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STRUCTURES AND MEDIA OF DISTANCE-EDUCATION COURSES

While the principles so far discussed may serve distance educators as guides to course structure, there are a number of further considerations of how to organize the presentation of course content that deserve our attention.

In most cases, distance teaching and learning are based on courses pre-produced for the purpose. As print is the dominating medium for the presentation of learning matter in distance education, the relation between distance-study courses and other presentations in print is of prime interest.

A printed study course is basically different from a textbook with questions. A textbook gives all relevant facts and, if it is a good textbook, does so in a clear and logical way, but it does not guide or teach. That is to say, it does not induce the student to learn, as we must expect a distance-study course to do. The presentation of facts in a textbook has normally to be supplemented by the exposition of a teacher, who kindles the interest of the students, tells them what to pay most attention to, what comparisons to make, directs their inquisitiveness towards profitable framings of questions, etc. A distance-study course guides and teaches by causing discovery learning and/or giving complete explanations with elucidating examples, by providing exercises of various kinds, by constantly referring to what the student has already learned to master, and by paving the way for successful problem solutions. This can be done by means of mediated guided conversations (see section *Overarching principles* in Chapter 4 above). The course is thus a substitute for both a conventional textbook and the exposition of a teacher (unless the course is attached to one or more books or other sources, in which case it replaces a teacher's comments and the discussion of the expo-

sition inspired by a teacher only). Naturally, this does not mean that a pre-produced course can be a complete substitute for the teacher in class (who not only lectures but also listens, argues, illustrates by means of experiments, etc., and generally interacts with the students). It must be borne in mind that the communication between the student and the distance tutor has essential tasks, however 'conversational' the pre-produced course is and however successful it is in meeting the requirements made clear by the Gagnerian functions listed on p. 66.

The subject matter to be taught is divided into parts, suitable as course units, which are usually sent to students as their work progresses. After students have completed their study of one unit, they answer certain questions, solve set problems, report on experiments made according to instructions, do some other writing (or, in some cases, orally recorded) work which is to be submitted for corrections, comments and suggestions. They also ask questions, request advice, and may initiate communication in other ways.

The idea behind the division of the material into course units is that students should be offered a suitable quantity of learning matter at a time so that they can regard the study of each unit as a separate task and can always survey the material to be learned. The theory is that in this way it is possible to prevent the bulk of possibly difficult study material from being intimidating. With each finished unit and with the tasks in it completed, the students see the result of their work.

The size, i.e. length, of course units varies considerably with the schools and universities that develop them. (In German and in the Scandinavian languages, course units are often referred to as 'letters' to emphasize the correspondence character of the communication they initiate.) Units from eight small pages to more than 100 large-size pages exist. Some attempts have been made to define criteria for what should be regarded as a suitable size (and the frequency of communication desirable), but so far nothing conclusive can be said. This is discussed on pp. 123–5.

The length of time that students spend at any one study session can be – and has in some cases been – a criterion for the size of course units. David Roberts concludes from an Australian study of his:

Students like to feel they have achieved something each

time they have a study session. It makes good educational sense, therefore, to divide learning materials into consumable morsels that can be intellectually devoured by the average student in a two-hour study session. Producing learning packages in two hour workload modules may be to the benefit of students if only because the production team is forced to think very carefully about the integration of notes, readings, self-assessment questions and other activities that will comprise each session.

(Roberts 1986: 37)

There can be little doubt that effective structuring of contents determined by the supporting organization to some extent becomes autocratic. Distance teaching may then mean 'teacher centred education', where the media are used as substitutes for the teacher, "telling" students what they ought to know' (Ljoså 1977: 79).

Most distance-education courses with their various components aim at leading their students straight to specific goals and do so on condition that the students are capable of following the exposition, doing the exercises, and solving the problems set. The course developers then tend to regard each study unit as an integral part and thus as a compulsory course component which is only rarely regarded as replaceable. The most common exception to this principle is no doubt an adaptation of the starting point to suit the prior knowledge of individual students.

This all-embracing course structure is often considered too rigid. It is felt only proper that the students should be offered a choice of which units of a course are to be regarded as relevant in each case. Such an approach leads to each unit or each small set of units being separate and providing sufficient treatment of a limited, and strictly defined, part of the subject. When that is the case, students can build their own curricula from units or sets of units belonging to different courses. This is what in German is called the 'Baukasten-prinzip', the principle of the box of bricks.

The advantage of this principle, which is usually stressed, is that each study unit or set of units can be used in different contexts. This is economical and can contribute to widening the offer of educational opportunities. Further, it makes a provision for requirements to study only one little part of a subject (and possibly acquiring a certificate; through a credit-point system, this

can be tantamount to securing what may be regarded as a mortgage on a degree or other formal competence) (Ljoså and Sandvold 1983).

The modular principle would seem to have another consequence of considerable importance in that it lends itself to supporting the general autonomy of the students. If each unit or set of units is provided with a kind of product declaration including statements of the objectives, the availability of sufficient numbers of units on related topics will allow individual students to select their own study objectives.

SELF-CONTAINED AND STUDY-GUIDE COURSES

A self-contained course in principle provides all the learning matter that is necessary. It has proved particularly valuable when the course content is fairly elementary and does not call for a study of different sources. Elementary courses in foreign languages can serve as typical examples. Such courses are complete in themselves and provide texts, grammar, vocabulary (with so-called synonyms), phraseology, phonetics, pronunciation exercises, exercises in composition, translation, etc. Other proficiency subjects, such as mathematics, are usually taught in the same way at a distance.

Sometimes, however, students must be made to see a complicated picture of a subject with conflicting theories and views, or they have to learn how to trace facts and arguments from different presentations and to study various sources critically. In such cases, self-contained courses may not offer the best solutions. Instead, a study guide steering or facilitating the study of set texts is usually more suitable in that it causes students to read and/or listen to presentations of various kinds, to compare and criticize them and to try to come to conclusions of their own. This study-guide approach is generally practical when the learning is to include part or the whole of the content of various books, papers, and other sources of knowledge. See also Holmberg (1977b, 1989c) Ljoså (1975); Weltner (1977).

Evidently study guides, like self-contained courses, can be and are used in different manners. Du Plessis underlines that

study guide design should afford individual students the opportunity of developing their own learning styles. Once

they have identified the teaching objectives, they should find, and be able to use, multiple access points to the subject matter. The study guide should enable students to keep to the order of presentation if they wish, or to select areas they consider relevant, skip material they have already encountered and do not wish to repeat, or evaluate themselves on any section where they wish to ascertain their standing, even if they do this before studying the relevant part in any great detail. It follows that study guides can hardly be 'too easy' in this regard. They should, however, provide a measure of 'difficult' work as well by, for example, inserting appropriate self-evaluation questions that challenge even the best of students.

(du Plessis 1987: 13)

Study guides should, preferably, in the interest of plurality, encourage students to use a number of different sources. This usually necessitates the availability of library services. A second best is the use of specially prepared readers which contain contributions representing different approaches. This practice evidently tends not to diminish interest in library facilities. On the basis of research by Winter and Cameron, Jevons states:

Where books of readings are supplied as well as study guides, students make more use of almost every other source of library material or information than do students who do not get readers. Their appetite is whetted rather than satiated.

(Jevons 1984: 32)

Making regular use of scholarly papers in periodicals is one way both of making students aware of different approaches with possibly conflicting views and of keeping courses up to date. Reprinting, with due permission, suitable articles for distribution among students is a procedure apparently widely adopted, for example in Australia where copyright legislation seems less restrictive to distance education in this respect than in most other parts of the Western world (L. Moore 1987: 26).

