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APPLICATION OF SYSTEMS APPROACH AT THE MICRO LEVEL IN EDUCATION : TWO CASES

by

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SYSTEMS APPROACH IN EDUCATION

The problems in the field of education are very complex. The process of education involves various human beings like students, teachers, parents, educationists, administrators and other members of the community. To effectively deal with the verious problems in education, and to plan necessary programmes, the complexity of the situation should be properly appreciated. Any problem in the field of education would have multiple causes, and the solution of the problem would require looking at several variables. Such a complexity lends itself to systems approach.

Systems concept has some underlying assumptions. It is assumed that phenomena occur in an inter relational context, that is, the effect of change in one aspect produces change in other aspects. The various programmes which are being designed have inter linkages. An effective

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planning and implementation of such programmes would require at least two things. First, critical areas have to be identified so that enough attention may be paid to these, and the programmes may be effective. Secondly, various steps taken to implement these programmes have to be taken in the right sequance. It is important not only to identify what should be done, but also in what order. Systems approach, therefore, assumes that variables are inter linked, that critical decision making requires looking at problems from different angles, and that various steps have to be put in a proper sequence.

Systems approach has become popular in several fields, and recently in the field of education. The concept of open system is used in education. The environment feeds in several inputs. The processing which goes on in the system is called throughout and the end results wanted from a programme are the outputs. This is a dynamic concept where several aspects of a system continuously interact with one another and acquire a state of equilibrium which again changes from time to time amongst various parts of the system. The output from one system becomes an input for another, and integration is possible through the feedback loop. Several good accounts of systems approach in education are available. The UNESCO publication A Systems Approach to Teaching and Learning Procedure presents the concept of systems approach in education. The book primarily focusses on the systems approach at micro level.

SYSTEMS APPROACH AT MICRO LEVEL: SCOPE AND STRATEGIES

While systems approach can be used for both macro and micro planning, several good accounts are available for looking at education from

macro level, from the point of view of Systems. Such an approach may help the central planners in designing a total system of education for a state or a country. At the micro level, the purpose of the systems approach is to help educational planners and teachers to use systems concepts to plan effectively instructional programmes.

As has been outlined in A SystemsApproach To Teaching and Learning Procedures, the systems thinking starts with an analysis of the existing situation followed up by setting up of goals for such a situation, defining evaluation mechanisms, generating alternate solutions to achieve the goal, selecting a solution that has maximum benefits and minimum cost, detailing out the design of the system, developing monitoring mechanisms and introducing selected solution. Systems approach is essentially an effective problem solving procedure. Like any effective procedure, it focusses on three main dimensions; diagnosis, action, and reinforcement.

Diagnosis: A current situation is analysed in detail to find out what is wrong in the situation and which parts of the situation need to be remedied. The various causes of concern and dissatisfaction in that situation are looked into so that the main problems can be identified. This leads to the setting of broad goals of the change programme. These goals may relate to improvement of a particular asepct of education or designing of new mechanisms. In order to work on such goals, it is necessary to translate them into objectives.

These objectives are called terminal objectives, because they are the end results that should be achieved if action is effectively implemented.

Each terminal objective should be measured after the action is over to measure its effectiveness. For this purpose, it is necessary to develop specific criteria for evaluating each terminal objectives.

Action: Diagnosis helps in generating ideas indicating various possible solutions of the problem. Such alternate solutions are listed so that one viable solution can be picked up for action. Such a solution is selected on the basis of several considerations, e.g. time and cost, availability of resources, the extent to which the solution is likely to improve the situation, the repercussions of the selected solution on other parts of the system, the extent of the changes produced in these are manageable, etc. After selecting one solution, base line data are collected to find out the present level of the problem. It is necessary because evaluation of the intervention would require comparing data at a later stage with the pre-intervention data. Objective methods are used to collect baseline data. The main part of this phase is the action plan. Specific steps to be taken are worked in detail, paying attention to both the sequencing of these steps and interlinkages. If one step should feed into a previous step the interlinkage is shown. Such planning is very important to make systems approach effective.

Reinforcement: The third and the final phase is primarily concerned with consolidating the gains from the action, and reinforcing the change that has been brought about. In order to do this, proper evaluation is planned with feedback loop. Collecting gdata fter the action is over, helps in identifying those aspects on which action has been effective, and the other aspects on which action has not been so effective. This information is very useful not only in consolidating the gains of change, but also in suggesting new ways of improving the effectiveness. Thus, evaluation provides feedback on action which helps to view the problem from a different angle. The final step of use of feedback for replanning becomes a kind of input for the next spiral development towards the solution of the problem. The 10 steps in the systems approach under three main phases are given in Figure 1.

