

CHAPTER IV

DEVELOPMENT OF THE THREE INSTRUCTIONAL STRATEGIES

As discussed earlier, modern mass education has to minister an expanded curriculum to increasing number of students with a wide range of individual differences in scholastic ability. One partial solution which may be proposed, is concerned with increasing the efficiency of teaching process itself. As a result, pressure of insufficient time with excess of teaching load, would be alleviated, allowing more pupils and a greater diversity of curriculum to be handled by a smaller number of teachers.

With a view to increasing teaching efficiency leading to the maximum achievement of the instructional objectives, the investigator has attempted to develop the three instructional strategies to teach the subject of 'nutrition' to the second year Home-Science Students of the M.S. University of Baroda. The three instructional strategies, each composing of different components were developed for the present study. The details regarding the main features of the developmental process such as specification of the selected content with the task analysis, entering behaviours and terminal behaviours; development of software materials and criterion tests; are presented in this Chapter. It also includes the description of the different teaching techniques used in the

instructional process and the evaluation and revision of the PLM; and the details of the try-out study.

SELECTED CONTENT WITH THE TASK ANALYSIS

Each instructional strategy developed, covers the three units viz. (1) proteins, (2) carbohydrates, and (3) fats; which form the part of the content of the course 'Elementary Foods and Nutrition', which is prescribed as a compulsory course for the II year, Home-Science Students of the M.S. University of Baroda.

As the first step, towards the development of the three instructional strategies, the selected content matter was analysed in detail. Based on this analysis, it was decided to deal with the contents of the course under three heads viz. (1) proteins, (2) carbohydrates and (3) fats. Thus for the purpose of presentation to the students, the content material was finally divided into the following three units.

Unit I - PROTEINS

Unit II - CARBOHYDRATES

Unit III - FATS

Proper sequence for the presentation of contents was decided on the basis of three flow charts prepared separately for the three aforesaid units. Flow charts were prepared with a view to discovering the interdependency of the different concepts to be covered and the demands they make on the

sequencing of the content matter. Flow charts I, II and III on the following pages, present the task analysis of the contents of the Unit I, Unit II and Unit III respectively. .

Based on detailed task analysis made, specific outlines to be covered for the topics, under each unit, were chalked out, specifying the different content points, in exactly the same sequence in which they ought to appear, in each of the three strategies, developed for the present investigation. These content outlines of the three units have been listed below.

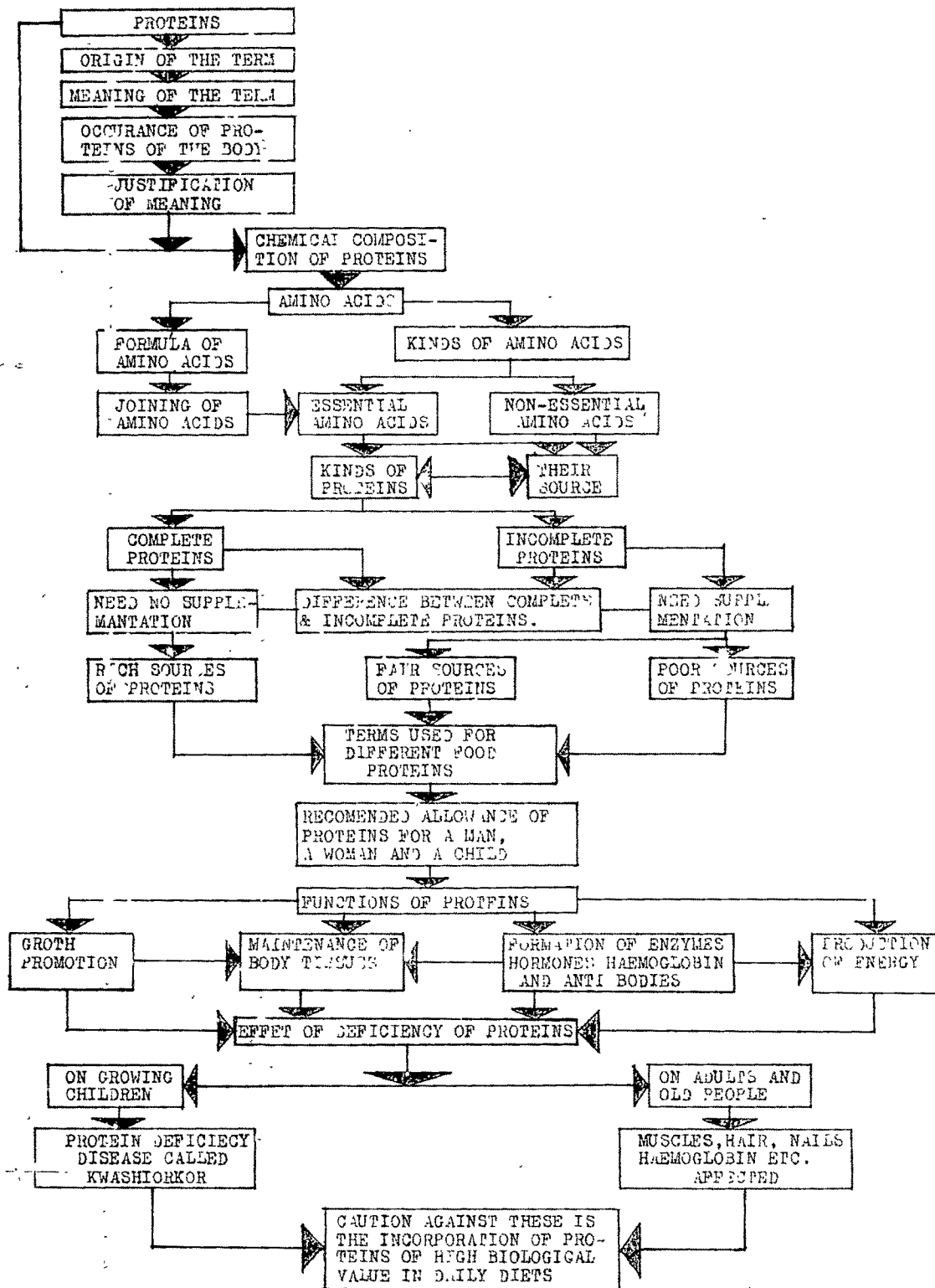
Content Outlines of the Three Units:

Unit I - PROTEINS

- (1) Origin of the term 'protein'.
- (2) Meaning of the term 'protein'.
- (3) Occurance of proteins in our body.
- (4) Chemical composition of proteins.
- (5) Building up of proteins.
- (6) Kinds of 'Amino Acids'.
- (7) Kinds of proteins.
- (8) Supplementary value of proteins.
- (9) Food sources of proteins.
- (10) Kinds of proteins.
- (11) The recommended allowance of protein.
- (12) Functions of proteins.
- (13) Effects of deficiency of proteins in growing children and adults.

