4. Determining the content of the course

Introduction

As discussed in the chapter on aims and objectives the process of determining the course content should start with determining for which (parts of) tasks of future work the students have to learn the skills in this course. Then you are able to infer what procedures and knowledge has to be included in the course.

We have also stated that most lecturers do not work in that sequence. They already have an idea of what the content of the course has to be and they start with structuring the content. Below, we give recommendations for improving the latter process that starts with the content.

1. Structuring the content.
2. Determining the main topics.
3. Checking the core of the course: application of the knowledge.
4. Prior skills and knowledge.
5. Required skills and knowledge in more advanced courses.

1 Structuring the content.

Many lecturers find they can best get to grips with their course content by *drawing a picture* of it. Drawing such diagrams is a personal and subjective activity. Its purpose is help you externalize your own understanding about how the concepts within your field inter-relate. So long as you find it helpful in your own course planning, there is no need to worry that others might have mapped the territory differently.

Two other possibilities in getting grip on the content are:

Concept map. A concept map is produced when the starting point is the name of a key topic or concept, and lines are drawn from it to a number of related concepts. The names of concepts related to these are then written in and also joined up with lines.

Figure 3 shows the first sketch of a concept map drawn for a course on diet and nutrition. The lecturer started with "Food" in the middle and then began to identify chains of connected concepts. He put down the ideas more or less as they came to mind, without wondering too much about whether all would be needed in the actual course, or what else might be needed in addition. Again, he drew lines wherever there seemed to be a relationship of whatever kind. The broken lines indicate links he was less sure about.

Of course, other people would map the field differently. But so might this lecturer on another occasion. The fact is, the diagramming served its purpose, at the time, as a course planning device. It enabled the lecturer to see his way around the field as he perceived it.

