
ICT TOOLS IN NATIONAL CURRICULA OF SCIENCE

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THE ROLE OF ICT IN SCIENCE EDUCATION

- Inquiry and experimentation
- Visualization of complex phenomena
- Modeling and simulation
- Data collection and analysis
- Collaboration and communication

ICT AND SCIENTIFIC PRACTICES

- Digital technologies allow students to:
 - observe and manipulate phenomena
 - construct and test models
 - analyze empirical data
 - explore otherwise inaccessible processes





ROLE OF CURRICULUM WHY STUDY CURRICULA?

- Curriculum documents:
 - define educational priorities
 - guide teacher expectations
 - Shape classroom practices
- Therefore, they influence **how ICT is positioned in science teaching.**

ICT TYPOLOGIES IN LITERATURE

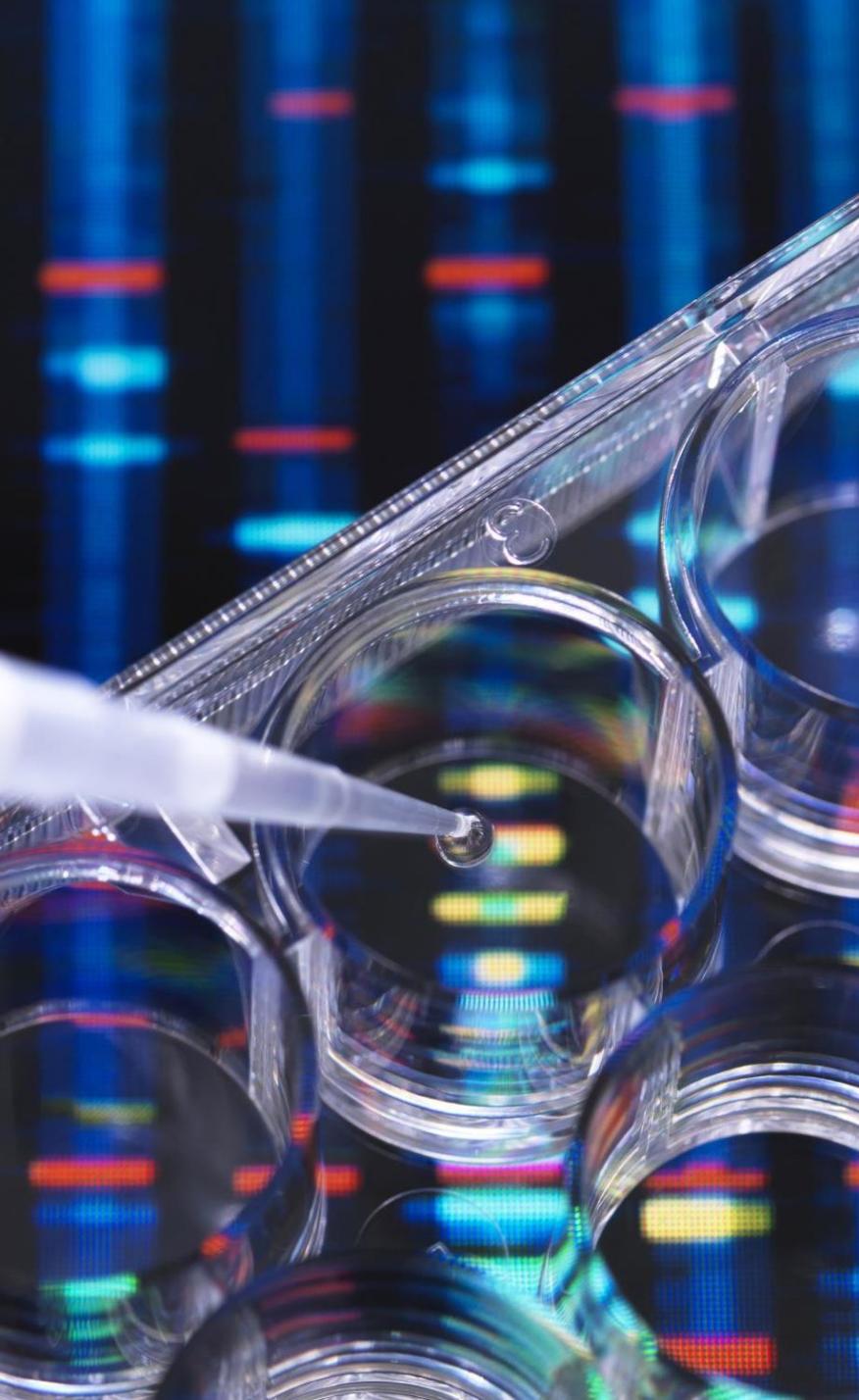
LITERATURE IDENTIFIES TWO KEY DIMENSIONS

ICT Tool Types

- Investigation technologies
- Information resources
- Communication platforms
- Data handling tools
- General digital tools