FLOW CHART - I

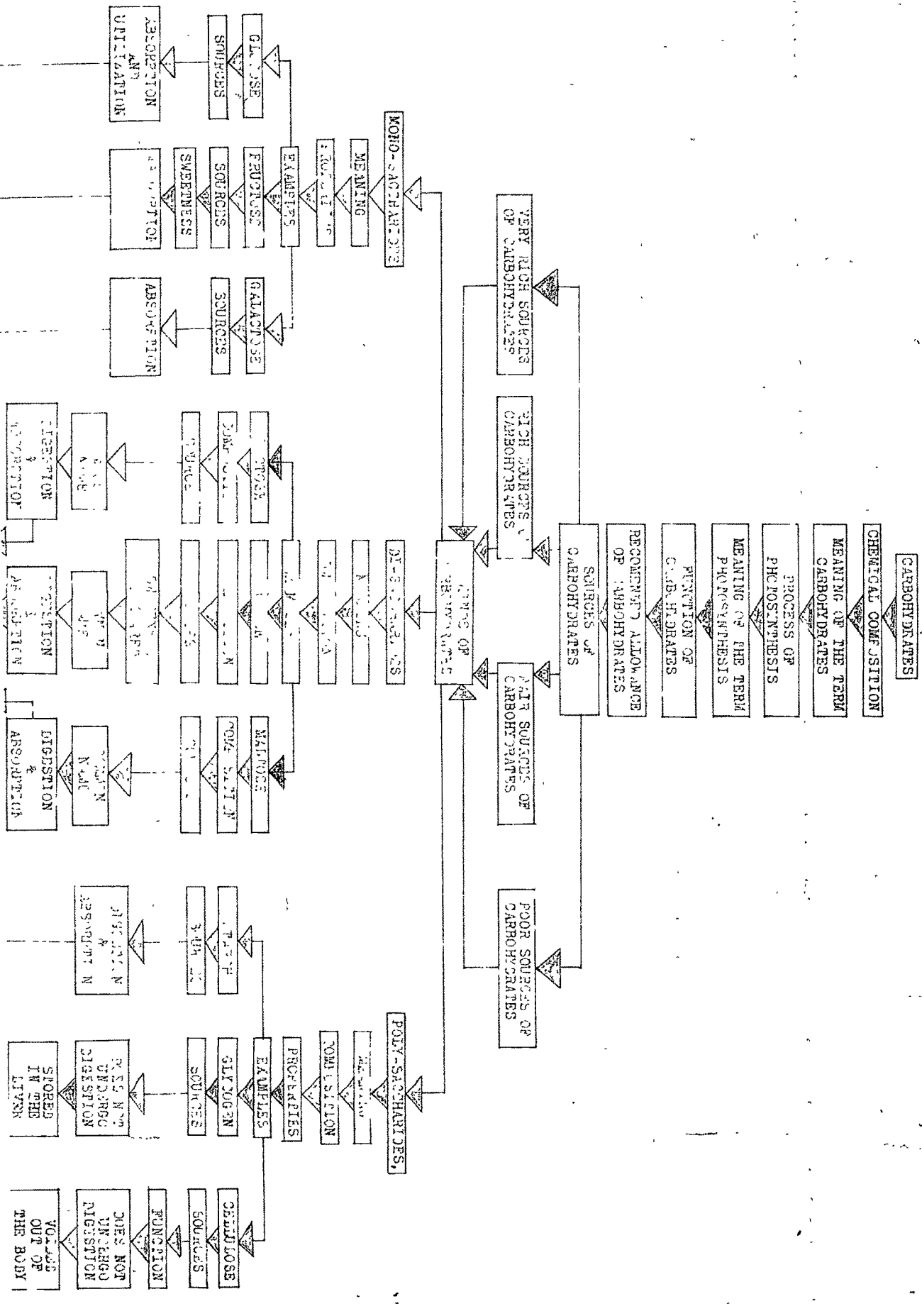
UNIT I

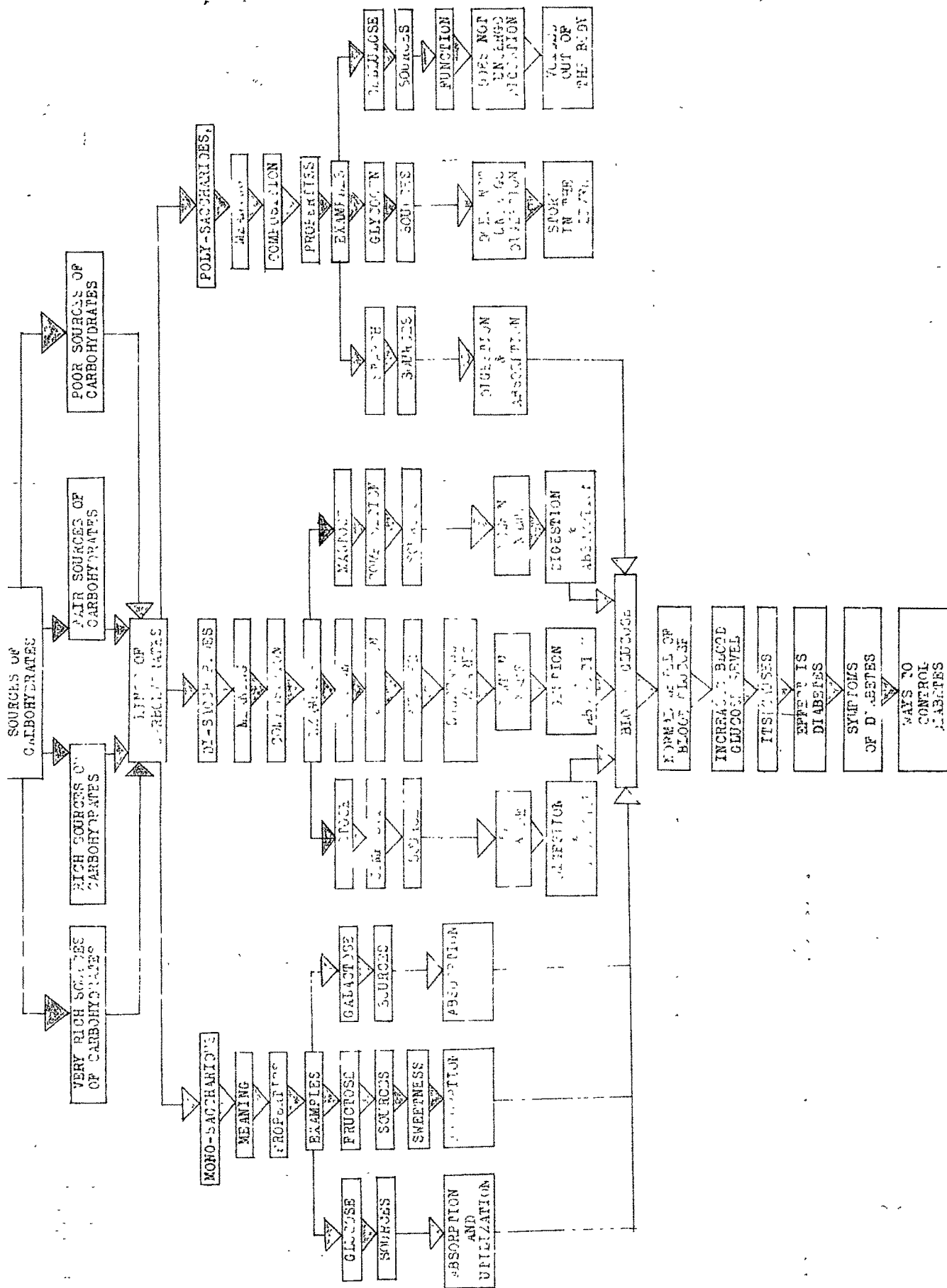


FLOW CHART II

UNIT II

86

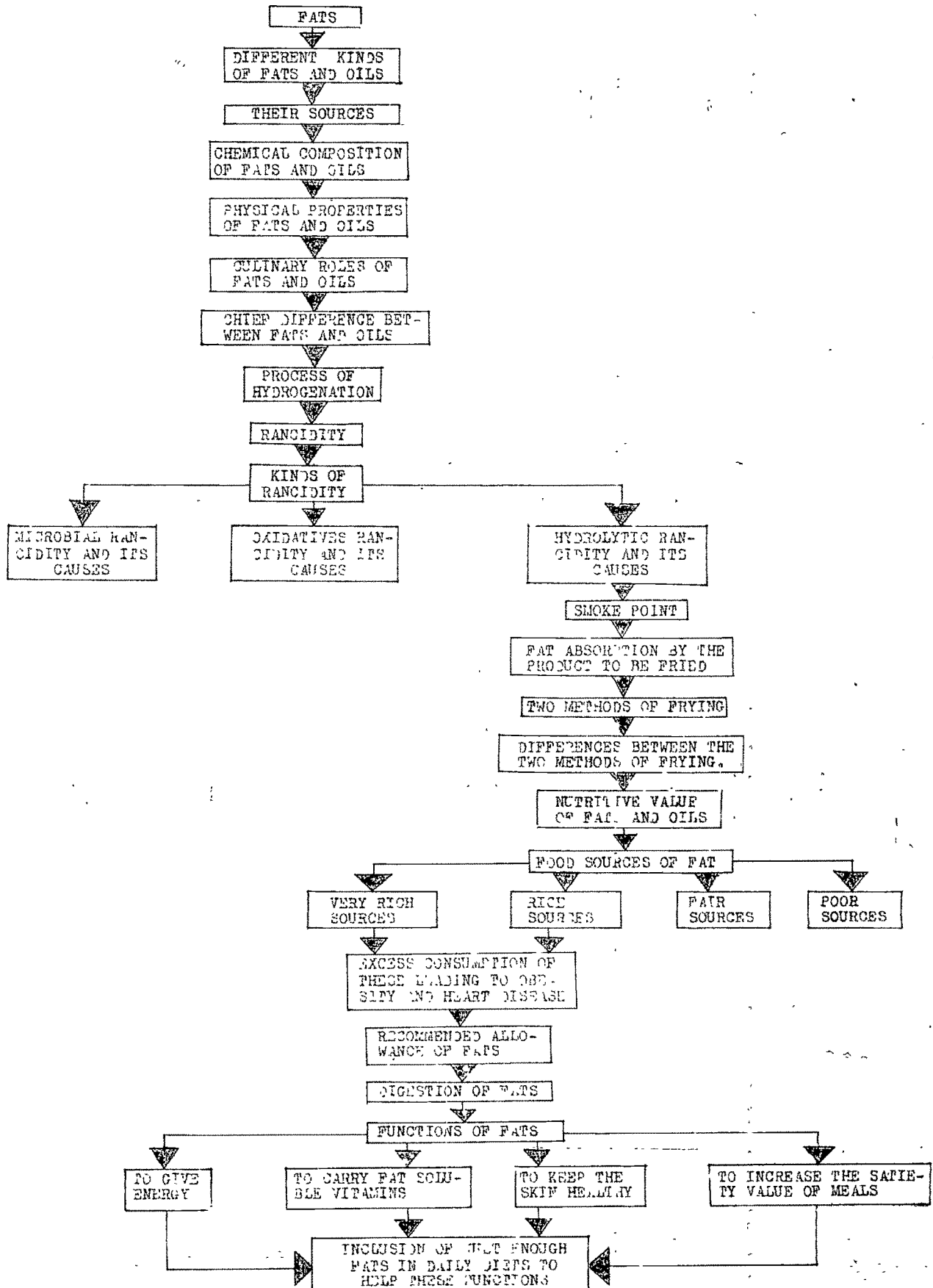




FLOW CHART - III

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UNIT III



Unit II - CARBOHYDRATES

- (1) Chemical Composition of 'carbohydrates'.
- (2) Meaning of the term 'carbohydrate'.
- (3) Process of photosynthesis.
- (4) An important function of carbohydrates.
- (5) Recommended allowance of carbohydrates.
- (6) Food-sources of carbohydrates.
- (7) Kinds of carbohydrates - including their properties, food-sources and digestion.
- (8) Diabetes - the ill-effect caused by excessive consumption of carbohydrates.

Unit III - FATS

- (1) Different kinds of fats and oils and their sources.
- (2) Chemical composition of fats and oils.
- (3) Physical properties and culinary roles of fats and oils.
- (4) Difference between fats and oils.
- (5) Process of Hydrogenation.
- (6) Rancidity - different kinds.
- (7) Deep frying and shallow frying methods.
- (8) Nutritive value of fats and oils.

- (9) Food sources of fats - (nutrient)
- (10) Ill-effects caused by excessive consumption of fats and oils.
- (11) Digestion and absorption of fats.
- (12) Recommended allowance of fats - (nutrient).
- (13) Functions of fats - (nutrient), in the body.

ENTERING BEHAVIOUR

An experiment which includes teaching of certain content matter, often demands assumptions regarding the behaviour of the students prior to the conduct of the experiment. In other words, an investigator has to determine what behaviour the learner shall already have at the time of understanding the selected units for the experiment. A list of such behaviors forms the entering behaviour.

To understand and learn the three selected units viz. 'Proteins', 'Carbohydrates' and 'Fats' in case of the present investigation, the compulsory pre-requisite is the basic knowledge of 'Seven Food Groups'. The specific entering behaviour in relation to the subject matter pertaining to the 'Seven Food Groups', for the present investigation, may be stated as follows:

At the time of the conduct of the experiment, the students must be able to -

- (i) Write the definition of 'Food' in about 2-3 lines.

- (ii) specify the three main functions of the foods; each in a line or two.
- (iii) state the reason each in a line, as to why foods are capable of performing those three functions.