CONTRACT AND PROJECT LEARNING

The learning can also be organized on the basis of individual students' and tutors' predilections, needs and interests. This means removing the choice of subject-matter from the preparation (in the terminology of Michael Moore 1975: 5, the preactive element) to the very teaching–learning process: tutor and student agree on which course literature is to be selected, what tutor support is required, etc. This is what happens in contract learning, which inevitably stresses tutor–student interaction more than many other applications of distance education.

Since 1836, London University has acted as a pioneer in this field by conferring degrees on students who have not attended any of its classes but have prepared themselves for examinations in other ways (Tight 1987: 51). Individual tutoring is based on the study of literature prescribed or agreed between the professor and the individual students. Recent developments along this line have occurred in the contract learning initiated in the USA by Empire State College, NY (Coughlan 1980; Worth 1982), in a diploma curriculum at the University of East London, formerly North East London Polytechnic (Bradbury et al. 1982; Hinds 1987), and at Murdoch University in Western Australia (Marshall 1984). The individual student exerts strong influence on the objectives of his/her study. In these cases, distance education is characterized by adaptability to students' needs and wishes, as far as content, time and methods are concerned. These are applications of far-reaching student independence at all levels. Contract learning unrelated to traditional distance education has proved very successful. See Lehmann on an early Empire State evaluation:

Relatively few students stated they were frequently worried (10%), bored (4%), confused (7) or concerned about mentor evaluation of their work (13%). On the other hand, most students said they were frequently interested (87%), challenged to do their best thinking (79%), and found the connections of life and learning exciting (81%).

(Lehmann 1975: 7)

An analysis of the potential and applications of contract learning in distance education is presented by Weingartz (1991). Similar activities occur as parts of otherwise more pre-

structured courses of study. They are then usually referred to as projects. The higher the level of study, the more important is the project work. The requirements for advanced project work have been worded as follows by Bynner and Henry:

- The project should represent continued work over an extended period of time.
- The project should provide opportunities for the student to undertake original work based on the student's use of local resources.
- There should be an opportunity to display higher cognitive skills (analysis, synthesis, evaluation), organizational and problem-solving skills in the conduct of the project and writing up of the report.
- Supervision and guidance must be available at appropriate times to ensure the work is both feasible and that it stays on course.

(Bynner 1986: 28)

While this type of work demands excellent library services and availability of highly competent supervisors, there is much evidence to show its effectiveness in distance study at the university level (see Bynner 1986 and his sources on post-graduate distance study).

Study starting out from individual problems rather than from the systems of knowledge known (see Lehner and Weingartz, whose research is mentioned on pp. 35 and 64) would seem to go well with contract learning and project work at various levels.

INDIVIDUALIZED COURSES AND COMMON-SENSE APPROACHES

The possibility of individualizing more traditional distance education should also be looked into. To base the presentation of distance education courses of a mass-communication character on the individual student's cognitive structure is naturally an unattainable goal. Nevertheless, there are practicable (and practised) procedures for individualization. Referring to 'increasingly sophisticated technology' Kathryn Atman claims that it is 'possible to develop interactive, individualized orientation pro-

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grams, based on psychological type differences that focus on personal skills' (Atman 1990: 149).

No sophisticated technology is required to allow students in the interest of individualization to start their distance study at different levels, i.e. to take additional introductory course units or skip some of the regular units. Students may also be offered supplementary study material related to the weaknesses which they find that they have as they work through their course. Such adaptations may be based on special diagnostic tests, on students' and tutors' conclusions from work done. They may also be left to the students' own initiative. It is helpful to arrange the presentation in such a way that the students' selection of what is relevant to them is facilitated. On this, see what Waller calls structure (see p. 98).

Within the framework of the aptitude–treatment–interaction research, Salomon has developed a remedial model, a compensatory model, and a preferential model. The first two correspond to the provision of additional study material, mentioned above, for the purpose of either correcting misunderstandings and generally putting things right or filling in gaps, thus compensating for prevailing deficiencies. The third tries 'to capitalize on what the student is already capable of doing' (Crombag 1979: 178; Salomon 1972). This implies a choice related to students' needs and predilections. It would seem to be implemented in distance education primarily through the choice of courses, although other applications are also possible and indeed practised (Moore 1983).

This is, of course, a reminder of Ausubel's basic principle, namely, 'If I had to reduce all of educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly' (Ausubel 1968: motto before preface).

This declaration of Ausubel's reflects not only his research orientation but above all common sense, a commodity that is a sine qua non as much in education as in other human endeavours. The studies and principles referred to above are all undoubtedly of value to distance educators, but in practical work they must be coupled with both common sense and elements of educational feeling. In fact, original thinking and intuition are required for us to make good use of any scholarly finding. The

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point was recognized by William James as early as 1899 and has been further developed by Gage (1978), who points out that neither doctors nor engineers can limit themselves to relying on scientific information. Educators are no less dependent on their own thinking and intuition. See also Huber, Krapp and Mandl, who stress that the search for applicable scholarly results 'remains a creative act on the part of the practitioner' (1984: 33). This very much applies to the structuring of distance-education courses. It may be based on psychological rather than logical sequencing as suggested by John Bååth. The presentation may begin

with a topic calculated to catch the students' interest and motivate them to read and to learn the other parts of the subject. You may compare this with the ways in which good fiction writers often begin a novel or a short story. They do not normally describe the whole background of the principal characters, their environment, their birth, childhood, adolescence, etc., before they proceed to the real story. Instead, they often throw the reader directly into the action, and introduce environment, background etc. afterwards. Something of this technique could very well be used in a correspondence course!

(Bååth 1986: 14)

SELF-CHECKING EXERCISES

The simulated conversation which is seen as an important characteristic of the style of course presentations can be, and is, also brought about by exercises which students do not submit but check themselves.

Self-checking exercises can be of different kinds. Some are introduced to help students solely to learn facts and to memorize, whereas others aim at providing opportunities for practical applications, normally based on the understanding and solution of problems.

To help students to learn facts, it has been found useful to provide them with a series of detailed questions intended to make it possible for them to check that they retain all important items. In most cases no answers to these questions are given, the idea being that the student, when in doubt about a question, should carefully re-read the relevant section of the course unit or other

work concerned and then tackle the question again. Some correspondence schools have a system of numbering small sections of their units and then referring to the numbers in the questions. Others reject this system, as they fear that it does not require sufficiently solid knowledge for the student to be able to answer the questions and that it may encourage him/her not to make an endeavour but merely to look up the answers while reading the questions. On the other hand, questions with full answers given on a following page occur in some courses. Sometimes answers to questions of this type on a topic already studied are included in a later course unit.

It is important not only to check knowledge but also to provide actual teaching by means of suitable questions and exercises, i.e. to make students think and thereby learn. Of course, this is nothing new but simply an attempt to apply an old method known as Socrates' 'maieutics', i.e. midwifery. Socrates put his questions in such a way that he made his listeners bring out into clear consciousness conceptions that were previously latent in their minds and made them draw the correct conclusions. He made his listeners see the solutions on their own. Something of the same kind can be brought about by suitable questions and exercises in a distance-study course. However, according to Thorpe, some Open University students tend to cut such inserted questions and exercises as expendable and one student comment runs like this: 'I don't know if they're helpful or not. Sometimes I feel they get in the way. They make me think. I don't want to think, I just want to get on' (Thorpe 1986: 39).

Lockwood, as quoted by Thorpe, adds: 'When students were asked what their reaction would be if activities were omitted from future teaching material, many said they would feel relieved. It would remove the feeling of guilt they experienced when skimming over or ignoring them' (ibid.). See also Clyde et al. (1983).

