# Computational Thinking in Indian K-12 Schools: Opportunities and Challenges

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# The Indian Context

**1972**

**Scheme of Education Technology**

Sponsored by the central government. Support given to states to provide computer assisted learning in secondary and higher secondary government schools

**1984**

**Computer literacy and studies in schools (CLASS)**

Started as part of the Scheme of Education Technology

**1986**

**First mention of Computer in Education Policy**

Curriculum based audio/audio-visual programs for broadcasts on Radio and TV

**1992**

**Program of Action, Revised NEP, 1986**

Focus on Radio/cassette content and infrastructure. Improvement in access to computers in secondary schools

**2005**

**National Curriculum Framework**

Differentiated between IT curriculum and Computer Science curriculum.

**2012**

**Education Policy on ICT in schools**

Focus on ICT literacy

**2020**

**National Education Policy**

Artificial Intelligence, Machine Learning, Coding, TPD, Content creation and dissemination platforms

# Computer Science in India

01 Terms IT, Computer Application and Computer Science used interchangeably in across school boards

02 No standard computer science curriculum for upper primary grades in Central and State Boards

03 Compulsory coding and other Computational thinking related topics to be added to curriculum by 2022-2023. (NEP, 2020)

04 Access to digital infrastructure continues to be a problem NEP, 2020 focuses on the need for personal devices

# Factors driving the computer science curriculum

- ➔ Demands of the labour market
- ➔ Global advancements in technology
- ➔ Digital India campaign (Year)
- ➔ National Education Policy, 2020

"Our present education system's inability to cope with these rapid and disruptive changes places us individually and nationally at a perilous disadvantage in an increasingly competitive world. For example, while computers have largely surpassed humans in leveraging factual and procedural knowledge, our education at all levels excessively burdens students with such knowledge at the expense of developing their higher-order competencies."

- *National Education Policy, 2020*

# Current Computer Science curriculum in CBSE Schools in India

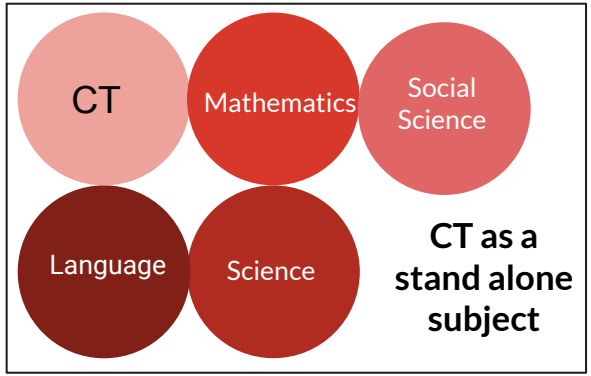
| Aims and Expected Outcomes of the Computer Application (Class IX & X) and Computer Science (XI & XII)for CBSE | | | |
|---|---|---|---|
| **Class IX** | **Class X** | **Class XI** | **Class XII** |
| 1. Ability to familiarise with basics of computers. | 1. Ability to create a simple website | 1. Develop basic computational thinking. Learn how to reason with variables, state transitions, conditionals, and iteration. | 1. Understand the concept of functions and recursion. |
| 2. Ability to navigate the file system. | 2. Ability to embed images, audio and video in an HTML page | 2. Understand the notion of data types, and higher order data structures such as lists, tuples, and dictionaries. | 2. Have a clear understanding of cyber ethics and cybercrime. Understand the value of technology in societies, gender and disability issues, and the technology behind biometric ids. |
| 3. Ability to create and edit documents, spread sheets, and presentations. | 3. Ability to use style sheets to beautify the web pages. | 3. Appreciate the notion of an algorithm, and understand its structure, including how algorithms handle corner cases. | 3. Get a basic understanding of computer networks: network stack, basic network hardware, basic protocols, and basic tools. |
| 4. Ability to perform basic data manipulation using spread sheets and use Indian languages in documents. | 4. Ability to write iterative programs with Scratch/Python. | 4. Develop a basic understanding of computer systems - architecture, OS, mobile and cloud computing. | 4. Learn about the concept of efficiency in algorithms and computing in general. |
| 5. Ability to send and receive emails, follow email etiquette, and communicate over the internet. | 5. Ability to Interface a web site with a web server and record the details of a user's request. | 5. Learn basic SQL programming. | 5. Learn basic data structures: lists, stacks, and queues. |
| 6. Ability to create and upload videos. | 6. Ability to follow basic cyber ethics | 6. Learn all about cyber safety. | 6. Learn file handling in Scratch/Python |
| 7. Ability to safely and correctly use websites, social networks, chat sites, and email. | 7. Ability to familiarize with network concepts. | | 7. Connect a Python program with an SQL database, and learn aggregation functions in SQL. |
| | | | 8. Learn how to create and use Python libraries. |

