**

Teachers may consider the following areas for the evaluation of the final project.

1. Relevancy of the project title or problem statement of the project.
2. Correctness of the algorithm and clarity of flowchart.
3. Functionality and readability of the codes
4. Evidence of following good programming practices (commenting and code optimizing)
5. Completeness and clarity of report
6. Delivery of the project presentation (in case of class presentations)

#### **Questions:**

1. What are some of the good programming practices?
2. What are the steps to be followed while doing a project?
3. How can Python be used to solve real-life problems?

#### **Resources:**

1. **Sample Python Projects:** The weblinks provide projects samples with codes for beginners to explore and derive ideas to develop Python projects.

- <https://www.dataquest.io/blog/python-projects-for-beginners/>
- <https://intellipaat.com/blog/python-project-ideas-for-beginners/>
- <https://www.guru99.com/initiation-phase-project-management-life-cycle.html>

2. **Python Project Evaluation Rubrics:** The weblinks provide sample rubrics to evaluate projects in Python programming. Teachers may modify the rubrics to suit their needs.

- <https://matthew-brett.github.io/cfd2019/projects/rubric>
- <https://www.slideshare.net/MarcAngeloSebastian/rubric-53788219>
- <http://shelbykimmel.com/Documents/Teaching/Templates/ProgramGrading.pdf>
- <https://assessment.fiu.edu/resources/rubrics-and-curriculum-maps/assets/rubrics/Computer%20Programming%20Grading%20Rubric%20-%20California%20State%20University%20Long%20Beach.pdf>

## Annexure

### Annexure 1: Class-wise period and time allocation

The period allocation for classes PP to XII ICT curriculum is as per the revised instructional time allocation notified by the Ministry of Education in March 2020.

<b>Class</b>	<b>No. of Periods per Week (40 mins per period)</b>	<b>Total Period in Year (30 weeks)</b>	<b>Total Time (in mins)</b>
PP	2	60	2400
I	2	60	2400
II	2	60	2400
III	2	60	2400
IV	2	60	2400
V	2	60	2400
VI	2	60	2400
VII	3	90	3600
VIII	3	90	3600
IX	3	90	3600
X	3	90	3600
XI	3	90	3600
XII	3	90	3600

## Annexure 2: Key stage-wise assessment matrix

The table below provides an overview of assessment weighting for five key stages. Assessment at each key stage is broken down into four modes of assessment as specified in the ICT Curriculum Framework.

Sl#	Assessment Area	Mode	Classes PP-III	Classes IV-VI	Classes VII-VIII	Classes IX-X	Classes XI-XII
			Weighting %	Weighting %	Weighting %	Weighting %	Weighting %
1	Participation and completion of classwork. (face-to-face or online) <i>(Formative assessment)</i>	Observation, Conversation	10	10	10	10	10
2	Participation and completion of homework. (face-to-face or online) <i>(Formative assessment)</i>	Observation, Conversation	10	10	10	10	10
3	Planning, research, documentation, creation and presentation of digital artefacts including coding projects. <i>(Formative assessment)</i>	Assessment of Digital Artifacts	80	60	50	40	30
4	Theory and/or Practical Test (unit, mid-term and annual exams) <i>(Summative assessment)</i>	Testing	0	20	30	40	50
Total			100	100	100	100	100

### Annexure 3: Breakdown of assessment weightings in two terms

The table below provides the breakdown of weightings in four areas of ICT assessment for two terms. ICT teachers are required to keep a daily record of observations and conversations with learners during and after school, provide projects or tasks to create digital content, and conduct examinations at the end of each term.

Key Stage	TERM I				TERM II			
	Class Activity (observation & conversation)	Home Activity (observation & conversation)	Digital Artefacts (digital products)	Testing (examinations)	Class Activity (observation & conversation)	Home Activity (observation & conversation)	Digital Artefacts (digital products)	Testing (examinations)
I	CFA			-	CFA			-
II	5	5	20	10	5	5	40	10
III	5	5	20	10	5	5	30	20
IV	5	5	10	20	5	5	30	20
V	5	5	10	20	5	5	20	30



### Annexure 4: Progress report format for key stage III

At the end of the year, students' record of formatives and summative assessment in ICT will be reflected in the progress report given below. To complete the report, ICT teachers are required to maintain a record of assessments carried out through observation, conversation, digital artefacts and testing in two terms.