- (iv) list the seven food-groups, with two examples of specific foods, for each food group.
- (v) write the list of names of nutrients.

Test on Entering Behaviour (Pre-Test):

To test and ascertain that students are ready to learn the three selected units, a pre-test was prepared by the investigator since no standardized test was available to be used for judging the pre-requisite knowledge on the 'seven food-groups', which is taught to the students before teaching the subject matter on "nutrients" such as proteins, carbohydrates, fats etc. The test-items developed in the pre-test covered all the entering behaviours. The test was of objective type where the students were required to write short answers in a few words or in 2-3 lines. The draft of pre-test is given in appendix A₁.

Besides the written pre-test, an oral pre-test was also conducted to judge the knowledge on English-names of all the commonly available food-stuffs, included in the seven food-groups, which too is equally essential to follow the content matter on the three units selected for the study.

The procedure followed for the oral test was that the

real foods, a few from each of the seven food groups, were placed in small glass-bowls in a food-laboratory. Only one student was asked to enter the laboratory to recall and speak out the English-name of each food. The investigator herself supervised both the tests, written as well as oral pre-test. The written pre-test paper was solved in the class-room, after the assessment of all the pre-test papers was over. In case of both the tests, it was found that most of the students could write and speak almost all the questions correctly. However students were informed and were allowed a time of two weeks to study before conducting these pre-tests, mentioned above.

TERMINAL BEHAVIOURS

It is an analysis of the behaviour which a particular content matter taught through a teaching technique is intended to produce on a learner. In other words, one, who undertakes to teach through either instructional technique or techniques forming a strategy, has to analyse the behaviour involved in the instructional material. One, thus formulates the instructional objectives in terms of the expected terminal behaviour of the students, i.e. what the students are expected to achieve and attain after studying a particular content matter through a specific instructional strategy. The following list provides the instructional objectives, for the three selected units, which are to be achieved by the students as their terminal behaviour.

