Design and Technology Progression Guide - Moving from GCSE to GCE and beyond

Introduction

When developing Design and Technology: Resistant Materials Technology (RMT) specifications for GCSE, GCE AS and A2, Edexcel's main aim has been to produce a suite of qualifications at all levels that would be stand alone qualifications but which would be part of a continuum that could be built upon, each level of study underpinning and progressing to the next to form a coherent and related route from GCSE to A2.

A key concern in designing specifications at all levels was to place as much control and choice as possible in the hands of teachers and students and to provide opportunities to maximise achievement through creative design and make activities. This ethos exists in all three specifications and is central to progression from one level to the next.

At each level of study, the course structure is similar in that at GCSE through Controlled Assessment, at AS through the Portfolio of Creative Skills and at A2 through the Commercial Design task, students have control over 60% of the marks available in the assessment of each qualification.

The other 40% of assessment is gained through a student's knowledge and understanding of Unit 2 at GCSE level, Unit 2 at AS level and Unit 3 at A2 level.

Progression from GCSE to GCE AS level – knowledge and understanding

In order to facilitate progression in gaining knowledge and understanding of RMT, 'layered learning' strategies are encouraged, where some topics appear in both GCSE and AS specifications, but the level of response expected in an examination for a similarly worded question would be greater at AS level, one year on from GCSE. For example, a question asking for a description of hardening carbon steel at GCSE level might require a student to understand the process in terms of heating the steel until red, then quenching, but at AS level reference to critical temperature and the formation of iron carbide might be expected. Having a fundamental understanding of topics from GCSE allows an ease of progression when a familiar topic is reinforced and extended as part of AS studies, this 'layering' facilitates progression in student learning.

In order to ensure the focused teaching of topics within the specification content of GCSE and AS, an introductory 'stem' is included which explains the approach that should be taken when dealing with each topic. These stems are often similar in wording but are progressive. An example of this is the stem statement for 'Polymers', which at GCSE states:

'Aesthetic, functional and mechanical properties, application and advantages/disadvantages of the following thermoplastics when manufacturing products'

The AS stem is exactly the same except for the addition of:

'Structural composition with reference to cross linking'

The definitive lists of polymers that follow the stems are statements of exactly which materials should be considered and only these materials will be asked about in examination questions. The defined list of polymers at GCSE level is:

- acrylic

- polyethene
- polyvinyl chloride
- polystyrene
- acrylonitrile-Butadiene-Styrene (ABS).

At AS level, the list is extended to include different forms of polyethene i.e.

- High density polyethene
- Low density polyethene
- Polyethene terapthalate

Polypropylene is also added, and in this way progression is achieved through the depth of required understanding and the breadth of materials to be considered.

As well as extending the range of materials and processes and broadening the approach, when progressing to AS level more topics appear in the specification content, such as 'conversion and seasoning of wood', 'faults in wood', 'quality assurance' and 'quality standards'.

Health and safety appears at GCSE level, where students need to be able to identify hazards and precautions and describe safe working practices, but at AS level they must learn specifically about the Health and Safety at Work Act (1974) and the bulleted points within that topic.

These examples are typical of almost all topics and illustrate how progression is achieved through a mixture of familiarity, leading on to more in-depth knowledge and an assimilation of new and extended information. When planning lessons at AS level, teachers should note the valuable foundation laid down in a student's GCSE work and use this as a starting point for progress.

Progression from GCE AS to A2 - knowledge and understanding

Progression from GCSE to AS level could be described as a gentle transition and development, largely involving familiar materials and processes, in keeping with the AS unit title 'Design and Technology in Practice'.

The step up from AS to A2 level is much more dynamic and focuses on design and manufacturing practices at a commercial level, living up to its unit title 'Designing for the future'. The unit complements Unit 4 'Commercial Design' and the focus is on developing knowledge and understanding of four topic titles:

- industrial and commercial practice
- systems and control
- design in context
- sustainability.

Each of these topics is sub-divided further to identify specifically what students need to know and understand and each sub-division is preceded by the familiar 'stem' to focus teaching.