Figure 1

Steps in the Systems Approach

Phase I	Phase II	Phase III
DIAGNOSIS	ACTION	REINFORCEMENT
1. Diagnosis	1. Preparing list of alternate solutions	1. Evaluation, with feedback loop
2. Setting of broad goals	2. Selection of one viable solution	2. Feedback and replanning
3. Terminal objectives	3. Collecting base line data	
4. Establishing criteria for evaluation	4. Action plan, with interstep linkages	

A Systems Approach to Teaching and Learning Procedures discusses the same steps using a different terminology. Chapter 2 of this book demonstrates the application of systems thinking at micro level to improve teaching learning situations. This has been done taking an example of developing material for teaching reading. The book also discusses a few broad situations and problem areas with scope for using systems approach. These have been mainly drawn from Indonesian experience. The authors feel that there is ample opportunity to apply systems approach in education at the micro level. Some suggestions of areas where systems approach can be used are given below.

Educational Administration

1. To develop a system of supervision for the school headmaster.
2. To establish a training system for increasing teaching skills.
3. To establish a placement system in professional education.

School Administration

1. To develop a reference system.
2. To design the library, the dining system in residential school, and a system of effective use of school resources.
3. To increase the level of activity by teachers.
4. To establish an effective system of school finances, faculty assessment, evolve faculty evaluation procedures and a record for outstanding work.
5. To introduce an innovation in the school.
6. To help the students plan their careers and to establish a communication system between teachers and the parents of students.

7. To organise the mid-day meal programme and establish school health services.

School System

1. To develop a minotoring system for maintaining desired school climate and class room climate.
2. To design a system of interactionfor effective classroom behaviour.
3. To develop motivation of staff and students and to increase student teacher communication.

Nonformal Education

1. To develop a system of adult literacy in rural areas.
2. To design the time table for part time school goers, start correspondence courses and design nonformal education.

Curriculum

1. To develop curriculum for various groups.
2. To design the school time table to suit the community convenience and integrate the school learning with community needs.
3. To set up a physical education system.
4. To improve extra curricular activities and develop creative attitude in students.
5. To design an effective student assessment system.
6. To improve students' study habits.
7. To develop a system of developing psychomotor learning in students, offer counselling services to students, and encourage student relationship.

Teaching

1. To design an effective system of home work, a system of remedial teaching and develop reading skills in students.
2. To develop a sense of responsibility in students and increase student initiative and trust, and their level of activity.
3. To establish a language laboratory, a televised instruction system, and design micro teaching system.

APPLYING SYSTEMS APPROACH: TWO SITUATIONS FROM INDIA

[redacted]

Two situations that offer opportunity for systems approach and are relevance to developing countries have been selected in this paper, and the case studies are presented in the following section.

Situation 1: Designing Mathematics Curriculum

The first case is on designing a useful Mathematics curriculum for standard five (age 11+) in a rural area with a high percentage of potential drop outs.

1. The Existing Situation

In India, a very high percentage of students (70 to 80 per cent) drop out of school after the level of standard five (11+age group). The curriculum for the fifth standard is designed primarily to perform the students for middle school. However, the high percentage of drop outs results in wastage of education . Parents of such drop outs complain that education does not help their children. Such a feeling acts as a negative motivator. Some parents need the help of their children in their occupations like agriculture, animal husbandary, carpentry, weaving, pottery, daily labour, small shop keeping, etc.

Education upto standard five it as exists at present does not motivate the parents to send their children to school.

2. General Aims

Teaching of mathemiatics should be so redesigned as to enable the drop to use their mathematics knowledge after leaving the school.

3. Evaluation

The evaluation would primarily be in terms of the perceptions of parents, students, and teachers about the usefulness of mathematics taught in the school.

4. Alternative Solutions

a. Educate parents about why a particular syllabus in mathematics is being taught. Such a programme would involve some cost. However, the cost would be marginal once the parents are educated and are convinced of the importance of teaching of mathematics. Only one or two evening sessions may be needed to reinforce such education. The school annual day could be used for such education campaigns. This solution is a feasible one, but it would serve only a limited purpose.

b. The second alternate solution is to completely change the mathematics curriculum so that only those parts of mathematics which are useful to the villagers in organising their economic activities (e.g.percentages, interest, profit and loss etc.) is taught. However, such a redesigning would mean introducing non uniformity of standards which may not be acceptable at the policy level. Secondly, the new curriculum has to be developed depending upon the needs of the community where the school is located. This would involve high cost manpower. A change in the examination system and new policies giving autonomy to the schools to

allow them to designing their own curriculum are also needed.

c. A third alternative would be to retain the existing curriculum, but introduce new methods of teaching. For example, concepts of percentage, addition, multiplication, division, interest rates, etc. could be taught with the help of examples given in a text book which is used all over a state or a country. Alternatively, the examples in a text book may be supplemented with additional examples from the community life. In a village community some of the mathematical concepts can be taught by explaining to students how, for example, a weaver would take a loan from banks to purchase raw material from the mills, selling the finished products in a nearby town, and repaying the loan he has taken. The teacher may even take the students to the weavers' place and collect more data as a learning experience. The school can have a handloom to teach weaving. The students may even undertake a project to find out the profit, loss etc. of weavers and learn the application of some of the concepts in mathematics. Similar activities existing in a community could be used. This process of learning would also involve the parents and so help them to perceive the usefullness and relevance of social learning.

