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ICT - Teaching programme for the Secondary and Primary cycle

**Approved by the Board of Governors on 26 and 27 October
1999**

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1.0 Introduction

The computer, software and networks are increasingly prevalent in everyday life. We use them in the office, at home, in the supermarket, at the airport. "New Technologies" or "Information Technologies" or quite simply "Computer Studies" have become part of the everyday vernacular in the different committees, councils and working groups at work within the European School system

The Board of Governors gave the Working Party on Information Technology the following mandate:

"To draw up programmes for the teaching of ICT in the primary and secondary sections and to establish a list of recommendations to the schools for the purchasing of networks, equipment and software."

Following analysis of the various proposed projects and developments, at its meeting in Berlin on 27 April 1999, the Board of Governors authorized the learning of ICT in all the Schools from the 2000-2001 school year. Those Schools which so wish may organize ICT courses from the 1999-2000 school year.

This document, based on documents 712-D-1998 and 1999-D-683, which it cancels and replaces, constitutes the new ICT teaching programme.

Before being presented to the Board of Governors, this new draft was considered by the usual preparatory committees.

- 1) The AFC received the additional information which its Chairman had requested (Doc. 1999-D-38).
- 2) The Board of Inspectors approved document 1999-D-28 at its meeting on 15 September 1999.

2.0 Principles of ICT teaching

2.1 In the nursery and primary cycles

As is clear from Document 93-D-24, it is impossible to design a nursery and primary “computing” syllabus as it would be restrictive and too narrowly defined.

The point is necessarily the introduction of new technologies in teaching.

At present, the education system has a duty to reconsider its own objectives in order to equip itself to meet society’s requirements.

One of the essential points which cannot be overlooked is the background and the operational value required for mastery of communication and of technologies, of the abilities implied across the board in any operational involvement in working life.

Multimedia communication cannot be considered from the technical angle only as it constitutes a cultural dimension which cannot be disregarded.

It is a fundamental requirement for the European Schools to draw up a plan for the introduction of new technologies capable of having a profound impact on the teaching and learning processes.

This plan should not be an extraordinary measure, but should form an objective and innovative development framework.

The pace of development in the strictly technological sector produces situations which are obsolete in a very short time and annual reprogramming should therefore be regarded as a characteristic feature.

2.2 In the secondary cycle

2.2.1 Organization of courses

The compulsory course is intended for all pupils in the first two years of secondary education and will be organized for one period per week or for 30 periods per year. The course will be taught in mother tongue. Where necessary, to avoid an ICT class with very few pupils, the course may be run in a working (vehicular) language or in the language of the host country.

The basic training will consist of studying current practice in the areas of word processing, spreadsheets, an operating system and networks (local area network and the Internet).

In the primary cycle

The course will follow up skills acquired in the primary section and will aim to equip teachers and pupils to use new technologies in the teaching of all subjects. The emphasis will be on interdisciplinarity and multidisciplinary

In year 3, the course will no longer be compulsory.

In years 4-5, the ICT course will be organized as a 2 lesson per week optional course.

In years 6-7, it will be a complementary course of 2 lessons per week.

In years 4-5 and 6-7 what has been covered in the basic course in years 1-2 will be extended and studied in greater depth, and electronic mail and databases will also be added. This will be the moment for pupils to develop a critical approach to dysfunctions of the system as a method of approach when one is called upon to solve problems involving a very large amount of data.

The ICT courses in years 4, 5, 6 and 7, taught in a working language or in the language of the country, are intended for those pupils for whom information technologies will play an important role in both their professional and private lives.

2.2.2 Summary table

YEARS	NUMBERS OF PERIODS	TYPE OF COURSE
1 and 2	1 period per week or 30 periods per year	<u>Compulsory</u> complementary activity
3	1 period per week or 30 periods per year	<u>Optional</u> complementary activity
4 and 5	2 periods per week	Option course
6 and 7	2 periods per week	Complementary course

3.0 Teaching programme

3.1 In the primary cycle

3.1.1 Pupils' knowledge and skills

Educating pupils through the use of multimedia leads to:

- improved expression and communication
- ability to search for, work out and represent knowledge related to the various communication channels
- interpersonal communication and collaboration, even at a distance
- effective approach to study and growth in terms of general knowledge
- acquisition of a mature and critical attitude towards the mass media

In the primary cycle

A pupil's familiarization with technological instruments develops a range of knowledge and skills which become the starting point for secondary education.