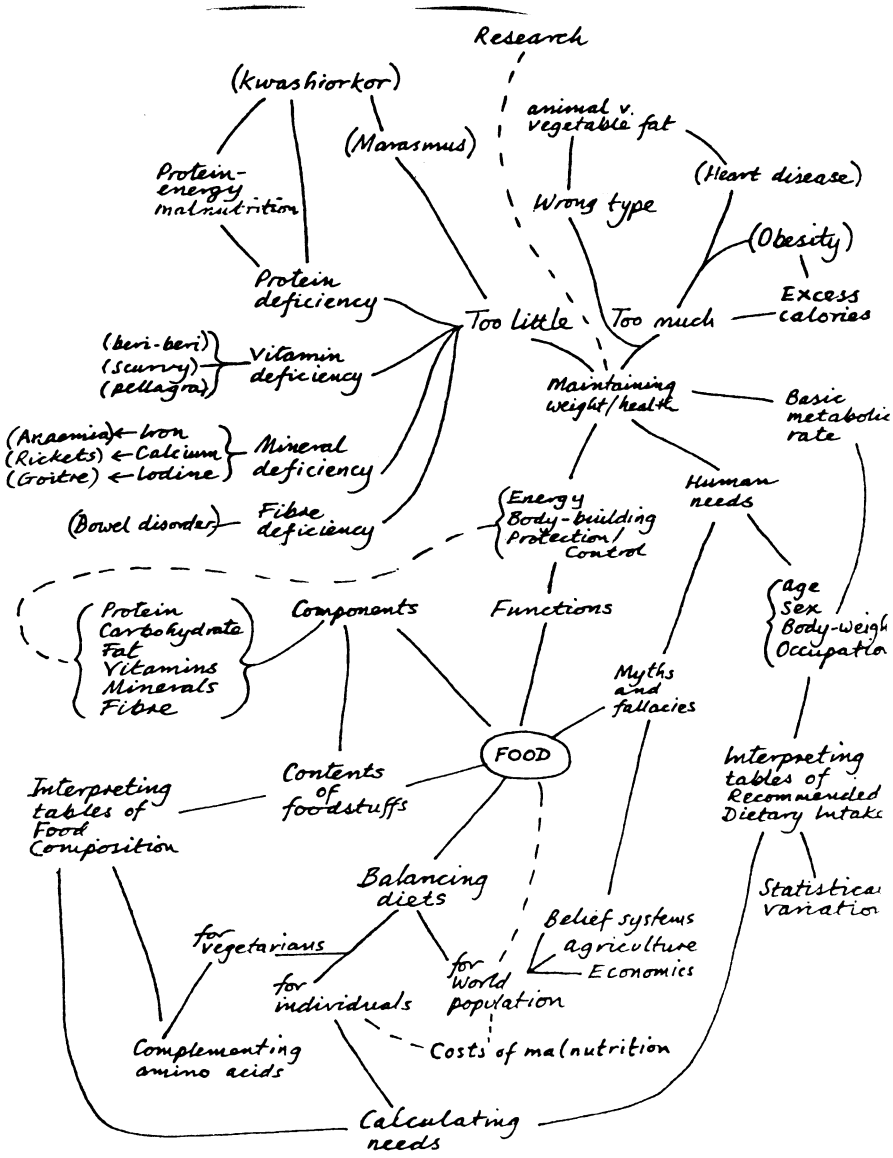

figure 3 : Initial Concept Map for a course on Diet and Nutrition.

Statement network. Sometimes a much more structured diagram may emerge from this kind of process. Figure 4 shows a well-developed network illustrating the relationships between climatic factors and the growth of trees. In this case, arrows link causes with effects. The column of double arrows down the centre indicates the primary chain of causation. To the right of it are factors affecting food storage, while the direct effects of growing-season climate on growth are to the left of it.

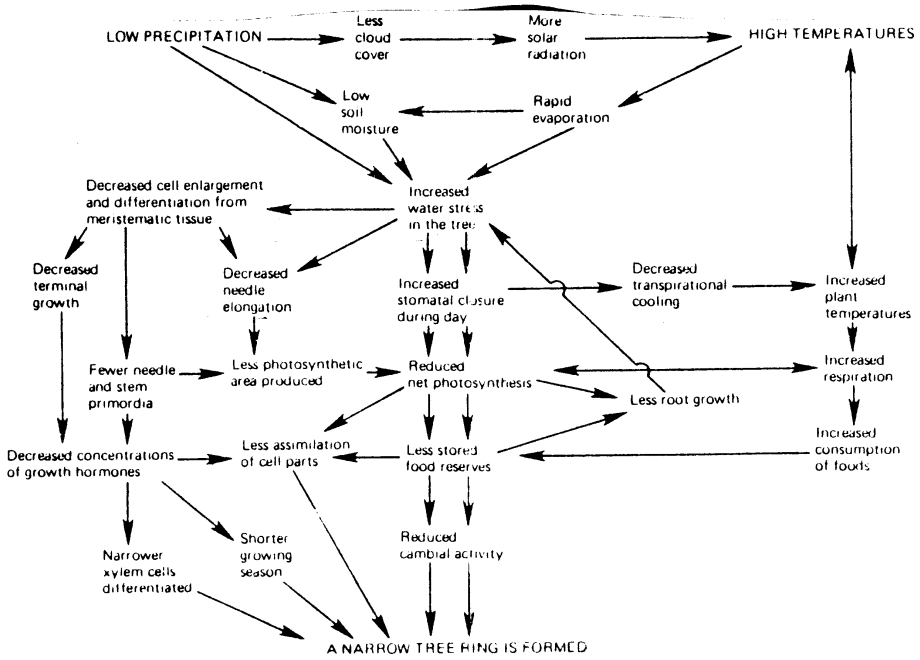

figure 4 : A Cause-Effect network for Tree-ring Growth.

Remember it is the process of drawing such diagrams that is meant to be helpful, rather than the final product. It may be, on occasion, that your diagrams will be so revealing of the structure of your subject (as with an algorithm, for instance) that you will want to share them with your learners. On the other hand, you may find it more to the point to help your learners develop their own pictures of the subject-matter. Finally, although you may use this technique for determining the content of an entire course, you may also use it for planning one lesson.