Progression from AS to A2 will require most students to step out of the comfort zone of having some knowledge and understanding of most topics as a starting point and into the situation of starting with little useful knowledge of sub-topics. For example CAD and CAM appear in the AS specification, but at A2 they are no more than a component part of 'Systems and control' and progression of understanding is achieved through a wider, more detailed study of commercial manufacture as part of 'Computer Integrated Manufacture (CIM)'. Progression is also achieved through the requirement that students will

understand and appreciate the social and economic effects of sub-topics where appropriate.

Under 'Information and communication technology (ICT)' many of the terms will be familiar to students. For example email, Local Area Networks and video-conferencing are common parlance to the vast majority of students who are expert users of ICT, but instead of a general understanding of these systems, they must progress their knowledge to appreciate how they are applied to the development and manufacture of products worldwide.

Progression to A2 level will require students to undertake a lot of 'new' learning, with the expectation that in an examination they would be able to apply their views on wider issues than knowledge recall or descriptive answers. A question asking for a comparison between the work of two designers for instance would require objectivity and interpretation of information and the ability to structure reasoned and accurate statements beyond what would be expected at AS level.

To ensure progress from GCSE through as to A2 level, teachers should consider the following:

- do not teach 'knowledge and understanding' in isolation. Teach in parallel with making activities
- always relate the specification content to practical activities. Remember the proverb 'Tell me and I'll forget, show me and I may remember, involve me and I'll learn'
- use teacher support materials published by Edexcel on-line
- refer to Sample Assessment Materials (SAMs) published by Edexcel
- use the textbooks endorsed by Edexcel, as they target GCSE and GCE specifications in RMT and progress from one qualification to the next.

Advice on examination taking, and preparation

Unlike design and make activities, students have no control over what will be asked of them on an examination paper. However, there are strategies that can help students to maximise their opportunities to match their potential.

Examination papers are in the form of question and answer booklets and all questions are compulsory. The GCSE exam paper is structured so that year on year the format will remain the same and questions will carry the same number of marks.

The format is as follows;

Q1 10 multiple-choice questions

Q11 short and longer answer questions testing subject knowledge and understanding

Q12 design question

Q13 product analysis question

Q14 mixture of short and extended questions including stretch and challenge

The total mark available is 80. The time allowed is 90 minutes.

At GCE AS and A2 levels, exam papers are in the form of a question and answer booklet consisting of short-answers and extended writing type questions. All questions are compulsory. Question papers are not templated in any way and the number of questions on an exam paper may vary from year to year.

The total mark available is 70 for each paper. The time allowed is 90 minutes for AS and 120 minutes for A2.

Advice for students sitting exam papers at all three levels is common and is as follows:

- consider the time allowed and the marks available and ensure that time spent on a question is appropriate to the marks available
- look at the number of lines provided for an answer. This is a guide to how much information is expected
- ensure clear handwriting is used so that answers are easily read by the examiner. Marks will not be awarded unless answers can be interpreted
- make sure that questions are read thoroughly from beginning to end, to avoid missing out responses unintentionally
- use correct technical terminology. Marks will not be awarded for incorrect terms
- keep answers concise; use bullet points in extended writing questions. Avoid repetition
- take care when sketching. Poor illustrations are not helpful. Use simple diagrams rather than 3D sketches for clarity
- keep answers inside the spaces provided. Question papers are electronically 'clipped' and marked. Answers recorded outside the spaces provided may be lost
- questions can come from anywhere, so the whole of the subject specification should be covered.

The language of exam questions in Edexcel's suite of RMT qualifications is common and there are 'command' words that students and teachers should understand and be familiar with, as these provide guidance to the kinds of responses required from a question and the marks value associated with each command word.

