
Ensuring Quality in Distance Education: Development of Instructional Material in Microbiology under the Department for International Development (DfID) UK Project

Uma Coomaraswamy

One component of the DfID Project was to train the staff of the Open University of Sri Lanka in producing high quality multimedia instructional materials for Open and Distance Learning. The training was to ensure that the staff involved were fully conversant with the characteristics of quality multimedia teaching materials and the methods by which such materials be produced.

This paper describes the sequential stages in the design and development of teaching material for a Microbiology course in Botany in the B.Sc. Degree Programme, using the skills and techniques acquired during the training under the DfID project. It focuses on the course team concept of planning and development of course material; contribution of pedagogic and technical expertise by qualified educational technologists, media specialists, graphic designers and language editors; through all stages of course development ensuring academic standards by outside academic editors; developmentally testing some of the course material on a group of students who have the necessary background knowledge as they have completed the pre-requisite course and evaluation after the course has been offered to students.

Introduction

In higher education in general and in distance learning in particular quality issues are becoming more important than ever before. Quality in distance learning is a multidimensional concept defined in various ways by many educationists. There are no prescriptive tools or international standards to measure quality. Yet quality is vital for the survival of the distance learning programmes and is the biggest issue facing us in the years to come.

In the context of distance learning, what constitutes quality characteristics can be thought of as high quality instructional materials, efficient and effective academic support, logistics of students receiving right materials and information at the right time and a strong research base. Of the many issues involved, this paper focuses on the production of instructional materials.

Print continues to be the mainstay of instructional material at the OUSL like in most open and distance educational institutions and it may remain a major medium of instruction in the years to come. This warrants that the Open University of Sri Lanka (OUSL) should pay greater attention to the development of quality course materials in print.

The quality of the print material may be reflected by validity in terms of its content, ability to understand by the student learner and readability in terms of being learner-friendly. It should be designed to be not only comprehensive but also interesting and motivating enough to compensate for the absence of classroom teaching. The learner should be able to learn on his own without a teacher and be able to develop skills through self directed learning.

The preparation of such material not only requires personnel who are competent to do so but also requires much time and financial resources. The need for people with knowledge and skills in course design and development is of paramount importance before we continue into the next millennium. Our staff need to be trained and they themselves have to become trainers in designing and developing distance and open learning materials. Staff development and training develop professionalism which in turn assures quality.

It is in this context that a project sponsored by The Department for International Development (DfID), UK was launched at the Open University of Sri Lanka (OUSL) in 1995. The project had several components one of which was Material Production and Desk Top Publication (MUK and DTP). The MUK and DTP component of the project aimed at providing academics in OUSL with training in the design and development of instructional materials.

MUK and DTP component of the DfID project

A series of workshops were conducted for academic staff to aid in the development of skills for course design and writing for the distance mode. Senior Academic staff from the Open University-United Kingdom conducted the workshops. The DTP workshops were mainly concerned with elements required for the preparation of camera-ready manuscripts for desk-top publication. During the workshops features required by the OUSL academics were identified and incorporated into style sheets and templates conforming to the House Style of OUSL. Two templates viz. course template and unit template, have been produced by the DTP team (House style 1998). The course template deals with presentation of preliminary materials such as cover pages, title pages, and the introduction to the course. The unit template is designed to help the writers with the presentation of the content of each unit. The two templates can be accessed on the computers.

Each of the MUK workshops had 3 - day intensive sessions on key phases of planning and development of instructional materials and 7-8 days on actual design and writing. During the training quality assurance procedures were also carefully defined. As part of the training all were encouraged to work in teams on the development of their own course. Each department was committed to develop or transform one course during the stipulated period of one year. The basic strategy adopted was to ensure that all involved were fully conversant with characteristics of good course material and the methods by which these materials could be produced. The progress of the work of the respective teams were carefully monitored by the consultant through a 12 - 18 month period.

The prime aim of this paper is to give an insight into the practical experience gained in the development of quality material so as to encourage good quality course material production by our colleagues. The process is illustrated here with the help of the experience gained and skills acquired in the successful production of quality course material for *Environmental and Applied Microbiology*, as a result of the workshops and close monitoring of the consultant.

Design and Development of Material for Environmental and Applied Microbiology

Good instructional design is the core of any quality open and distance learning material. It is a systematic process of planning, developing, organising and evaluating such material. (Melton 1997).

Environmental and Applied Microbiology, a level 5 course, was identified for development of course materials under the DfID project. Staff members of varied expertise were brought together to work within a *course team environment*.

Course Team

The course team included the main author, two staff members earmarked to be involved in presenting the course to students after it was developed, media designer and an educational technologist. As required by the workshop proceedings, a course team chair was established to give academic leadership to the team. A course team manager was appointed to be responsible for the co-ordination of all activities with regard to the development process of the course material. After the conclusion of the workshop and during the development process other members such as a content editor, a language editor, a desk top publisher, a graphic artist and a word processing operator were appointed to the course team. The main objective of the course team method was to enable the members of the team to work close together, interact with one another and critically analyse the material produced and provide feedback on the materials produced at each stage of the

development process thus making improvements on the design and development of the material. This was to ensure quality assurance.

Broad outline of the course

The first task of the course team was to develop a *broad outline of the course*. The broad outline of a course includes the following elements: identifying the target group, the broad aims and objectives of the course, how the course will be structured and the teaching strategies to be adopted.