Almost no cost is involved in this system. A teacher should be given some amount of freedom to organise various learning processes. Whatever methods he may use, he would be teaching the same concepts and principles which the State Board of Education has prescribed. In terms of the benefits, the drop out children would be of some help to parents in maintaining their accounts for the house and in analysing the profits,

loss, etc. of various activities undertaken by their parents. The parents would also view school education as more realistic and useful.

In the following section using system analysis, an attempt is made to design a teaching methodology system for standard five mathematics class.

5. Selection of a Solution

The solution should be acceptable to the teacher in a school as it involves a change in mathodology to be adopted by the concerned mathematics teacher. The teacher need to take some initiative in designing various activities inside and outside the class room. He might work out a mathodology to integrate the earlier patterns of teaching with the new pattern. Unless the solution is acceptable to the teacher, its implementation may not be effective.

The various mechanisms or processes by which the solution may be worked out are presented in step 1 of the following details.

6. Steps

a. One of the following approaches may be adopted to start the process of designing teaching material relevant to community needs.

(i) All the teachers of fifth standard sit together and generate alternate solutions.

(ii) Each teacher individually brings alternative solutions and together in a group they decide a solution.

(iii) Mathematics teacher works out the solution all by himself.

b. The mathematics teacher finalises his plan and gets it approved by the headmaster.

c. In case of necessity to coordinate, the headmaster calls a meeting and sorts out issues of coordinating activities of various teachers.

d. Mathematics teacher works out the detailed design and mechanisms of implementing this project.

e. Mathematics teacher lists out the various topics to be covered in the syllabus (e.g. additions, multiplications, divisions, averages, percentages, interest rates, profit and loss etc.).

f. Mathematics teacher identifies opportunities where knowledge of his subject may be used in the village and makes an occupation-wise list. An example is given in Table 1.

Table 1 about here

7. If the mathematics teacher is not aware of the opportunities:- the village or if he is an outsider, he spends sometime going into the village, talking to people or to some key persons and collecting data on the occupations, activities, etc. in that village.

8. The mathematics teacher lists out the mathematical skills, principles or concepts that are needed for understanding each of the activities in each occupation. An example is presented in Table 2.

Table 2 about here

9. Mathematics teacher prepares an exhaustive list of activities in the village and the concepts relevant from his syllabus.

10. All teachers get together and exchange notes. Some teachers may modify or add to the list of activities they have prepared on the basis of what they have seen in the notes of other teachers.

11. Mathematics teacher prepares a list of students in his class and tabulates the frequency distribution of parental occupations of students in his class for that particular year. He then decides the weightage to be given in terms of providing learning experiences to students from various occupational families for teaching mathematics.

12. Mathematics teacher decides the activities to be used as learning experiences to teach mathematics. He finalises the list taking into consideration the number of families in that village involved in that occupation and the number of children coming to school from that occupational group. More the number of people involved in a particular occupation and more the children from that group coming to school, more activities relating to that occupation need to be provided as learning experiences. For example, if most of the people sell foodgrains from their fields to the merchants in their town, learning experiences on buying and selling, profit and loss etc. could be provided through examples of this activity.

13. Mathematics teacher lists down examples or mathematical problems centering round each activity as illustrations to teach that concept in mathematics. For example, from taking a loan from a bank

the following mathematical problem may be formulated. "X bank gives loan at the annual interest rate of 10 percent. Shankaraiah, a weaver, borrowed a loan of Rs. 500/- on 15th March 1975. He purchased cotton with this money and made clothes. He earned some money and therefore wanted to return the loan he took from the bank on 15th September 1975. How much does he have to pay to the bank? If the bank loans money at an interest rate of 5 percent for agriculture purposes how much should Satish, the farmer, pay to the bank if he took a loan of Rs. 500/- on 15th March for purchasing fertilizers and wants to repay on 15th September the same?" This problem deals with the activity of getting loan from banks at the same time it gives information about facilities offered by the bank to farmers. Thus for each activity the learning experiences to be provided may be determined.