2 Determining the main topics.

When the structure of the course content has been drawn, certain topics emerge. Again, determining the main topics is a personal and subjective activity. (Another lecturer would have made other decisions!). Determine the topics you will include in your course. The diagram shows how they relate to other topics.

Although the main topics of your course have now been identified, the course content is not yet ready. You have to change, add or remove topics in line with the statements which follow.

3 Checking the core of the course: application of the knowledge

In the chapter about Objectives we have already stated that you need to check retrospectively (and correct if necessary):

- D*oes the course content match the tasks the students must be able to perform in future work situations?* You may wish to add or remove topics. More often than you expect you will discover that topics are not as essential as you thought they were. Many topics are taught since they traditionally belong to the field, and are thought to complete the overview of the subject-area. But consideration of the topics from the viewpoint of demands imposed by future work situations leads to the judgment that

these topics are inessential. In that case you may choose to omit them.

- *Does the course content focuses on the use of the information and not on the information itself?* If not, extend the topics by including procedures or add special procedure-topics.

4 Prior skills and knowledge.

In a course lecturers present specific procedures and knowledge. To learn these procedures and skills the students need specific procedures and knowledge already learned elsewhere: prior skills (procedures) and knowledge. Very often students do not have the skills and knowledge required to be able to learn the new course content.

There are several reasons for this state of affairs

1. The students come from different secondary schools.
   The final levels are not what they should be when students enter the first year courses at the university.

2. Courses in a curriculum are sequenced. But the courses are often not planned well. Entrance requirements for one course are not taught in prior courses, or are not taught at the right level.

3. The curriculum is well designed; the prior courses do teach the required skills and knowledge at the right level. But the exam does not test the required skills and knowledge at the right level. Or the exam has tested at the right level but many students have failed and therefore the lecturer has changed the standard. The consequence in both cases is that students have passed who do not have the necessary skills and knowledge.

4. The prior courses have taught and tested the required skills and knowledge at the right level, but too long ago. The problem in this case is that the students have partly.forgotten them They mastered the skills and knowledge weeks ago, more often months ago. They need to recall their learning.

What is to be done?
When you teach the first course in a curriculum about a specific subject you must add topics at the beginning of the course to bridge the gap between mastered and required skills and knowledge. Do not expect the students to bridge the gap by themselves.
When you teach an advanced course:

- Indicate to the teachers of prior courses what topics you wish them to include in their courses. Indicate to them the required level. Let them know exactly what the students must know and be able to do, in your course.
- If those courses have already been taught, you must include those topics at the beginning of your course.

Whenever you teach basic courses or more advanced courses: it is always necessary to refresh the already mastered skills and knowledge the students need in your course. You may give a summary, you may give some problems in which they need the required skills and knowledge, you may give an entrance test, etc.

By conscious recall, the students are prepared for learning new information and you help them to make connections between what they already know and the coming information in the new course.

5 Required skills and knowledge in more advanced courses.

As we have already seen in the previous section courses do relate. Your course has to teach your students not only knowledge and procedures they need for future work, but also knowledge and procedures they need in subsequent courses. Therefore check carefully that your course content includes the required skills and knowledge at the right level. If not: change and add topics. Talk to the teachers of more advanced courses. Find out what the students must be able to do in their courses. Read the curriculum design. Etc.

6 Literature consulted.

Rowntree, R., Teaching through Self-instruction, Kogan Page, New York, U.S.A. 1986. (page 49, 51-54 and 58 are partly copied)

7 Roadmap

1. Create (personal and subjective) global concept map of the course
2. Add relations
3. Mark the main topics
4. Check if beside the concepts / theory are there tasks/procedures. Add them if needed.
5. Mark or add context
6. Add the focus on the use of information
7. Mark the subjects (or add is needed) what is prior knowledge and skills.
    a. Mark the prior knowledge and skills the need to master (and practice)
    b. Mark the prior knowledge and skills to refresh
8. Mark the themes that they need for subsequent courses and future work
9. Order / mark / number themes based on (different) sequencing ideas
10. Order mark Fcae-2-Face and selfstudy.
11.