Pedagogical Functions

- Assessment & feedback
- Collaboration
- Inquiry processes
- Knowledge presentation
- Learning organization



PURPOSE OF THE STUDY

- **The Research Gap**
 - Extensive research on ICT in classrooms
 - Limited comparative analysis of **how curricula conceptualize ICT**
- This study addresses this gap through curriculum analysis.
- To examine how national science curricula conceptualize ICT in relation to:
 - the types of digital tools referenced
 - the pedagogical purposes attributed to these tools

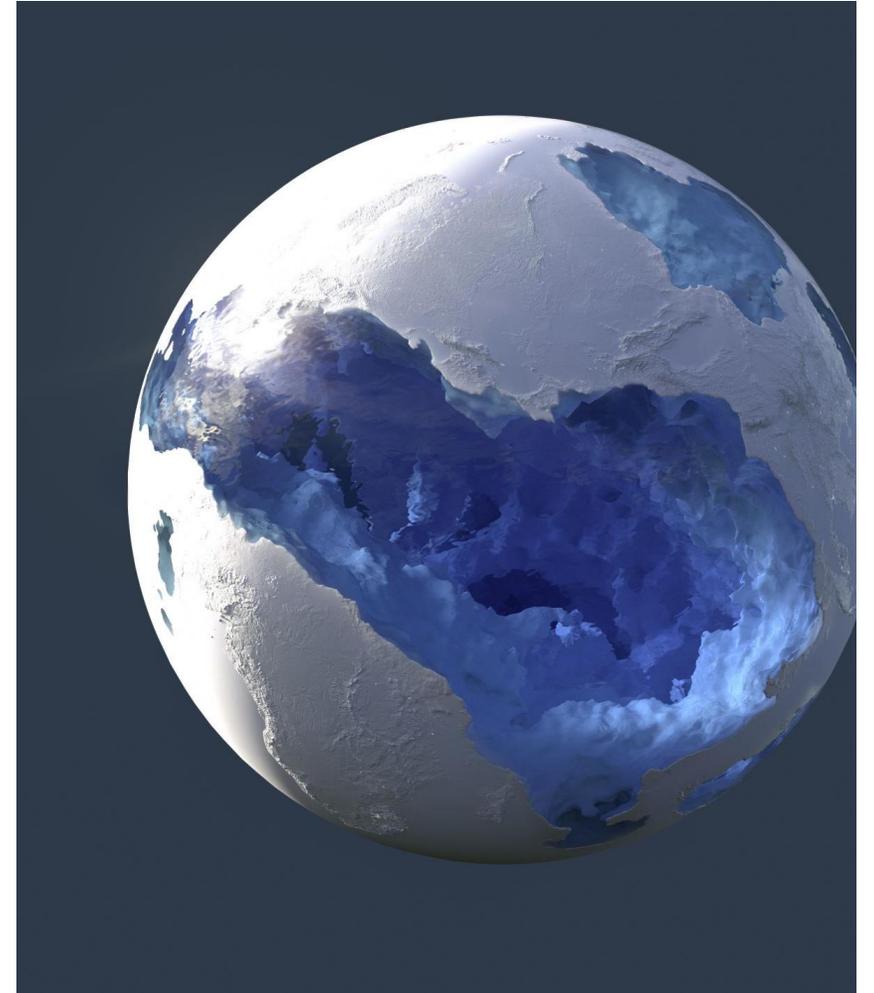
RESEARCH QUESTIONS

- RQ1: Which ICT tool types are referenced in national and regional science curricula?
- RQ2: For which pedagogical purposes are these tools positioned or recommended?