Target group

Knowing about the intended learners i.e., the target group is required to provide effective open and distance learning materials. As this was a level 5 course with a pre-requisite of a level 4 course on *Principles of Microbiology*, student profiles were already available in the OUSL database. From the student profile, learner characteristic of the *target group* were analysed. The background of the target group identified for this course is given in Figure 1.

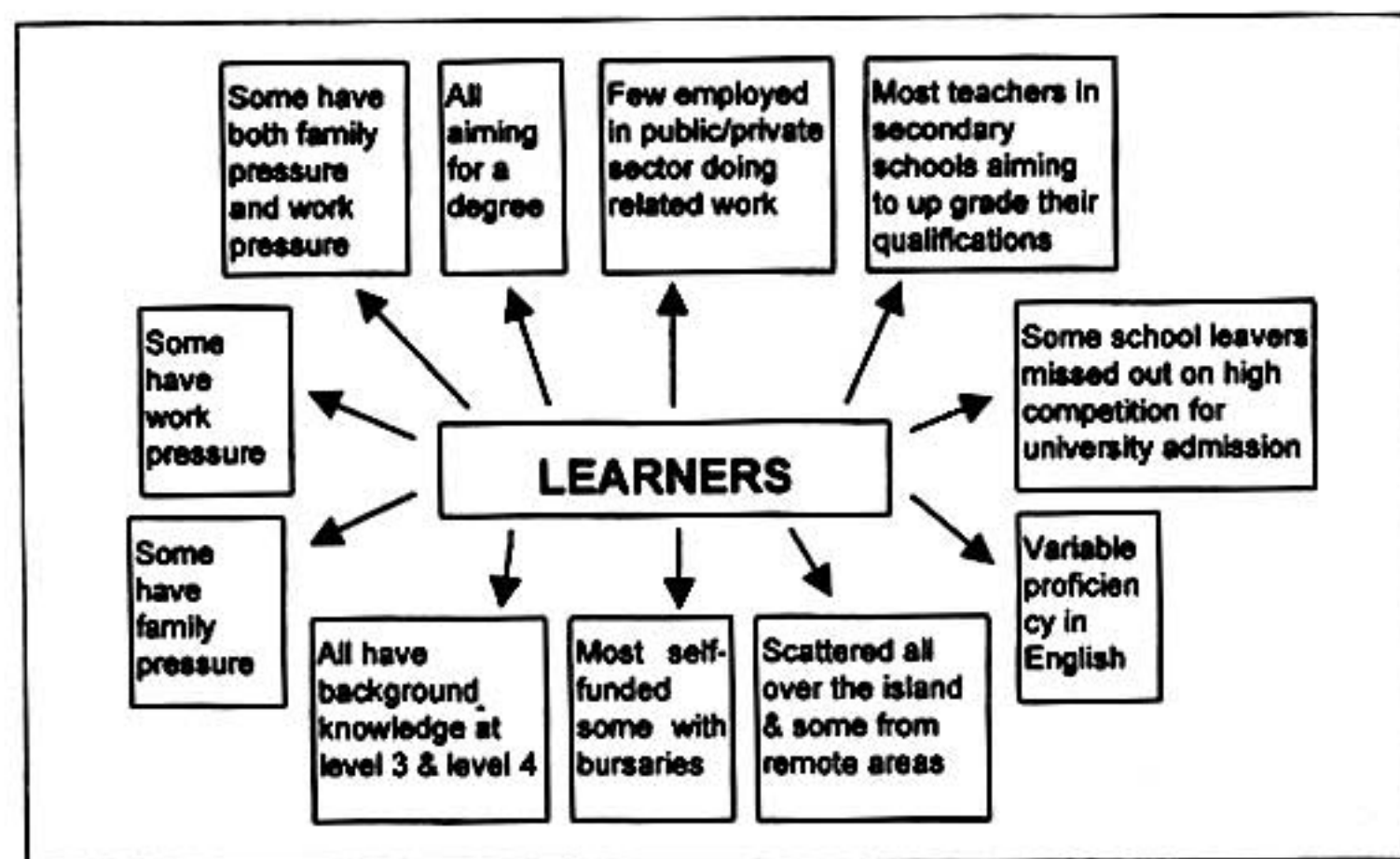


Figure 1 - Background of the Target Group For the Course on Environmental and Applied Microbiology

Aims and Objectives

Once the needs were analysed the next step was to identify in broad terms the aims and objectives of the course. These will show the learners what they might get out of the materials. Also they help the author to decide what to include in the content.

After broad aims have been identified, these need to be broken down into increasingly specific ones. A hierarchical form of analysis was used to achieve this. This involved the breaking down of each broad aim in a sequence of stages into increasingly specific aims and objectives as illustrated in the hierarchical flow diagram (Figure 2). This form of analysis identified in broad terms, the contents of the course and how it could be structured.

