Responsible Design & Innovation

GCSE suggested subject content

May 2023

Contents

Content for Responsible Design & Innovation

Introduction

1. The GCSE subject content sets out the knowledge, understanding, expertise and educational outcomes common to all specifications in GCSE Responsible Design & Innovation (RD&I).

2. RD&I should focus on contexts grounded in societal responsibility as the purpose of design and engineering practice, where knowledge and understanding of material science is applied to the practical process of prototyping in the context of solving real world challenges drawn from a set of thematic areas, such as the United Nations Sustainable Development goals.

3. The GCSE specifications in RD&I should teach content from four core strands of learning:
   - Design process
   - Material science
   - Digital and physical prototyping
   - Responsibility

4. The GCSE specifications in RD&I should enable students to understand and apply design, systems or circular thinking approaches through which they can **empathize** with users, **define** problems, **ideate** creatively, **prototype** solutions and **test** these for viability. Students should be able to solve problems by designing and by making prototypes, that solve real contemporary problems. GCSE specifications should also provide opportunities for students to apply knowledge from other disciplines, including mathematics, science, art and design, computing and the humanities.

Aims and Objectives

5. GCSE RD&I specifications must enable students to design and to prototype by responding to design challenges that apply knowledge, understanding and practical expertise, in order to:

    - develop the mindsets and behaviors of designers and engineers who aim to solve ambiguous and complex problems
    - utilize through designing and making, advancing and more automated digital technologies and manufacturing processes
    - prioritize the ability to “learn to learn” within a complex process or project
    - develop empathic intelligence, enhancing students’ emotional engagement to designing for people or the environment, with commitment and persistence to solving the problem
    - develop the ability to make connections with others, seek out collaborations, intuit solutions and apply capabilities beyond the classroom environment
    - contribute to a better prepared workforce for tomorrow, capable of working with advancing technologies and prioritizing human capabilities
    - develop knowledge and expertise of design, through design, systems and circular thinking methods
    - utilize materials and prototypes in both purposeful and responsible ways when solving challenges
    - innovate around broken economic systems by designing solutions that account for interdependencies and human impact

Subject Content

Design process

6. The application of design that involves the use of strategies for understanding design needs and opportunities (empathize and define), visualizing and generating creative and innovative ideas (ideate), planning and creating viable solutions (prototype), analyzing and evaluating the ideas that best meet the criteria (test).

7. In order to make effective design choices, students will need a breadth of knowledge that includes understanding, analyzing and evaluating the areas of design process, approach and purpose as follows:

8. **Design Process**
    - Researching the problem area, accounting for stakeholders (people) and ecosystems (environments)
    - Methods to generate, identify, prioritize, select, elicit, combine, and evaluate ideas as part of a design approach
    - Developing creative solutions that are suitable to prototype and test, including methods for concept ideation and developing a design rationale
    - Learning from prototypes through repeated testing and failure
    - Pitching, reporting and presenting, including the use of prototype demonstrations, to validate solutions
    - Commercial viability of solutions, including strategies for enablement and implementation in the real world

9. **Design Approach**
    - Design thinking as the approach for fostering effective and collaborative design
    - Systems thinking as the approach to designing solutions for problems and opportunities that are the sum of many interconnected parts
    - Circular thinking as the approach of designing solutions that focus on eliminating waste and pollution, circulating products and materials within the economy, and regenerating nature.
    - How to design, develop and implement research tools tailored to different design approaches and stakeholders
    - The approach to designing products out of a system e.g. Design using Circular Design principles

10. **Design Purpose**
    - The values and purpose of the design and engineering industries

- Designing for different users including: Consumers, Citizens, Communities, Inhabitants, both through inclusive design principles and when designing for exceptional people
- The impact of design in society, including the history of design and the importance of inclusive design practice
- Psychology in design including anthropometrics, emotion, behaviour and wellbeing

11. Students should use the knowledge and understanding listed above to develop, demonstrate and apply practical expertise when designing and when producing prototypes. In addition, GCSE specifications in RD&I must require students to demonstrate:

- The behaviors of successful British and International designers and engineers (Questioning, Curiosity, Empathy)
- Experience of collaborative design in teams including teamwork and stakeholder engagement
- How to consolidate data and research, considering GDPR
- Designing for real world contexts in a local setting
- The features and characteristics of designing physical and digital outcomes

Material Science

12. The expertise to make informed decisions about materials and understand that materials are subject to ongoing changes in availability, processing methods, price, and that new materials are constantly being developed. In order to make effective designing and making choices in relation to materials, students will need to be able to draw upon domain knowledge the covers:

- Existing materials used for prototyping, and new material innovations, studied in the context of their impact, through:
    - Classification (e.g. physical, chemical, structure and defects)
    - Properties (e.g. mechanical, thermal, electrical, magnetic, optical)
    - Sourcing & extraction
    - Longevity global reserves
    - Footprint
    - Embodied energy, carbon, and water

Digital and Physical Prototyping

13. The material domain knowledge and practical expertise applied to digital, physical and roleplay prototyping to create a solution for testing, capable of validating ideas and identifying further refinement. In order to make effective design choices in relation to prototyping, students will require domain knowledge that includes the understanding of:

    - The purpose of prototyping – for testing, learning and communication
    - Different methods for digital communication and prototyping – e.g. computer aided design and digital presentation
    - Digital devices to create and test solutions in a digital environment e.g. simulation
    - Different methods for physical communication and prototyping including sketching, rough models and both functional and proof-of-principle prototypes
    - Fundamental process knowledge of additive and subtractive manufacturing, casting, molding, forming, machining, joining and coating.
    - Using data and mathematical models to simulate and predict performance

14. In addition, when designing and producing prototypes, students should also apply knowledge of roleplay and human enacted prototyping, using the knowledge above to develop, demonstrate and apply practical expertise to designing and prototyping to create solutions based in real world contexts.

Responsibility

15. Learning about global challenges, such as those represented within the United Nations Sustainability Development goals. In order to make choices about designing and making that prioritizes responsibility and societal need, students will develop a breadth of broad contemporary knowledge that includes:

    - Global frameworks (e.g. the SDGs), legislation, regulation, measures and agreements.
    - The relationship between responsible design and commercial businesses
    - How circular & regenerative economies provide opportunity for innovation

- Methods for eliminating waste and pollution through circular approaches
- Analysing and critiquing existing impactful products and systems including; Fashion; Energy; Transport; Food; Housing; and Carbon Footprint

Contextual Challenges & Assessment

16. For GCSE specifications in RD&I, the application of design should be set within responsible and societal contexts, that translate into local, regional, national or global perspective. An example list of contexts using the UN SDGs would be:

UN Sustainable Development Goal: Thematic Areas	
Economy	i) Work with growth of the economy ii) Industry, innovation, and infrastructure iii) Responsible consumption and production iv) Reduced Inequalities
Society	i) Poverty ii) Hunger iii) Gender Equality iv) Quality education
Climate Action	i) Good health and wellbeing ii) Affordable and clean energy iii) Peace, Justice and strong institutions iv) Sustainable cities and communities
Biosphere	i) Life on land ii) Life below water iii) Clean water and sanitation

17. For Non Examined Assessment (NEA), GCSE specifications in RD&I must require students to complete two assignments set by the Awarding Organization.
    - The first should require students to apply and demonstrate their knowledge and understanding developed across the course to designing solutions without the constraints of making physical outcomes, assessed through an internally assessed, externally moderated digital design portfolio.
    - The second should require students to undertake a make and evaluate practical assignment experienced under exam conditions, assessed at centre.