SAMPLE

- 21 national / regional science curricula, available online :
- *Greece, Cyprus, France, the United Kingdom, Ireland, Iceland, Sweden, Norway, Finland, Estonia, Poland, the United States (Next Generation Science Standards), Ontario (Canada), India, Singapore, South Korea, Nepal, Australia, New Zealand, and South Africa*
- Qualitative research. Coding was implemented.
- CATMA software was used, which is available online for free.



ICT TOOL CODES (RQ1)

- 1.1 Display & Investigation: *simulations, virtual labs, digital microscopes, interactive models*
 - 1.2 Information: *digital textbooks, websites, databases*
 - 1.3 Connectivity: *shared workspaces, including learning management systems, discussion forums, video conferencing tools*
 - 1.4 Data: *data-logging software, spreadsheets, and sensors*
 - 1.5 General ICT: *digital tools, or unspecified technological resources, including computers, tablets, generic digital devices*
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PEDAGOGICAL FUNCTION CODES (RQ2)

2.1 Assessment & Feedback: *digital quizzes, automated feedback systems, e-assessment platforms, and self-assessment tools*

2.2 Collaboration & Communication: *digital platforms and technologies supporting interaction, discussion, digital communication tools*

2.3 Inquiry & Experimentation: *virtual experiments, digital investigation tasks, modeling activities*

2.4 Knowledge Presentation: *digital animations, visualizations, presentations, diagrams, and multimedia explanations*

2.5 Resource Access & Lesson Organization: *learning portals, resource repositories, digital lesson plans, and organizational tools for instruction.*

CODING PROCEDURE:

Identify ICT reference

Assign tool code

Assign function code

Review for consistency

Insert into a matrix

DUAL CODING FRAMEWORK

- Matrix structure applied
 - Tool Type
 - Pedagogical Function
- From Codes to Patterns
 - Frequency distribution
 - Co-occurrence analysis
 - Pattern identification

OVERVIEW OF RESULTS

- 133 ICT-related excerpts coded
- Clear distribution across:
 - Tool types
 - Pedagogical functions
 - Co-occurrence patterns

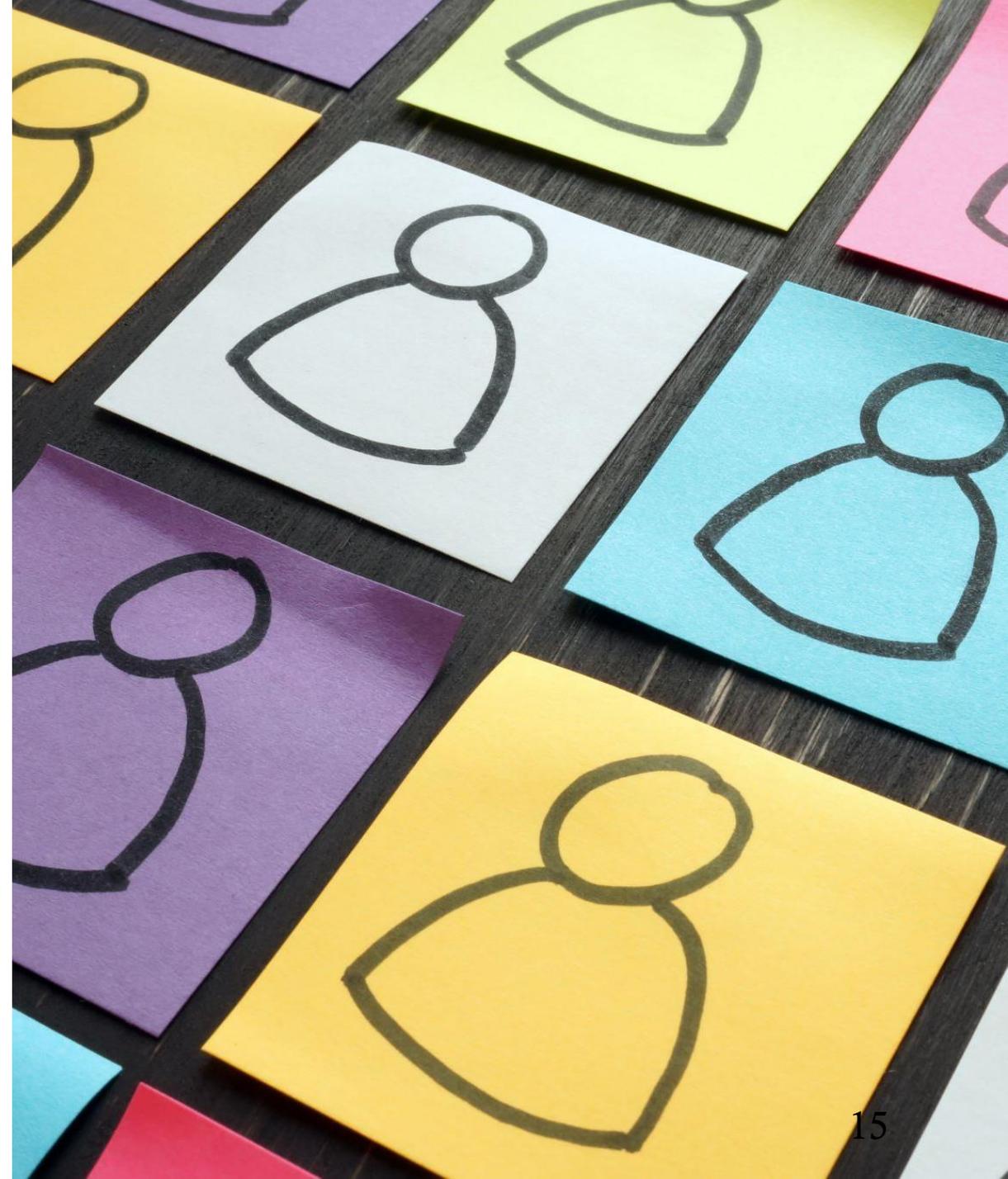
Codes	2.1 Assessment	2.2 Collaboration	2.3 Inquiry	2.4 Presentation	2.5 Planning	Row Total (Total Codes)
1.1 Display	3	4	16	9	19	51
1.2 Information	0	1	2	7	5	15
1.3 Connectivity	1	5	3	1	5	15
1.4 Data	1	4	5	2	2	14
1.5 General ICT	3	2	8	3	22	38
Column Total (Total Codes)	8	16	34	22	53	Grand Total: 133