Unit I - PROTEINS:

- (1) Students will be able to state the meaning of the term 'protein'.
- (2) Students will explain what an amino-acid is and will state the reason as to why it is called so.
- (3) Students will be able to explain the structure of an amino acid, stating its formula.
- (4) Students will specify the name of the compound from the number of amino-acids forming that compound.
- (5) Students will recall the name of the linkage joining each two amino-acids.
- (6) Students will point out the correctly joined amino acids from the given combinations, of two amino-acids each.
- (7) Students will mention the correct kind of amino acid against the given names of the amino acids.
- (8) Students will give reasons as to why each kind of amino acid is called so.
- (9) Students will define "Complete proteins" in three lines.
- (10) Students will define "Incomplete proteins" in three lines.
- (11) Students will point out a particular function of protein related to the high biological value of proteins.
- (12) Students will recall a term which can be used to express "the capacity of mixed plant proteins to take care of one another's amino-acids' deficiencies".

- (13) Students will recall any four good quality protein-rich foods.
- (14) Students will recall the 'kind' of the protein present in the given food.
- (15) Students will point out the correct set of foods, belonging to the 'poor sources of proteins'; from the given sets of foods.
- (16) Students will point out the exact term used for maize protein, from the given set of terms assigned to different food proteins.
- (17) Students will recall the recommended allowance of proteins for man and woman.
- (18) Students will correctly point out as to who would require more protein per unit of body weight; a child, an old man or a woman.
- (19) Students will specify the four main functions of proteins, each in 1-2 lines.
- (20) Students will recall the number of calories produced when one gram of protein is oxidized in the body.
- (21) Students will point out the right 'age' when a child should be weaned, from the different lengths of periods stated.
- (22) Students will interpret that a given situation is an example of protein deficiency disease.
- (23) Students will recall the term used for protein deficiency disease.