These findings would seem to indicate a need for course developers to consider carefully the lucidity and completeness of the subject-matter presentation that is offered and, above all, what kinds of questions can be helpful. They should help the students consciously to control their own learning.

Skill at solving problems and applying knowledge acquired is essential, even at an elementary stage, in mathematics, physics, chemistry, technical subjects, languages, accountancy, etc. and so

it is of great value to the student to get an appropriate amount of practice. It is not enough for the student to follow a theoretical discussion leading to the correct conclusions; he/she must be able independently to produce solutions to problems similar to those discussed in the course. Much practice is needed in some subjects, such as foreign languages. To cater for this, it has proved practical to include in the various course units a series of problems for self-checking. Thus, a considerable amount of active work on the part of students can be brought about to stabilize their knowledge and practical skills. In some cases, printed or duplicated forms, where the students fill in gaps, solve problems, answer self-checking questions, etc., can contain the exercises, and specially prepared exercise books of this type are in use.

As already indicated, model answers and complete solutions to problems given in this way are often provided in the course, either in the unit containing the exercises or in the following unit. Marland and Store, who find that 'the practice of providing model answers makes good pedagogical sense', also point out that their 'usefulness to students will increase if the purposes of the model answers are explained to them and if they are told how to use them' (Marland and Store 1982: 95).

It has proved useful and even necessary to supplement some of these model answers or solutions with comments explaining, with reference to the course, why the solution given is the correct one, how it has been reached, and what possible alternatives there are. All educators should remind themselves from time to time that the average student cannot be expected to see, without assistance, all of the logical contexts that a tutor may wish or, judging from what has been taught, expect him or her to see; course developers must be on their guard against regarding as self-evident the reasoning behind correct answers or proper solutions once a correct reply has been provided.

Comments of the type mentioned in connection with exercises are more often required than they actually occur. A discussion based on the solution of even simple problems is very often valuable in considerably improving the students' capacity to benefit from the course. Discussions in writing or on audio-tape are naturally necessary in all cases when there is no self-evident correction solution.

Bååth (1980) reports on an empirical research project that in courses examined it seemed possible, 'without any noticeable

effects – neither negative nor positive – to replace substantial numbers of assignment questions by self-checking exercises with model answers and pre-produced comments within the teaching material' (p. 152).

The computer is a valuable instrument for self-checking exercises bringing about simulated communication. See the following section on media.

MEDIA FOR SUBJECT-MATTER PRESENTATION

There can be no doubt whatsoever that print, in the form of printed texts, is the most important medium for subject-matter presentation in distance education. It is more or less regularly supplemented by illustrations, diagrams, blueprints and sketches, occasionally for three-dimensional viewing, and in some cases by elements programmed in short-step frames, linear or branched. Print allows individualization of information, functions in a wide range of study environments, and is easily accessible for revision. The potential and functions of printed course materials have been analysed by Peters (1973, 1979); Bååth (1986); and others. The use of the printed word in distance-education courses is an important theme in this work.

Recordings, mostly on cassettes, have become a second very common medium, functioning in most study environments (cassette players, earphones). Students often seem to feel that audio and video recordings provide a certain closeness to reality and have something of an enactive character. In some subjects, such as science and technology, concrete materials like models and kits with oral work instructions on tape occur as supplementary media for the enactive mode of presentation (Holmberg and Bakshi 1982; Kember 1982).

Radio and television belong to some systems of distance education, and recorded television programmes for use in video-recorders have gradually become important elements in several distance-education programmes. Ether media have long attracted distance educators as being likely to be both motivating and effective. Distance educators have amassed a considerable amount of experience of the use of radio and television programmes, mainly as supplements but also to some extent as the main teaching media, thus, for instance in the Chinese distance-education system (Peters 1990; Zhao 1988). A further example is

the *Envision* programme of Laurentian University in Ontario (Gervais 1987). In some cases, use is made of satellite communication, a characteristic feature of the teaching of the University of the South Pacific, for instance, and of increasing interest to work elsewhere (Forsythe 1984).

Systematic use of radio and television as supplementary media occurs in the British Open University where the main medium of instruction is the written word, i.e. correspondence study. Most European countries, the USA, Canada, Australia, New Zealand, and several African, Asian and Latin American nations have experiences of using ether media for general educational purposes or as a back-up to organized distance study.

In spite of this, it is difficult to find a consensus of opinion about methodology. Probably, a majority of distance educators have come to the conclusion that television, apart from its potential for demonstrations, can have a strong motivating influence and that this to some extent also applies to radio. Television has also proved to be a powerful means for bringing about attitude change (see pp. 15–16). These characteristics are important not only in connection with the choice of media but also for the methods used when these media are applied.

The University of Mid-America tested television as a means to attract people who are assumed to find it difficult to learn from print. It was found that 'television was liked when its content was closely related to the course, and disliked when it tried to amuse and entertain'. Further, there were signs both that students considered television less important than the printed course material provided and, on the other hand, that 'where and when television is not available, course numbers are smaller and attrition rates higher' (Hawkridge 1978: 40–1). The pacing influence of the television programmes was evidently felt to support completion of the courses.

A case study of some relevance is the Swedish Delta project, an updating course on mathematics for teachers of that subject. It was offered as an integrated television–radio–correspondence course in 1969–71. A study of the attitudes of the students (i.e. the participating teachers) showed that, whereas more than 90 per cent of them found the correspondence and radio parts of the course satisfactory, more than 50 per cent of them reacted negatively to the television elements, which were found to be

neither motivating nor providing good surveys (Holmberg 1973b: 47–52).

There have been similar experiences elsewhere. This probably reflects exaggerated expectations as far as the television element is concerned rather than a rejection of television as a medium of instruction. Critical students evidently do not want course items presented on television which can equally well be presented in print, nor do they normally want to hear formal lectures which, if provided in print, they can read in much less time than is required for listening and can then consult again and again. However, audio cassettes with recorded lectures are occasionally used in distance education (Leslie 1979, 1986).

It must be borne in mind that what suits one target group may not suit another. At an advanced level, television and radio should probably be reserved for such items as cannot be dealt with entirely in writing. Demonstrations in medicine, surgery and science, and study of such objects, circumstances, and processes as should be seen but cannot be made available to students individually would thus be suitable for television, whereas dramatic presentations, discussions, and talks on items of day-to-day current interest would be suitable for radio and/or television.

This, however, is more a general declaration of intent than a methodological guideline for the use of ether media in distance education. But see Laaser (1984) and (1986); Bates (1984: 29–41); Brown and Fortosky (1986).

It is tempting to regard broadcast radio and television programmes as educationally more or less identical with audio and video recordings respectively. This would be highly inaccurate, however, as succinctly explained by Bates:

Broadcasts are ephemeral, cannot be reviewed, are uninterruptable, and are presented at the same pace for all students. A student cannot reflect upon an idea or pursue a line of thought during a programme, without losing the thread of the programme itself. A student cannot go over the same material several times until it is understood.

(Bates 1984: 31)

Recordings can be used in a different and usually more profitable way. See Nicola Durbridge (on audio cassettes):

For students, study material presented on cassettes offers

considerable freedom. Students can choose to listen at a time and place convenient to themselves and thus use the material as and when it appears most relevant to their individual needs. They can moreover exploit the hardware of cassette-players – the stop, pause and replay devices – to organise their study approach according to personal style and preference. Thus, it can be argued that cassettes provide students with a learning medium which shares many of the advantages inherent in a written text; it is adaptable to such study techniques as skimming and reviewing and listeners can, to a large extent, control the pace and methods with which they engage with particular content. This point alone goes some way towards compensating for the ephemeracy of a sound medium.

