National Council for Curriculum and Assessment
An Chomhairle Náisiúnta Curaclaim agus Measúnachta

Leaving Certificate

TECHNOLOGY

Ordinary level and Higher Level

Guidelines for Teachers

Draft: November 2006

Preamble

These draft guidelines are being made available to support the implementation of Leaving Certificate Technology. They are available for download from the NCCA website www.ncca.ie (see Publications/Draft Syllabuses and Guidelines).

As the programme of support for teachers develops and as dedicated resource materials for teaching and learning become available, the guidelines will be updated to reflect these developments. The experiences of teachers in the initial phase of implementation will also contribute to this updating of the guidelines. When completed, the final draft of these guidelines will be printed and circulated to teachers and schools.

Further information on the support service, hosted by Galway Education Centre, can be found at http://www.t4.ie

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1 Role and aims of the guidelines

Introduction

The successful implementation of Leaving Certificate Technology represents a major professional challenge to all partners in education and especially to the teachers and schools concerned. Along with this challenge comes an opportunity to educate in new and exciting ways. While the syllabus is the definitive document with regard to course content, these guidelines will assist teachers in relation to the emphasis to be given and possible methodologies to be used in teaching this subject; they also offer suggestions in relation to resources, assessment, etc.

Role and aims of the guidelines

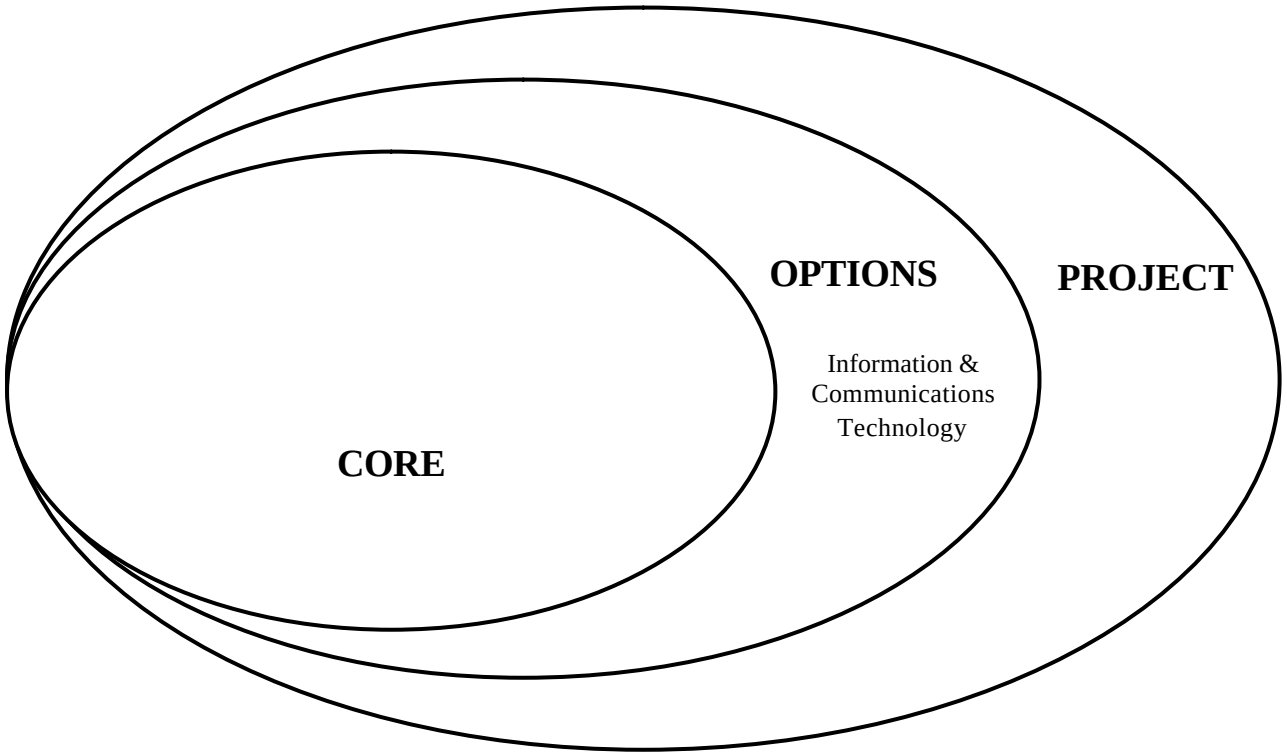
In preparing these guidelines, particular emphasis is placed on methodologies that use innovative approaches to technology education. Given the new structure in the syllabus, which includes extensive learning outcomes, the emphasis in these guidelines will be on pedagogic approaches rather than exposure and development of syllabus content. It is vital that these guidelines are used in conjunction with the syllabus. Teachers should consult the syllabus for differentiation between Higher level and Ordinary level material.