- (24) Students will state the names of any two protein rich semi-solid food preparations which can help to cure the protein deficiency disease, to some extent.

Unit II - CARBOHYDRATES:

- (1) Students will state in a line, the chemical composition of carbohydrates.
- (2) Students will explain the meaning of the term 'carbohydrate' in 1-2 lines.
- (3) Students will describe the whole process of photosynthesis including the meaning of the term photosynthesis in a paragraph.
- (4) Students will recall an important function of carbohydrates.
- (5) Students will recall the number of calories produced when one gram of carbohydrates is oxidized in the body.
- (6) Students will recall the recommended allowance of carbohydrates for an adult.
- (7) Students will name the rich sources of carbohydrates, in terms of foods from which we get maximum energy.
- (8) Students will recall the names of two important foods which can be categorized as very rich sources of carbohydrates, on the whole.
- (9) Students will recall the names of two important foods which can be categorized as poor sources of carbohydrates on the whole.

- (10) Students will name the three main kinds of carbohydrates with three specific examples in each case.
- (11) Students will state the two common properties of simple sugars, in 2 lines.
- (12) Students will recall the comparative sweetness of fructose and sucrose with that of glucose.
- (13) Students will state the two common properties of complex sugars in 2 lines.
- (14) Students will match the name of the carbohydrate with the correct name of the food-source in which it is present, when the two lists, one bearing the names of carbohydrates and the other bearing the names of foods, are given.
- (15) Students will recall the name of an enzyme which is present in the digestive system of plant eating animals and the same being absent in that of human beings.
- (16) Students will specify the names of the enzymes helping the digestion of given carbohydrates; along with the names of the simple sugars into which the each of the given carbohydrate is broken down, during the process of digestion.
- (17) Students will recall the important function of cellulose.
- (18) Students will recall the names of four carbohydrates which do not undergo digestion.

- (19) Students will recall the normal blood level of glucose.
- (20) Students will interpret that the given situation is an example of diabetes.
- (21) Students will specify the two causes of the disease diabetes; only in a few words.
- (22) Students will write any three foods which can be advised to control the disease diabetes.

Unit III - FATS:

- (1) Students will state the reason, as to why cooking oils are called "Vegetable oils" whereas cooking fats are called "animal fats".
- (2) Students will recall the chemical composition, physical properties and the culinary roles of both, fats as well as oils; to prove that both are similar compounds as far as the chemical composition, physical properties and the culinary roles are concerned - in a paragraph of 6-7 lines.
- (3) Students will give reason as to why oils are liquid but fats are solid at room temperature.
- (4) Students will name and explain in 2 lines, the process by which vegetable oils can be converted to ghee-s, including the two advantages of the same process, each in a few words.
- (5) Students will explain what rancid fats and oils are; followed by the description of the causes of the three kinds of rancidities - each in 2-3 lines.

- (6) Students will recall the name of the point at which the oils or fats give off visible fumes, when heated.
- (7) Students will recall as to how smoking temperature is affected when the fat is repeatedly heated or if the burnt particles are not removed, from the oil, once used.
- (8) Students will interpret, the case of under-heating, the case of over-heating and the case of heating just to the smoke point, all included in a given situation.
- (9) Students will discriminate between "Deep-frying" and "Shallow frying" methods, stating 4 points, each in a few words, under each method.
- (10) Students will reason out as to why oils are used for deep frying whereas fats are used for shallow frying.
- (11) Students will specify the nutritive value of fats and oils, in terms of proteins, carbohydrates, fats, vitamins and minerals.
- (12) Students will recall that fats and oils are very rich or concentrated sources of the nutrient 'fat' as they contain 100% fat.
- (13) Students will give reason to justify that the given names of the foods fall in the category of "fair sources of fat".
- (14) Students will recall that the given names of foods, can be classified as the 'poor' sources of fat.
- (15) Students will recall the two ill-effects caused by the excess consumption of fat-rich foods.

- (16) Students will recall the name of the enzyme present in pancreas necessary for digestion.
- (17) Students will explain the process of digestion and absorption of fats in 3 lines.
- (18) Students will recall the recommended allowance of fats for an adult person.
- (19) Students can calculate how many calories can be produced when ten grams of fats are oxidized in the body.
- (20) Students will state four functions of fats, each in a line.

CRITERION TESTS

There were no standardized tests available for the three selected units, that can be used as criterion tests, for the present investigation. Three suitable criterion tests were, hence developed by the investigator, for the three units viz. 1) 'Proteins', 2) 'Carbohydrates', and 3) 'Fats'. The test items formulated in each test covered all the terminal behaviours stated under each of the three aforesaid units. The types of test items were (1) filling the blanks, (2) multiple choice, (3) matching, (4) give reason for, and (5) short answers and (6) judging the situation. About 80 per cent of the items in each test were of objective type. Even the essay type items required the students to write only short answers. Further for such questions, the length of the required answer and the number of points to be included in the answer are clearly specified in order to make them as objectively

scorable as possible. Marks were assigned for each item in accordance with the relative importance of the expected terminal behaviour, it attempted to test. A time duration of 45 minutes was allowed as mentioned on the paper of each unit. All the three criterion tests were tried out with a representative group of students at the end of the presentation of each unit, during the try-out study and the modifications were done accordingly. The final draft of each criterion test is given separately in the appendix, A₂, A₃ and A₄.

This was followed by the development of the software materials required to present the content matter on the three selected units, through the three instructional strategies.

DEVELOPMENT OF THE SOFTWARE MATERIALS

Keeping in view the instructional objectives specified in terms of the expected terminal behaviours of the learners, the ways of treating the content matter were decided at length. The illustrations to be used and the figures and diagrams to be presented were also thought about. The presentation of these, as the actual learning experiences in the three different strategies was also put to thorough consideration. The sequencing of these learning experiences in a logical manner was also decided. The software material for the each teaching unit to be presented through the three instructional strategies, were developed. In all there were five such software materials prepared for the three units taught through three instructional strategies.