(Durbridge 1984: 101)

Technology contributes further possibilities, for instance in connection with television. This would seem to apply to video discs with their large storage capacity coupled with freeze-frame and fast-search equipment (interactive video). Graphics whose construction is shown by animation techniques belong here.

Presentation of text and graphics on a screen instead of on paper is becoming more and more common (viewdata/videotext, teletext), but may not be a wholly desirable development. It undoubtedly is useful when ephemeral, urgent, really new information is provided, i.e. information not available in books or articles (the parallel with information about rates of exchange, aeroplane bookings, etc. is illuminating). For teaching purposes, the presentation of verbal subject matter in print is decidedly superior to screen presentation: it is easier to read, it facilitates leafing and browsing and it is open to all printed sources. There can be little doubt that, for serious study, the reading of printed material will remain a prime medium. Using computer-stored information available for screen reading (or on printouts) is a fashion that makes sense only if it means making data accessible which would otherwise be hard to come by. This is a far from unusual situation, however. Search for relevant information in computerized data bases and problem-solving by computer processing are valuable methods and can be useful academic exercises. It is nevertheless harmful to wean students from using printed sources when they look for occasional data. To use hand-

books, encyclopaedias, dictionaries, reports of various kinds and other reference books, and do so with ease, remains a necessity.

Reservations of this kind do not detract from the potentials of modern information technology. These are considerable, particularly for student-tutor and student-student interaction, on which see Chapter 6, but also in our present context, the one-way traffic by means of which subject matter is presented. Apart from relevant motion pictures, for instance such as illustrated processes and the development of graphics, the opportunities to make unprinted data available should be mentioned. Artificial intelligence, including so-called expert systems and knowledge representation, may lead to further developments of interest (Naughton 1986). 'Hypertext' systems are being looked into. They imply non-sequential presentation of learning matter, in which the student can browse and find his/her own way through the material available. Mandl et al. (1991) have studied hypertext empirically. Their conclusions are cautious; they recommend further studies before its value is judged. Schnotz warns that 'free navigation' may hinder rather than help learners with poor prior knowledge' (Schnotz 1990: 15; cf. above Chapter 4, *Further approaches*). On hypertext see further Hall et al. (1989) and Schulz (1989).

As mentioned under the section *Self-checking exercises* computer media can – and to an increasing extent do – bring about programmed, i.e. simulated, interactivity as part of distance-education courses. Drill exercises, for example when learning language patterns, and problem-solving tasks when indisputably correct solutions exist, are examples of interactive computer use. On-line communication also occurs in simulation exercises and in the study of branched programmes. Early experiments of interest were made at the Open University, e.g. in the CICERO project (Lockwood and Cooper 1980) and viewdata/teletext, 'in which a television screen is linked to a telephone, and hence to pages of data stored in a computer' (King, Sewart and Gough 1980: 14), as well as elsewhere (Kaufman 1986). Various kinds of progress have been made with the use of on-line systems (Bates 1984 and 1990a; Kaye 1985; Mason and Kaye 1989).

Programmed interaction of the kind that makes students interact not with a human being but with a computer program can in a truly educational situation supplement but hardly replace

real interaction between students and tutors. On media for student–tutor and student–student interaction see Chapter 6.

Up-to-date presentations of media for distance education are given in Bates (1990a). Modern practice is illuminated in an international study by Doerfert and See-Bögehold (1991). The latter report that 114 distance-education organizations have set up separate media departments, 60 of which have provided detailed information about their work and problems.

THE CHOICE OF MEDIUM/MEDIA

In distance education the selection possibilities are often extremely limited for financial and other reasons. The printed and written word on the one hand and audio-recordings on the other sometimes exhaust the selection opportunities. Suitable combinations of these offer additional choices. For instance, it may be useful to provide recorded instructions on how to study charts and pictures that are presented in printed form, a procedure which has proved profitable for target groups with little reading skill. In other cases, however, the choice can be made among several of the media referred to above.

If, in the spirit of educational technology, course development is based on target-group analyses, specification of lucidly communicable objectives, and logical–psychological sequencing as elements of a system, it seems natural to include media selection for subject-matter presentation in this rational procedure. Several attempts have been made to create a standard taxonomy, ascribing specific functions and applications to each of the media available, so that a natural, logical choice could be made for each part of a course of study. See Reiser and Gagné (1983) on a media selection model of an algorithmic type. No such taxonomy has been shown to be generally useful or applicable, however. Ever since Wilbur Schramm published his now classical study *Big media, little media* in 1977, it has been generally admitted that any claim about the superiority of one medium over another has limited relevance. 'There is no cookbook of recipes for media selection that can be applied automatically in every educational system' (Schramm 1977: 263).

This admission does not mean that it does not make sense to consider the value of individual media in relation to functions desired. The availability must needs be the starting point for such

considerations. Here the circumstances of social infrastructure, technical development, and cost may be decisive.

Of course, it is what a medium can do and not what it is like technically that is important in selection situations. This means that we must first pay attention to the relevant attributes of media rather than media themselves:

The attributes of a medium ... are the capabilities of that medium to show objects in motion, objects in colour, objects in three dimensions; to provide printed words, spoken words, simultaneous visual and auditory stimuli.... Some attributes, such as the capacity to provide pictorial stimuli, are shared by many media. Other attributes, such as the capacity to show objects in three dimensions, are properties of relatively few media.

(Levie and Dickie, as quoted by Clark 1975: 199)

Kathleen Forsythe, in developing her theory of conversation (pp. 54–5), directs her readers' attention to the 'generative' and 'degenerative' effects that a medium may have. 'A degenerative effect would be one that inhibited conversation. This could be effected by stifling the imagination or isolating the participant from conversation' (Forsythe 1986: 23). She refers to criticism of television in this context and underlines the necessity to choose and use media in a way that encourages creativity and to avoid 'feedback information in closed loops' (ibid., p. 24). This is particularly relevant to the use of computer technology, which often causes programming in advance. Forsythe rejects this as negative to 'the variety so necessary for learning' (ibid.).

Sparkes starts out from 'the assumption that the natural learning process is analogous to a conversational process' and 'emphasizes the teaching process of "educational conversation" ' (Neil 1981: 112). See pp. 46–55. Sparkes

draws particular attention to three communicational pathways, according to purpose. These are the primary forward path (teacher to student) and two feedback paths – problem identification and remedial tuition. He then goes on to relate each of fourteen media to the three pathways, indicating his opinion on how well each pathway is likely to be served by each medium, from a communicational technology point of view.... The fourteen media are related,

according to their degree of usefulness on a three-point scale, to the affective domain, to two levels in the cognitive domain, and to the domain of skills (following Bloom's Taxonomy). For example, Sparkes states: 'In general, teaching in the affective domain requires a form of communication with a strong appeal to the emotions. TV, radio, novels, drama, are particularly successful here. On the other hand, abstract concepts usually require verbal expressions rather than visual (abstract ideas cannot be photographed) although visual analogies and animation can be used to illuminate them. Tapes have the advantage over broadcasts for teaching the deeper concepts in the cognitive domain, since they can be replayed repeatedly, but texts seem the natural channel for teaching complex ideas.'

(Neil 1981: 113)

A theoretical approach, bearing on media selection, which has wide implications for distance education, has been presented by Chang et al. (1983), on the basis of Olson and Bruner's learning model. In a kind of taxonomy of educational objectives, they first make a general distinction between knowledge and skills. Skills to be learned through distance study are divided into operations on knowledge and operations with knowledge. The latter imply application of knowledge acquired and are concerned with 'results in the exterior world, reality' (Chang et al. 1983: 15). 'Operations on knowledge (critique may be a good example) apply to coded knowledge and result in new or new representations of knowledge, and in the skill of producing new forms of knowledge out of existing knowledge' (op. cit. p. 14). Distance educators following this approach must judge where these two types of operation are required and, as a guideline for selection, for each procedure and each medium must decide to what extent it helps students to acquire the operational capacities concerned.