Teacher guidelines prepared by the National Council for Curriculum and Assessment are published initially in draft form. This initial draft of guidelines for teachers of Leaving Certificate Technology is being provided to complement the programme of support for teachers and the web-based resources being provided through the support service. They will inform, and be informed by, developments in that support service and through the professional insights of teachers working with the syllabus in classrooms, and can be amended and updated accordingly. The guidelines place the teaching of technology in a wider educational context, suggesting teaching approaches and activities that are not prescriptive, but that teachers may find useful.

The aims of these guidelines are to

- help teachers understand the nature and emphasis of the subject
- familiarise teachers with the structure of the syllabus – core and options – and the presentation of syllabus content in the form of topics and learning outcomes
- advise on teaching strategies and approaches, with suggestions for a variety of teaching, learning and assessment activities

- support teachers in planning activities and investigations required by the learning outcomes specified in the syllabus
- suggest ways in which appropriate resources can be developed and accessed
- support teachers of Leaving Certificate Technology in planning their programmes, in designing the learning experiences for their students, in assessing and evaluating those experiences and in preparing students for the Leaving Certificate examination
- place the teaching and learning of Leaving Certificate Technology within the broader context of student experience of science and technology at primary school and in the post-primary junior cycle
- support teachers in the development of a school policy on technology as part of School Development Planning
- indicate ways in which learning in Technology may be linked to other learning experiences in the senior cycle and to the everyday lives of students.


OPTIONS
PROJECT
Information &
Communications
Technology
CORE

Stages of a design process

The following stages of a design process are used to arrive at a solution in the form of a product or system whether open or closed. The process is not meant to be linear and many of the stages overlap to form a seamless progression. Advancement is often dependent on revisiting earlier stages in order to address problems that arise. Students should be encouraged to evaluate their progress at each stage and they may discover that they need to return to an earlier stage to make modifications. Students need to keep a constant record as they move through the various stages; this will form part of the communication element of a design process, resulting in a portfolio.

Project management

Project management is a vital aspect of a design process. Students should be introduced to project management from the start, so that they can develop their ability to analyse a brief and to schedule and monitor the important stages and processes involved in a project, taking an overview of the entire process from initial brief to project completion. Each stage in the process should be identified and presented in the form of charts and diagrams showing stage, process, sequencing and expected time allocation. As the project evolves from initial brief and progresses through the various stages and processes, students should record these processes and the timescales involved, noting any variations from, or adaptations to, their original plan. Through this experience, they can develop their ability to more accurately gauge the processes, sequence and timescales required for subsequent projects.

Identify and analyse problems and opportunities

An open brief will present a situation exposing a need, opportunity or problem requiring a solution. At this stage it is necessary to focus on and define the requirements of the brief individually and in groups. This will lead to many different and equally valid interpretations in order to satisfy the brief requirements. Each student should rewrite the brief and clearly define the parameters for their particular solution.

Recognise constraints

There is a need to recognise and expose any constraints and limitations associated with the brief. This area can be broad and refer to the designer, manufacturer, user or its impact on society. Time, money, manufacturing resources, safety and skills may also be constraints.

Investigate and research new and existing solutions

The use of resources such as libraries and Internet search engines (books, CDs DVDs videos magazines journals and websites) will expose existing solutions or partial solutions. Brainstorming should be encouraged to develop new and novel ideas and possible modification of existing solutions to satisfy design requirements. Experience with open-ended problem solving will give students practice in responding to challenges for which prescribed solutions do not already exist.

Generate, evaluate and justify ideas

Students should make sketches of a number of their ideas as this process will concretise mental images and make it easier to evaluate and consider modifications and changes to satisfy the brief requirements. Sketching and drawing techniques need to be developed so that tangible expression can be given to mental images. A list of criteria to satisfy the brief requirements should be developed after close scrutiny of the brief. The different ideas will each be considered with reference to how they satisfy the criteria. When the preferred solutions are chosen the students consider such factors as what materials, tools, and resources are available, the amount of time needed to carry out different procedures, and any relevant ergonomic and aesthetic requirements. The construction of a model from card or other easily manipulated media will further concretise ideas and allow the student to evaluate how it meets with the requirements. A model will also give the student a better idea about proportion and ergonomic considerations. Based on the results of these activities, they choose the solution that seems best to them. They record the reasons for choosing a particular solution in the design portfolio.