In addition learning experiences may be provided by asking students to collect data from their parents. For example, the students may ask their parents whether they have taken any loan from a bank or any other source, the interest rate etc. and calculate how much they have to repay. If their parents do not know interest rate, the student can calculate and tell them. Similarly they may collect data on net per-acre yield in their fields, and calculate the labour and other production costs and tell his parents how much they are earning on their land, whether

it is profitable for them to use mechanical farming, whether it is profitable to open a saving bank account etc. The teacher should list down in relation to each activity the possible learning experience.

14. Mathematics teacher then prepares a manual of problems and learning experiences he wishes to provide as additional inputs to the students and arranges them topic-wise. The following format may be used for the manual.

a. Topic : Interest rate

b. Activities : (i) Loan from a bank, (ii) giving loans to others in the village, (iii) taking loans from others in the village, (iv) loan from other sources, (v) subsidised loans, etc.

c. Problems

Different problems like the one illustrated in step. 12. The problems should range over various occupations and should cover all the activities.

d. Learning experiences

(i) Each students collects data from his parents whether they have taken or given any loan, the interest rate, date of the loan and calculates the repayable amount.

(ii) Each student prepares a chart of the amount to be paid over the next two years in cases of loans taken or given.

(iii) Find out the interest rates offered by money lenders in the village or nearby town and compares them with bankrates.

(iv) Find out different sources of available financial assistance to the villagers and compares the interest rates.

(v) The children may bring problems to be solved in the class.

(vi) All teachers prepare a manual of learning experiences to be provided to their students and arrange them topic-wise.

15. Mathematics teacher looks at the manual of others and seeks suggestions from others.

16. Mathematics teacher finalises his manual of learning experiences.

17. Mathematics teacher taken the time-table allotted to his subject for that year and plans out a schedule for integrating the learning experiences he prepared into the curriculum prescribed by the education department. He prepares his lesson plans accordingly.

18. Mathematics teacher teaches for an year using this curriculum.

19. The mathematics teacher interiviews a few villagers at random after the year's teaching, tells them what has been taught that year and invite suggestions, and surveys more activities.

20. Mathematics teacher updates his list of activities on the basis of people he talked to in the village covering different occupations.

21. The process continues.

Various steps involved in this process are presented in Figure 2.

Figure 2 about here

Situation 2: Systems Approach for Improving the Tutorial System in a Residential School

The following is an account ofthe application of systems approach in a residential school for improving the tutorial system.

1. Background

A residential school located in the mountainous parts of North India was selected. The headmaster of the school was innovative and interested in the improvement of the school and development of the status. He sought the help of three experts to help him in designing self-renewal programme for the school system.

Residential schools have over the years worked out methods of educational techniques which have been accepted by teachers as useful. An analysis of the system is, however, necessary from time to time to ensure that the school does not stagnate. This is likely to happen because teachers in residential schools tend to be rather insular and self satisfied as a community. A reason for this is perhaps because the system has been developed into a routine which is easy to operate.

A general programme of self-renewal was therefore undertaken by the teaching community of this school with a view to analyse the existing systems, identifying problem areas and introduce new systems where necessary with clearly defined objectives.

A five day seminar/workshop was organised for all the teachers of the school. It aimed at helping the teachers analyse their role and that of school in the context of the changing society and design strategies for improving the school's activities. It also analysed teacher's

impact on the studnets and the community.

During the seminar teachers identified the following issues as of immediate concern to them vis-a-vis the school:

1. Student participation involvement and responsibility.
2. Teacher participation and involvement.
3. Establishing linkages between the school and the community.
4. Communication process and improving student-teacher interaction.
5. Development of student identity.
6. Staff evaluation.
7. Role relationships among teaching staff.
8. Process of self, and
9. Evaluation of school's progress vis-a-vis school's objectives.

2. Area of Improvement and Selection of a System

From the above issues the school faculty selected staff evaluation, communication process, student involvement and responsibility, and self-renewal for intensive work. The school had several sub-systems. It was difficult to start a renewal process in all sub-systems simultaneously and improve on the existing situation in relation to these four areas selected. Therefore, the faculty decided after considering various micro-systems in the school, like housemasters system, student evaluation system, staff evaluation system, curriculum, classroom behaviour etc.

While evaluating these micro-systems for election, the flexibility offered by the micro-system for change, the human costs involved, the importance of the system to the school, the extent of contribution of the system to the school's objectives, the material costs likely to be involved in changing the system etc. were considered. This kind of a cost-benefit analysis was done to choose a viable micro-system for renewal.

The choice was made after small group discussions instead of any formal evaluation procedures.