Strategy 1:

The software material for strategy one (S_1) was the programmed learning material developed stepwise and also separately for the three selected units. The same was evaluated and revised through individual try-out and later through the group try-out study. The thoroughly revised form of the programmed learning material on all the three units including the response sheet for each, is presented in the appendix B_1 , B_2 and B_3 . The details of the developmental process involved in preparing the above stated PLM are included in the same Chapter.

Strategy 2:

The software material for the strategy two (S_2) was the structured lectures written out stepwise following the same sequence of presentation of the content matter as it appears in PLM. The content matter included in the structured lecture for each of the three units, was edited by the content expert, and was later revised, after the same had been used for the try-out study. The thoroughly revised form of structured lectures on the three teaching units are presented in the appendix C_1 , C_2 and C_3 . It may be noted that these written out structured lectures were not distributed to the students. They serve as only the ready material for the practising teacher. The developmental process for the same including the technique of presentation of the content matter through the same, is discussed in this Chapter.

Strategy 3:

The software materials for the strategy three (S_3) were (i) the three separate scripts written out unit-wise for the same material to be taped, (ii) the charts, and (iii) the work-sheets; all three being developed separately for the three units. The content matter included in the script was edited by the content specialist, and was later revised after the taped material had been used for the try-out study. The thoroughly revised form of the script on three units, used for tape-recording, is presented in appendix D_1 , D_2 and D_3 .

Charts were prepared using white thick drawing sheets and sketch pens of twelve different colours. The length and breadth of each chart was $2' \times 2\frac{1}{2}'$. Each chart was neatly prepared and was numbered on its top in a bold figure. The figures in the charts were duly labelled. Sometimes in the place of figures some words or verbal statements were given, as per the need. There were 21 charts in all, 7 charts for each of the three units. These are presented in appendix E_1 , E_2 and E_3 .

The work-sheets comprised of several sets of questions, each meant to cover a group of related concepts; were written out. The work-sheets contained questions followed by empty spaces for the students to write their own answers in. The work-sheets on all the three units are presented in appendix F_1 , F_2 and F_3 .

The content matter pertaining to the three selected units, was thus thoroughly analysed to be presented through

the three instructional strategies. As mentioned earlier in Chapter III, the present investigation has made use of the components like PLM, structured lecture with black-board work, taped commentary with charts and work-sheets, laboratory demonstration, library reference work and discussion, from three instructional strategies, each composed of a few of these. The significance of all these components has already been discussed in Chapter III. The following information provides details about the technique used for programming the content matter. This will be followed by the evaluation and revision of the same.

I. TECHNIQUE USED FOR PROGRAMMING

Format and Style:

Many different types of formates have been adopted in presenting the frames and correct answers in programmed learning materials. In the present case, frames have been presented in between horizontal lines; and the correct answer to the question asked in a frame is given, again between the two horizontal lines, immediately below the frame. Students were provided with a thick rectangular paper-slip (3" x 6") for covering the correct answer. Students were also provided with a separate response sheet. Frame numbers were specified and the necessary space was provided for writing the answers, in the response sheet. Students read each frame covering the correct answer with the thick paper-slip provided, wrote their own answers in the response sheet and compared the answers

with the correct answers provided in the programmed learning material.

Programmed learning material developed in the present study, has been of the linear style, although it is not a linear programme of the traditional skinnerian type. . However the programme style is basically linear in the sense that each student takes the same path through the instruction when they studied through strategy one; as PLM is included in strategy one. The investigator is of the opinion that college level students should be able to compose responses rather than select the same from a set of alternatives, as it would be in case of a branching type of programme. Moreover, in a linear programme, a student has to pass through a carefully designed sequence of steps, one after another, in a manner that makes learning cumulative through out the whole sequence of frames. It was with these views, that the investigator selected linear type of programming.

Frame Components:

Each frame in the programmed learning material, including the correct answer may be taken to consist of four main components.

Example: Frame No. 75 is given below from the PLM on Unit II
- Carbohydrates.

75. You already know that blood contains certain normal amount of glucose. If our body does not make use of

the total carbohydrates, we consume daily, then the extra glucose formed, remains un-used and accumulates in the blood.

Study the above fact and answer the following question only in a word.

In what, does the extra un-used glucose gather in the body?

Answer : Blood

As can be seen in the above frame, the first component consists of one or more sentences presenting some information. The second component consists of instruction given to the students as to the way they should write their answer. This is followed by a question which forms the third component. The correct answer given immediately after each frame constitutes the fourth component. The second component viz. instruction to the students, which is generally not found in most of the programmes, has been included in the present case, for the certain specific reasons. They are: (1) to instruct the student regarding the way in which he should write the answer, (2) to instruct here regarding the type of answer she is expected to write, and (3) to facilitate the organization of her own answer without an extra strain on her. This would help the student to compare her answer easily, with the correct answer already stated in the same specific way. However, it may be noted that, the second component of 'instruction to

the students' was not made use of where the students were required to straight away fill in the blank which was already drawn in the statement of the question.

Frame-Size and Frame-Type:

It is indeed very essential, that the students must pass through a carefully designed sequence of steps often of considerable length, in order to acquire a complex behaviour. As the same time each step must be so small that it can always be solved correctly and doing so the student moves somewhat closer to fully competent behaviour. However the principle of very small steps has not been strictly followed while writing the present programmed learning material. Several large sized frames can be traced in the same; although each frame presents only one point for learning.

The present programmed learning material includes teaching frames, practice frames as well as review frames; depending upon the sequential position they occupy in the behavioural change process. Prompts and cues are used in the frames when a new concept or fact has to be taught. The same fade gradually as and when the student is required to respond independently on her own.

Frame Structure:

The term "Frame Structure" has been used to mean the specific type of questions included in different frames of the programme. In the present programmed learning material, the frame structure does not fall in line with any one single

style. Different types of frame structures which appear in the present programmed material are (1) short answer type, (2) 'Yes' or 'No' answer type, (3) multiple choice type, (4) completion type (5) tick mark / or X type, (6) filling the blanks type, and (7) matching the pairs type. It was on the basis of the suitability of a particular type of question, that the frame-structure in each situation was decided upon. No specific rule has been followed in the same regard.