Presentation of ideas – communicating

The use of manual and CAD drawing methods should be encouraged. Orthographic and pictorial drawings, using manual and CAD should be produced and used for the manufacturing stage. A parametric/solid modelling CAD package can be used to develop ideas with regard to shape and form. It allows students to experiment by changing shapes easily, thus making for more informed decisions about their final solution. Photographic images from a digital camera along with a suitable graphics package will form another method of communicating the route through the various stages of the design process. The use of a computer word processing package will also allow students to communicate their ideas with words and diagrams for presentation in their portfolio.

Manufacture

It is in manufacture that life is given to ideas and students see their design becoming a reality. A broad selection of materials should be in stock and the general properties should be taught and the processes developed so that students begin to see what is possible within the constraints of a school workshop. It is necessary that initial skills are developed at an early stage so that students can work in a safe environment. Skills such as using tools and marking out instruments to transfer ideas to materials should be developed. The use of hand tools such as saws, files, planes and drills, etc. should be developed.

Evaluation

A discussion involving an overview of all stages of the entire process is considered in the evaluation. Students evaluate the various design stages and the final outcome against their initial brief, noting any variations or adaptations introduced. The social implications for their designs can be commented on and the costs and benefits can be considered. Possible modifications and improvements to the design and manufacture should be discussed and justified as appropriate.

Presentation of design portfolio

A design portfolio should be developed from the beginning, and used to maintain a record of each stage in the project. Freehand sketching techniques should be taught at an early stage so that students can present and develop their ideas. A wide range of presentation methods are available and the use of ICT will contribute significantly to the presentation of the design portfolio. Graphics software can be used to manipulate and integrate images into the portfolio. Modelling software used in the development of 3D solid drawings will show the development of the student's ideas, which can be converted into 2D drawings for marking out and manufacture. Application software such as a word processor or spreadsheet package can be used to present text, tables, charts, graphics, etc.

5. Resources

The Department of Education and Science website has published resources for Leaving Certificate Technology, including the room layout, machining and preparation area along with equipment lists and specifications. These should be read in conjunction with the general guidance documents published for second level schools.

The syllabus is available online at www.education.ie (go to **Curriculum, Syllabus & Teaching Guides)**.
The equipment list and specifications are available at www.education.ie (go to **School Planning/Building Furniture and Equipment lists)**.
Room layouts for post-primary schools are available at www.education.ie (go to **School Planning/Building Technical Guidance)**.

In parallel with developments relating to physical resources, a national programme of professional development will take place where all teachers will have access to in-service education and training. This will take the form of cluster-group meetings, workshops, seminars and practical, hands-on activities. Material will be presented in paper and electronic format. Appropriate and relevant websites will facilitate self-directed learning for teachers.

Over the initial years the support service will develop a range of support materials for teachers that they can use in their classrooms and workshops. Teachers will be encouraged to contribute to the development of these resources and to their evaluation in the school context.

ICT will enhance and modernise the way teachers and students work in the technology subjects by using

- the Internet, CDs, DVDs, etc. for research and investigation
- digital media such as cameras, scanning and imaging to record and communicate information
- CAD for developing and modelling design ideas and solutions
- application software such as word processors which will enable students to create, present and communicate a record of their work in the form of text, graphs, tables, graphics, etc.
- software to design, control, test and simulate manufacturing processes.

The main ICT skills to be developed are associated with

- Research /Analysis
- Multimedia
- CAD/Modelling
- Production - CAD/CAM
- Presentation
- Communication

As a support to the use of ICT a teacher will need to have access to both software and hardware resources. Whilst all schools have computers, school policy may differ on how these are distributed. The majority of schools have a computer room with shared resources using a Local Area Network (LAN) and a Broadband Internet connection. In many cases there are other computers in various locations around the school connected to the LAN and Internet.