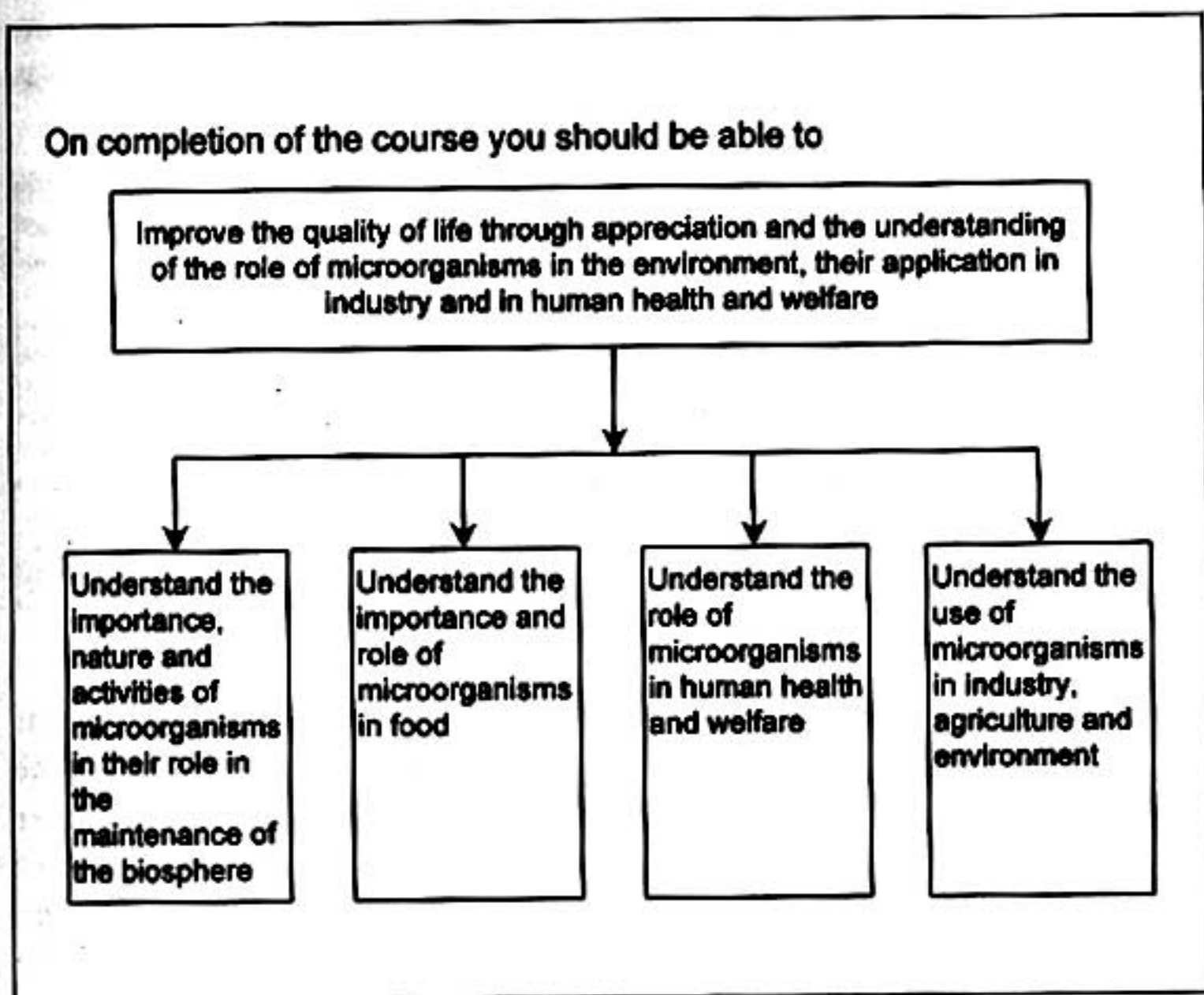


Figure 2: Hierarchical analysis of overall aims and objectives

Framework for the course

Of the various models available the model selected by the team for the framework of the course is illustrated in Figure 3 (House Style 1998).

In Figure 3 the course is presented in several units, each unit making up a number of study sessions. The number of study sessions to be included in the course was planned in relation to the student workload. The credit rating of the course being developed was 1/6. According to the OUSL specification (Samarawickrama; 1997). 1/6 credit requires 75 hours of study time. These hours of study includes the time taken for reading and understanding the lesson material in print, audio-visual material, practical component and day schools. A study session is expected to cover content comprising 2500-3000 words at an average of 300 words per page i.e., approximately 10 pages. This 10-page print material needs 2 hours of study. Not to overload the students was essential in the proper planning of the course.