Further suggestions helpful to distance educators were developed at an early stage by Gagné (1970 and 1977), in relation to the didactic functions he has described; by Handal (1973), who, apart from his own model, summarizes those of Bretz, Tosti and Ball, Briggs, Campeau, Gagné, and May; by Svensson (1973), who in his (Swedish) presentation with tables for the various media includes educational, technical and economic aspects; and by others.

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A further approach that is undoubtedly interesting, although difficult to apply and exerting little influence on distance education, is the aptitude–treatment–interaction (ATI) research, which aims at relating the choice of media to students' personality characteristics. From these, and from the objectives of study, it should be possible to draw conclusions about the characteristics of the medium/media suitable in each case, which in their turn will decide the choice. Heidt (1976 and 1978) uses this and Salomon's 'supplantation' approach as bases for a careful study of media and learning processes. The ATI (or, as it is also called, TTI: trait–treatment–interaction) aims and procedures are well illuminated in Clark (1975) and Allen (1975). The latter makes specific suggestions for developers of learning materials and lists a number of tentative generalizations from research data available.

ATI (TTI) approaches to distance education, with their courses for large numbers of students, meet with great difficulties. They will require instruments developed for students, by means of which the students can diagnose their own structure of intellect, and facilities that will make it possible to offer a wide range of choices of both learning tasks (objectives) and course materials which are presented by means of different media related to specific learner characteristics.

Experiences from today's reality, with more or less mass-produced courses, indicate that varying media combinations can be equally successful as educational tools for the same learning matter. There are signs that it is the use made of the media rather than the media themselves that is decisive for learning outcomes.

In cases where there is a reasonably free choice of media, i.e. when cost considerations and other so-called frame factors do not limit the choice to a minimum, practitioners nevertheless had better adopt some systematic method to guide them in their choice of media. It has proved profitable to start the selection by listing first the media available for the course that is being planned and second, the criteria by means of which the selection among the available media can be made. Among the selection criteria belong such considerations as the time available, the attitudes of the students, the cost, the opportunity of profitable coordination with practical work, the degree of risk involved in experiments, etc. It is useful to judge the relative importance of the selection criteria. This can be done by awarding each of them

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a mark in the form of a number, e.g. from 1 to 3 in relation to their importance. With these two lists as instruments, an attempt can immediately be made to find out which medium/media meet the requirements of the most important criteria for each part and each group of objectives of the course. This approach, which I have developed elsewhere (Holmberg 1987: 19–21), is inspired by Lehmann, who himself stresses its evident weakness, namely that it hardly prevents bias from influencing the outcome (predetermined conclusions can be rationalized by idiosyncratic scoring systems). However, the approach offers a practicable guideline which, when used with judgement and discretion, seems to be of some use.

PRESENTING THE LEARNING MATTER

Sensible structuring of the learning matter, as well as the use of an appropriate medium or appropriate media, are prerequisites for the development of learner-friendly courses. The writing of texts will be our prime concern, not only because print is the basic medium of most distance teaching but also because presentations in other forms (broadcasting, films, audio and video recordings, etc.) are regularly based on scripts.

Style and language

As already indicated, any text to be used for teaching–learning purposes must be developed in a way to facilitate learning not only by providing information but also by helping the learner to relate newly acquired knowledge to what is already known, i.e. to anchor it in already existing knowledge structures (Ausubel, 1968: 107). This has been called coherence formation, which

can be seen as an intentional strategical process where the reader constructs a mental representation of the topic matter by using not only text information but also his or her own prior knowledge. From a communicational perspective coherence formation results from a co-operation between the author and the reader.

(Schnotz 1986: 2)

Distance-teaching courses thus can – and should – activate students so that, instead of being passive (and therefore possibly

inattentive) receivers, students do real work in that they process information, compare new concepts with those already known, draw conclusions, apply and practise knowledge acquired, etc. It has proved useful to encourage them to make tables and summaries, to consider questions and solve suitable problems.

What this thinking further implies in practice is as matter for consideration and discussion. To the present author there can be no doubt that the conversational approaches discussed on pp. 46–55 effectively contribute to facilitating the acquisition and application of knowledge.

Texts used must organize and explain ideas and must be perfectly lucid (for a different opinion see Rowntree (1973) below). They should not only clarify concepts but, on the basis of the distance educator's experiences of teaching and learning, foresee probable errors, provide correction of these, confirm and reinforce fruitful thinking and correct solutions. Consolidation of essential contexts and items as well as necessary overlearning (see p. 36) must be catered for by revision exercises and references to relevant experiences.

The requirements concerning the lucidity of written presentations have been studied, in a way that is relevant to distance education, by scholars analysing the use of English and German printed texts. Langer et al. have shown, on the basis of German instructional prose, that the accessibility of texts – i.e. how intelligible ('verständlich') they are – mainly depends on four 'dimensions' of the text characteristics, as follows:

1. simplicity of sentence structure and vocabulary
2. structure and cohesion
3. succinctness and relevance
4. additional stimulation.

These dimensions are largely independent of one another. Nevertheless, the authors point out that 3 and 4 usually influence each other.

In the third dimension, a medium value (between extreme succinctness, making almost every word important, and long-windedness) seems preferable, whereas the other dimensions denote qualities of positive value for the readability of texts (Langer et al. 1974: 13–25). Another German study (Groeben 1972), which relies more on theoretical considerations than the

one referred to and is concerned with learner-text interaction, largely supports these conclusions.

The importance of simple grammar for readability and understanding has been shown to be a decisive factor. The active form of verbs facilitates reading compared with the passive form. However, practice in the reading of passive sentences seems to eliminate this difficulty, which may be an important fact for presentations in German, for instance. Short clauses, many finite verbs, many pronouns, and short and well-known words are advantageous from the points of view of readability and understanding (Coleman 1965; Groeben 1972: 18–23). Readability problems are particularly great for courses written in German, as the German scholarly tradition favours a complicated style. A thorough study by Tergan (1983) of readibility, as related to success in distance education, confirms the importance of text accessibility in German. The problems are far from negligible in other languages. Research illustrating this, based on texts in English, has been succinctly summarized by Davies (1971: 140). Also compare the following extract from Taylor:

Learners grasp affirmative more easily than negative statements. They understand the active voice more readily than the passive. Equally, a declarative sentence is more easily understood than an interrogative.

Abstract nouns make continuous discourse harder to understand. They can, in most cases, be replaced by verbs. For example, 'Great emphasis must be placed on the importance of consultation of the attached plates in attempting the identification of a particular species', which can be rendered, 'We must emphasize how important it is to consult the attached plates when you are attempting to identify a particular species.' The use of personal pronouns facilitates the transformation from abstract nouns to verbs. Coleman (1971: 167), for example, feels that most of the abstractness in scientific writing can be attributed to the traditional avoidance of the words 'I' and 'we.' Verbs, on the other hand, increase the ease of presentation. A high proportion of verbs makes understanding easier. However, a difficult passage is not made easier by merely adding more verbs without taking into account the length of sentences or the frequency of occurrence of the verbs. A useful strat-

egy, as already indicated, is to change abstract nouns into verbs. By this means the communicator gains the double advantage of increasing the number of verbs and reducing the number of abstract nouns. Educational psychologists who insist on properly defined behavioural objectives usually make precisely this transformation. They exchange nouns like appreciation, understanding and knowledge for infinitives like to differentiate, to identify and to write (Mager 1962). Comprehension decreases as adjectives increase, but pronouns, on the contrary, make the message easier. Miller (1951) found that communications with more pronouns were easier to understand, and attributed that fact to the personal interest they stimulated. Apart from such psychological factors, however, other and more powerful linguistic variables may well be involved. Lastly, prepositions decrease comprehension. The more prepositions, the harder the communication.