3. Steps in Analysing the Problems and Designing Solutions

The faculty divided theemselves into four groups, each group working out mechanisms for redesigning the tutorial system to improve one of the above four issues. The faculty were presented with various steps involved in analysing a problem. The steps involved are presented in figure 3, which is self-explanatory.

4. Steps Involved in Developing a System to Increase the Sense of Responsibility in Students Through Tutorial Systems

The various steps involved in analysing a problem and designing a solution is exemplified below in relation to the problem of increasing student responsibility through tutorials.

a. Objectives

To increase the sense of respobsibility in students through the existing tutorial system.

b. Objective Concepts

Respobisibility may be with reference to various tasks the students handles , his responsibility to people, to the community, to the school, to the teacher and to himself.

c. Existing Structure

Class-monitor system, study hours, house-leader system, extra-curricular activities, and disciplined time-table, etc. provide some opportunities for student development and increase the sense of responsibility.

d. Existing Processes

The effectiveness of the existing systems is doubtful. Their contribution to the students' sense of responsibility is not known. In the traditional tutorial system very little opportunity for developing student responsibility exists as the tutorials are conducted more or less on remedial teaching patterns.

e. Opportunities in the Existing Structure and Processes

1. Flexible time-table
2. Freedom to the teacher
3. Facilities in the school including physical facilities
4. Headmaster's encouragement of innovations
5. Conducive climate
6. Cooperating teachers and other roles
7. Student discipline
8. Student interest, etc.

f. Opportunities that Could be Initiated

1. New activities
2. A record of the daily activities
3. Greater student-teacher interaction
4. More time
5. Individualized attention
6. Bright students to help weaker ones
7. Nearby poor schools could be adopted.

g. Mechanisms Required to be Adopted for New Opportunities

1. Close supervision
2. Detailed designing
3. Self-checking
4. New schedule of time-table
5. Group discussions, etc.

h. Constraints

1. Limited faculty strength
2. No extra remunaration to the faculty due to financial constraints
3. Teachers should not be expected to carry heavy work-load,
4. Close supervision may make students so dependent that sense of responsibility is not developed.

i. Eliminations

1. Close supervision
2. Some activities to be eliminated

g. Evaluation of Feasible Alternatives

1. Students should maintain a diary, of all the daily activities and get them checked once in a week by their tutors. The cost of this is the material costs of the diary, student-time, faculty supervisors time. Benefit is in terms of the student developing self-discipline and responsibility.
2. Bright students should help weaker students in their subject matter. The cost is only the helper students' time. Benefits include the weaker student getting helped by a bright student and thus the one getting helped develops a sense of

responsibility. The helper is disciplining himself and is showing a sense of responsibility by helping the weak student. By helping his own class fellow he is also practicing his learning. Instructor/tutor time is saved for better activities.

3. Seminars and discussions on community life, community needs, etc. This helps students to understand the problems in society and thus contributes to the development of responsibility. Participation in these also helps students develop confidence and sense of responsibility. In terms of cost instructor time, space and other facilities for discussions are required.

h. Criteria for Choice

1. The method should contribute to student development and development of responsibility in students
2. It should be within the existing school budget with no additional funds.
3. It should not demand more than an hours time in a day from the tutor.

i. Choice

All three mechanisms are acceptable as they meet the criteria. All the three are mutually exclusive and supplementary. Even when the three mechanisms are simultaneously in operation the above criteria are fulfilled.

j. Plans

1. Integrate this with the outcome of other three groups (working on increasing communication, staff evaluation, and self-renewal in tutorial).

2. Finalise the steps

3. Introduce

(The detailed plans are not given here as this is dependent on the work of other groups. The responsibilities are allocated for implementation after discussion with the other groups).

5. Steps Involved in Developing a System of Self-Renewal in Tutorial System

The following is another example of translating the planning steps in relation to the development of a self-renewing tutorial system. Only the important steps are given. Other are similar to those outlined above in relation to student responsibility.

a. Objectives

The mein objectives for self-renewal of a tutorial system are:

1. Integration or coordination of various activities in tutorials,
2. Innovation in various activities and in tutorial system,
3. Information or collection of knowledge from different sources,
4. Review and evaluation.

b. Existing Structure

The existing system comprises of house, pupil tutor, and house master all of whom are a part of the school.

c. Process

(as stated earlier)

d. New Mechanisms

The following activities could be used to achieve the above stated objectives: Self-checking, Meditation, Observation, Discussion, Seminars, Visits, Feedback, Training, Cooperation, and Evaluation.