In this area, the following skills should be developed:

- technical use of computers (starting up, switching off, using the mouse)
- searching for and entering texts (word processing, graphs, etc.)
- searching on the Internet
- use of electronic mail
- critical use of technical objects

3.1.2 Teaching sectors

The introduction of new technologies into the European Schools leads to more effective teaching and learning of the various subjects by:

- changing the organization of the teaching-learning process in terms of presentation of the lesson and of communication, facilitating learning by changing the role of the teacher, who is no longer the sole transmitter of knowledge but instead becomes the organizer of didactic activity, motivating pupils' work, checking their progress, suggesting or defining learning objectives and evaluating achievement of the objectives
- changing classroom management
- changing the teaching plan
- going beyond the organization of the syllabuses of the various subjects (whose content is no longer separate, becoming instead grouped themes and arguments with multidisciplinary valence)
- allowing a wider range of working equipment for educational purposes to be offered
- allowing individualized teaching schemes to be organized
- making school activity more attractive to pupils
- allowing interactive exchange between pupils
- permitting access to a large number of types of training in a very wide variety of sectors for all the people involved in the learning process.

3.1.3 Planning and organization of teaching

In introducing multimedia teaching aids into nursery and primary education, the following factors need to be borne in mind:

- the teachers' differing motivation and preparation
- continuity of relations between the nursery and primary levels on the one hand and between the primary and secondary levels on the other
- diversity of technology and rapid technical developments
- basic training in the ICT field
- school organization and flexibility of the system.

The starting part of the school's project should never be technology; technology is an aid to teaching and may never become an end in itself. The educational relationship and the teaching-learning process must continue to

be the starting points. Against that background the teacher's role will be enhanced. As the person responsible for the pupil's development towards maturity, his/her specific task is to organize teaching-learning activity, to motivate children to work and to respond adequately to pupils' needs, whilst also fulfilling the requirements of the curriculum to be taught.

3.1.4 Materials

The introduction of multimedia teaching aids necessitates precise analysis of the software. It is essential for teachers to evaluate a program before adopting it. The following points should normally be taken into account when evaluating software:

- editorial characteristics
- characteristics of the users for whom it is intended
- technical characteristics
- educational and content characteristics
- didactic characteristics
- context of use characteristics

The fact that a software package does not meet all these criteria does not rule out its use; a teacher may indeed use a product for purposes different from those suggested by the authors, he/she may use it in part or in different contexts and at different times.

3.2 ICT syllabus in the secondary cycle

3.2.1 Objectives

The course should

- contribute to the individual development of every pupil;
- develop a precise and rigorous approach both in work and in reasoning;
- meet the needs of present-day society;
- introduce the basic skills and knowledge required for effective use of ICT;
- develop a healthily critical approach in all matters relating to the automatic processing of data in the field of computing.
- train the pupil to work as part of a team.
- stimulate the imagination and creativity of the pupil.
- show the pre-eminence of the human mind over the computer.

3.2.1.1 *Years 1-2*

CENTRAL THEME: THE COMPUTER AS A TOOL

By the end of year 2 every pupil should be able to use the computer as a learning tool, both as an individual and as a member of a team.

In order to

- solve a problem

ICT syllabus in the secondary cycle

- select the relevant information
- choose the most suitable program for a particular task
- store and retrieve information
- produce a document containing a solution or the required information.

ASSESSMENT

In years 1-2-3 assessment of the skills acquired by the pupils in ICT courses is formative. It is not taken into consideration for promotion to a higher class.