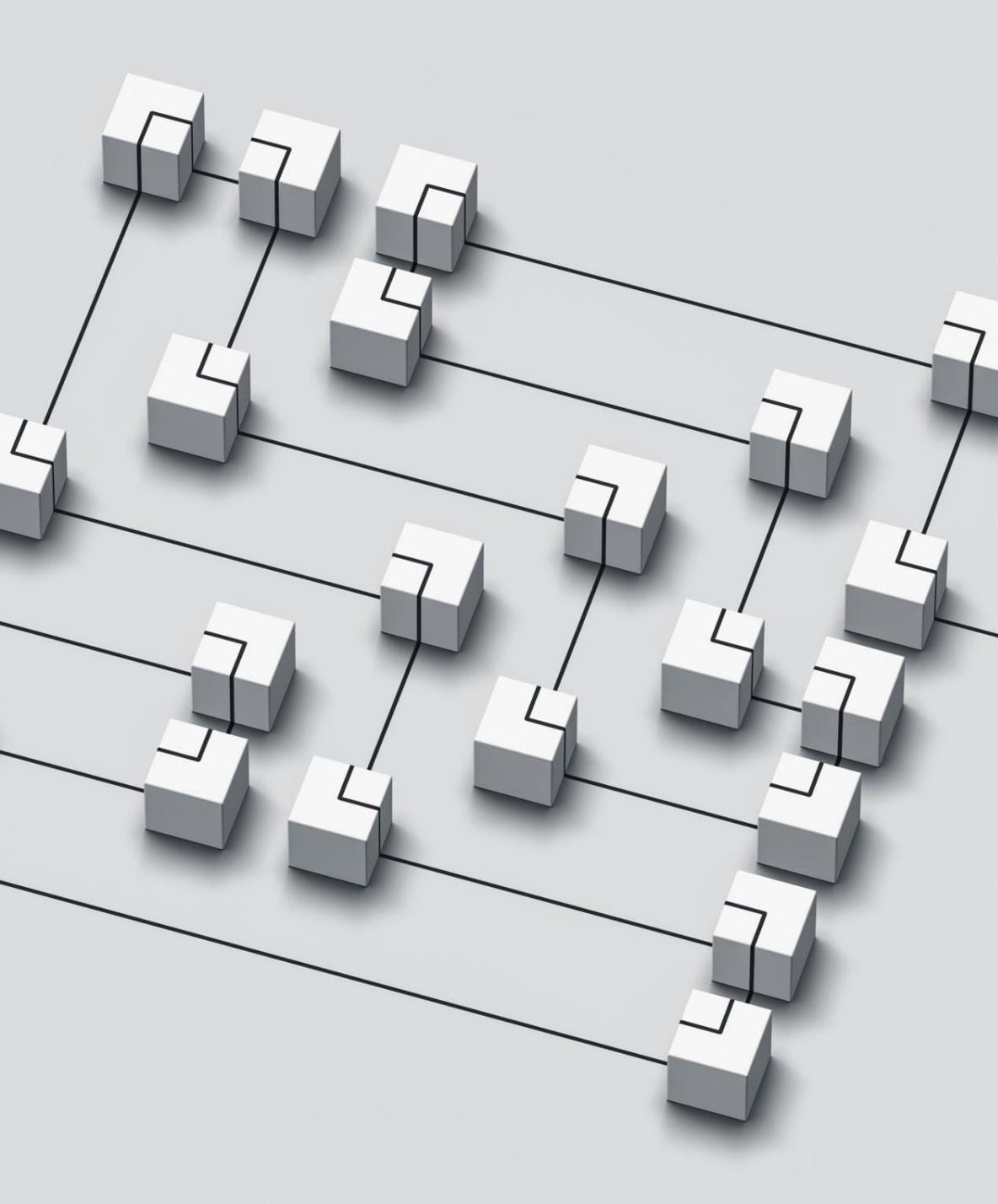
ICT TOOL CATEGORIES (FREQUENCY)