Hardware resources for teaching and learning

- PC/laptop
- Printer, scanner
- Data projector
- Digital camera/ movie camera
- LAN system connected to the Internet

Software resources for teaching and learning

- Application software, e.g. word-processing, presentation, desktop publishing
- Internet Explorer, Navigator, Web Research
- Email: Outlook, Outlook Express, webmail or equivalent
- CAD software (to include solid modelling)
- CAM software, CNC machining (lathe, router)
- Graphics package, e.g. Paint Shop Pro

Useful websites

The following list of websites is not exhaustive and many other websites from Ireland and abroad provide a rich resource for students and teachers. It is important that students are encouraged to search the Internet for information and to evaluate and integrate the information obtained in an appropriate manner. They must show how the information informed their thinking rather than directly copying and pasting such information into their own work.

Note that websites can be subject to change without notice; their status should be checked periodically.

http://www.education.ie Department of Education and Science
http://www.examinations.ie State Examinations Commission
http://web.data.org.uk/data/index.php Design and Technology Association
http://www.bbc.co.uk/schools/gcsebitesize/design/ [Technology systems and control, materials, electronics and graphics]
http://www.nc.uk.net/webdav/servlet/XRM?Page/@id=6004&Subject/@id=3624 National Curriculum Online UK
http://www.technologystudent.com [Resources on design process, graphics, Health and safety, electronics, mechanisms, etc.]
http://www.dtonline.org/
http://www.berkley7.freeserve.co.uk/ [Clipart for tools]
http://www.coillte.ie/ [Wood and forests]
http://www.flying-pig.com/pages/education.htm [Technology]
http://www.teachingplastics.org/ [Plastics]
http://www.flamefast.co.uk/ [Heat treatment]
http://www.bpf.co.uk/bpfindustry/process_plastics.cfm [Animation showing plastics formation]
http://www.howstuffworks.com [animations about how machines and processes work]
http://ergonomics4schools.com/ [Ergonomics site]
http://www.gglover.co.uk/ [logical design process site]
http://www.deyes.sefton.sch.uk/technology/ [Concise CDT second-level school site (UK)]
http://www.bbc.co.uk/schools/gcsebitesize/design/ [General CDT website]
http://www.becta.org/postnuke/modules.php?op=modload&name=Web_Links&file=index&req=viewlink&cid=51&POSTNUKESID=bdfc6acc06e93e1ae9a3b8894f9c274d [ICT Resources]

6. Assessment

Both assessment *of* learning and assessment *for* learning can inform the effectiveness of the teaching and learning. They should be an integral part of teaching methodology.

Assessment for learning can be defined as activities undertaken by teachers and/or by their students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged.

Assessment of learning involves working with the range of available evidence that enables teachers and the wider assessment community to check on pupils' progress and to use this information in a number of ways. This form of assessment includes end-of-term and state examinations (such as the Leaving Certificate) in the form of examination papers, projects, etc.

Assessment of Leaving Certificate Technology

The syllabus will be assessed in terms of its stated objectives and learning outcomes at each of two levels, Ordinary and Higher, by means of a terminal examination paper and a project. The assessment weightings at both levels are given in the table below.

Assessment components

Component	Sub-component	HL	OL
Examination Paper	Section A: Core	30%	30%
[50%]	Section B: Options	20%	20%
Project	Artefact	25%	30%
[50%]	Report Folder/Portfolio	25%	20%

Terminal examination paper

There will be one examination paper at Ordinary level (2 hours) and one at Higher level ($2\frac{1}{2}$ hours). At each level, the paper will be presented in two sections, as indicated in the table above. Since the Core is mandatory, students will be assessed on all main elements of the Core in Section A of the examination paper. Section B will cater for the five Options and students will be required to answer questions related to two of these. Throughout the examination paper, in addition to factual recall, candidates will be expected to show understanding of the subject matter involved and to apply the knowledge and skills they have developed over the two years of the course.

Question 1 in section A will be compulsory and will be allocated 36% of the marks for the paper. It will consist of fifteen parts of which the candidate will be required to answer twelve. The remainder of section A will be allocated 24% of the marks for the paper. Candidates will be given a choice of questions which deal in greater detail with topics from the core.

Section B will be allocated 40% of the marks for the paper, equally divided between the two chosen options. Five questions, one for each option, will be presented in section B, with candidates required to answer two questions. Each question will contain sub-sections which, although linked, will not be interdependent so that a candidate will be able to attempt a sub-section without the necessity to have completed the previous subsection. There will be an element of choice within each of the option questions.

