

IMechE response to the Department for Education consultation on proposed updates to the current Computer Science GCSE subject content (July 2024)

The Institution of Mechanical Engineers (IMechE) represents 115,000 engineering professionals and students in the UK and worldwide. The Institution plays a significant role in promoting education and skills in mechanical engineering, thus inspiring pupils and young people into engineering careers.

Within the Institution, the Engineering Policy Unit informs and responds to UK policy developments by drawing on the expertise of our members and partners, and the Education and Skills Strategy Board works to influence government and other stakeholders across the field to recognise the contributions and potential of engineering to society. By engaging widely with key actors in the field, the Institution campaigns to shape education policy and raise the profile of engineering, technology, STEM education and engineering careers.

As an institution, we are dedicated to advocating for engineering opportunities to be available to all students, regardless of their socioeconomic backgrounds. We recognise the importance of inspiring pupils to explore the world of computer science and want to learn more about computer science and not swamp them in monotonous outdated content.

Computer science GCSE subject content (Questions 10 – 14)

10. Is the proposed new introductory paragraph clear and unambiguous?

The introductory paragraphs explain the purpose of the GCSE subject content, its relationship to assessment objectives, and its role. The bullet-pointed format enables clarity and accuracy, covering various relevant aspects of computer science, from fundamental principles to practical skills. The introductory paragraphs emphasise theoretical knowledge and practical application, mainly through programming, which highlights the broader context of digital technologies and their potential impact.

According to the subject aims, despite the clarity and unambiguity of the proposed content, it would be relevant to include the importance of data protection and ethical considerations in the digital world.

11. Is the knowledge and understanding set out in this section clear and unambiguous?

Overall, the knowledge and understanding section of the consultation is unambiguous about key areas of computer science. However, further elaboration and providing some examples would enable a broader audience to understand this section. In this regard, providing clear examples and definitions is relevant as the level of detail varies across different topics. For example, the programming concepts are highly detailed, while the broader impacts of computing are less explicit and would benefit from explanations. These examples could be real examples provided by industry.

The section about ethical and societal considerations in computing, including data privacy, algorithmic bias, and responsible AI development, should also be expanded and include potential future implications. In connection with this perception, UK organisations and relevant stakeholders in the field have emphasised the ethical use of AI in any relevant systems¹. These considerations help ensure the GCSE Computer Science curriculum remains current and relevant, preparing students for further study and careers in the evolving computer science world.

12. Do you support the opportunity for visual programming languages to be used in meeting the GCSE's programming requirements, in addition to textual ones?

It is essential to update the current curriculum to ensure pupils learn the most relevant and up-to-date knowledge and skills necessary for further study or employment in computing or related fields. In this regard, we are supportive of the idea of using clear guidelines on how visual languages can be incorporated alongside textual programming, specifying that they will not replace textual programming in the short term and abruptly.

In addition to ensuring a balanced approach to introducing visual programming languages and textual programming, it is crucial to regularly review and assess how awarding bodies offering GCSE Computer Science qualifications implement visual programming to ensure effective implementation of the visual programming languages. These actions are essential as visual programming languages can make coding more accessible to a broader range of students and potentially boost engagement. As visual programming languages evolve, there must be a mechanism for curriculum review and update, to keep learning relevant.

13. Do you agree that computer science students whose GCSE programming study is completed using a visual, rather than textual, programming language, will not be disadvantaged on progression to A level study, which mandates textual programming?

IMechE recognises the importance of both textual and visual programming skills for engineers, particularly in the context of new technology evolution and the need for an updated curriculum in engineering fields. While the Institution recognises that the adoption of digital technologies, including programming tools, is crucial for the future of engineering and manufacturing², we believe students who have primarily used visual programming may face difficulties transitioning to the mandatory textual programming at A level if the necessary actions and guidelines are not in place.

¹ British Computer Society. Living with AI and emerging technologies: Meeting ethical challenges through professional standards

<https://www.bcs.org/articles-opinion-and-research/living-with-ai-and-emerging-technologies-meeting-ethical-challenges-through-professional-standards/>

² Institution of Mechanical Engineers. Future Skills week: Why programming is key to engineering communication

<https://www.imeche.org/news/news-article/future-skills-week-why-programming-is-key-to-engineering-communication>

In this regard, some institutional concerns include the need to introduce textual programming alongside visual programming at the GCSE level, as both approaches have value, and future engineers should be familiar with programming concepts to stay competitive in the evolving industry landscape. Also, it is vital to develop courses or materials to bridge the gap between visual and textual programming, help students acquire the necessary skills for the future and ensure that the programming concepts are thoroughly taught, regardless of the language used. It is also important that students are given an opportunity to understand real life applications of programming, as this would also bring the learning to life.

