Does the UK benefit from the extended study of Computing?

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Introduction

Computing is one of the newest subjects on the curriculum. As we move to become a more tech focused society it is no coincidence that computer science is one of the fastest-growing subjects at GCSE, where computer science entries rose by 12% in 2023, above the average growth of 3% across all subjects (British Computer Society, 2023).

However, while technology will play an ever-increasing role in our lives, the question remains as to whether the adoption of computing as a compulsory subject throughout primary and secondary education is helping to benefit the UK as a whole.

Computing Education in the UK

Computing as a subject is new and has developed as computers themselves have evolved. The modern subject referred to as computing was introduced in 2014 when it replaced the former curriculum under the name of ICT after a report in 2012 by the Royal Society found the ICT curriculum to be "highly unsatisfactory" (The Royal Society, 2012).

The reason for this change was to create a new course less focused on "office skills," the main criticism of the former ICT course. This refresh included a rebranding of the curriculum to use the term "computing" to refer to the three main subject areas: Information Technology, Digital Literacy and Computer Science.

The first branch, Information Technology, focuses on the use of computers in the workplace, along with project management. This makes it the most similar to the former ICT course, however for the purposes of this project it is not relevant to my question.

The second branch, Computer Science, focuses on both the theoretical (algorithms and data structures) and the applied aspects (programming and problem solving) of computing. Nowadays, when you mention the word "computing" or "computer science" this is what most people think of.

However, the third branch, digital literacy, is the most widely applicable to most people. It focuses on the ability to use computers effectively. This encompasses the organization and storage of documents, as well as how to efficiently use Google and other internet-based tools to complete tasks.

Nowadays, students are taught computing throughout KS1-KS3. The national curriculum does not require computing to be taught as a subject during EYFS or KS4. However, during KS4 all students, including those not taking it as a separate GCSE, must be taught general digital literacy skills.

While computer science as a GCSE is widely available (as of 2018 79.2% of all students can study it at non-selective state schools), the actual uptake is much lower, sitting at just 15.6% of all students at schools which offer computer science as a subject choice (Kemp & Berry, 2019).

In addition to this, at KS4 the average lesson time for non-GCSE computer science digital literacy lessons averaged just nine minutes per week (Kemp & Berry, 2019). Despite computing becoming a more widely available and important subject, the average (non-computer science GCSE) student is receiving little computing education. Overall, total hours of computing education at KS4 have halved compared to the levels in 2012, and similar drops are seen across KS3 and KS5 (Kemp & Berry, 2019).

While for many people their computing needs are served well by the mandatory digital literacy elements, the benefits of studying the computer science elements are not to be understated. Considering how technology will be playing a vital role in our society in the near future, computer science education should continue to be extended so that more students are encouraged to take it as a choice at GCSE.

A follow up study by the Royal Society in 2017 noted that 24% of girls and 17% of boys cited their reason for not studying computer science at GCSE as "not needed for future plans" (The Royal Society, 2017). As I will elaborate on further later in this report, computer science education brings many skills often underdeveloped by the "typical" GCSE subject spread. However, these skills are often not recognised by students, and there is little attention given to these skills during subject selection.

Furthermore another 55% of girls and 38% of boys cited "not interested in subject" (The Royal Society, 2017). This shows that the mandatory digital literacy course needs to be expanded to involve more aspects of computational thinking to develop the soft skills found in the more specialised computer science course.

The Importance of Digital Literacy

Digital Literacy is one of the branches of computing taught throughout primary and secondary education in the UK, and notably is the only statutory [mandatory] part of the curriculum.

However, the current digital literacy curriculum does not do enough to keep up with the future usages of technology, nor does it encourage development of problem-solving skills.