3.2.1.2 *Years 4-5 and 6-7***3.2.1.3** *Years 4 and 5*

In years 4 and 5 the course is no longer compulsory. It builds on the basic skills acquired in years 1-2 and is intended to meet the needs of those who will require more highly developed skills in this area for their intended future studies and career.

The proposed course has a modular structure reflecting the standard applications used in the field of ICT, but it should be stressed that the different applications form part of a whole and should not be seen, or studied, in isolation from one another. Concrete examples will be used to illustrate this reality.

Operating systems will not be studied systematically but the possibilities and necessary techniques will be introduced and discussed at the appropriate moment, the aim being to ensure that students have the necessary skills to enable them to work effectively and independently away from the formal teaching situation.

Experience has shown that, in ICT courses, homogenous groups are rare. In addition, the world of information technology is one of constant and rapid change and it is important that this reality be reflected in the syllabus. To cater for these needs a certain amount of flexibility is necessary. Under the heading «Advanced techniques», the teachers will be able to study with his/her pupils the latest developments in Information and Communications Technology.

3.2.1.4 *Years 6 and 7*

This course is intended for students who wish to widen their knowledge and experience in the ICT field in preparation for their intended course of study or career.

The proposed modular structure means that students in years 6 and 7 can successfully follow the course without having taken the option in years 4 and 5.

ASSESSMENT

In years 4-5 and 6-7 assessment is based upon:

- tests of knowledge and the ability to use the computer
- a project undertaken by the pupils, either individually or in groups

3.2.2 COURSE SYLLABUS

The subjects studied in the ICT context are dependent on the rapid development of information technology. The proposed syllabus appended hereto is the outcome of the experience gained at Bergen, Munich and Varese. The proposal may be used by the Schools for guidance in designing their own syllabuses, based on study of the following subjects:

Years 1 and 2

Compulsory subjects

- Word processing,
- Drawing program,
- Hardware,
- Operating system and graphical interface,
- Digital sources of information,
- Communication,
- Spreadsheet.

Years 4-5 and 6-7

Compulsory subjects

- Desktop Publishing (Years 4 and 5)
- Word Processing (Year 4)
- Spreadsheet (Years 4 and 5)
- Database (Years 6 and 7)
- Web Publishing (Years 6 and 7)

Optional subjects

- Advanced Word Processing applications
 - Advanced Spreadsheet applications
 - Advanced Database techniques
 - Advanced Graphical applications
 - Computer viruses
 - Computer hardware
 - Integrated circuits
 - Computer architecture
 - Bits and bytes
 - Problem solving – stepwise refinement
 - Programming
 - Advanced techniques
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ICT syllabus in the secondary cycle

The annexes :

- ANNEX 1 : ICT teaching - Secondary cycle
DESKTOP PUBLISHING
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WORD PROCESSING
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set out in detail the syllabuses designed at Bergen, Munich and Varese, which should help the schools to design their own syllabuses.

ANNEX 1: ICT teaching - Secondary cycle

DESKTOP PUBLISHING

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
1. Basic skills	<ul style="list-style-type: none"> start the program close the program the working environment: windows, bars, buttons, menus, sheets save a document open a document change the name of a document print a document (use sample printouts, select printer, alter printer settings) use the on-line help function create different types of publications with the aid of a wizard understand how a wizard works use the on-line help function delete objects change size of objects paste objects copy objects insert figures from a clipart library cut figures enlarge and reduce figures insert figures with the aid of a scanner insert self-made figures (using integrated or other drawing program) copy, cut and paste figures import figures from a multi-media application (from CD-ROM) import figures with the aid of the Internet type header(s) format header(s) copy, erase, paste header(s) change typeface and letter size introduce special graphics effects 	<p>Before starting with running and closing programs the student must be familiar with the graphical user interface:</p> <ul style="list-style-type: none"> working with the mouse working through menu structures storage media: hard disk, floppy disk, zip-drive local and network drives folders (directory structure) <p>Wizards are an ideal way in which to get to know the possibilities of a program.</p> <p>By first learning to change an existing publication it will be simpler for the student to learn to create a publication.</p> <p>The inserting, editing, sorting, ordering and bringing together a collection of objects (of completely different types) forms the basis of desktop publishing.</p>
2. Using wizards		
3. Edit publications		
4. Graphical objects		
5. Header objects		