5. Sequencing the content

Introduction

When you have decided what the main topics of your course will be (See chapter "Determining the content of the course"), you have to decide which topics you will teach in which lessons. When you have decided what the content of one lesson or one chapter in a textbook will be, you have to decide in what sequence you will present the content. In both cases you have to choose an appropriate sequence. Do not forget however that for all topics or parts of topics the students not only need to acquire the information but also need practice!

§1 and 2 present some of the possible kinds of sequences. You may use them both within your course and within one lesson or chapter. More than one type will usually be evident within any one course, and sometimes within one chapter or lesson.

§3 presents 3 strategies that are suitable for use on a smaller scale; in any one chapter or any one lesson. Those strategies are less suitable when you work at course level.

1 Varieties of sequence.

1.1. ***Topic-by-topic.*** What we might also call the "parallel themes" approach, involving the study of a number of related themes or topics which (after an initial introduction to the overall purpose of the course) could have been studied in any order. The topics are independent, parallel rather than forming a sequenced series.

Within the lesson(s) on each topic, however, other types of sequencing would probably be needed.

1.2. ***Chronological sequence.*** In such a sequence, happenings, events, or discoveries over a period of time are presented in the order in which they occurred. This order will obviously suggest itself when your subject-matter is historical and this is not confined to "history" courses. Chronological sequence may be necessary in dealing with the development of institutions, of economic or social theories, or of scientific discoveries; wherever understanding of one event or of one stage depends on the understanding of what had occurred.

1.3. ***From the whole to parts.*** Most lecturers prefer to begin with the parts of a subject and from that build the whole. Students often prefer the contrary. They understand the topics better when they first study the whole, the main points before they study the parts and the details. When the students have seen the whole they are better able to study the parts. They already know how the parts relate and function together.

Examples of this kind of sequence:

- Present an overview of the organization of a fish hatchery or organize an excursion to a fish hatchery before the students study the specific parts of the organization.
- Show the students the complete procedure before you let them practice parts of the procedure.
- In both cases: do not only begin but also end with the whole: the complete organization of the fish hatchery, practising the complete procedure.

1.4. ***Concentric circles.*** In this case the first topic is included in the one following, and that in the next, and so on. For instance, a management course in which the sequence of the blocks is as follows:

1. Each student as a manager.
2. The manager and his/her team.
3. The team within the organization.
4. The organization within the wider world.

Beginning with the basic techniques required of a manager the course goes on to discuss how these techniques need to be blended with social considerations in coordinating the activities of the members of the manager's team; then how the work of the team is affected by the structure and culture of the organization of which ir is part; and finally how the work of the organization is affected by social, legal and economic changes in the outside world.

1.5. ***Causal sequence.*** This kind of sequence is closely related to the chronological. Learning based on a causal sequence will follow a chain of cause-and-effect for an event or phenomenon, so that when learners reach the end of the chain they can explain the final effect, the event or phenomenon itself. This sequencing applies where cause-and-effect relationships are taught, especially if the objective is that the learners should be able to work out and explain such a relationship.

This kind of sequencing might be relevant in meteorology or in geomorphology, where the learners are establishing the cause-and-effect relationships that result in different weather patterns or in different landscape formations. You might use a diagram like that shown in figure 2 in the chapter "determining the content of the course" to explore the possible causal sequences that might be followed.

1.6. ***Structural logic.*** Here we are talking about a sequence dictated by the logical structure of the subject. Sometimes it is clear that a certain topic can not be learned without prior understanding of some other topic. For instance, in basic arithmetic, the idea of multiplication will not make sense unless addition has already been learned. And in order to carry out division, the skill of subtraction must first have been learned.