> *Digital literacy should be a fourth pillar of education, alongside reading, writing and maths*
>
> *– (House of Commons Digital, Culture, Media and Sport Committee, 2019)*

In a world which has ever expanding sources of information, fake news and disinformation has become a real issue, especially on social media. There were many examples of this during the Covid-19 pandemic. Between January and July 2020 fact checking organisations have reported on over 1500 posts on X (formerly Twitter) identified as making false or partially false claims (Shahi, et al., 2021). However, the current curriculum does not focus on this issue at all. Just 2% of children have the digital literacy skills to identify fake news, and 53.5% of teachers surveyed believe that the current curriculum does not teach the skills required to identify fake news (National Literacy Trust, 2018).

Today's children have grown up surrounded by technology their entire lives. However, the naïve assumption that children are "digital natives" is wrong. Digital literacy is often overlooked as something inherently understood by children as they have grown up around it, however children do not necessarily inherently possess a deep understanding of digital literacy (ICDL, 2014).

The digital literacy pillar of computing can be improved by modernising and looking at the new technologies people should be aware about. During the coronavirus pandemic the general public was first exposed to the power of artificial intelligence outside of a theoretical example. This was when we saw the launch of the first Large Language Model (LLM) from OpenAI, and in 2022 we saw the introduction of DALL-E 2, an image generator using natural language.

Technologies such as these are increasingly powerful and are becoming more prevalent in day-to-day life, and so extending the curriculum to teach about the potential issues around artificial intelligence and artificial intelligence generated work should be added to improve the digital literacy course.

While not everybody is interested in going down the route of studying computer science, the need to have a comprehensive understanding of digital literacy is essential. However, the curriculum is not updated frequently enough to keep up with the pace at which the internet and computers themselves develop.

A refresh of the digital literacy course would help modernise it and ensure its relevancy. As the course nears ten years since its development, the internet and the world we live in has changed dramatically. By extending the digital literacy course students would be better able to adapt to the realities of the modern internet.

Furthermore, elements of the digital literacy curriculum could be intertwined into other subject areas. This allows for it to be applied to real life situations. For example, implementing it into a geography case study would allow students to apply their understanding and build further on their digital literacy skills to search for sources, and organise them effectively.

> *Digital literacy is an essential tool that underpins other subjects and almost all jobs.*
>
> – (House of Lords Select Committee on Digital Skills, 2015)

Nowadays digital literacy is no longer considered a "nice to have" skill, but an essential part of work life. As seen during the Covid-19 pandemic, where remote working became common, the ability to quickly adapt to new software and use it efficiently was essential.

By promoting a new and refreshed digital literacy course the younger generations will be better equipped to deal with the modern workplace. Having the ability to state that you are "tech literate" provides an advantage over other people as its now a key skill that employers are looking for in almost every job, even those that are unrelated to tech.

Soft Skills: The Skills Taught by Computer Science

However, as fundamentally important as digital literacy is, I argue that it's not the most essential skill taught by the computing curriculum. There is a key skill that is primarily taught in the Computer Science course which is highly valued and useful in most jobs.

Computational thinking refers to being able to solve a complex problem by breaking it into smaller steps, abstracting the useless details away, and then designing a solution to it. These problem-solving skills are increasingly useful and sought-after yet often go underdeveloped by other subjects that students choose to study.

The key benefit to computer science is the development of these computational thinking skills. This approach can be utilised in most jobs, as almost all necessitate a degree of autonomy and critical independent thinking and therefore the improved ability to define, evaluate and implement a solution is seen as a useful skill. Furthermore, these talents can be often applied to management positions, where leadership warrants extensive reasoning skills.

These skills are often underrepresented in the curriculum as they are only primarily touched on in maths. Computer Science not only implicitly develops these skills through programming, but also explicitly through the teaching of computational thinking. For example, under the Edexcel GCSE Computer Science curriculum, topic 1 is dedicated to this and unit 1.1 focuses on decomposition and abstraction.

> *[Students should] understand the benefit of using decomposition and abstraction to model aspects of the real world and analyse, understand and solve problems*
>
> *– (Pearson Edexcel, 2020)*

The four key areas of computational thinking are decomposition, pattern recognition, abstraction, and algorithms. Given any problem you break it into smaller and more manageable steps, identify patterns within the problem, remove unnecessary details, and develop a solution to solve this smaller problem.