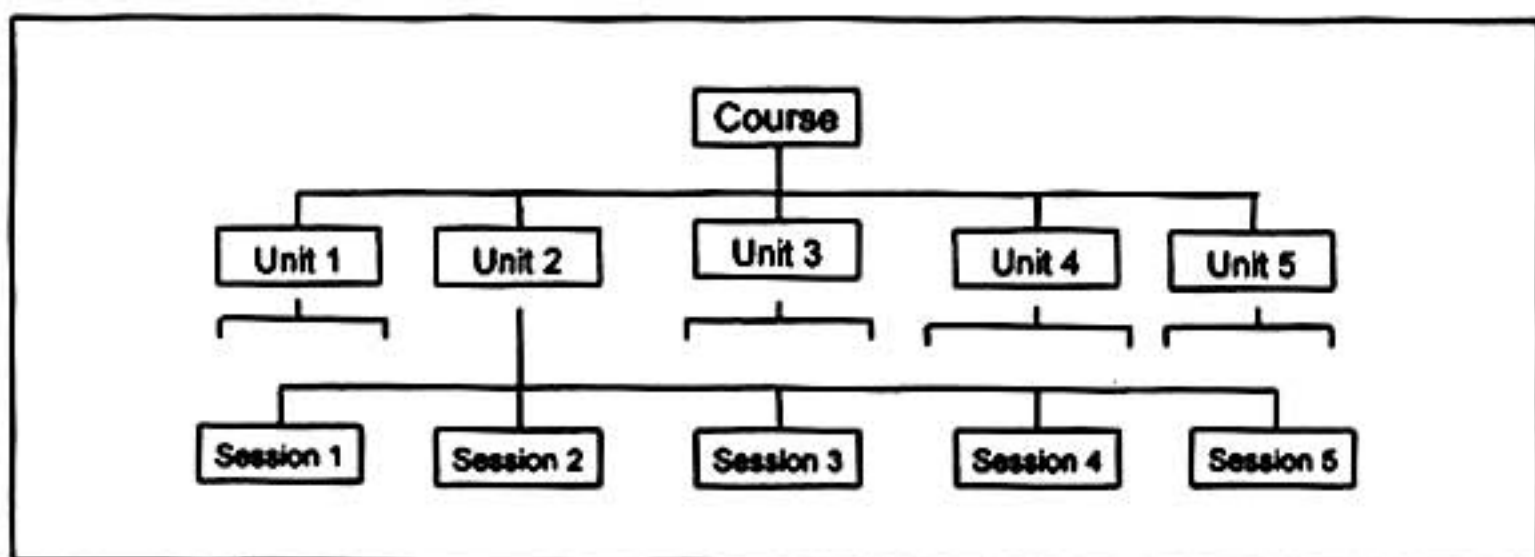


Figure 3 - Hierarchical arrangement of components in a course

The hierarchical analysis of the aims and objectives of the Course was used to identify the units (Figure 4) of instructions which were to be developed and the order in which the units can be sequenced. By further analysis of aims and objectives of the unit, study sessions within a unit were identified (Figure 5). Skills and techniques to be acquired through laboratory and project work in the topics in each unit were also identified as depicted in the flow diagram (Figure 6).

On completion of the course you should be able to

Improve the quality of life through appreciation and the understanding of the role of microorganisms in the environment, their application in industry and in human health and welfare

Specifically you should be able to

Understand the importance, nature and activities of microorganisms in their role in the maintenance of the biosphere

Understand the importance and role of microorganisms in food

Understand the role of microorganisms in human health and welfare

Understand the use of microorganisms in industry, agriculture and environment

More specifically you should be able to

Understand that the soil is a complex environment and to know about the soil microorganisms, their activities, interaction between them and their role in cycling of matter
Microbiology of Soil

UNIT 1

Understand the activities of microorganisms in the air and water and their distribution and importance; pollution of water and its implications; public health aspects of poor quality drinking water; purification of potable water and the role of microorganisms in waste water treatment -
Microbiology of water and air

UNIT 2

Understand the essential concepts of microbiology food - namely the normal flora of microorganisms and contaminants; microbiological changes in food resulting in food spoilage; food borne illnesses; principles underlying food preservation and microbiological quality control

UNIT 3

Understand all about the microorganisms and diseases of man - some species cause disease and others are normal inhabitants; how microbial pathogens spread and cause disease; how man defend himself against microbial diseases; prevention and control of infectious diseases

UNIT 4

Understand that microorganisms could be manipulated to obtain commercially important products from basic food to the still experimented AIDS vaccine and are used in agriculture to increase the yield and in the breakdown of environmental pollutants i.e., exploitation of microorganisms by humans

UNIT 5

Figure 4: Hierarchical analysis of aims and objective leading towards units of instruction of the course

On completion of this unit you should be able to

Understand the essential concepts of microbiology food - namely the normal flora of microorganisms and contaminants; microbiological changes in food resulting in food spoilage; food born illnesses; principles underlying food preservation and microbiological quality control

On completion of the session you should be able to

Characterise the microorganisms which are important in food microbiology and indicate how they have gained entrance into foods; explain how food serve as a source of nutrients for microbial growth i.e., food as a substrate for microorganisms

Session

Describe the characteristics of the microorganisms which cause spoilage of food and describe the principles concerned in the microbial spoilage of foods and the spoilage of specific food

Session

Explain the role of food as a source of pathogens with emphasis on food poisoning and food infections

Session

Describe the general principles governing preservation of foods including basic methods and their applications to specific food

Session

Explain the principles of food sanitation and microbiological quality control and describe methods to determine the quality of food

Session

Figure 5: Hierarchical analysis of aims and objectives of Unit 3

Providing instructional material alone for distance learners will not be sufficient to facilitate learning. Therefore *teaching strategies* were identified so that learners will be given the support they require, be motivated and stimulated to learn what is in print. Strategies identified for the various units of the course is shown in Figure 7.

From the laboratory and the field work you should be able to acquire skills to

- gain knowledge in the selection and use of appropriate scientific apparatus and equipment
- conduct and interpret scientific investigations and write reports
- keep and maintain records of activities
- extend the knowledge in techniques in microscopy, culturing and identification of microorganisms in their environments to evaluate hygienic quality of foods, milk water and pharmaceutical products
- to adapt techniques for use in processes in the local/home environment on food processing, brewing of wine etc.

Figure 6 - Skills and techniques to be acquired through the course

	Course	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
1. Printed material - core text	✓	✓	✓	✓	✓	✓
2. Laboratory work – including work books in the form of a laboratory manual	✓	✓	✓	✓	✓	✓
3. Project work – assignments based on learners work place or home and report writing.	✓	✓	✓	✓		✓
4. Audio Tapes	✓	✓				
5. Video Tapes	✓		✓	✓	✓	✓
6. Face to face discussion during day schools	✓	✓	✓	✓	✓	✓
7. Peer group discussions and face to face discussions with instructors during practical classes	✓	✓	✓	✓	✓	✓
8. Activities - self assessment questions, review questions and tutorial assignments	✓	✓	✓	✓	✓	✓

Figure 7 - Teaching Strategies for all Units

Introduction to the course

For the learners to know at the very start what they are going to learn, why they have to learn and how they will be doing so, an "Introduction to the Course" was written. It is also referred to as an 'advance organiser'. This provides an overview of the textual material the relevance and importance of the topics that are discussed and their objectives, how the course has been structured, the pre-requisites for the course, features that have been used to enable easy learning; time required for study; strategies that have been used for facilitating learning; type and amount of face-to-face teaching they would get and the types of assessments that will be used to monitor their progress. Careful attention was paid to stimulate students interest in the topics and to motivate them.