These findings are broad generalizations derived from correlational studies and should be applied cautiously and intelligently. Until more rigorous and controlled experimental studies are designed, these are all we have.

(Taylor 1977: 115–16)

One of those who go far in their application of these and similar principles is Rowntree:

Write plainly:
— Cut out surplus words,
— Use short familiar words,
— Use precise words,
— Use strong, active verbs,
— Use specialist vocabulary – but with care,
— Write short, simple sentences.

(Rowntree 1986: 231–2)

Without detracting from the appreciation of the studies mentioned in the quotation from Taylor, at least one reservation should be voiced. We have to contend with some intervening variables influencing the results. Personal motivation, the standard of prior knowledge and cognitive structure of the students concerned, the time available, and other circumstances evidently influence the results of studies of this kind (Klare 1976). Further,

we must consider which types of learning are concerned. What is relevant for purely reproductive learning and simple transfer achievements need not apply to problem learning and understanding. Some scholars are apt to regard formal text criteria as relatively unimportant in relation to individual cognitive structures and the learning activities of students endeavouring to solve problems. See Weingartz and Marton below.

Readability formulae using word length, word frequency, sentence length, and similar measures to predict reading difficulty have been used with success (Gilliland 1972). Naturally, the reservations regarding other formal criteria of understanding apply to readability formulae as well.

Gilliland (1972: 96) points out, for example, that reading difficulty is not necessarily caused only by word and sentence length (e.g. 'grandfather' is a more familiar word than many shorter ones and short sentences of unusual structure may also be more difficult than longer ones).

(Aitchison and Aitchison 1987: 23)

Nevertheless, like the guidelines provided by Langer et al. (1974), readability formulae can be quite useful. They are also usually easy to apply. In a critical study of language in texts, Macdonald-Ross comes to the conclusion that, in spite of the problems known, a 'readability "filter" is ... more reliable than the exercise of unaided human judgement' (Macdonald-Ross 1979: 5). He refers to what is known about

the clear relationship between readability and learner acceptability (Klare et al. 1955), between readability and efficiency of reading (Klare et al. 1957). Klare and Smart (1973) found a rank-order correlation of 0.87 between the readability level of correspondence material and the probability that students would send in all their lessons (with length held constant). Such decisively clear-cut field results are not to be put aside lightly.

(ibid. p. 4)

The compactness of a text, i.e. the degree of succinctness with which something is explained, also influences the readability to a great extent. In most cases, the compactness can be judged in relation to how many words are used per item of information. We may therefore speak of the density of information in a study

text. In a scholarly paper the density of information can be extremely high, whereas in a conversation it is usually kept to a level that makes immediate comprehension possible. Faust and Anderson (1967) and Frase and Silbiger (1970) have shown the value for motivation and learning of moderate density of information in print. Langer et al. stress the importance of avoiding both extreme concentration and long-windedness, whereas other scholars show that marginal information of illustrative value both supports the learning of the main points and is itself incorporated in the knowledge acquired. Rothkopf and Kaplan (1972) report after an experiment that 'increases in density of instructional objectives resulted in decreases in the likelihood that any intentional item was learned' (Rothkopf and Kaplan 1972: 295).

Taylor (1977) expresses similar conclusions:

The effective communicator elaborates his discourse. He identifies the novel and more difficult concepts. He gives examples, he rephrases his exposition and provides repetition.... When the amount of elaboration is low, the presentation is considered difficult. As elaboration increases, the discourse gets easier for the subject. Up to 30 per cent elaboration reduces presentation difficulty. When the amount of elaboration exceeds 30 per cent the presentation gets more difficult. A more general statement of this effect would be that redundancy improves ease of comprehension. This point has received ample experimental support.

(Miller et al. 1951)

Taylor's 1953 study, using the 'cloze' technique, also illustrated how 'messages with a high level of redundancy convey their meaning more successfully than those low in redundancy' (Taylor 1977: 47).

The warning quoted against extreme concentration on the one hand and long-windedness on the other, as well as the reservations about formal text criteria as indicators of text effectiveness, may be taken to question how far the educational editing should go to make the reading palatable. Rowntree (1973), quoting Sanders, is quite categorical in rejecting the most readable texts as patterns to be followed:

The more explanatory and 'clear' the exposition, the less

there is for the student to do. Some texts are so 'perfect' as to stifle all real thinking activity. Sanders (1966) has this to say about textbooks:

'Although many are attractive, accurate, readable and understandable, they are also one of the biggest deterrents to thinking in the classroom, because the writers assume that students learn best by studying a polished product. The key function of the writer is to explain, and a good explanation is interesting, orderly, accurate, and complete. The vocabulary suits the level of the student and complex ideas are clarified by dissection, integration, example and visual images. Thus, the textbook is weak in that it offers little opportunity for any mental activity except remembering. If there is an inference to be drawn, the author draws it, and if there is a significant relationship to be noted, the author points it out. There are no loose ends or incomplete analyses. The textbook is highly refined and as near perfection as a human mind is capable of making it – but the author does the thinking. The book never gives a clue that the author pondered (maybe even agonized) over hundreds of decisions.

The result is that the creative process and the controversy of competing ideas are hidden from the students.'

(Rowntree 1973: 2; Sanders 1966: 158)

When considering this warning against text perfection, we should ask whether, in case Rowntree and Sanders are correct in their assumptions, it is the clarity, the interesting presentation, the readability, the intelligibility, the perfection, or something else that makes the 'polished product' detrimental to thinking.

It is probable that a text that seems very simple and full of platitudes makes a reader inattentive. But is such a text to be described as attractive and interesting? Conversely, it is well known that a text that is not lucid, however important it is, makes some readers impatient and thus little motivated to learn.

It is my contention that clarity, readability, and forms of presentation that attract interest all promote reading and learning. The fault with the type of text criticized by Sanders and Rowntree lies elsewhere, i.e. in the presentation of learning matter as a ready-made system instead of as something to be looked into and considered. The texts described do not require the students to ask

themselves questions, try possible solutions leading to conjectures and refutations, or search on their own. There can be no doubt that guiding students in this way is what must be required of study texts, unless they aim at providing material for memorizing only.

Groeben (1972) expresses views which closely agree with Sanders: 'Do not accept the principle that you must be entirely intelligible to the student.' Groeben recommends what he calls an intermediate degree of intelligibility. It appears probable, however, that what he objects to is not perfect lucidity but the presentation of knowledge as facts and ready-made systems instead of a series of complex problems: 'Do not lack in responsibility in that you enumerate the facts you know.' This could imply an interpretation that agrees with the one I have developed above. To attain a reasonable degree of intelligibility, the measures recommended by Groeben imply helping the students to structure concepts (Groeben 1972: 147).

Techniques have been developed to direct students' attention to important issues, to considering and searching for solutions. Rothkopf's questions aimed at promoting 'mathemagenic–positive' behaviour belong here. The use of questions as attention directors, along the line of Rothkopf, has been criticized. Whereas much research endorses this use and many agree with Macdonald-Ross in regarding this as supporting common sense, others are rather negative. This would seem to apply to Weingartz, who considers formal text criteria fairly insignificant in relation to the basic text design, which may either start out from problems to be solved and thus support problem learning, or simply present ready-made systems of knowledge for reproductive learning. Even more negatively inclined is Marton, who fears that all kinds of attention directors may avert students' interest from the content to the technical aspects of the reading process, thus encouraging surface learning and leading to neglect of deep-structure learning (see pp. 34–6).