Most subjects have a certain amount of "structural logic" in them, either in the connection between one major topic and the next or at least within such topics. Thus, in learning a new language, it may be clear that learners must learn to distinguish between sounds in that language before they can hope to imitate them in their own speech. Conversely, what we often take to be "the" inner logic of a subject is sometimes nothing more sacred than the order in which we once happened to have learned it ourselves!

1.7. ***Problem centred sequence.*** Lecturers may sometimes be able to structure a course, or lessons within it, around the exploration of an issue or problem. If you present your learners with a problem and then engage them in developing solutions or interpretations, you may be providing them with a realistic context in which to learn the essential knowledge and skills of the subject.

For instance, an in-service course for family doctors might focus on the problem of "What do patients really expect from doctors?" An interdisciplinary humanities course might develop a variety of approaches to the problem "What is the most suitable material from which to mass-produce car bodies?".

1.8. ***Spiral sequence.*** In this kind of sequence, learners will meet a concept again and again during their progress through the course, each time at a more complex or demanding level. This may appeal to you as lecturers if your subject is of a kind where learners cannot engage at a deep level with any one topic or concept unless they already have some familiarity with most of the others. Thus you may decide to give your learners a brief tour of the main conceptual landmarks before coming to a close examination of them, and, later still, analysis at a yet greater depth. At each new level, learners will treat the concepts in more sophisticated ways, relating them to a growing network of more recently acquired understanding.

An example from elementary physics: The concept of "force" might first be introduced as "push" or "pull"; then discussed in terms of acceleration, using graphs; and, later on, it might be represented symbolically.

1.9. ***Backward chaining.*** Whenever objectives involve the learning of sequences (or "chains") of activity or decision-making whether simple chains (like tying a knot) or complex (like applying a problem-solving routine), it may be helpful to teach the final step in the chain first. You might then teach the second to last step, and so on.

For example, you might teach your learners to interpret the results of a chemical test before you teach them how to carry out such a test. And you might then teach them to do such tests (which they can already interpret) before teaching them how to select the appropriate test. Figure 5 below shows how such a sequence would work with a chain of five steps.

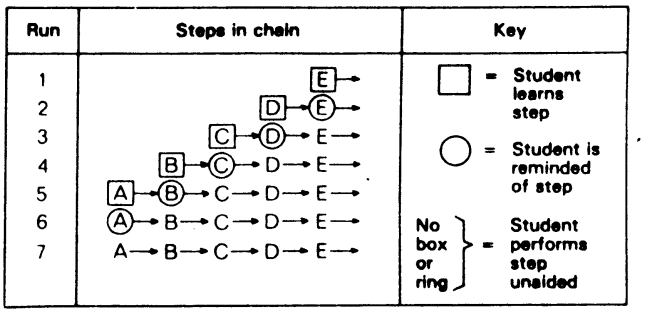

figure 5 : Sequencing a Five-step Chain.

Such backward chaining offers an unusual advantage; it can provide your learners with the satisfaction of mastering the final stages of the job at the outset of instruction.This can also help motivate their future learning in that they now see the relevance of each step they then need to learn in order to reach the stages they have already mastered.

2 Logic versus Psychology

Whatever types of sequence you select, do so on the grounds of which ones you believe will appeal to your learners and help them learn. Do not just follow the traditional "logic of the subject" as enshrined in the textbooks. This will be the logic of people who are already expert in the subject. It may or may not appeal to newcomers.

What you should be looking for is not so much the best logical order as the most satisfying psychological order. For instance, despite the usual advice to go from simple to complex, concrete to abstract, learners may sometimes enjoy starting with something fairly complex, e.g. as a challenge or as an indication of what the basic work will be leading up to. (Backward

chaining would be one example). Similarly, while one might traditionally start at the beginning of some chronological subject-matter and work towards the present, the psychological order might be to work backwards from the present.

3 Three basic teaching strategies.

How do you get your main ideas across to your learners? In any one lesson or in any one chapter? How are the main concepts and principles to be taught? It is well known that giving examples is very important for understanding. But how do we use examples?