Thus the development process adopted by the team had gone through three distinct stages in a sequence. These stages were :

- identifying the needs of the target group
- clarifying the aims and objectives of the course and working on the structure and contents of the course
- developing an introduction to the course

Having set out the broad principles of course development, a *schedule of work* was prepared indicating the stages and deadlines at which detailed materials will be written, tested and reviewed by course team members. Such a schedule made for the course indicated is illustrated in Figure 8. Efforts were taken to make the schedule of work a realistic one taking into consideration the personnel available and on-going commitments at OUSL. The detailed schedule helped the course team members to keep to the target dates for the handing over of drafts at various stages. This made it possible for the team to complete the final manuscript by December 1998.

The direction, guidance and the much required hands - on experience received during the 11-day workshop enabled the team to complete the first three crucial stages in the design of instructional material described above within 10 days i.e., by the end of the workshop period in June 1997.

The final stages of the development process involved the preparation of detailed development of materials for each study session and then linking the study sessions to producing units of instruction. The deadline for completion of work was December 1998 with monitoring sessions by the consultant planned for in March and June 98.

Preparation of study session

The hierarchical analysis flow diagram (Figure 6), shows how a unit is structured in terms of its study sessions. Similar analysis was done for all the units. Having identified the structure of the course in terms of the units to be developed and the study sessions to be included within each unit, the team set out to develop detailed instructional material for individual study sessions keeping in mind the deadlines set in the schedule of work given in Figure 8.

The development of each study session was planned in sequential stages. Advance organiser for each study session was prepared to include the main topics and themes addressed in the session, relevance and importance of the topics, broad aims to be achieved and learning strategies used. This was used to introduce students to the content of instruction. Core text material was then prepared to help students to acquire knowledge, understanding and skills. Teaching strategies were identified. To help students to develop competence and skills and to ensure the involvement of students in the learning process activities, projects and experiments to be done individually and in groups were built into the learning process. Video films were prepared to illustrate water purification sewage treatment, food spoilage types, and human diseases due to microorganisms and there were integrated into the text.

To enable the students to assess themselves whether or not they have achieved particular objectives and the progress they make, self assessment questions were interspersed in each study session. When activities and/or self assessment questions are included in the session reference is made to this within the statement of the related objectives.