SUBJECT WISE ACADEMIC TRANSCRIPT							
Subject	TERM I			TERM II			GRAND TOTAL (Total I + Total II)
	C A	Mid Term Examination	Total I	C A	Annual Examination	Total II	
Dzongkha							
English							
ICT							
Mathematics							
Physics							
Chemistry							
Biology							
History							
Geography							
Eco/TVET/MS/ES/ AgFS/Rigzhung							
	Percentage			Percentage			
	Position			Position			
	Attendance			Attendance			
	Total no. of students			Total no. of students			
Signature of Parent/Guardian:				Signature of Parent/Guardian:			
Signature of Class Teacher:				Signature of Class Teacher:			
The detailed criteria for the continuous assessment (CA) and the examinations for each subject should be based on the guidelines provided in the syllabus/guidebook for each subject.							

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**SAMPLE DIGITAL ARTEFACT**

**ICT Curriculum | Class IX**

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**Title:** Colourful Clock

**Artefact Number:** 1

**Tools to use:** Python Turtle

**Objective:**

- o Draw circles and lines
- o Apply concepts of rotations - angles, direction, centre
- o Add numbers, texts and colours

**Instructions**

1. Draw a clock using Turtle graphics in Python. The sample output is given below. In the clock, add numbers, text and colours to make it realistic and attractive.
2. Apply Mathematical concepts of rotation such as angle, centre and direction in the drawing. You may refer to chapter two - unit 5 of the class IX Mathematics textbook.
3. Complete the task within one week. Save the file and submit it before the due date.



**Areas of assessment:**

- o Use of different Turtle methods (Text, colour, shapes. etc.)
- o Application of Mathematical concepts (rotation)
- o Design and creativity
- o Code readability and efficiency

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## SAMPLE DIGITAL ARTEFACT

### ICT Curriculum | Class IX

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**Title:** Result Analysis

**Artefact Number:** 2

**Tools to use:** Microsoft Excel

**Objective:**

- o Use formulas or functions to perform calculations (sum, average, max, min).
- o Apply logical operators (greater than, less than, greater than or equal to, less than or equal to).
- o Apply formatting tools such as merge and centre, borders, etc.

**Instructions**

1. Use Excel to create the given worksheet on the calculation of students' marks to create analyse their performance in each subject.
2. In the worksheet, perform the following operations to complete the table.
  - Find the total marks of all the subjects(Dzongkha, English, Maths, Science) for all the students under the "Total Marks" column. Use Excel formulas or functions for calculation.
  - Under the "Grade" column, provide letters A, B, C & D as per the criteria given below:
    - a. If Total Marks  $\geq 300$  then grade is A
    - b. If Total Marks  $\geq 250$  then grade is B
    - c. If Total Marks  $\geq 200$  then grade is C
    - d. If Total Marks  $< 200$  then grade is D
  - Calculate the highest, lowest and average marks scored in each subject
  - Add two new columns to calculate the percentage of each student and find out their position in the class.
3. Answers the following questions after completing the table.
  - In which subject do students perform the best and the worst?
  - Who is the topper in the class?
  - How many students are in grades A, B, C and D? What does this mean?
  - What is the overall performance of the class in the exam?

	A	B	C	D	E	F	G	H
1	<b>Marksheet of Class IX Students</b>							
2	<b>Roll No</b>	<b>Name</b>	<b>Dzongkha</b>	<b>English</b>	<b>Maths</b>	<b>Science</b>	<b>Total Marks</b>	<b>Grade</b>
3	1	Dawa Zam	56	65	66	65		
4	2	Sonam Dorji	78	77	78	76		
5	3	Ugyen Sonam	78	39	53	55		
6	4	Tobgay	45	40	44	45		
7	5	Chimi Dema	55	56	73	76		
8	6	Chencho Om	36	59	81	45		
9	7	Bida	77	78	45	38		
10	8	Kinzang Lham	89	95	58	59		
11	9	Dorji	65	60	78	67		
12	10	Wangchuk	73	67	49	56		
13		Highest Marks						
14		Lowest Marks						
15		Average Marks						

**Areas of assessment:**

- Data entry and completeness.
- layout and formatting (heading, row/column labels, number labels).
- Use of formulas or functions for the calculations (sum, max, min, average, rank, if)
- Data interpretation.
- Overall presentation and creativity.