There are three basic teaching strategies for teaching concepts and principles.

1. We can give the learner a "rule" (e.g. a definition): then illustrate with an example of the application of the rule; and finally offer the learners an example to which they must apply the rule themselves.

2. We can show the learners a number of examples and non-examples of the idea we are trying to develop. We show then the similarities and differences and finally formulate the "rule" that distinguishes between the examples and the non-examples.

3. We can show the learners a number of examples and non-examples of the idea we are trying to develop; then encourage them to discover the similarities and differences themselves and finally help them to formulate the rule that distinguishes between the examples and non-examples.

The main difference between this and the second strategy is that we try to enable the learners to discover and formulate the "rule" (or principle, or definition) for themselves, by discovering personally how they can relate the new rule to what they already know. Since you have given your learners practice with the idea they will understand the new idea better than when taught by the first or second strategy.

An (primary school) example of the first and third strategy follows.

> Suppose we want to teach the meaning of "triangle". We could start by saying "A triangle is a three-sided figure. Here are some figures. Which of them are triangles? Now you draw some triangles". With practice, the definition would be driven home.
>
> Alternatively, we might begin by showing our learners a set of shapes, all of which have four sides, except one that has three. We then ask the learners to tell which shape stands out from the others. We could then give them the name "triangle" and ask them to pick out the only triangle from a new set of shapes, all but one which have four or five sides. Then we might show our learners a number of different triangles mixed together with other shapes and again ask them to pick out the triangles. Next we ask them to draw a triangle.

To do this they must actively see what attribute distinguishes a triangle from the other shapes. Finally, we can ask them to put into words what makes a triangle different. So we will have taken our learners through four stages of discovery:

1. recognition
2. naming
3. reconstruction
4. definition

In this strategy, experience comes before verbal definition.
Once we have led our learners to observe the key point, we can elaborate upon it just as if we had stated it openly for them in the first place. We will be hoping, however, that they will have understood it better, because they will have contributed more thought to the definition.

Sometimes this strategy will be too time-consuming, of course, both for you and for your learners. Besides, we cannot always arrange for the learners to have all the necessary information and experience from which to derive the rule themselves. Sometimes we have no choice but to give them the definition or principle first and then help them practice with examples.

The important thing, though, is to keep these three possible strategies in mind. Be aware of which you are using from section to section, and why. Choose whichever seems most appropriate and practicable. Strategies are worth using, neither is superior to the other for all purposes.

4 Literature consulted.

Rowntree, D., Teaching through Self-instruction, Kogan Page, New York, U.S.A., 1986. (page 62-66, 148, 149 and 151 are partly copied)

6. Sequencing practice

1 How beginners learn.

We saw from chapter 1 "Teaching and Learning" that the procedure used to solve a problem is very important. When a beginner and a more advanced learner use the same procedure you will observe many differences.

For example:

- Beginners have to carry out all the steps carefully and pay a great deal of attention to each step. They will need plenty of time. As they make progress they can take the steps faster, two at once, etc. They will act more and more as experts.

- Beginners need to see as concrete a learning presentation as possible. They need schemes, drawings or the real objects to understand what they are doing. They need to write down all they do. The more experienced they become the more they will carry out the steps of the procedure mentally, in their heads.

- Beginners can only use the procedure in contexts and problems which are familiar and not complicated. The more experienced they become the more complicated and the less familiar the context and problem can be.

- Beginners will make many mistakes. They will need much more help than a more advanced student.

Every time you learn something totally new is learned, students will start as beginners - not only in school situations but also at home. Think of the first time you worked on a personal computer, or if you have never worked on a computer imagine what that would be like.

Think of a child starting to learn to write. Think of teachers preparing their first lesson. Think of students solving a new kind of maths problem or calculating how much food the fish pound needs each day.

2 Consequences for the learning situation.

The way beginners start to learn has several consequences for lecturers' organization of the learning situation.