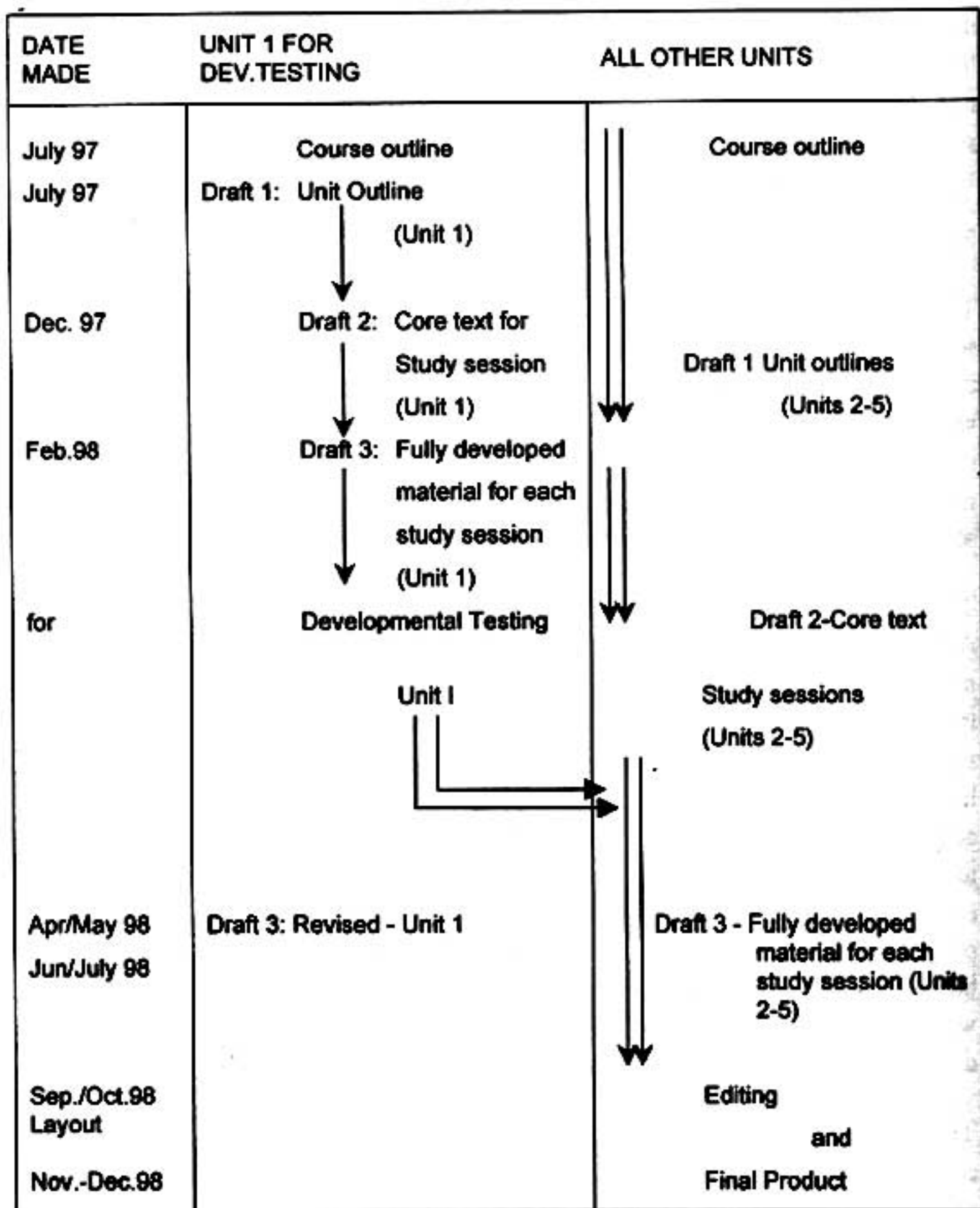


Figure 8: Schedule of work

To achieve particular objectives where relevant, reference to videos and audio's were included in the text. Subject content was well illustrated by plentiful examples, photographs, diagrams, graphs, tables and lists. Cross references to other texts and experiments in the Laboratory Manual were made in the margins. Major concepts presented in the study sessions were tied together in the summary. This was to enable students to reflect back on what has been learnt. As a part of the summary a list of objectives was given at the end of the study session to reinforce relevant learning. The model of a study session used in this course is given in Figure 9.

To make the text clearer and understandable (i.e., reader-friendly) plain, simple, conversational language was used preferably in active voice. Wherever possible short paragraphs, informal tone, headings and sub headings were used. To help the students find their way through the content icons were used (Samarawickrama; 1997).

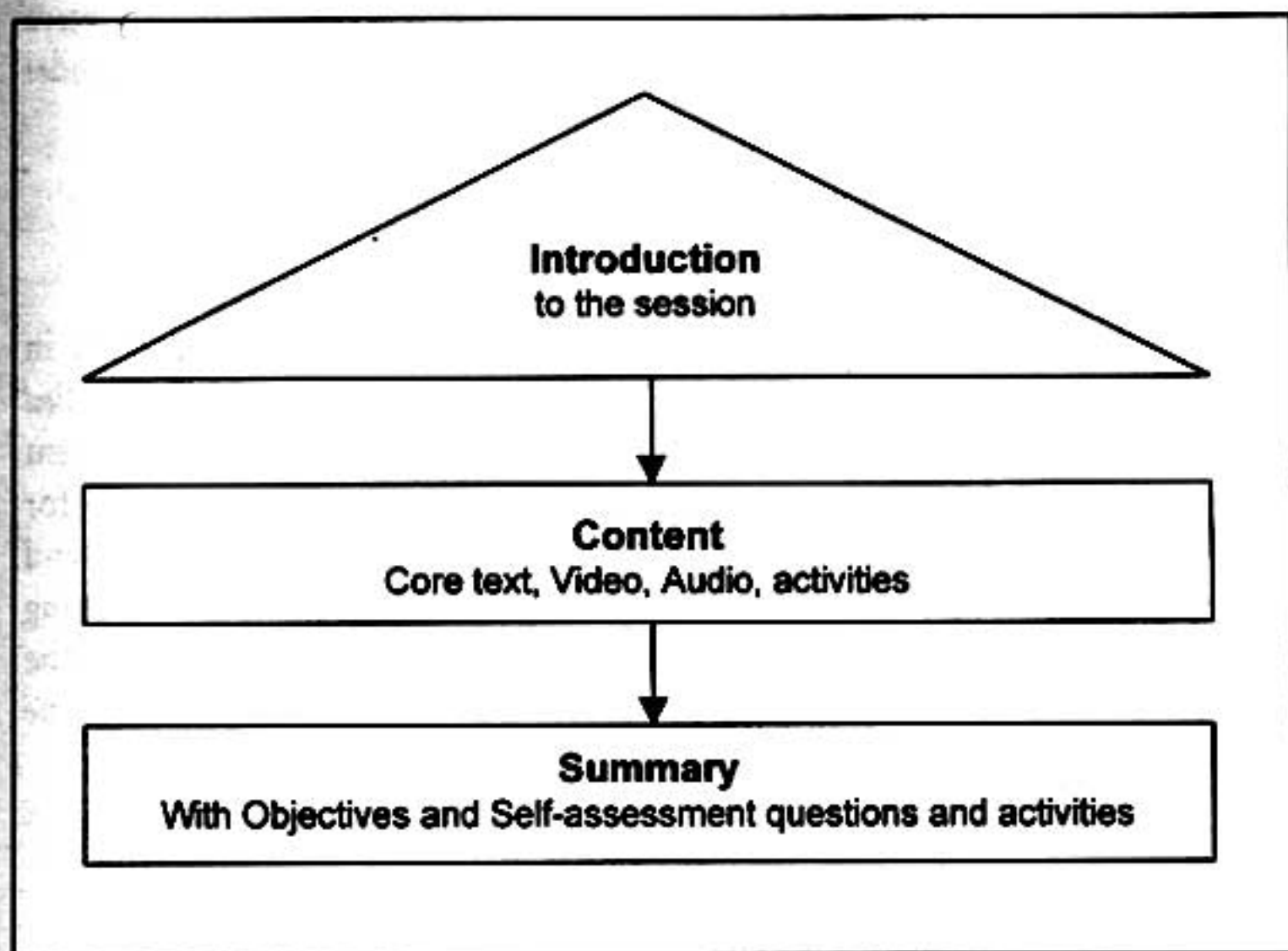


Figure 9: Basic model of the study session

Developing units of instruction

Having developed the study session in the manner described above the study sessions were linked together in a logical sequence as prescribed earlier by the framework for a particular unit in Figure 6.