Pupil being the most important, his personality development, social behaviour, academic standards and physical fitness are the focal points in the system. The pupil himself with the help of a tutor in the company of other students and with cooperation of the housemaster can achieve these aspects.

e. Opportunities

The intereaction between the pupil and various others provide opportunities for using these. These include:

1. The pupils work individually (self-interaction)
2. Pupil-tutor interaction
3. Tutor-tutor interaction
4. Pupil-pupil interaction
5. Pupil-housemaster interaction
6. Housemaster-tutor interaction can provide opportunities for self-renewal. For example, the pupil, by self-checking, modification and observation and develop personality.

The pupil in his interaction with tutor through discussions, seminars, training, cooperation, and feedback can attempt to achieve a few more objectives.

The following is the breakdown of different activities that can be used in the various interactional opportunities.

f. Objectives

Pupil: To improve personality, social behaviour, academic standard, and physical fitness.

Tutor: To acquire, use and improve organizational ability coaching and guidance skills, communication skills, leadership skills, and willingness to help.

g. Tutorial Structure

The structure should include strength of the tutorial, place and time of tutorials, meeting frequency, and recording mechansims,

Activities

Self-checking, Meditation, Observation, Discussion, Seminars, Visits, Feedback, Training, Cooperation, and Evaluation. These activities can be used in different interactions as shown in Table 3.

Table 3 about here

The following is a further break-down of the activity (self-checking) into different mechanisms.

Objective

To develop self-discipline, to assess progress, and to create awareness of the progress through self-checking mechanism.

Mechanisms

Diary, Discussions, Record, Review, Thinking, Assessment

The interactions that can use different mechanisms are presented in Table 4.

Table 4 about here

Using this pattern a complete plan of using various interactional opportunities as mechanisms for student development through various activities can be worked out. Such a plan is not presented here due to limitations of space and scope.

Choice

After listing out the various possible alternatives and evaluating them, the group on self-renewal decided to use personal diary for the pupil where he can record detailed personal achievements as a machanism for achieving the above stated goals. Meditation was also decided to be used.

Implementation

The groups also worked out detailed steps for implementing the activities.

6. Integration and Finalization

After each of the four groups offaculty worked on their respective areas and prepared detailed system designs in the manner described above for achieving the objectives they chose and developed the mechanisms. Each groups design was presented to the total community of faculty for discussion and modifications. After each design was discussed separately representatives were selected for each group to discuss and integrate the designs emerging out of the four areas

and prepare an overall design for the tutorial system to achieve the orignal objectives. The representatives of the four groups got together and finalized the design.

Time Period

This system has since been detailed out further and implemented in the school. Designing of this system took about a year since the first seminar. About eight meetings were held by the groups for detailing out the problem analysis and solution designing over a period of one year. At the end of it one day was spent in presentation and another day on finalization by group representatives.

Evaluation

Self-renewal is a continuous process. The effectiveness of the new tutorial system has to be judged in terms of the increased communication processes, increased responsibility-taking behaviour by students, better techniques of staff evaluation etc. Student and teacher satisfactions are also important. As the system has just been implemented, evaluation of these dimensions can take place in course of time. There are indicators of satisfaction expressed by teachers at present.

MATERIALS FOR SIMULATION IN TRAINING SEMINARS

In the first case presented in this monograph an application of systems approach for designing mathematics curriculum was presented. In this section some data are presented to form materials for simulating a case for designing mathematics curriculum relevant to the needs of a community. A brief description of a school and the community surrounding the school are presented below. These descriptions form the background material for the simulation exercise to be used in any training workshop on systems thinking. The case study is followed by role instruction sheets for different role players. The simulation game may be designed for a full-day. In real situations it may require a month or so. The simulation period can be extended to three days or reduced to three hours depending on the time available in the workshop. The different steps involved in using the materials are presented below. The materials given later are referred by the following codes:

AS	=	The Alpha School and its Surrounding Community
HM	=	Headmaster, Role Player
MT	=	Mathematics Teacher
GST	=	General Science Teacher
GT	=	Geography Teacher
WL	=	Workshop Leader

The following sequence of activities may be followed in using

this simulation. These activities are designed for one day (8 hours) simulation.

1. WL introduces the topic (5 mts.)
2. WL divides the class into groups of four. Each group has to work independently (5 mts.) (take care that people with respective subject backgrounds get as far as possible the roles of respective subjects)
3. WL distributes instruction sheets to HM, GST, MT and GT (3 mts.)
4. WL distribution AS to HM, GST, MT and GT almost immediately or simultaneously as 3 (3 mts.)
5. HM, GST, MT and GT read the first step in the instructions and the AS (20 mts.)
6. Clarifications by WL (10 mts.)
7. HM, GST, MT and GT read steps 2 and 3 in the instruction sheet (3 mts.)
8. While they are reading step 2, WL distributes the case study on designing mathematics curriculum.
9. HM, GST, MT and GT read the case study (10 mts.)
10. WL clarifies any doubts on the case study (10 mts.)
11. HM, GST, MT and GT meet to work out the system steps for designing the curriculum and the system (60 mts.)
12. The different groups share the sequential steps they worked out (no. of groups x 15 mts.)
13. The different groups finalise their steps on the basis of discussion (15 mts.)