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## SAMPLE DIGITAL ARTEFACT

### ICT Curriculum | Class X

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**Title:** Charts for Data Representation

**Artefact Number:** 1

**Tools to use:** Microsoft Excel

**Objective:**

Use formulas or functions to perform calculations (media, quartiles, mode).

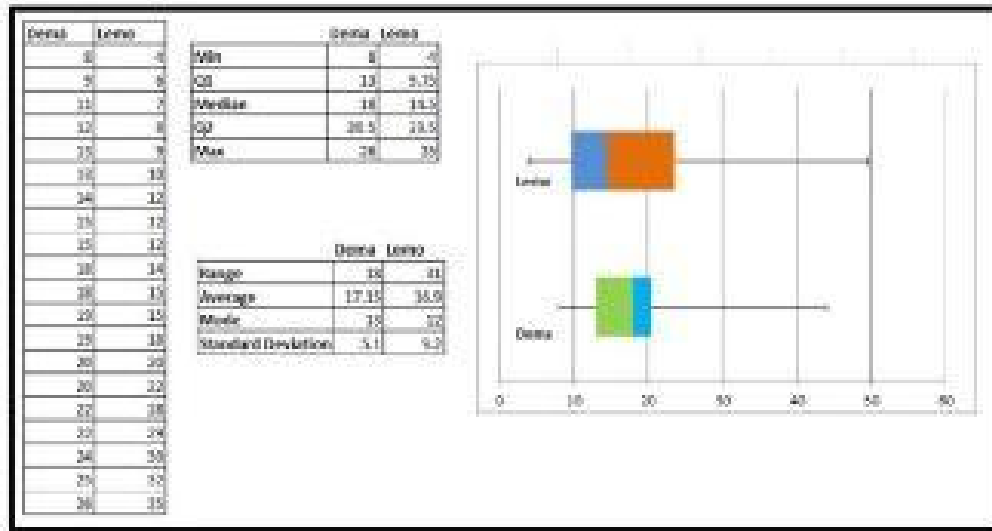
Create a box and whisker plot to represent and analyse data.

**Instructions**

1. A set of data on points scored by Dema and Lemo in their last 20 basketball games is given below. Enter the data into MS Excel for analysis and representation. (A sample chart is given below for teachers' reference)

Game	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Dema	25	22	19	26	19	20	24	22	12	18	14	20	8	15	9	18	11	13	13	15
Lemo	9	20	6	30	12	32	4	12	29	8	14	7	15	10	22	28	18	12	35	15

2. Calculate the minimum, maximum, first quartile, median, second quartile, mode and even the standard deviation using the Excel functions.
3. Based on the calculation, plot a Box and Whisker chart to compare the scores of Dema and Lemo. Apply proper formats and design of the charts.
4. Write a short description/report by comparing the two sets of data. Explain what each graph indicates and conclude who has the better score in the basketball games.
5. Make a presentation of your data analysis and representation to the class.



**Areas of assessment:**

- Data entry and completeness.
- layout and formatting (heading, row/column labels, number labels).
- Use of formulas or functions for the calculations (minimum, maximum, quartiles, median, mode, standard deviation)
- Quality of box and whisker plot.
- The description of the data analysis and representation (report).
- Class presentation.

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## SAMPLE DIGITAL ARTEFACT

### ICT Curriculum | Class X

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**Title:** Phone Book

**Artefact Number:** 2

**Tools to use:** Python

**Objective:**

- Create an application using Python to maintain a contact list for the users.
- Add, delete and search for contacts in the contact book

**Instructions**

1. Create a phone book simulation in Python. The sample output is given below for your reference.

```
.....
                          Phone Contact List
.....
      You can now perform the following operations on this phonebook
.....
1. Add a new contact
2. Remove an existing contact
3. Delete all contacts
4. Search for a contact
5. Display all contacts
6. Exit phonebook
Please enter your choice: 1
['Dorji', 17831373, 'dorji@gmail.com']
.....
```

2. Include the option to add, remove, search, and display the list in the contact in the phone book.
3. For the phone book, you may have to define your own functions and use data structures such as lists, tuples or dictionaries.

**Areas of assessment:**

- Use of user-defined functions (able to create all the functions correctly).
- Use of data structures (list, tuple or dictionary).
- The logical flow of the program.
- The output of the program (no syntax error, give correct output).
- Good programming practices (codes are optimized and comments are used).