The following key features were prepared for each unit; an advance organiser which introduced the unit and the nature relevance and importance of the study sessions; learning strategies; a summary which reflected back on the content of the unit as a whole both in terms of relevance and importance of what has to be learnt from the unit as a whole and in terms of objectives what students should be able to do at the end of studying the unit. Similarly a summary was developed for the course to enable students to reflect back on what they learnt throughout the course. Glossaries were provided with simple explanation of the keywords used in the text. Equivalent Sinhala and Tamil terms were given to English technical terms. An Index was given in alphabetical order of subject with numbers of the page in which the words were found. A list of books for further reading was also provided. The model of a unit of instruction used in this course is given in Figure 10.

Layout

The five sequential stages (Section 3.1-3.5) the team went through in designing material for the course *Environmental and Applied Microbiology* were a major step towards ensuring quality in the content of the course material. Another aspect which needs consideration for increasing the readability of the material, and for stimulating and motivating the reader is an effective layout (Distance writing - Bridging the Gap 1998). Styles developed by the DTP team and prescribed in the House Style (1998) and Bridging the Gap (1998) were used to present the text.

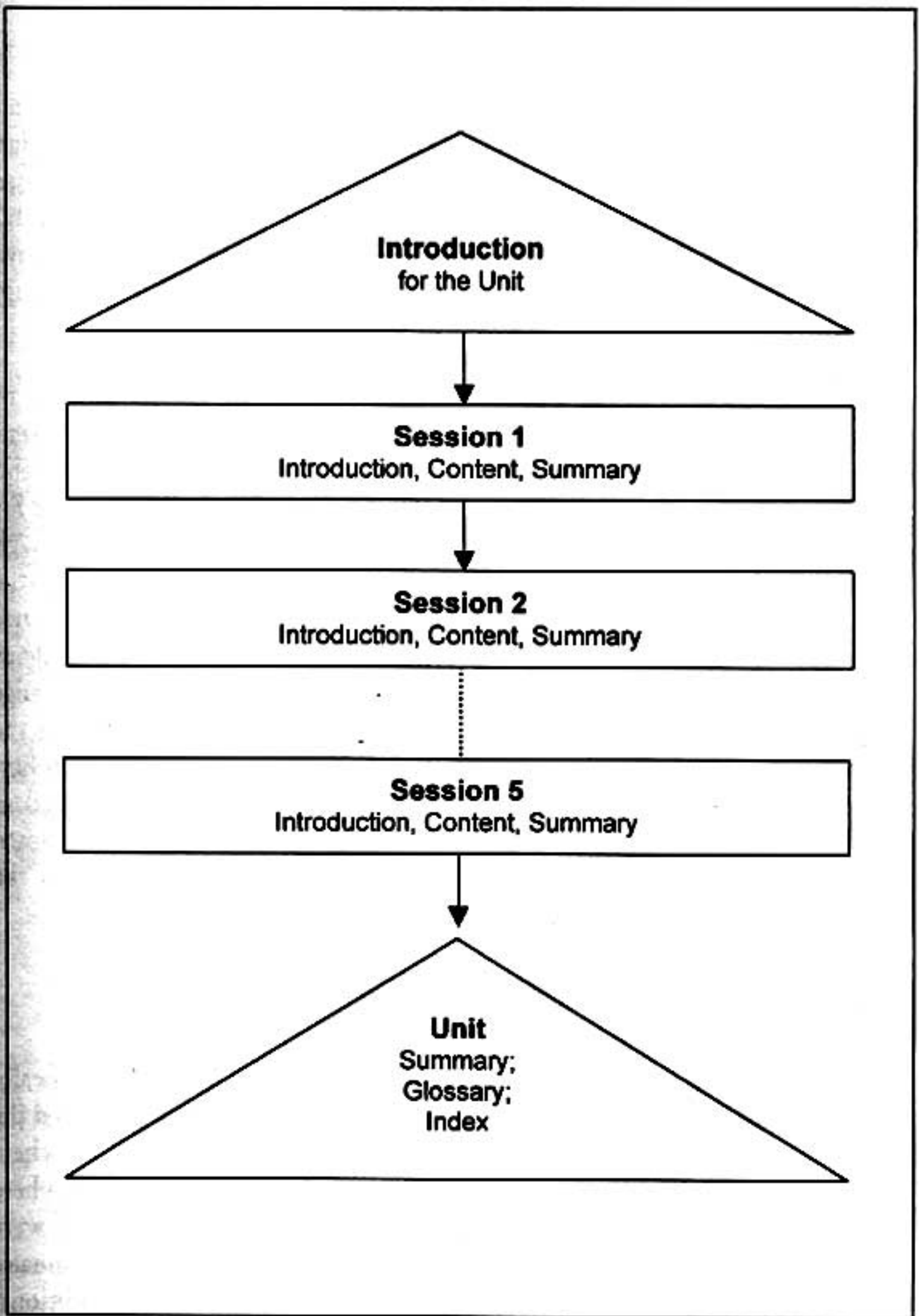


Figure 10: A Basic model of a Unit of Instruction in the Course developed

Evaluation of the Course

High quality learning materials can be produced only if the writer is open to improvement based on feedback gathered from learners and possibly from peers as well. Course material must be evaluated during its development and after it is presented. Evaluation of the course produced at different stages of the development process is an integral part of the developmental process. Evaluation of material will improve the teaching-learning process and ensure that the content is adequate, up-to-date and user friendly.