Additionally, students need to learn more about data and its specifications related to how it can be manipulated, for example, via algorithms and emerging technological tools. This knowledge will enable students to be critical of outputs and ways to use computer science more effectively.

14. Is the Skills section of the subject content clear and unambiguous?

The Skills section is generally straightforward and clear. However, a few areas and concepts could benefit from further clarification and providing examples—for instance, the section about applying computing-related mathematics leaves room for interpretation and ambiguity and should specify what type of skills this includes.

Similarly, the section would be more specific if examples or more specific criteria for each skill were included to ensure consistent interpretation from broader audiences and emphasise the importance of problem-solving skills and ethical considerations in software development and technology use.

Equalities – Question 15 to 16

15. Do any of the proposals have the potential to have a disproportionate impact, positive or negative, on specific groups, in particular those who share a ‘protected characteristic’ (age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex and sexual orientation)?

IMechE has long advocated for strategies to ensure the inclusion of minorities and vulnerable groups into engineering and is actively working to promote diversity and inclusion.

Concerning this effort, the Science Education Tracker 2023 provides valuable insights into the current state of GCSE Computer Science education, particularly highlighting persistent issues with gender representation and differences in uptake across ethnic groups. The tracker shows a significant gender gap in GCSE Computing uptake. For instance, in 2023, 33% of male students in years 10-13 reported studying computing at GCSE, compared to only 10% of female students³.

³ The Royal Society. Science Education Tracker 2023.

The proposed changes, while comprehensive, also highlight areas where specific groups, particularly girls and students from disadvantaged backgrounds, may require additional support. However, these changes also hold the potential to ensure equitable outcomes, offering hope for a more inclusive future. Furthermore, by establishing up-to-date technological tools, the proposed content can aid all students in understanding and retaining information more effectively, which is beneficial for students who struggle with traditional learning methods.

Although the updates do not specifically address the gender disparity in engineering, which means the subject could continue to see lower female participation, we consider additional measures should be included to encourage girls and students from vulnerable groups to enrol and ensure teachers keep up to date with training.

Additionally, the proposal should include recommendations for better teacher access to continuous professional development, especially around ensuring equality, diversity, and inclusion in computing education. This is relevant as there is also a shortage of STEM teachers in schools, particularly in the most deprived areas. Encouraging more students to take GCSE Computer Science can help address this shortage in the long term⁴.

16. How could the proposed subject content of the GCSEs be altered to:

• better eliminate unlawful discrimination, harassment and victimisation and other conduct prohibited by the Equality Act 2010;

In better eliminating unlawful discrimination and advancing equality of opportunity through the proposed GCSE changes, content that addresses the impact of digital technology and AI on different groups in society should be considered, particularly those with protected characteristics. Similarly, the document should include clear guidance to the awarding bodies implementing the changes and offer alternative assessment formats for students who struggle with the traditional exam format. Also, the changes should ensure the language used in subject content is inclusive and hinders any form of discrimination. By considering broader actions, the GCSE subject content could better eliminate discrimination and provide more equitable access to education for all students.

• better advance equality of opportunity between persons who share a protected characteristic and those who do not;

To better advance equality of opportunity between persons with a protected characteristic, the proposed changes should promote inclusive computing education, incorporating content that addresses how to make computing and technology more inclusive and accessible to all groups in society.

<https://royalsociety.org/-/media/policy/projects/science-education-tracker/science-education-tracker-2023.pdf>

⁴ Engineering UK. Engineering and Technology are of vital importance to the UK

<https://www.engineeringuk.com/media/w4qfkojw/facts-and-stats-engineeringuk-jan-24.pdf>

- **better foster good relations between people who share a protected characteristic and those who do not.**

To better foster good relations between people who share a protected characteristic and those who do not, the proposed subject content of the GCSE Computer Science 2024 could design specific projects that require collaboration among students from diverse backgrounds to encourage discussion, collaboration and create an inclusive classroom environment that respects and values diversity to prevent racism and discrimination in the classroom.