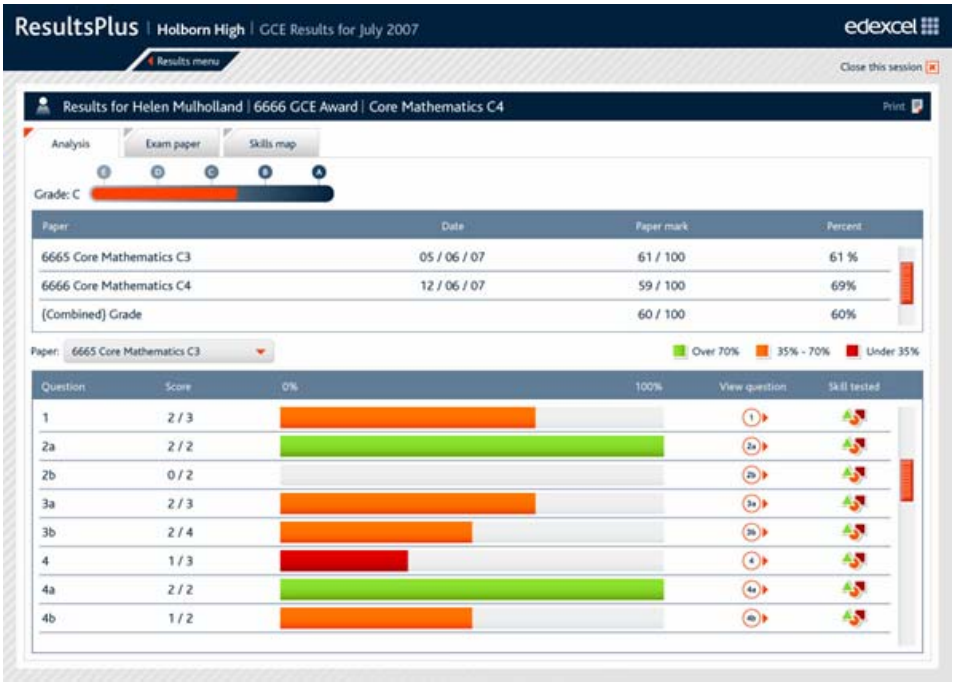
The chart below details command words and their description.

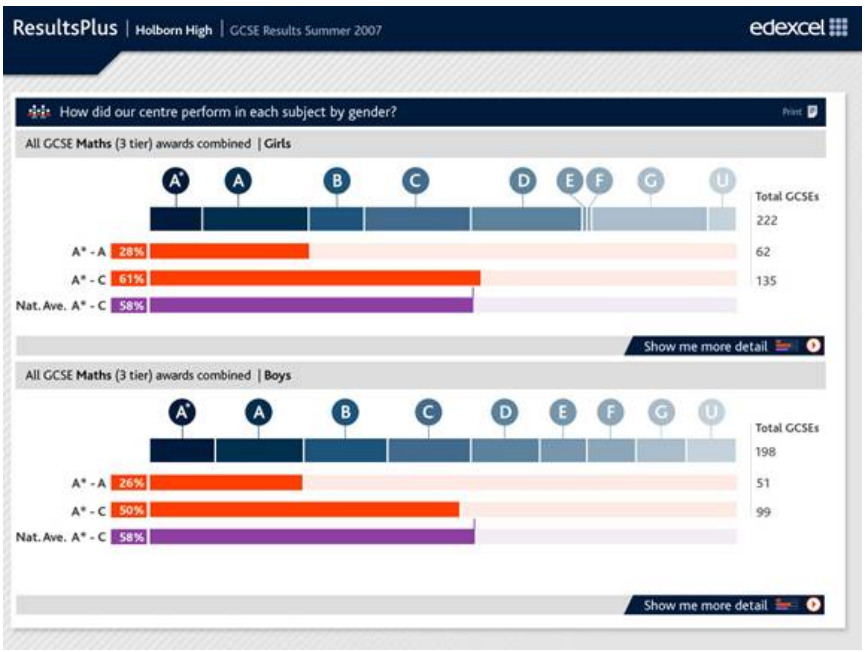
Command word	Marks awarded	Description
Give/state/name	(1 mark)	These type of questions will usually appear at the beginning of the paper or question part and are designed to ease students into the question with a simple statement or short phrase.
Describe/outline	(2 + marks)	These type of questions are quite straightforward. They ask students to simply describe something in detail. Some questions may also ask students to use notes and sketches, therefore, they can gain marks with the use of a clearly labelled sketch.
Explain/justify	(2 + marks)	These type of questions are asking students to respond in detail to the question – no short phrases will be acceptable here. Instead, students will have to make a valid point and develop/justify it to gain full marks.
Evaluate/discuss/ compare	(4 + marks)	These type of questions are designed to stretch and challenge students. They will always be awarded the most amount of marks because they require students to make a well-balanced argument, usually involving both advantages and disadvantages.

Exam papers are ramped, which means that questions are designed to be more difficult as they progress through a paper. Individual questions are also ramped in order to allow all students to attempt some parts of most questions. Ramping is used to differentiate the performances of students sitting an exam.