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
6. Text objects	type text mark text with the mouse insert text delete text copy text paste text link text frames insert special symbols (accents, etc.) work with columns format text (underscore, italic, bold etc.) change typeface and letter size format paragraph (left, right, centre, indent, width, etc.) format page: (line spacing, set margins) undo formatting number pages	
7. Formatting text	import text from a word-processor copy text from another application with aid of clipboard import text with the aid of the Internet import text using an OCR program working with lines and frames (alter type of line, etc.) working with shading working with colour copy, position, place erase objects, sort objects working with several layers sound film clips ...	•see also: word processing •see also: networks
8. Importing text		
9. Formatting objects		•
10. Ordering objects		•
11. Other objects		

ANNEX 2: ICT teaching - Secondary cycle

WORD PROCESSING

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
1. Tables	<ul style="list-style-type: none"> insert a table format a table (typeface, order, borders, shading etc.) alter column width and row height insert cells delete cells paste cells copy cells sort a table format text in columns alter the width of a column alter the number of columns insert diagrams from a clipart library. format diagrams (frames, cutting, make larger and smaller, etc.) position diagram in relation to text copy, position and paste diagrams 	<p>A table is more than just a matrix with text or numbers. In complicated publications with text and illustrations a table can be a very useful aid.</p>
2. Columns	<ul style="list-style-type: none"> format text in columns alter the width of a column alter the number of columns insert diagrams from a clipart library. 	
3. Diagrams	<ul style="list-style-type: none"> format diagrams (frames, cutting, make larger and smaller, etc.) position diagram in relation to text copy, position and paste diagrams 	
More advanced skills		
4. Graphics	<ul style="list-style-type: none"> insert a graphic insert graphic data alter graphic data determine the type of graphic format graphics (title, labels, colours, etc.) copy, position and paste graphics import text from other word-processing systems (conversion of text) import text with the aid of OCR import text from a multimedia application (e.g. encyclopaedia on CD-ROM, etc.) import text with the aid of the Internet 	<p>see also: spreadsheets</p>
5. Importing of text	<ul style="list-style-type: none"> import text from other word-processing systems (conversion of text) import text with the aid of OCR import text from a multimedia application (e.g. encyclopaedia on CD-ROM, etc.) import text with the aid of the Internet 	<p>see also: graphics applications see also: networks</p>
6. Importing diagrams	<ul style="list-style-type: none"> import text from other word-processing systems (conversion of text) import text with the aid of the Internet import text from a multimedia application (e.g. encyclopaedia on CD-ROM, etc.) import text with the aid of the Internet insert a self-made diagram (with the aid of an integrated or other drawing program) scan and import images import an image from a multi-media application (encyclopaedia on CD-ROM, etc.) import an image with the aid of the Internet 	<p>see also: graphics applications</p>
7. Including other objects	<ul style="list-style-type: none"> insert an equation special formatting effects for titles, etc. insert sound ordering objects etc. 	<p>see also: graphics applications</p>

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
8. Dictionaries and language tools	work with electronic dictionaries (CD-ROM)	
9. Templates	<ul style="list-style-type: none"> use language tools use a template create a template edit a template create a macro 	see also : programming
10. Adapting the word-processing program	install and adapt the automatic functions in a program	
11. Publishing	<ul style="list-style-type: none"> publish a document on the Internet print a document using a network printer print a document using a fax machine 	
12. Integration	<ul style="list-style-type: none"> copying data from a spreadsheet into a document linking a spreadsheet to a document 	<p>Programs are not a series of islands cut off from one another. The student must learn to choose the most appropriate tools for a given problem and to combine the results of using different tools to create a single finished report.</p>
13. More advanced techniques	To take into account students' interest and new developments	