The Project

Students will be required to undertake a project, based on a specified thematic brief and within stated parameters. Emphasis will be placed on the application of technology in a societal context, with the candidate required to provide a solution to an identified problem or situation. The project will involve the design and production of an artefact and an accompanying folder. At Ordinary level, 60% of the project marks will be allocated to the artefact, with 40% allocated to the folder. At Higher level, the project marks will be divided equally between the artefact and the folder. Separate tasks, with separate assessment criteria, will be set for each level. At Ordinary level, a directed project having a fuller context and more specific detail will be provided. At Higher level, a thematic brief will be provided[1].

In undertaking the project, students combine knowledge and skills developed through their study of the core and chosen options. Students must indicate on their folder the two options they are taking. The project, which must be completed in school and be the unaided work of the student, should integrate the various elements of the study of technology and should represent the highest standard of knowledge and skills attained by the student. The folder should reflect all stages of the student's work from design to realisation, and should include an overall evaluation.

[1] A conversion factor will apply where a candidate presents a Higher level project but subsequently takes the Ordinary level examination paper.

Students will be expected to analyse or develop the brief, conduct research into existing artefacts or part solutions and evaluate these, prepare outline designs of possible solutions, choose one—or an appropriate combination—of these for development and justify their choice, prepare a plan of manufacture, select and use appropriate materials and processes to produce the artefact or solution according to that plan, and evaluate the final product in the light of the original brief.

In both the design and realisation of the project, students must take due account of ergonomics and work in a safe manner.

Draft assessment materials

Initial draft assessment materials will be developed by the NCCA for discussion by teachers in conjunction with the programme of professional development and support. Feedback from teachers will inform subsequent refinement of these materials by the NCCA, who will issue advice to the Department of Education and Science by December 2007 on the assessment of Leaving Certificate Technology. The State Examinations Commission will issue the sample papers in September 2008, with the first examination taking place in June 2009.

Appendix

Symbols and Units

Throughout the course, students will be expected to recognise and use the correct symbols and units for physical quantities. They will also be expected to recognise and use standard prefixes representing multiples of these quantities. The table below shows the most common quantities likely to arise in Technology.

Physical Quantity	Symbol	Unit Name	Unit Symbol	Expressed in terms of other units
length	*l*	metre	m	
area	*A*	square metre	m^2	
mass	*m*	kilogram	kg	
time	*t*	second	s	
speed	*v*	metre per second	m s^{-1} or m/s	
force	*F*	newton	N	
moment of a force	*M*	newton metre	N m	
torque	*T*	newton metre	N m	
work	*W*	joule	J	N m
energy	*E*	joule	J	N m
power	*P*	watt	W	J s^{-1}
temperature	*T* *t*	kelvin degree Celsius	K °C	
electric charge	*Q, q*	coulomb	C	
electric current	*I*	ampere	A	
potential difference	*V*	volt	V	
capacitance	*C*	farad	F	C V^{-1}
resistance	*R*	ohm	Ω	
frequency	*f*	hertz	Hz	s^{-1}
angle	*q*	degree	°	

The following SI prefixes may also arise in Technology.

Prefix	Symbol	Factor	Prefix	Symbol	Factor
giga	G	10^9	milli	m	10^{-3}
mega	M	10^6	micro	μ	10^{-6}
kilo	k	10^3	nano	n	10^{-9}
centi	c	10^{-2}	pico	p	10^{-12}

Relationships and Formulae

Some typical relationships and formulas used in Leaving Certificate Technology are presented below. Others may be found in the official Mathematical Tables.

Uniform linear motion: $velocity = \frac{distance}{time}$

Work: $work = force \times distance\ moved\ in\ direction\ of\ the\ force$

Average power used: $\frac{total\ work\ done}{total\ time\ taken}$

Moment of force: $force \times perpendicular\ distance\ to\ fulcrum$

Mechanical advantage: $\frac{load}{effort}$

Velocity ratio: $\frac{distance\ moved\ by\ effort}{distance\ moved\ by\ load}$

Gear ratio: $\frac{speed\ of\ driving\ gear}{speed\ of\ driven\ gear}$ also $\frac{no.\ of\ teeth\ on\ driven\ gear}{no.\ of\ teeth\ on\ driving\ gear}$

Efficiency (%): $\frac{power\ output}{power\ input} \times 100$

Ohm's law: $V = I \times R$

Resistors in series: $R = R_1 + R_2$

Resistors in parallel: $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

Electrical power: $P = V \times I$