Progression in achieving improved examination performance will be gained over time as teachers build up a library of resources including past question papers and become familiar with the qualification.

A powerful tool in ensuring progression in exam success is Edexcel's Results Plus service, which allows teachers to analyse the performance of their teaching groups in comparison with national standards and to determine where weaknesses and strengths were throughout an exam paper. Each part of each question can be analysed separately and strategies for future improvement can be employed. Analysis can be applied to whole groups or individual students. Accurate use of this service will facilitate progression and improvement within a teaching centre.





Coursework

In all three specifications, GCSE, AS and A2, coursework is the major player, carrying 60% of assessment credit for each qualification, so it is important that students have opportunities to reach their potential and to progress their skill and competencies year on year.

Coursework content is essentially the same in each qualification requiring students to design and make functioning RMT products. The structure of each course differs, but all are based on the acquisition and progressive development of skills, and levels of response are expected to demonstrate the gains made, one year on from assessment of the previous course.

GCSE Controlled Assessment

GCSE coursework is now called Controlled Assessment and has to be carried out under controlled conditions using tasks set by Edexcel.

In order to allow maximum choice of controlled assessment task and to give teachers and students as much control over their work as possible, five very broad headings for RMT tasks are set by Edexcel. Students and teachers choose one or more headings to work under when developing and refining a personal design brief.

Controlled assessment 'task taking' is carried out under medium levels of control, which means being supervised by teachers as work progresses. Edexcel's Controlled assessment guide for D&T and an accompanying podcast are posted on their website.

Progression at GCSE level will be achieved through the formal teaching of skills in the form of focused tasks, taking place in the early part of the RMT course and teachers should plan to develop those skills useful to students when they take on their controlled assessment

task. In order to progress, students should be encouraged to take on challenging tasks that introduce and develop new skills.

The options offered by Edexcel for controlled assessment facilitate progression by allowing teachers to choose the most appropriate path for their students to follow and develop their RMT skills.

One option is to design and make a product in the traditional way, where students make what they design. This approach involves students in designing and making the same product over the whole of their controlled assessment time, and suits those who can sustain interest and enthusiasm for a single task over an extended period.

A second option is to design one product and make another. This supports the progression and development of design skills, as students are not restricted in their conceptual thinking by the realities of having to make what they design, or by the limitations of resources they have access to.

Progression in making skills is also supported by this option where a making task is presented by the teacher. In this case a student who produces weak designs but possesses better making abilities is not restricted to the simplistic skills and challenge of manufacturing a simplistic design.

Skills developed in RMT at GCSE level should be seen as foundation skills that can be built upon at the next level, so a breadth of experiences are important to further progression.

GCE: AS Portfolio of Creative Skills

Coursework at AS level is called a Portfolio of Creative Skills and is designed to be a collection of work produced over a year by a student. Historically, many students showed little progression between AS and A2 levels because of the requirement that at GCSE, AS and A2 a single major project was required that followed almost identical assessment schemes and as a result students began to lose interest in repeating the same process three years in a row. This course more than the other two under discussion is a vehicle for progression in Design & Technology and removes the requirement for an integrated design and make project to be produced. As with GCSE, teachers and students are given as much control over what they do within the confines if the subject specification as possible, allowing progression and skills development to be focused on by individual students and teachers.

The portfolio is divided into three distinct sections that have to be evidenced by a student:

- product Investigation
- product Design
- product Manufacture.

In Product Investigation, students analyse an existing commercial product and progression is achieved through their application of knowledge and understanding gathered from their Unit 2 studies and their appreciation of how and why materials and processes are used. Foundation information learned at GCSE level will be extended and built upon as students investigate materials, components and processes used in the product under investigation and how its quality was assured. This section provides students with a coherence and relevance in their work. The teacher or student should select the product for investigation.

In Product Design, the options are similar to GCSE in that students are not required to manufacture what they design and are encouraged to be as creative as possible. Progression in this section is achieved through students exploring a range of approaches to their work, using their knowledge of technical detail, materials, techniques and processes to produce realistic design proposals that match set design criteria.