Response Mode:

Although no uniformity has been maintained in the frame structure, the response mode is uniformly "overt" in nature. For each frame, irrespective of the type of question, the student has to indicate her answer in writing on the response sheet. Then she compares the answer with the correct answer provided in the programme. She proceeds to study the information in the next frame if her answer is correct, but if her answer is incorrect, she tries to follow the previous frame or frames again, and then proceeds to the succeeding frame.

EVALUATION AND REVISION OF THE PROGRAMMED LEARNING MATERIAL

The first draft of the programme was written keeping in view, the entering behaviours and the terminal behaviours listed in this Chapter. Also were followed the specifications regarding the nature of the frames, their sequence and presentation while writing the frames for the programmed learning

material. The first draft of the programme, written for each unit separately, was edited by an expert (the subject master) from the point of view of content. It was also edited by another expert (the guiding teacher) from the point of view of programming principles or internal validity. Whenever the need was felt, the frames were also discussed with other knowledgeable people in the field of nutrition. Consequently several modifications were made in the structure of the frames, as well as their presentation sequence. It was now ready for individual try-out. The investigator herself sat with six students in all, attending to only one at a time and had all the frames tried out by these students who did have the pre-requisite knowledge of the concerned units. Another aspect of the frames that was checked during the individual try-out, was regarding the language of the frames. The words, the meaning of which the students did not know were noted down and further simplified. Very simple language was used to avoid differences in the language ability which would not interfere in the process of learning. Along with the programme, the criterion tests for the three units were also scrutinized for their content validity, by the expert keeping in view the terminal behaviours specified for the respective programmed units. Thus the edited programmed material for all the three units was now thoroughly modified and made ready to be used for the try-out study.

As the content matter on all the three units to be presented through one of the teaching-techniques namely

programmed learning method was sufficiently validated, the task of planning and writing out the structured lectures; as well as the script to be tap-recorded; was made very easy. Structured lectures and the content matter to be taped were both written out following the same sequence in the subject matter as used for the programmed learning material, and thus both were made ready after being edited by the content specialist, to be used during the try-out study.

The details covering the techniques used in the development of the other components namely (i) structured lectures with black-board work, (ii) script^{for} taped-commentary material, with charts and work-sheets, (iii) laboratory demonstrations, (iv) library reference work, and (v) discussion are given below.

II. TECHNIQUE USED FOR STRUCTURED LECTURES WITH BLACK-BOARD WORK

The lectures for all the three units were structured in the sense that the instructional objectives were defined in terms of the terminal behaviours; and the task-analysis for the content matter was done to plan the lectures. It may be noted here that both the terminal behaviours and the task-analysis of the teaching matter were the same as used in the writing of the programmed learning material, because the same units were to be made use of for teaching through the different instructional strategies. In brief, for planning the structured lectures, the subject matter was sequenced exactly as it was for programmed learning material.

Each lecture was linked properly with the previous lecture. Before commencing the verbal presentation on an unit, the investigator, who is the practising teacher, wrote out all the outlines, pertaining to that unit, in the left corner of the black-board, where it remained till the unit teaching was over. All the students were specially instructed to take down these outlines. This helped to emphasize the element of structuring in lectures. Besides, this was meant to serve the students as memorandum during revision. Modulation of voice while presenting the content-matter verbally, was kept in view. The language used was very simple and the speed with which the lectures were delivered was neither too slow nor very fast. The teacher cared to pause at suitable points while delivering the lectures. The students were free to take down notes while listening to verbal presentation. They were also allowed to interrupt, during the course of content presentation, to solve their difficulties or clear their doubts. Examples and anecdotes were made use of wherever necessary. All the new terms were written out, and the diagrams, figures, etc. were drawn on the board during the course of presentation. In fact, black-board was made use of, to the maximum. The main points were revised and the names of reference books with the chapter numbers, to be studied, were dictated at length.

III. TECHNIQUE USED FOR TAPED COMMENTARY WITH CHARTS AND WORK-SHEETS

For the present study, the same content matter on the

three selected units written out in the conversational form, was tap^e-recorded, unit-wise, using a Grundig tape-recorder; in the voice of the investigator. Recording was carried out in a completely closed room without the echo quality. There were no interruptions and no undesired background noise when the content matter was being taperecorded.

The investigator adopted the following procedure to present the content matter through the tape-recorder.

To start with, all the charts concerning the unit to be taught, were fixed in the right order i.e. number-wise, on a big flannel board in the class-room. It may be noted here that each chart was numbered in a bold figure, it being drawn on its top. Next, the work-sheets bearing the sets of questions, were distributed to the students. Then the students were introduced with the new method of learning. They were also instructed about the procedure they had to follow while learning through this technique.

After this, the investigator would start the tape-recorder. The students were made to sit separately to listen and study the content matter being presented through the tape-recorder. Many a times, students were instructed through the tape-recorder only, to concentrate on a chart of a particular number to understand the relevant material. After presenting a set of related facts for five to seven minutes, the tape-recorder, itself would announce to stop for a while to solve the related set of questions mentioned in the work-sheet. The same questions would also be relayed through the

tape-recorder; after which the investigator would stop the tape-recorder and allow approximately seven minutes on an average for answering the questions. The tape-recorder would be again switched on, to present the second set of facts on part of the content matter and then would be stopped when the students had to solve the related set of questions in the work-sheets. This would continue till the whole unit was taught. This was followed by helping the students to solve those questions in the work-sheet, which they found difficult and thus could not solve in the regular session.

IV. TECHNIQUE USED IN LABORATORY DEMONSTRATIONS

There are two principal types of demonstrations, method demonstrations and result demonstrations. In the former, a procedure is carried out step by step, slowly and accurately before an audience, the demonstrator ascertaining that the audience has understood how to perform it. In the latter the results of some activity, carried out by the educator or another, possibly a member of the audience, are demonstrated and discussed. Method demonstrations seem to give better returns for effort and money than do result demonstrations.