14. HM, GST, MT ans ST finalise one topic each by going through the total sequence of steps they worked out (15 mts.)
15. The teachers go through the system and come out with a final set of curricule (3 hours)
16. WL may provide hypothetical data to teachers who need the data.
17. Sharing the curricula in the respective groups (40 mts.)
18. Modifications and finalization in groups (20 mts.)
19. Presentation by different groups (60 mts.)
20. Review of the process (20 mts.)

The timings are approximated and are subject to testing and finalization.

(AS) The Alpha School and its Surrounding Community

Alpha school was a primary school located in a rural area. This school was established in 1957 with one teacher to provide education (literacy) to the children of thenereby communities. The population increased and by 1972 the school was convarted in to a middle school with classes upto VIII standard with 14 teachers. The school strength was about 370 students in total. The school catered to about 11,000 population of the nearby rural areas (6 villages). The occupations of the people included agriculture, animal husbandary, poultry, carpentry, and beedi making. There was a forest nearby. A part of this forest was bought by a private company in 1956 for establishing one of its industrial towns. As they got a better site, the company abandoned the idea of using the forest. The company had since decided to allow the villagers to use the forest resources by paying nominal price. The wood being very useful for making safety matches a

few industrialists had come forward from the nearby towns to set-up a match-making industry. The villagers are being used to cut the wood, transport it by bullock carts to the village where the wood was processed and safety matches were made in small factories. There were three such factories. About 150 people from six villages were employed in this business. A few villagers who could read and write, after working for two to three years in the factory left and went to a big city 200 miles away and joined there in a large match-making compnay. They got there four times the salary they were getting in their villages.

The forest also had tobacco plants that were used to make beedis. As bedi smoking was becoming popular, interest in beedi manufacturing incread. Knowing the resources in the forest a small industrialist from another part of the country came and started a beedi factory in one of the villages. He got tobacco to the villages from a place 100 miles away. He bought the tobacco leaves from the villagers. He used villagers to process the tobacco leaves.

Any villager trained in making beedis was free to collect a specific quantity of tobacco and beedi leaves in the morning and returned the ready beedis and left over material in the evening. He was paid on the basis of the number of beedis made. When the business was started in 1965 some villagers had to be trained to pluck and process the beedi leaves, process tobacco, cut and wrap the beedi leaf neatly to make beedi etc. Later, other villagers learnt the technique. About 20 villagers were involved in collecting andprocessing beedi leaves. Five workers were employed to process the tobacco, distribute it to villagers,

count the returns, etc. Every day about 50 to 60 villagers took the material from the factory, made beedis and returned in the evening, thus earning their livelihood.

There was one poultry farm in each village. The eggs were delivered to a nearby town every day. Four of thepoultries were owned by a landlord in the nearby town and the other two small ones by two students. One of them was a graduate and the other had just completed his training. Two years back they took loans from a bank in a nearby town and started the poultry.

Quite a few families in the six villages, were agriculturists. About 50 per cent of the families had agriculture land ranging from one to fifteen acres. Most of them fell in the range of 3 to 5 acres of land ownership. The rainfall had been quite good in thepast few years. The crops included paddy, wheat, lentils, tomatoes, chillies and sugarcane. A few attempted to grow tobacco but could not do well due to lack of technical gudiance. The farmers used traditional methods of agriculture.

There were about eleven carpenter families. These people made the implements like cart, plough etc, for farmers. The farmers got the wood from the forest and supplied to the carpenters for making the required implements. The carpenters charged for their services. A few carpenters have started making furniture. Recently some people from a nearby town came and bought furniture from one of the carpenters at a very high price. He advised them to start making good quality products for the people of the town.

There were two rice mills in the community. The mill owners bought the paddy from the farmers and stocked them. They sold paddy or rice to the nearby town at a high price. They also sold back rice to the villagers. Vegetables grown are locally consument. Only tomatoes and chillies in small quantities are sent to the town.