During the development process there was an on going process of evaluation by the interaction of the course team members and by staff who have experience in teaching the subject in the laboratory and helping the team in editorial assistance. Once the detailed material for one unit was completed feed-back was obtained from students through developmental testing. Careful consideration was given to the scheduling of *developmental testing* within the whole process of course development. A sample of students (60) were selected and these students were regarded as testers. Testers possessed the background knowledge required to study the material because they had already followed the pre-requisite for this course and have obtained at least an eligibility. Testers included students who performed poorly, average and well in their pre-requisites course. They had considerable motivation to learn this course in the subsequent year and willingness to go through the various steps in testing and give the feedback.

Developmental testing

Material on unit 1 together with a questionnaire developed specifically for this purpose were handed over to the students when they visited the Regional centres for study purposes. Questions were close - ended where responses must be chosen from a given list or open -ended where respondents were allowed to give their own responses. Students were requested to study the material at home and answer the questionnaire after studying the unit. They were also interviewed to obtain additional feedback if any. The questions asked in the questionnaire were around

the following areas: target group, objective, type of assessment, content, time for study, teaching method, style, physical format, effectiveness of A/V.

Feedback on the products at each stage of course development from learners and peers were received. Feedback from the learners indicated that

1. In unit 1 the schematic diagrams illustrating the biogeochemical cycles were too crowded and complicated. It needed to be simplified.
2. To insert more photographs of organisms and instruments.
3. To include more examples to illustrate facts.

Based on feedback from the learners and peers the unit was revised. This method of evaluation helps to improve the material before further developing them into the next stage. Development testing was done for unit 2 as well.

Running parallel to this was the development of core-texts for other units as shown in the work schedule (Figure 8).

As an additional safeguard a checklist of items was prepared by the author and drafts and revised drafts were checked against it for any possible lapses and shortcomings. The check list included the following items.

- Was the work load considered i.e., is the length of the manuscript is appropriate with respect to the credit rating of the course?
- Is the advance organiser (introduction) interesting and stimulating?
- Are the aims and objectives stated clearly for the course, unit and individual study sessions; are the objectives relevant to the content?
- Are there appropriate activities in relation to the objectives ; are the instructions for the activities clear?
- Are there adequate self assessment questions and activities to achieve the objectives?

- Are the explanations about new concepts and terms in the subject content sufficiently clear and properly introduced?
- Have the ideas in the material been put together logically?
- Is the material learner friendly?
- Are the illustrations, tables, graphs etc. used where needed; are they presented so that they can reinforce learning?
- Has other media be used wherever appropriate?
- Is the material interesting, challenging as well as pleasurable to study?
- Is the material visually attractive?

Evaluation after the course has been offered

Evaluation should be an on-going process, even after the course has been offered for students.

The course developed under the DfID project is being offered during this academic year. 98/99. Questionnaires have been developed and will be distributed to all students offering the course. The following criteria will also be determined.

- Performance of students against the objectives specified
- Performance of students at final examinations.
- Number of students enrolling on courses
- Percentage of students successfully completing the course

Information obtained from questionnaires and personal interviews would be used to further improve the material during revision stages.

Conclusions and Recommendations

The confidence of the students is the greatest asset an institution can have. It is time, therefore, for the OUSL to raise the quality of its instructional materials significantly. The higher the quality of self instructional package produced by a multi-disciplinary team the more

likely it is that it will enhance the learning experience of distance education student and contribute to the maintenance of standards and quality in the Institution.

The DfID workshops were potent tools which provided us the much needed impetus and training as well as appropriate attitudes to develop quality instructional material.

Quality in the development of instructional materials can be assured through the following stages: training of a course team; adherence to instructional design principles and norms regular course team meetings and review of progress according to the schedule; developmental testing of course materials; initial revision; evaluation of the course while or after being offered in the first year; final revision if required.

There should be continuing efforts by the OUSL to develop the discipline and commitment of staff to undertake the production of quality instructional materials. A quality assurance system or unit should be set up at OUSL to monitor and ensure that quality related activities are being performed effectively.

Acknowledgement

The commitment and the valuable assistance rendered by the course team members Ms. Geetha Kulasekara, Ms. Vasantha Karunaratna, Ms. K. Thiagarajah and Ms. Gayathri Jayathilake towards the production of the course material is gratefully acknowledged. The Author and the course team is grateful to the Open University of Sri Lanka for providing us with the valued opportunity of being among the participants of the first training workshop. Mr. E. Sivanantha for DTP assistance and Ms. Chandani Seneviratne and Mr. N. Subasinghe for the secretarial assistance given are also acknowledged.

References

- Buddhi Weerasinghe; Gamini. S. Algama; Padmika. C. De.Silva; (1997). *The Credit Rating of selected Distance Education study Material at the OUSL*. OUSL Journal. Vol. 1.
- Distance Writing - Bridging the Gap* (1998). The Open University of Sri Lanka; Open University Press.
- House Style*, (1998). The Open University of Sri Lanka; Open University Press.
- Melton, Reginald, F. (1997). *Objectives, Competencies and Learning Outcomes: developing instructional materials in Open and Distance Learning*. London : Kogan Page.
- Samarawickrama, R.G. (1997). *OUSL House Style*; Sri Lanka : Open University Press.