1. Students have to practice a great deal. Only by doing and repeating can they master the use of the procedures and solve problems. Observing the lecturer may be a good beginning to the learning process but it is insufficient.

2. All the steps of the procedure must be made clear to the students. Demonstrations of the steps used by the lecturer are helpful; and it is also helpful when the lecturer makes the problem and the steps as visible as possible by making schemes, drawings, marking the steps, etc.

3. Begin with small-scale and simple problems and then switch to more complicated ones. At the end of the learning process the students will be able to use the procedures in less familiar contexts and problems.

4. Beginners make many mistakes and need a great deal of help. That does not mean that lecturers solve the problem for them but that they give directions so that students can go on by themselves. The more advanced they are the less help they need.

5. This help must be individual. Each student makes individual mistakes. What has to be explained to one student does not have to be explained to another. Give each student the particular support needed.
   Only when many students make identical mistakes it is more efficient to resort to plenary given feedback and methods use of the blackboard. Do not use the board too often. For most students, plenary methods are not helpful. Some do not need this assistance: they have already solved the problem. Others have not yet reached that problem and the assistance comes too early in the learning process.

3 Organization of a lesson: an example.

We conclude with a suggestion for the organisation of a maths class of 90 minutes (30 students) in which the above procedure has been accomplished. In other courses or with more students the achievement of the above schedule will be slightly different and sometimes more difficult to accomplish.

Teaching-activities	Time
1. Introduction	5"
2. Presentation of the new theory and procedures	15"
3. First problem : demonstration by the lecturer	15"
4. Second problem: students work independently lecturer gives plenary support lecturer gives individual feedback	45"
5. Third and following problems: students work independently lecturer gives individual feedback	
6. Conclusion	10"
	90"
7. Homework	180"

figure 6 : Suggestion for the organisation of a maths class of 90 minutes (30 students).

Explanation:

ad 3. Lecturers demonstrate one problem on the blackboard. They focus on the procedures, on how to solve the problem.

ad 4. The second problem: the students try to solve the problem themselves. Sometimes lecturers start to solve the problem on the blackboard, plenary by asking questions of the students. Then the students work on the problem independently. Very often the lecturer has to provide plenary assistance by focusing on difficult parts in the problem solving process and giving extra clues.

ad 5. The students work independently. The lecturer gives feedback to individual students. Only when many students make the same mistake is feedback given plenary.
Do not demonstrate the solving of problems on the black-board that have already been solved by the students independently. For most of the students that kind of feedback is overdone and therefore a waste of time. Moreover it will not stimulate the motivation of students.

ad 6. At the end of the class the lecturer gives a summary of (the new theory and) the new procedures. Difficult parts of the procedures or parts that need special attention are pointed out. If necessary, the lecturer gives directions or clues for the home-tasks.

ad 7. Home-work.
Ask the students to study the new theory. Provide extra problems to solve at home, to practise more. Do not choose the most difficult problems to solve at home. The lecturer is not present, therefore (most of) the students must be able to solve the problems without help. Ask the students also to solve at home the problems that have not been finished in class.
In the next class lecturers will not spend much time on giving feedback on the home tasks. In the introduction they may ask what difficulties the students had when solving the problems. If many students have experienced the same kind of difficulties they may decide to discuss them plenary. Then the introduction will last longer. In all other situations they should give individual help to students during section 5.

Finally:

It is possible to change the sequence a little. You may start the lesson by letting the students solve a problem, before you demonstrate or even before you present the theory.
Most students will not succeed but they will have experienced what the difficult sections are and they will know better what is the use of the theory you are going to present next. Anyway the students will be more motivated and interested in the new theory and in your demonstration of how to solve the problem.

4 Literature consulted.

Dam, G.T.M., ten, Smuling, E.B., Handleiding voor het begeleiden van werkcolleges, OC, University of Twente, The Netherlands, 1987. Smuling, E.B., Brants, J., Pilot, A., Oriëntatie op leren en onderwijs, HOR, Wolters-Noordhoff, The Netherlands, 1990.