ANNEX 3: ICT teaching - Secondary cycle

SPREADSHEET

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
1. Names	<ul style="list-style-type: none"> assign a name to a cell / to a constant assign names with the aid of row and column headers delete names position names in formulae rules for assigning names use logical function IF() define formulae use nested definitions use logical operators use: totals and subtotals, mathematical and trigonometric functions, numbering with series, search for a value, date and time functions 	A more in-depth approach follows on from the introduction in years 1,2,3.
2. Cells and functions	<ul style="list-style-type: none"> create a graphic data series and discrete data select and alter graphic types insert, delete and alter graphical data copy, delete and paste graphics format graphics draw within a graphic 	see also: word processing in years 1,2,3.
3. Working with graphics	<ul style="list-style-type: none"> insert diagrams/illustrations from a clipart library draw diagrams (with the aid of an integrated or other drawing program) format diagrams (frames, cutting, make larger, smaller etc.) position diagrams in relation to text copy, place and paste diagrams 	see also: word processing in years 1,2,3.
4. Working with diagrams (graphical objects)	<ul style="list-style-type: none"> use a template create a template edit a template use functions for control of imported data save a template workbooks and worksheets linking worksheets 	
5. Templates		
6. Links		
More advanced aspects		

7. Adapting the user environment	save cells and worksheets create macros adapt the automatic installation of the program.. use the spreadsheet to solve problems	
8. Problem solving		Simple examples taken from other subjects: physics, economics, etc.

ANNEX 4: ICT teaching - Secondary cycle

DATABASE

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
1. Basic skills	<ul style="list-style-type: none"> start the program close the program the working environment: windows, bars, buttons, menus, sheets select a database open a database change the name of a database use the on-line help function 	<p>Before starting with running and closing programs the student must be familiar with the graphical user interface: working with the mouse</p> <p>working through menu structures</p> <p>The student must be familiar with: different storage media: hard disk, floppy disk, zip-drive local and network drives</p> <p>folders (directory structure)</p>
2. Establishing a database	<ul style="list-style-type: none"> create a database enter data in a database process data in a database: editing, deletion of data search in a database sort data 	
3. Manipulation of tables	<ul style="list-style-type: none"> fix typeface and character size fix row height and column size paste columns hide columns block columns print data sheets 	

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
4. Working with tables	<ul style="list-style-type: none"> set up a table table properties select table definition change table name copy, paste, delete a table define fields determine data type determine input mask fix standard values for a field validation rules index a set of data create and change simple and compound primary keys create simple and compound indexes subsequently change table structure insert fields alter field names delete fields alter data types create relationships between tables / link tables define standard relationships create relationships change, delete standard relationships join-properties referential integrity relationship type: one-to-one / one-to-many 	

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
5. Queries	<ul style="list-style-type: none"> create queries insert tables in queries: define, process, format, print a dynaset, select and order columns determine field properties in an column hide columns delete columns sort columns determine properties of a query define query criteria logical operators and logical expressions combine criteria define sort criteria select and execute a query calculate fields prevent duplicate records group records statistical functions group data 	
6. Reports	<ul style="list-style-type: none"> properties of steering elements (control properties: hide duplicates, running total, page break, etc.) report section and report properties report properties <ul style="list-style-type: none"> report heading, page heading report footnote, page footnote report section en detail section report properties sort and group table from a report <ul style="list-style-type: none"> define sorting order define sort region alter sort criteria grouping report data <ul style="list-style-type: none"> define groups alter grouping criteria area of grouping criteria 	