Progression in computational thinking related topics in the cbse curriculum

# Progression in Computer Science Curriculum

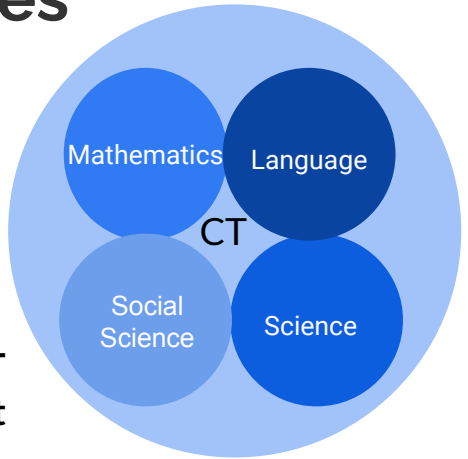
- Progression is moving from simpler to complex competency
- Very late introduction to basic digital competencies and computational thinking
- Not mapped to developmental age
- Competency of grade 9th far below, in the light of NEP 2020 will the same be pushed down to start from 6th grade?
- Or will there be integration of broader CT and 21st century skills

# Relationship between informatics/computer science curriculum and other academic disciplines




- Focused attention on CT skills and its progression with close tracking and scaffolding.
- Responds to career aspirations in Computer applications.
- Requires less TPD and no/less restructuring

**Integrating CT in core subject**



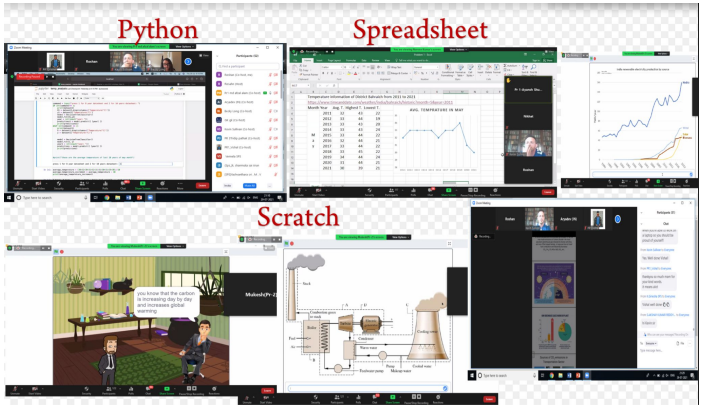

- CT using the context of core subjects will scaffold authentic learning in core concepts.
- No separate assessment of CT will save commercial coaching and marks driven teaching and learning.
- Increased integration of CT skills with different careers, calling for  for integrated approach in the curriculum.

# Formal and Informal boundaries

- **Formal learning platforms:** Added curriculum of CT by outside organizations/academia within the Computer Science syllabus-(e.g. **Computer Masti)
- Leverage **informal spaces within the formal systems** (e.g. ITE)
- **Informal spaces.** Mostly online mushroomed especially in CLP. (Understand the implications and market agenda of currently informal learning spaces iis critical).

**Other Suggestions**

- Research and impact studies of pilots of integrating in the curriculum and assessment.
- Focus on plugged*as well as unplugged activities for larger adoption across grade levels
- Need a robust curriculum of CT and its potential integration in pre and inservice education.




*(Coding, Programming and the Changing Curriculum for Computing in Schools, Symposium, OCCE 2018)
** Iyer, S. , (2019). IIT, Bombay, Teaching-Learning of Computational Thinking in K-12 Schools in India, In S.-C. Kong and H. Abelson (eds.), Computational Thinking Education,

Other examples of WebQuests and its implementing manuals can be found at

https://leap21stcentury.org/Webquest