This is a really valuable skill. The ability to split a large task into many manageable sub-tasks that have the detail abstracted away can be useful not just in programming, but in schoolwork, business and life in general.

As an example, I used computational thinking to write this project. I began by splitting the task into the manageable sub-sections that I was interested in talking about, identified patterns in my points between them, and then worked my way through the project one chunk at a time. This helped to ensure that I never experienced burnout, and that I was always focused on the smaller task at hand, rather than obsessing about the big picture, until the jigsaw puzzles fit together.

And while computing is often viewed as incredibly STEM focused, it also encompasses creativity with its problem solving. In many ways computer science is equivalent to an artist's paint brushes and a blank canvas. Given a set of guidelines, the problem can be tackled and interpreted in many ways. This problem-solving skillset is only developed by the computer science aspect of computing, and therefore is not covered by the broader and more generally taught (and statutory) digital literacy module (Romero, et al., 2017).

In my opinion, computational thinking is the most useful part of the computing curriculum, and yet it is underrepresented across the board. Problem solving is something that is useful in almost every area of life. Yet, because it is primarily only taught as part of GCSE Computing in KS4, most people miss out.

I believe that computational thinking should be expanded so that it is covered more extensively and earlier within the computing curriculum and that it is introduced into other subjects so that it can be built on further. By extending the study of computing we are equipping young people with the skills to solve problems easily from a younger age, and this can be used to their benefit throughout the entirety of their lives, even in jobs outside of the tech industry.

Conclusion

Overall, the need for computing has increased dramatically since the introduction of the new curriculum in 2014.

Nowadays, digital literacy is essential, not just in the tech sector, but across almost every role. However, the critical part of the computer science curriculum is the computational thinking, and it is this part that benefits students from childhood to old age. These problem-solving skills are viewed as valuable resources to employers and so improving computational thinking skills improves the ability of the younger generation to compete in the workplace.

Computing allows for the development of key skills not developed across the remainder of the curriculum. Skills like this are best developed when young, and I would recommend that the computing course be extended and elements, such as the digital literacy and the computational thinking, be implemented into other subjects to reinforce their usage.

The need for computing in the future cannot be fully stated, and the skills that computing brings cannot be understated. I believe that by extending the study of computing we will be directly equipping students with the skills they can use across all aspects of their life for the rest of their life.

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Appendix A

Source analysis for *Computer Science fastest growing STEM subject – British Computer Society*

British Computer Society	Computer Science fastest growing STEM subject
Date of Publication	24 August 2023, making this source the newest of all my sources.
Source Summary	This is an article published by BCS, the charted institute for IT commenting on the growth of computer science at GCSE level in 2023.
Relevance	This source relates to my project as I use it to reference the computer science GCSE numbers
Authority	BCS is the professional body for IT which makes them an authoritative source
Accuracy	This source referenced data from JCQ, Ofqual, CCEA and WJEC which are the bodies representing the exam boards, making their information accurate
Purpose	The purpose of this article is to inform the reader about how computer science is a fast growing GCSE subject as more people take it. While the organisation may be biased due to their role, the first part of the article (which is what I referenced) remained objective in their stance.

Appendix B

Source analysis for *Why 'digital literacy' is now a workplace non-negotiable – Alex Christian and the BBC*

Alex Christian (published by the BBC)	Why 'digital literacy' is now a workplace non-negotiable
Date of Publication	27 September 2022, meaning that this source is still current
Source Summary	This is an opinion piece published to discuss how the term digital literacy has evolved and how its now an essential skill for most jobs. This source was only used while referencing for my HPQ and is not cited as it is an opinion piece
Relevance	This source relates to my project as digital literacy is a key pillar of computing
Authority	The BBC is a reputable source in the UK. The writer, Alex Christian, is a freelance writer but who has published articles for tech companies. However, I believe that he is qualified to write on this topic as it is about working in general
Accuracy	This is an opinion piece, however there is no signs of bias in this source
Purpose	This article is intended to persuade the reader that digital literacy is a core workplace skill in the modern day. The viewpoint however is unbiased.