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
7. Forms	<ul style="list-style-type: none"> form properties adoption of control elements select, paste, alter control elements ruler and grid duplicate, copy, erase control elements alter tabulator control elements: label, text box, combo box, list box, check box, option button, toggle button, etc. form sections and form properties form header and page header form footnote and page footnote form properties 	
8. Graphical objects	<ul style="list-style-type: none"> paste objects with clipboard (from a clip-art library or a self-made illustration from a drawing program) 	see also: graphical applications
9. Integration	<ul style="list-style-type: none"> exchange data with a word processing application via the clipboard with linked tables standard letters (circulars) 	see also: word processing
More advanced techniques		not compulsory
10. Queries	<ul style="list-style-type: none"> establish cross-tab queries execute dynasets establish parameters in query-criteria special types query's: Update, Make table, Append, Delete set up queries in SQL 	
11. Reports	<ul style="list-style-type: none"> report in column form main and sub-reports report as a model for a new report 	
12. Exchange of data	<ul style="list-style-type: none"> exchange of data with a spreadsheet via the clipboard with linked tables import of data from other database programs compressing a database encrypting and decoding a database 	see also: spreadsheets
13. Storing of data	<ul style="list-style-type: none"> create a macro 	
14. Working with macros	<ul style="list-style-type: none"> execute macros macro exercises macros in forms 	
15. Programming	<ul style="list-style-type: none"> programming in Visual Basic 	see also: programming

ANNEX 5: ICT teaching - Secondary cycle

WEB PUBLISHING

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
1. Introduction to Web Authoring Software	<p>The user environment. Menu bars. Use of online help. Opening existing projects. Saving projects. Headers. Paragraphs. Simple lists. Tables.</p>	<p>Packages such as Hot Metal Pro and Microsoft Front Page are both easy to use and, when needed, very powerful authoring tools.</p>
2. Developing a simple Web Page	<p>Formatting text: alignment. size, style and fonts. colour. Use of lines. horizontal lines. break lines.</p> <p>Background colours and designs for page. Preview and Printing with the aid of a browser. Between pages of a site.</p>	<p>These are the basic ingredients of a web page. From these modest beginnings ambitious Web projects may be built up.</p>
3. Web Page design	<p>To bookmark positions in a document. To other files (e.g. graphics). To another site. To an email address. "hot image" links.</p>	<p>At this stage some mention should be made of URLs and the different possible transfer protocols.</p>
4. Inserting links		

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
5. Publishing a Web Site	<ul style="list-style-type: none"> Creating a project from existing files. Modifying an existing project. Adding pages (folders) to a project. Reviewing site structure: <ul style="list-style-type: none"> folders, subfolders and files. link structure. Publishing the project on a local server. WWW Publishing 	<p>Publishing the project can, in the first instance, be done on the local server in the school LAN.</p> <p>This provides an ideal basis for interdisciplinary projects with students presenting the end results of the projects as sites on the local server.</p>
6. More advanced aspects of Web publishing	<ul style="list-style-type: none"> Working with images Working with tables HTML Frames <ul style="list-style-type: none"> creating and sizing frames use of scrollbars in frames hyperlinks and frames Web site maintenance <ul style="list-style-type: none"> finding & replacing text finding HTML tags finding and fixing broken links Active Web pages <ul style="list-style-type: none"> Hover buttons Dynamic Billboards Hit counter News tickers Forms and form fields <ul style="list-style-type: none"> text boxes and scrolling texts drop down lists check buttons and radio buttons reset and submit buttons Applets Scripts Database Integration in Web sites 	<p>see also: graphics option</p> <p>This list is neither prescriptive nor exhaustive.</p> <p>As in other modules the actual topics covered will depend on the aptitude and interests of the students, and should reflect new developments in a rapidly changing multi-media environment.</p>

ANNEX 6: ICT teaching - Secondary cycle

OPTIONAL TOPICS

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
Optional topic 1 Advanced aspects of word processing	see word processing	
Optional topic 2 Advanced aspects of spreadsheets	see spreadsheets	
Optional topic 3 Advanced aspects of databases	see databases	
Optional topic 4 Advanced aspects of graphics applications	<p>advanced operations with a powerful pixel-oriented package for photo software.</p> <ul style="list-style-type: none"> touching up images working with lenses (colour and tone corrections; moving in and out of focus etc.) working with filters (artistic filters; rendering filters; noise filters; colour transformation filters, focussing filters etc.) working with three-dimensional models creating animations for the Web exporting and importing images advanced operations with an object-oriented drawing package working with several layers grouping and ungrouping objects pasting, cutting and pasting, cutting out working with three-dimensional models working with contours overlapping objects distorting objects create 3D objects create Internet objects working with bitmaps importing bitmap files exporting vector objects to bitmap files 	<p>The aim is that the student learns the difference between a pixel-oriented package and a vector, or object-oriented drawing package, so that the student can choose the most appropriate program for a particular task.</p>

