Cyber Security education in schools

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Children are increasingly online

In 2020:
- √ 82% of children aged 3-4 went online
- √ 97% of children aged 5-15 went online
- √ 42% of 5-12 used social media

Ofcom (2021)
Risks recognised by parents

Outline

This talk looks into how 9 developed countries embed cyber security in their pre-university education
Preliminary findings reported in this talk are part of an on-going research project funded by the GFCE (Global Forum on Cyber Expertise), and conducted by a group of researchers at the Institute of Cyber Security for Society (iCSS), University of Kent.

Cyber security education

- Cyber security content is often embedded within pre-university computing / ICT education

  - The extent of cyber security coverage and whether and how it is incorporated to the curriculum differ per country
  - Cyber security education may be packaged as ‘online safety’, ‘digital skills’, ‘digital literacy’, ‘digital fluency’...
Map of pre-university school stages in 9 countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Age: 5</th>
<th>Age: 6</th>
<th>Age: 7-11</th>
<th>Age: 12-17</th>
<th>Age: 18</th>
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Cyber security education: **England**

There is a National Curriculum (Department of Education, 2014), and **digital literacy** appears under the **Computing** subject.

- **Age: 4-7**
  - Use technology safely and respectfully
  - keeping personal information safe and knowing where to go for help

- **Age: 7-11**
  - Use technology safely, respectfully and responsibly
  - recognising acceptable / unacceptable behaviour

- **Age: 11-14**
  - Online **identity and privacy**
  - recognising inappropriate content
Cyber security education: **Wales**

- There is a National Curriculum (Welsh Government, 2015) and the ICT subject appears in it
  - However, it **does not explicitly mention any content related to cyber security education**

- Wales also has a [Digital Competence Framework](https://www.gov.wales/topics/education-training/digital-competence-framework/index.html) (Education Wales, 2018) with a strand on **citizenship** for 8-16 years old which directly covers aspects of cyber security education » *but it is guidance*

- Identity, image and reputation
- Digital rights licensing and ownership
- Online behaviour and cyberbullying

Cyber security education: **Scotland**

The Scottish “Curriculum for Excellence” (Education Scotland, 2017) contains ‘**cyber resilience and internet safety’** benchmarks for **digital literacy** – under the subject area “the technologies”
Cyber security education: Scotland

Competencies:

Age: 3-5
- I can explore, play and communicate using digital technologies safely and securely.

Age: 5-8
- I can extend my knowledge of how to use digital technology to communicate with others and I am aware of ways to keep safe and secure.

Age: 8-11
- I can explore online communities demonstrating an understanding of responsible digital behaviour and I'm aware of how to keep myself safe and secure.
- I can keep myself safe and secure in online environments and I am aware of the importance and consequences of doing this for myself and others.
- I can explore the impact of cyber-crime for business and industry and the consequences this can have on me.

Cyber security education: Northern Ireland

The Northern Ireland divides the national curriculum (CCEA, n.d.) in stages (4 documents: foundation, key stages 1-2, 3, 4) – all have Using ICT as cross-curricular skills

Age: 6-16
- Under "Using ICT", pupils should be enabled to understand how to keep safe and display acceptable online behaviour
- An extra guiding document on Online Safety (Circular 2016/27) is available to support this

Awareness of risks:
- Content risks
- Contact risks
- Conduct risks
- Commercial risks
Cyber security coverage on national curricula (summary)

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<tr>
<th>Age reached in school year</th>
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- **England**: content added to Computing
- **Wales**: content added to Citizenship
- **Scotland**: content added to ICT
- **Northern Ireland**: content added as cross-curricular skills

Cyber security education: United States

The U.S. have no national curriculum for ICT / computing, but the **K–12 Computer Science Framework (2016)** informs the development of state-level curriculum.
Cyber security education: United States

Core concepts of the K–12 Computer Science Framework

- **Computing Systems**
- **Networks and the Internet**
- **Data and Analysis**
- **Algorithms and Programming**
- **Impacts of computing**

**Safety, law and ethics**

Achievements by end of grades 2, 5, 8 & 12 (adapted):

- **Age: 6-8**
  - **authentication measures** should be used to protect devices and information from unauthorized access
  - **harmful behaviours**, such as sharing private information and interacting with strangers, should be recognized and avoided

- **Age: 8-11**
  - **security measures** can be physical and/or digital
  - the ease to send / receive media on the Internet can create the opportunity for unauthorized use (online piracy, copyright, attribution)

- **Age: 11-14**
  - **security measures** (encryption, access control) should proactively protect personal and private data
  - people can be **tricked into revealing personal information** when more public information is available about them online

- **Age: 14-18**
  - **network security** depends on a combination of hardware, software, and practices; needs of users and sensitivity of data determine security level
  - **laws** govern many aspects of computing (privacy, data, property, information, and identity)
Cyber Security education: Australia