Appendix C

Source analysis for *Disinformation and 'fake news': Final Report: Government Response to the Committee's Eighth Report of Session 2017-19 – House of Commons Digital, Culture, Media and Sport Committee*

House of Commons Digital, Culture, Media and Sport Committee	Disinformation and 'fake news': Final Report: Government Response to the Committee's Eighth Report of Session 2017-19
Date of Publication	9 May 2019 making this source current
Source Summary	This is a report by the House of Commons DCMS committee primarily regarding the government's actions against disinformation. However this source comments on their recommendations for Digital Literacy in Recommendation 46
Relevance	This source relates to my project
Authority	The House of Commons DCMS Committee was appointed to serve as the body in the legislature to look at the DCMS Department. This makes them an authoritative source
Accuracy	The source is mainly opinion based in regards to the recommendations. However because of this there are no sources referenced directly in the report.
Purpose	This report is intended to persuade the Government to improve its approach to disinformation and digital literacy. Due to the political nature of the report, there may be bias within its recommendations. Furthermore, I have ignored all of the government response sections due to the fact that they are highly likely to contain bias

Appendix D

Source analysis for *Summary and summary of conclusions and recommendations – House of Lords Select Committee on Digital Skills*

House of Lords Select Committee on Digital Skills	Summary and summary of conclusions and recommendations
Date of Publication	This source was published in 2015
Source Summary	The House of Lords published this report to encourage the new Government to prioritise "digital skills" within their agenda for the Department for Education
Relevance	This source relates to my project
Authority	The House of Lords Select Committee on Digital Skills was appointed to research the digital skills currently taught so that the UK can become a digital leader in the future
Accuracy	This source does not reference its sources, and therefore the accuracy of their reference information cannot be checked
Purpose	This source was designed to encourage the new Government to increase digital skills in their agenda. While the House of Lords is not directly political, due to the party affiliation held by many of its members there may be political bias within this source

Appendix E

Source analysis for *The fallacy of the 'digital native' – ICDL*

ICDL	The fallacy of the 'digital native'
Date of Publication	2014, making this source one of my older ones. However, I do not believe that there have been significant changes since 2014 in regard to this project and therefore I believe it is still current
Source Summary	This is a report by ICDL showcasing their position on digital literacy in the workplace. This source argues that despite growing up around tech, children are not inherently gaining digital literacy skills
Relevance	This source relates to my project
Authority	ICDL is a global social enterprise whose aim is to raise awareness about digital literacy in the workplace and society as a whole. This means that they are qualified to write about this topic
Accuracy	The source is supported by many references and is primarily factual and objective
Purpose	This source is designed to inform readers about the importance of continuing digital literacy education for children, as digital skills are not inherently gained. There may be a slight institutional bias as this organisation is dedicated to improving digital literacy in the workplace, school and society

Appendix F

Source analysis for *The Roehampton Annual Computing Education Report: pre-release snapshot from 2018 – Peter EJ Kemp & Miles G Berry*

Peter EJ Kemp & Miles G Berry	The Roehampton Annual Computing Education Report: pre-release snapshot from 2018
Date of Publication	This source was published in 2019 making it current
Source Summary	This report by the University of Roehampton provides statistics regarding Computer Science GCSE, such as access to it as a subject and hours of teaching
Relevance	This source relates to my project
Authority	University of Roehampton is a reputable source for research reports such as this one
Accuracy	The source is supported by references and is factual
Purpose	This source is to provide statistics regarding Computer Science as a GCSE topic in the UK. There are no biases in this source

Appendix G

Source analysis for *Fake news and critical literacy: final report – National Literacy Trust*