Display & Investigation	51
General Digital Technologies	38
Information Technologies	15
Connectivity Technologies	15
Data Technologies	14

PEDAGOGICAL FUNCTIONS (FREQUENCY)

Resource Access & Organization	53
Inquiry & Experimentation	34
Knowledge Presentation	22
Collaboration & Communication	16
Assessment & Feedback	8





PATTERN 1: ICT AS INFRASTRUCTURE

- High emphasis on:
 - Resource access
 - Lesson organization
 - General digital tools
- Less emphasis on:
 - Discipline-specific data work
 - Structured assessment

TOOL × FUNCTION ASSOCIATIONS

- Strong links:
 - Display → Inquiry
 - General ICT → Organization
- Weaker links:
 - ICT → Assessment

WHAT THE MATRIX REVEALS



- ICT frequently supports:
 - Access
 - Presentation
 - Organizational tasks
- Less frequently supports:
 - Formative assessment
 - Advanced data practices
- **Core observation:**
ICT present — but often broadly framed.

UNEVEN ICT INTEGRATION ACROSS CURRICULA

- Some curricula show:
 - Systematic embedding of ICT
 - Clear inquiry alignment
 - Explicit pedagogical articulation
- Others show:
 - Fragmented references
 - General or umbrella terms
 - Limited disciplinary positioning



SPECIFIC VS. GENERIC ICT LANGUAGE

Generic framing:

- Digital tools
- Technology use
- ICT competence

Explicit framing:

- Modeling
- Data manipulation
- Scientific investigation

Specificity shapes pedagogical clarity.

UNDERREPRESENTATION OF ASSESSMENT

Limited curricular
references to:

- Digital formative assessment
- Feedback mechanisms
- Data-informed teaching

Possible implication:

- ICT framed as delivery tool
not as evidence-building tool.

POLICY POSITIONING OF ICT

ICT often
conceptualized as:

- Infrastructure
Organizational support
Presentation medium

Less often as:

- Epistemic tool

IMPLICATIONS

For curriculum design:

- Clarify pedagogical functions of ICT
- Embed ICT in disciplinary practices

For teacher education:

- Support inquiry-oriented digital pedagogy
- Strengthen formative assessment integration

FINAL MESSAGE



- ICT is widely present in science curricula.
- But presence alone does not guarantee pedagogical depth.
- *A limitation is that findings are based on curriculum documents and do not examine classroom enactment.*
- *While grounded in systematic document analysis, the study does not examine classroom enactment, highlighting the need for further research on implementation and impact.*
- Clearer curricular articulation can strengthen inquiry-based science learning.
- Thank you.

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