All Australian states have to follow the national curriculum (F–10 Australian Curriculum: Technologies 2017 & Senior Secondary School 2017)

- There is an online safety curriculum connection to “guide teachers to identify content in the Australian Curriculum that supports the teaching and learning of online safety”
- A curriculum review is under way and it is expected to introduce 4-5 years old to cyber security

Dimensions of the Curriculum Connections: Online Safety

- **Age: 6-11**
  - Values, rights and responsibilities
  - Informed and safe use of information and devices

- **Age: 11-14**
  - Values, rights and responsibilities
  - Informed and safe use of information and devices
  - Respectful relationships
  - Digital media literacy

- **Age: 14-16**
  - Values, rights and responsibilities
  - Informed and safe use of information and devices
  - Respectful relationships
  - Digital media literacy
  - Wellbeing

For all year levels, online safety is explicit in Health and Physical Education, Digital Technologies, English and The Arts.
Cyber security education: **Canada**

Canada has no national curriculum for ICT / computing. However, a *Digital World: A Pan-Canadian K-12 Computer Science Education Framework* is currently being designed to better align education across the provinces.

**Focus areas of the Pan-Canadian K–12 Computer Science Education Framework**

- **Cyber security**
- **Ethics, safety, and the Law**
- **Design**
- **Technology and Society**
- **Data**
- **Computing and Networks**
- **Programming**
Cyber security education: **Canada**

**Kindergarten**
- Start here
- Emerging Learner
- Developing Learner
- Proficient Learner

**Cybersecurity**
- Define cybersecurity and create safe passwords using effective criteria.
- Describe common types of cyberattacks and identify malicious content (e.g., spam, spyware, viruses, phishing, etc.).
- Apply common prevention practices (e.g., antivirus software and encryption) that prevent or minimize the impact of cyberattacks.
- Assess the role that people play in creating, preventing, and minimizing the impacts of cyberattacks as well as consider how they affect people and society.

**Going Further**
- Define major cybersecurity risks and recommend security measures that can be taken to prevent them.

**Ethics, Safety & the Law**
- Identity strategies to protect their personal data and identity online.
- Define and apply basic copyright principles. Practice ethical use of others’ material by using public domain or creative commons material and properly crediting the source.
- Explain the privacy concerns related to using personal data to profile and target people or to inform automated decision-making.
- Assess the effects of computer crime, hacking, virus distribution, and other illegal or unethical digital activities on society.
- Analyze and evaluate how policies governing technology and innovation have shaped and will continue to shape the evolution of digital technologies.

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Cyber security education: **Singapore**

Singapore has a **Character & Citizenship Education** syllabus that is **compulsory** for primary school (P3-P6) (CCE Primary, 2014) and for secondary school (CCE Secondary, 2021).
Cyber security education: Singapore

Age: 9-12

- Aspects of cyber security and online safety are embedded within Character and Citizenship Education regarding online friendships, communicating online and managing online bullying / abuses

Age: 12-17

- Cyber security continues to be embedded throughout Character and Citizenship Education throughout secondary school, with cyber wellness a key aspect of the syllabus: wellbeing of students online, positive online presence, using ICT for positive means, and being safe and responsible users of ICT

Cyber security education: New Zealand

A revised technology learning area has been incorporated to the New Zealand Curriculum in 2020

Technology areas:

- Designing and developing materials outcomes
- Designing and developing processed outcomes
- Design and visual communication
- Computational thinking for digital technologies
- Designing and developing digital outcomes
Cyber security education: New Zealand

Achievement related to cyber security:

Age: 6-11
- Students understand that **digital devices impact** on humans and society

Age: 13-14
- Students understand the **role of operating systems** in managing digital devices, **security**, and application software
- Students understand that with storing data comes responsibility for ensuring **security and privacy**

Age: 14-18
- Students use an iterative process to **design, develop, store and test digital outcomes**, identifying and evaluating relevant social, ethical and end-user considerations

Cyber security coverage on national curricula (summary)

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U.S.: content added to Computer Science
Australia: content added across subjects
Canada: content added to Computer Science
Singapore: content added to Character and Citizenship
New Zealand: content added to ICT

✓ = compulsory
x = not covered
* = optional
Observations about pre-university cyber security education

- Federated countries studied are adopting national frameworks
- The majority of countries incorporate cyber security content into ICT / Computing / Computer Science while others incorporate it across subjects (e.g., NI, Australia)
- Level of coverage of cyber security content vary
  - Lighter: Wales, Singapore, New Zealand
  - Deeper: Australia, Canada, U.S., England, NI, Scotland
- Scotland, Canada and Australia are targeting very young pupils (4-5 years old) to first introduce cyber security

A little about us

- 1 of 19 ACE-CSR in the UK
- BSc Computer Science (Cyber Security)
- MSc Computer Science (Cyber Security)
- MSc Cyber Security
References