National Literacy Trust	Fake news and critical literacy: final report
Date of Publication	This source was published in 2018 making it fairly current
Source Summary	This source discusses the findings by their report showing that children are not taught to identify fake news
Relevance	This source relates to a specific point I was making
Authority	The National Literacy Trust is an authoritative source in the UK for discussing literacy
Accuracy	The source is supported by references and is factual
Purpose	This source is designed to inform about the lack of fake news education. There are no biases in this source

Appendix H

Source analysis for *GCSE (9-1) Computer Science Spcification – Pearson Edexcel*

Pearson Edexcel	GCSE (9-1) Computer Science Specification
Date of Publication	This specification is the current specification for Edexcel Computer Science GCSE, published in September 2020
Source Summary	This is the official specification for the Edexcel Computer Science GCSE, which covers digital literacy and computational thinking
Relevance	This source relates to the wider topic of digital literacy and computational thinking
Authority	This is the official specification for Edexcel, and is therefore authoritative.
Accuracy	This source is the primary source and cannot have any further sources
Purpose	This specification is to instruct teachers on the content of the board

Appendix I

Source analysis for *Computational thinking development through creative programming in higher education – Margarida Romero, Alexandre Lepage and Benjamin Lille*

Margarida Romero, Alexandre Lepage and Benjamin Lille	Computational thinking development through creative programming in higher education
Date of Publication	This paper was published in 2017, however the topic remains relevant
Source Summary	This source discusses how computer science (in particular programming) is a very creative subject, but despite this it still develops computational thinking
Relevance	This source relates to my topic
Authority	The authors are reputable, and their reports focus on computational thinking
Accuracy	The source is supported by references and is factual in nature
Purpose	This source is intended to discuss the how computational thinking can be developed through programming, an inherently creative subject There are no biases in this source

Appendix J

Source analysis for *An exploratory study of COVID-19 misinformation on Twitter – Gautam Kishore Shahi, Anne Dirkson and Tim A. Majchrzak*

Gautam Kishore Shahi, Anne Dirkson and Tim A. Majchrzak	An exploratory study of COVID-19 misinformation on Twitter
Date of Publication	This source was posted in 2021 during the Covid-19 pandemic
Source Summary	This source discusses the misinformation about Covid-19 spread on X (formerly Twitter)
Relevance	While this source is not relevant to my topic at large, it was relevant to a specific point I was making
Authority	The authors focus on social media and therefore are reputable and authoritative sources to use
Accuracy	The source is supported by references and is factual
Purpose	This source is designed to inform about how widespread misinformation about Covid was on X I don't believe that this source has any biases

Appendix K

Source analysis for *Shut down or restart? The way forward for computing in UK schools – The Royal Society*

The Royal Society	Shut down or restart? The way forward for computing in UK schools
Date of Publication	This is my oldest source published in 2012, pre the curriculum reforms. While the information is no longer current due to the reforms, the report was the driving factor behind them
Source Summary	This source discusses how the former ICT curriculum was unsatisfactory and how a new subject has to be developed to better reflect computing in schools
Relevance	This source directly relates to my topic, as it focuses on computing education
Authority	The Royal Society is a body designed to promote science across the UK. They are therefore an authoritative source on computing education
Accuracy	The source is supported by references and is factual
Purpose	This source is designed to persuade the Government to change the ICT curriculum. There are no biases in this source

Appendix L

Source analysis for *After the reboot: computing education in UK schools – The Royal Society*

The Royal Society	After the reboot: computing education in UK schools
Date of Publication	This source was published in 2017 as a follow up to their 2012 report
Source Summary	This source discusses the effectiveness of the curriculum refresh done in 2014, and also mentions the main issues that still need resolving
Relevance	This source relates to my topic
Authority	The Royal Society is a body designed to promote science across the UK. They are therefore an authoritative source on computing education
Accuracy	The source is supported by references and is factual
Purpose	This source is designed to inform readers about the effectiveness of the new computing curriculum, as well as to persuade the Government to take it further. There are no biases in this source