Considering arguments for and against inserted questions, it would seem to be important what type of questions are asked. If they merely concern facts, wordings, and examples provided in the text, they may certainly encourage what Marton calls surface learning. Questions causing students to think independently, to formulate their thoughts and relate these to the text are not only radically different from the questions attached to the wordings of

texts but also would seem to be useful instruments to encourage problem learning and deep-structure study as Marton and Saeljö define this concept. Research reviewed by Faw and Waller (1976) confirms this. See also Marland and Store (1982: 93). On students' reactions to inserted questions see above under *Self-checking exercises.*

It would be extremely interesting to know more about how students really use the various devices developed to facilitate their learning. Perc Marland recommends as investigation method the use of self-reporting techniques 'such as think-aloud, journal-keeping or stimulated-recall interviewing' (Marland 1989: 180).

If used with judgement and discretion, aids to making distance-study units and other texts accessible and instructive can no doubt be valuable instruments in the hands of sensible course developers. In my view, this applies to readability formulae; to the principles of intelligibility discovered by Langer *et al.*; to the research quoted on density of information and on questions based on texts to support mathemagenic–positive study. They all contribute to the character of didactic conversation that I have described as highly conducive to individual learning. Irrespective of the medium used, an argumentative presentation, which encourages problem learning in the spirit of Lehner and Weingartz, adapts itself in a natural way to the forms of didactic conversation that state and suggest, query, reconsider, search for additional information, improve the wording of a finding and use this as a basis for further deliberations. The style of didactic conversation no doubt has its rightful place in distance-study courses.

All this evidently means that there is a considerable difference between a distance-teaching course presented in print and a conventional book (see p. 68). Guidelines and activities of different kinds naturally belong to a course which has to train students to evaluate their study material at a more or less academic level. See Iley (1983: 76).

Typography and layout

It is usually assumed that the layout and general typography of a printed course may exert influence on its teaching effectiveness. Decisions on the graphic presentation of text usually rely predominantly on general assumptions about legibility, on intuition

and personal taste. This does not mean that there is a lack of scholarly studies in this field.

The history of typographic research is a lengthy one, going back to the 1880s and probably before. The research has been ably summarized by several workers, notably Tinker (1969), Spencer (1969), and Katzen (1977). Yet despite its long history, it is clear that much typographic research seems to have little practical relevance for writers, editors, typographers, publishers and printers.

(Hartley 1980: 127)

Distance-education practice in this respect relies only to a very limited extent on research. Among the studies on typography that are relevant for distance educators, those of Hartley and Tinker seem particularly fruitful. The following guidelines, inspired by Tinker, would seem to be useful:

1 Two-point leading improves the legibility of 8-, 9-, 10-, 11- and (to some extent) 12-point type in lines of moderate width.

2 With 10-point type and 2-point leading, it seems to be possible to vary the line width between 13 and 28 picas without any significant change in legibility; however, readers seem to prefer approximately 20-pica line width.

3 With 11-point type, under the same conditions, line widths from about 14 to about 30 picas would seem to be practicable; for 12-point type the safety zone seems to be 15 to 34 picas.

4 Eleven-point type seems to be preferable to other sizes; with 2-point leading, line widths of about 22 picas are apparently optimal.

A slight modification by Hartley and Burnhill should be added:

In general, however, a good all-purpose size is 10-point type on a 12-point line to line feed: 8-point on 10-points is possibly as small as one would want to go in the design of instructional materials.

(Hartley and Burnhill 1977: 190)

Clarity rather than typographical elegance is usually stressed as important. Thus Hartley and Trueman (1979: 102) provide this recommendation:

1 Set the text unjustified (i.e. with equal word spacing and ragged right-hand margin, as in normal typescript).

2 End each line at a sensible place syntactically (e.g. at the ends of clauses). Avoid word breaks (hyphenation) at line ends.

Logical divisions of the text into reasonably short paragraphs, and generous spacing of chapters, sections, and paragraphs can evidently help the student considerably. A number of headlines and sub-heads are valuable not only in facilitating legibility but also in structuring the contents.

A valuable contribution to the theory of graphic elements has been offered by Waller, who has developed the notion of access structure (Waller 1977 a, b). His thinking is based on the insight that the normal way of reading is selective. We do not normally read every word or from the top to the bottom of the page, but look for what is relevant to us at the time of reading. What a reader needs, according to Waller, is help both to plan and execute his reading strategy. Lists of content, statements of objectives, surveys, and explicit suggestions may be helpful for planning. Graphical devices, e.g. headings, are useful for the execution in that, as Macdonald-Ross (1979: 30) says, they signal 'the status of the communication to the reader'.

Another relevant approach is presented by Doerfert (1980) on the basis of information theory and the so-called redundancy theory developed by von Cube. The formation of 'supersigns' is regarded as particularly important for learning efficiency. Supersigns are comprehensive concepts including 'signs' on a lower level, in the way that a word is a supersign in relation to the individual letters of which it is made up. According to von Cube, supersign formation is an effective means to bring about 'redundancy', as this concept is understood by him.

Von Cube's theory is based on a cybernetic approach, mathematically defining the probability of what a student can foresee. The gist of the redundancy theory can be described as follows. Each study task contains a certain amount of information that is to be absorbed. Each item of prior knowledge and each step on the path of learning leads to a reduction of the amount of information left, and so does the capacity to form supersigns with the inclusion of new knowledge matter in its proper context. To the individual student, the task then contains redundant information beside what remains to be learned. The more that is

learnt, the smaller the amount of remaining subjective information and the greater the redundancy. Felix von Cube explains all learning processes by means of this theory. The fact that meaningful material is learnt more quickly than meaningless material is explained by the higher statistical redundancy in the meaningful material: thus the amount of information per unit to be learned is lower than in the meaningless material. Similar illustrations are given of conditioning and learning by success.

Doerfert applies this thinking to the use of graphical elements in distance-study courses. The use of structuring key-words in the margin, to denote essential concepts in the course presentation, has been tried with success: these key-words reproduce the content of the course unit as a kind of abstract and, according to Doerfert, in this way facilitate the formation of supersigns favouring redundancy. Various typographical measures including the use of italics, underlinings, etc., which aid the understanding of relations between concepts and other items of a presentation, are also seen as facilitators of supersign formation.

From another point of view, Waller tends to reject general information theory as 'unhelpful and somewhat misleading'. 'Information theory while having a limited direct impact on the study of graphic communication, left a metaphor for communication, reflecting the transient nature of electronics signals rather than the permanence of the printed media' (Waller 1979: 213). Following Hatt, Waller favours 'a taxonomy of communication outcomes in which the rejection or partial use of a message is seen as quite valid and not necessarily inconsistent with adequate comprehension' (ibid., p.216). He further argues that 'the construction of a text (or diagram) is itself part of the process of organizing and structuring ideas' and discusses graphic devices as aids to problem-solving. Here, in accordance with his selectivity approach mentioned above, he refers to cases 'where the sequence and strategy for obtaining information is determined largely by the reader, and is conditional on, firstly, his goal and secondly, on the outcome of various steps in the problem-solving process' (ibid., p.221).

The application of typography to distance education is investigated within the general framework of teaching strategies in Marland and Store (1982).