Thus, for the present study, method demonstrations were made use of by the investigator. These demonstrations were carried out in the college food-laboratory. Students were taken to the laboratory for the demonstrations to look at the concrete things, after they studied a part of the content matter in each unit. The laboratory demonstrations were easy

to see, hear and understand. They were also interesting and short enough to keep the attention of the students. The investigator, as a demonstrator, allowed the students to take part in the discussion and also provided an opportunity to them, to repeat the procedure themselves. Locally available things were used for the demonstrations.

Some nutritionists have reported that they have found this, to be the best method of teaching in their areas. Susan Parkinson, a nutritionist in the South Pacific Health Service, found demonstrations using real foods to be the most successful way of teaching nutrition to the people in that region. She stresses that real foods are to be preferred to posters, flannelgraphs, or other artificial aids. The investigator too, planned the method demonstrations in the laboratory, using real foods. In brief all the laboratory demonstrations pertaining to the three teaching units were organized with a view to have an effective out-come. The objectives of the laboratory demonstrations for the three units along with the foods displayed and the teacher activity in the laboratory are listed in the appendix G₁, G₂ and G₃. It may be noted that the same laboratory demonstrations were made use of, while teaching through all the three instructional strategies.

V. TECHNIQUE USED FOR LIBRARY REFERENCE WORK

Students were dictated the chapter numbers from different books, immediately after the presentation of the teaching matter

on each unit through structured lecture with black-board work in strategy two was over. Only three books were prescribed for the library reference work due to the short time limit in which the students were expected to do the same. It was kept in view that students should have an easy access to these books for completing the work assigned. The names of the books with the chapter numbers are quoted in the appendix H.

VI. TECHNIQUE USED FOR DISCUSSION

Discussion was held, at the end of the presentation of each unit. In other words, when the students had finished learning through the first two components included in strategy one (S_1) and strategy three (S_3). It may be noted that 'discussion' was thought unnecessary and thus omitted in strategy two (S_2) which included the communication through lecture by the teacher.

To start with, the teacher would announce a few points, decided to have discussion on, pertaining to the same unit being taught. Pupils were encouraged to participate and substantiate their own personal opinions about a topic with accurate information and logical thinking. All the students who were anxious to involve in the discussion were given an opportunity to express their thoughts. The silent students were stimulated to speak. 'Discussion' on the whole helped the students to solve their difficulties and clear the doubts, about the content matter already learnt through the first two components, concerning each unit. The points selected

from each units to have discussion on are presented in the appendix I.

Thus all the three strategies each composed of a combination of three components viz. PLM + Laboratory demonstration + discussion forming strategy one (S_1); structured lectures with black-board work + laboratory demonstration + library reference work forming strategy two (S_2); and taped commentary with charts and worksheets, laboratory demonstrations + discussion; forming strategy three (S_3) were ready with the particular content matter specified for each component in different teaching units. These three strategies were used in a try-out study to judge their effectiveness.

TRY-OUT STUDY

The edited content material of the three selected units, was tried out through the three above mentioned strategies, on a group of thirty students belonging to the II year class of Faculty of Home-Science, the M.S. University, Baroda. For the sake of experiment, these students were further divided into three groups, each consisting of ten students. The try-out study involved 3 X 3 Latin square design, that is to say, all the three groups of students were exposed to all the three instructional strategies while learning all the three units. The same 3 X 3 Latin square design is explained in details in the next Chapter. The students were oriented about the learning procedure before teaching through a strategy. At the end of presentation of each unit, the corresponding crite-

rion test was administered. The average scores obtained by the students on different criterion tests have been presented in table 1.

Table 1 : Mean Percent Scores on Criterion Tests

	Unit I	Unit II	Unit III
GR. I	(S ₁) 89.6%	(S ₃) 80.0%	(S ₂) 81.6%
GR. II	(S ₂) 90.0%	(S ₁) 68.4%	(S ₃) 80.8%
GR. III	(S ₃) 67.2%	(S ₂) 79.2%	(S ₁) 57.2%

In the above table GR. I, II and III are the three groups of equal strength into which the 30 students were randomly divided. Unit I, II and III denote the units on 'proteins', 'carbohydrates' and 'fats' respectively, taught to the students. S₁, S₂ and S₃ stand for the instructional strategy one, two and three, respectively; which were compared for their effectiveness.

Difficulties encountered by the students regarding the language, frame sequence and the like were noted. Errors committed by the students on the programme frames were analysed. Error analysis was also done for each item of the criterion tests.

Based on the analysis of errors on programme frames and on criterion test items, and also considering the difficulties reported by the students, the programme frames were revised.

The similar, necessary changes were also done in the structured lectures and taped material. The content matter included in all the three units was thoroughly revised to be presented through the three instructional strategies, to conduct the experiment for the present investigation undertaken. The next Chapter V gives details concerning the conduct of the experiment.

REFERENCES

1. Davidson, S. and Passmore, R. (1975) Human Nutrition and Dietetics, The William and Wilkins Company, Baltimore.
2. Educational Technology (1971) The Design and Implementation of Learning Systems, Centre for Educational Research and Innovation, Netherland.
3. Govinda, R. (1975) Development of a Programmed Text on Educational Evaluation and Experimentally Studying its Effectiveness as Instructional Material for B.Ed. Students. Unpublished PH.D. Thesis Submitted to the M.S. University of Baroda.
4. Kochhar, S.K. (1967) 'Methods and Techniques of Teaching', Sterling Publishers (P) Ltd., Delhi.
5. Mager, R.F. (1962) 'Preparing Instructional Objectives', Fearon Publishers, Palo Alto, California.

6. Proudfit, F.T. and Robinson, C.H. (1965) Normal and Therapeutic Nutrition, Oxford and IBH Publishing Co., Calcutta.
7. Swaminathan, M. and Bhagwan, R.K. (1976) Our Food, Ganesh and Co. (Madras) Pvt. Ltd., Madras.
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