In comparison to GCSE, an improvement in communication skills should be seen as these are important in conveying ideas and students should be encouraged to practise the use of any appropriate means of illustrating their work that they are comfortable with, as long as the results are clear and easily understood. Effective annotation is an important feature of this section to enable students to explain details of design thinking and to offer evaluative statements regarding their design proposals. Progression here will be seen through the generation of more sophisticated and realistic alternative ideas, comprehensive design development and the use of technical and precise language in annotation. The teacher or student should set design briefs.

In Product Manufacture, students are encouraged to produce more than one high quality product in order to develop specific skills identified as useful in preparation for the A2 project. Progression is ensured in this section as students should be targeting new skills that they have not had experience of before that are more demanding than those used at GCSE level.

It is important that the teacher sets the manufacturing task, or intervenes to ensure that skill developments are appropriate to the level of response required at AS and will be useful at A2 level.

GCE: A2 Commercial Design

In this unit, students are encouraged to be creative and adventurous. They have a completely open choice of project, which is a fully integrated design and make exercise and an opportunity to show skills and expertise developed at AS level, which in turn were built from a GCSE foundation.

In order to reach high levels of achievement, students are required to approach their work from a commercial point of view, reflecting how a product designer would work. When choosing a design problem, it should have a real commercial use and a client or user group should be identified and consulted throughout the design and make process.

Sustainability is an important feature of designing and this should be evident as part of the commercial approach to the selected approach.

Progression at this level is seen and achieved through students bringing together their skills and subject knowledge into the synoptic activities contained in their A2 project work. Complexity of task and level of demand are indicators of progression, as is the response from students who should be able to demonstrate improvements in all areas of the design and make process.

There is an expectation that students will be expert in all areas of understanding relating to their selected project and will demonstrate true ownership of their work. When selecting a task students should consider:

- time and resources available
- whether the project will elicit maximum potential from themselves
- whether the proposed project commercially viable
- whether the project matches the description of a Resistant Materials Technology product as defined in the subject specification.

Progression in targeting marks relies on understanding what is required in order to meet all aspects of the assessment criteria. Students should consider the following:

Assessment Section	Evidence
Analysis	Identify the problem; plan a route through it; work out exactly what needs to be researched; clarify design needs.
Research	Identify client and interview them; focus research only on the needs from analysis and client; be selective; do not include information on things not yet decided e.g. materials - do it later, after the specification is written; sum up findings "from my research I have found that I need to include the following in my specification....."
Specification	Use specific statements that come from research and analysis; use measurable points that can be evaluated; justify points "it must be blue – because....."; use bullet points; use sub-headings of function, user requirements, etc.
Design	Produce alternative ideas that would work; present fewer ideas highly detailed rather than lots of ideas poorly detailed; include materials and processes; evaluate against specific points; involve client; take care with sketching.
Review	Formalise evaluation of ideas to decide which to develop; no tick boxes or marks out of ten; use pros and cons to discuss.
Develop	Continue designing in detail; develop means change and move design on; include technical details of materials and processes; produce a final design proposal; working drawing; cutting list; details to allow another person to make the product. Model product in resistant materials or 3D CAD; annotate a reason for modelling – to test proportions, finish etc; model to scale; consult client.
Communicate	Evidenced throughout Design & Develop
Planning	Plan for 'your' product – one off; indicate differences for higher volume production; show sequence of manufacturing events in the correct order; show time in hours/minutes not weeks, lessons, days; show quality control; show safety checks.
Tools & equipment	Evidence in diary of making photographs; show yourself using tools and equipment; show close up images of your work.
Quality	Justify selection of materials and processes – annotate photographs or write short notes; Show completed product and details of quality.
Complexity/ level of demand	Show technical challenge of manufacture; include jigs, moulds, etc.
Testing/evaluation	Test in use; photograph testing; write how tests were carried out; write what was being tested; test against performance of product and measurable specific points, use client to test, evaluate against all specific points, avoid self congratulation, suggest modifications to improve performance or quality, include sustainability.

Useful resources

Teacher support materials are available on Edexcel's website for GCSE RMT and include schemes of work, exemplar controlled assessment projects ad teachers guidance materials. A textbook is due to be published in April 2010 and this will be dedicated to the RMT course.

At GCE level, there are numerous support materials on Edexcel's website and the 'getting started' booklet contains many useful website addresses and publications that can be used to support teachers and students. A dedicated textbook is also available to support GCE RMT Product design.