Illustrations

Illustration of what is presented or discussed in a course is usually felt to be valuable from the points of view of both motivation and instruction. In a verbal presentation, whether printed, broadcast or recorded, illustrations take the form of visualizing through graphs, drawings, and pictures included in printed matter or offered separately (slides, films). If the presentation is based on printed material, illustrations may consist of both pictures and sound. How illustrations are to be used is partly a matter of selecting appropriate media and partly a matter of creating course units within the limits of a medium or media already chosen.

For printed courses, Kaufman et al. (1982) have developed a two-dimensional model for classifying visuals according to their function (instructional, motivational, and directional) and mode (drawing or photograph).

Weaving texts and pictures into what Sven Lidman calls one integrated lexivisual presentation, including explanatory drawings and text units, panoramic pictures and photographs of details, documentary illustration, etc., has been tried with success and is evidently a form of presentation that distance educators will have to investigate further (Lidman 1979; Lidman and Lund 1972).

According to Bock (1983), complementarity between text and illustration is a necessary condition for influence on learning, whereas mere repetition has been shown to be without effect, at least in some experiments. Lidman's lexivisual approach aims at complementarity, of course, in that text and picture each contributes its part to the whole. Applications of this principle can be found, independently of Lidman, in distance-teaching courses, for instance when processes and procedures are illustrated not by one picture but by a series of consecutive drawings or photos with verbal explanations. A Swedish example, from an elementary course of mathematics used in the early 1960s, is shown in Figure 6. Here learners are shown how to proceed consecutively to divide an angle into two angles of equal size. Pictures 2–4 demonstrate how an angle can be divided into two angles of exactly equal size by a pair of compasses, no protractor being used. The pictures show the consecutive positions of the compass leg and the marks made by the compass pencil.

Although any number of examples could be shown to illustrate the application of text-picture complementarity, few, if any, clear-
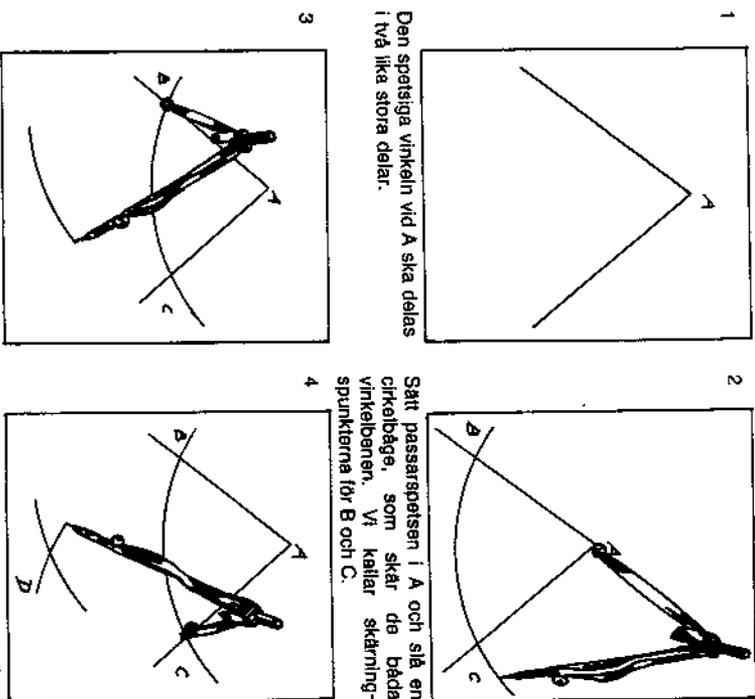
1
Den spetsiga vinkeln vid A ska delas i två lika stora delar.

2
Sätt passarspetsen i A och slå en cirkelbåge, som skär de båda vinkelbenen. Vi kallar skärningspunkterna för B och C.

3
Sätt sedan passarspetsen i B och slå en båge med godtycklig radie, som dock inte får vara alltför liten.

4
Behåll måttet i passaren och flytta passarspetsen till punkten C. Slå en cirkelbåge med lika stor radie som i bild 3. Om de båda bågarna inte skulle skära varandra, har Ni valt en alltför liten radie i cirkelbågarna.

Figure 6 Series of drawings with explanatory texts
Source: Hermods

cut rules can be derived from studies of practice or experiments. Not a little research has been done (Willows and Houghton 1987), but so far it is with little practical impact. Cognition psychology pays considerable attention to the issues concerned, however, also from the point of view of distance education. See, for instance, Fernstudium aktuell 8, 3–4 (1986), the journal of the German Institute for Distance Study (DIFF) at Tübingen University. In this Institute, painstaking research on learning from texts and pictures has been done for several years (see Ballstaedt, et al. 1987).

Non-contiguous oral and video presentation

Apart from the section on typography, most of what has been said so far also applies to the endeavours that are made non-contiguously to facilitate learning by oral means (radio or audio recordings) and by combined oral and visual means (television or video recordings).

The main difference between radio and TV on the one hand and recording on the other hand being the ephemeral character of broadcasts, the latter would seem to be relegated to new items and spontaneous supplements to pre-produced courses, at least in developed countries where recorders and cassettes are constantly available. This need by no means be an inferior function, however, as demonstrated in a number of question-box programmes applied, for instance, in the Swedish Delta project described on p. 151.

Audio and video cassettes or tapes, on the other hand, are parts of the pre-produced course which, like printed course units, students can refer to again and again. Combinations of spoken, recorded instructions with printed illustrations have proved very useful. Durbridge (1984) illuminates their use at the university level. In Sweden in the 1960s, Hermods worked with audio cassettes to guide the study of brochures containing illustrations and very brief printed comments. This was in the teaching of elementary physics and chemistry. In the latter case the target group consisted of textile workers being retrained for jobs in mechanical industry.

CONCLUSIONS ABOUT COURSE DESIGN

The above comments will have shown that a number of different but – as a rule – compatible approaches to subject-matter presentation have been developed and applied. I am convinced that the empathy approach is the most helpful guideline to course developers and should pervade the whole of the distance-education process. There will be reason to return to this in the part of this book devoted to distance-education theory.

In OTIC, the centre for distance-education research at the Dutch Open Universiteit, 'embedded support services' are being developed to facilitate learning from texts (Valcke and others in OTIC research reports). In Valcke et al. (1993) and Dochy (1988),

a number of theories relevant to instructional design are looked into.

A report on an Australian research project is of particular interest to course developers considering the various methods discussed above:

It was found that students valued and were aided by access structures, i.e. devices which gave them access to the author's argument, enabling them to gain an overview of the text and to locate the key elements of the subject. Although few used the terms 'access structures' or 'advance organizers' to describe these devices, they did mention the assistance given by tables of content, objectives, headings, introductory chapters, selective sampling and summarising. All this confirmed the importance of access structures . . . It also led to the conclusion that access structures are of greater help in studying than legibility features.

The further conclusion was that the use of unambiguous and logical language, with appropriate sentence and paragraph sequences, can compensate for inadequate typographic signalling; that headings, illustrations and photographs that are not directly relevant can annoy those who seek connections between all elements of the textural presentation.

(Parer 1988: 1)

This largely applies to course presentation also when other media than the printed word are used. There is always a text in the background. Dubin and Taveggia (1968: 47), underline the powerful impact of textbooks 'which cannot be washed out by any known methods of instruction'. Juler who refers to this quotation, concludes that 'text is basic to all education and that the interactions students have with their texts are just as important as the interactions they have with people' (Juler 1990: 28). This, of course, applies even more to distance education than to conventional modes of teaching and learning as distance students wholly or mainly rely on non-contiguous, i.e. mediated communication. It is the realization of this that is the reason for the emphasis above on the empathy approach, conversational style and the organization of learning matter presented in print.