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
Option 5: Virus	<p>What is a virus ? Types of virus</p> <p>How to take precautions against viruses detecting a virus killing a virus</p>	
Optional topic 6 Computer hardware	<p>General description of the functioning of the various parts of a computer</p> <p>processor RAM / ROM hard disk floppy zip-drive CD-ROM drive tape streamer soundcard SVGA-card + screen plotter different types of printers modem scanner server work station types of networks</p>	<p>The aims are that the student acquires an insight into the working of the different components of a computer system, how the components work together, which alternatives (for example printers) are available, advantages and disadvantages of various options, awareness of recent market developments</p>
Optional topic 7 Logic circuits and chips	<p>basic concepts of electricity</p> <p>charge / current / voltage / resistance</p> <p>conductors / insulators / semi-conductors</p> <p>diode / Zener-effect / transistor /</p> <p>Boolean operators : AND, OR, NOT</p> <p>integrated circuits</p> <p>from electron bus to integrated circuit</p> <p>designing ICs</p> <p>production of ICs</p> <p>examples of integrated circuits</p> <p>microprocessor</p> <p>memory chips</p> <p>temperature limit</p>	<p>This option gives an insight into the way in which information of many different types can effectively (for processing such as calculation) be expressed in a suitable form using very simple means: 0 and 1.</p>

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
<p>Optional topic 8</p> <p>bits and bytes</p>	<p>data and information</p> <p>representation of alphanumeric data</p> <p>alphanumeric data</p> <p>ASCII-table</p> <p>applications</p> <p>representation of numbers</p> <p>positive integers</p> <p>calculation and machines</p> <p>positive integers: binary, hexadecimal and decimal system:</p> <p>representation and conversion from one to another</p> <p>positive and negative integers: 2's complement method</p> <p>numbers with fixed comma</p> <p>numbers with floating commas</p> <p>normalisation of numbers with floating commas</p> <p>error terminology</p> <p>representation of graphical data</p> <p>bitmap / number of colours</p> <p>as objects</p>	<p>This option gives an insight into the way in which information of many different types can be expressed in a suitable form using very simple means: 0 and 1.</p>
<p>Optional topic 9</p> <p>Developing and describing solutions to problems</p>	<p>top-down refining</p> <p>top-down refining as a method of analysing solutions to problems.</p> <p>analyse the problem and represent the solution in the form of a tree diagram.</p> <p>the refining of an abstract exercise to a concrete exercise</p> <p>describing a solution by means of control structures</p> <p>introduce and use the three control structures (sequential / selective / conditional and unconditional iteration) in, for example, diagrammatic form</p> <p>realise that the solution of a (part) problem can be described in terms of these three control structures</p> <p>execute and test solutions</p> <p>realise that the processor slavishly executes the algorithm and this is the basis of working with computers</p> <p>identify errors in algorithms</p> <p>possibly express the algorithm found in a high level programming language.</p>	<p>Although it is not necessary to program the solution developed, it could possibly be translated into a programming language such as Pascal.</p> <p>The aim is that students learn to solve problems which are susceptible to algorithmic solution systematically and, in doing so, apply a fixed method, namely that of step-by-step refining.</p> <p>It is not the end product (the algorithm developed) but rather the process (the manner in which the student works towards a solution) which is important.</p> <p>The computer can be used:</p> <ul style="list-style-type: none"> to test whether the algorithm is correct to better motivate the student.

Subjects	Knowledge and skills (the student should be able to:)	Possible teaching approaches
Optional topic 10 Multi-media	Using multi-media CD ROMs gather information and import this into standard applications: word processor, spreadsheet, database.	This option can give a significant impulse in the direction of developing real, inter-disciplinary computer projects.
Optional topic 11 Programming	Object-oriented programming	
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