There was ageneral feeling in the villages that the education their children got was not useful to them. There was no change in their economic conditions. All these villagers were exposed to TV education for a few months through an experimental programms. The TV education taught them that there were lot of opportunities for people who take initiative and use the developmental facilities like interest subsidised loans, etc. offered by the government. Most of the parents in these villages after getting exposed to the programme were highly motivated. They wanted their children to get economically relevant education. In a series of programmes on rural entrepreneurship, the TV programme exposed several entrepreneurs who did not have education, beyond third or forth standard. A few opinion leaders in the community who watched the seres took the opportunity of a village festival to get together and proposed that the village should do something to prepare their children for economic development. Consequently a delegation was sent to the school headmaster requesting him to teach their children such things which would help them to improve. The headmaster arranged a joint meeting with all the teachers of the school. In the meeting, the village leaders pointed out that there were about 70 to 80 people in thesix villages who had studied upto fifth standard and were not using their education in any way. Therefore, it was agreed

to arrange evening classes for them for a year. The school faculty volunteered to teach a few critical subjects in the evenings. These classes were meant to revitalise the forgotten fifth standard knowledge. It was agreed that such classes would help the participating villagers to understand their environment and the opportunities. It was agreed that on thebasis of the experiences of this one year, the fifth standard curriculum in the school should also be accordingly modified to make it more relevant to the community. The leaders agreed to compensate the teachers for their extra work by giving them whatever little they could.

Role Briefing for the Headmaster (HM)

1. You are the headmaster of Alpha School which has 14 teachers and 370 students. Please go through the description of your school and its surrounding community given to you before you proceed to the second step.

2. As you have seen in the case, you, and your teachers have agreed to help the villagers by teaching the group of fifth standard students in the village things relevant to the economic and social life in the village. Your school agreed to undertake this by conducting night classes for a year. You do not have much freedom to change the syllabus or curriculum of the fifth standard in your school as it is prescribed for the total district of 270 schools (of which you are one) by the education ministry. You and your faculty feel that the existing syllabus has not relevance to the village life. For example, in mathematics

all the problemsare taken from urban life. On the basis of your experiences you intend to change the school curriculum within the freedom available for the coming year. You have a month's summer vacation before the next academic year begins. You decide to spend this time to design thecurriculum. You also decide to teach Mathematics, General Science, Civics and Social Studies, and Geography.

3. Your subject is Civics and Social Studies. You have three other teachers to work with you to design a curriculum for teaching other subjects. In order to acquaint yourself with the use of systems analysis techniques for designing curriculum please go through the case study I on designing mathematics curriculum given in this report.

4. On the basis of this reading, you may now calla meeting of your three teachers to work out a sequance of steps for designing the curriculum You may discuss with your teachers and then prepare a sequential diagram of your activities for desiging the curriculum. You have about one hour to do it.

5. After you complete the sequential model each of you may choose one topic for further work. For example, the mathematics teacher may take up profit and loss, the geography teacher may take up a topic like tobacco growing soils, general science teacher may take up plants and plant life or tobacco plants, you may take up cooperatives, etc. Choose one topic each and go through the sequential process. You may instruct the other three teachers also to complete the process taking up one of the topics they want to elaborate. By the end of it each of you will have detailed curriculum for one topic. This may

be in the form of a lesson plan or a series of lesson plans. You might use up about three hours. You may select such topics that can be worked out in two to three hours time.

6. After you have designed the curriculum work out along with your other teachers in a system for introducing the same or similar curriculum for your regular fifth standard students.

Instructions for the Mathematics, Social Studies and General Science Teachers

1. You are the mathematics/social studies/general teacher for Alpha School. You teach this subject to the fifth, sixth and seventh standard students of Alpha School. Please go through the description of your school and its surrounding community given to you before you proceed further.

2. As you have seen in the case you and your colleagues along with the headmaster have agreed to help the villagers by teaching to a group of adults with education upto fifth standard by educating them about social and economic aspects. You agreed to undertake this for a year in the school in the form of night classes. You do not have much freedom to change the syllabus. However, you strongly feel that whatever you are teaching is not of much use to the school boys who do not continue their studies beyond this school. All the examples and text material given are relevant to urban life. However, the same syllabus if taught in a different way may make a lot of sense to the villagers. On the basis of your experience of designing a curriculum and teaching the adults of the surrounding community you want to

teach in a different way than you teach your regular class. Your school now has a month's summer vacation in which you, your headmaster, and the other two teachers decided to spend designing the curriculum for the adult education next year.

3. Please go through the case on designing mathematics curriculum given to you to understand the sequence of steps involved in designing a curriculum.

4. Figure 2 in the case presents the sequence of steps involves in designing a socially relevant curriculum for the fifth standard students. Now you in consultation with your headmaster and other teachers may work out the sequential process steps involved in your designing of the curriculum. Please sit with them and prepare the sequential model.

5. After completing the model you may choose one topic from your subject and work out the details using hypothetical data. You have about three hours. The outcome may be one or a series of lesson plans for a topic choosen by you.

6. Work out mechanisms of introducing the same or a similar curriculum to your regular students.

TRAINING IN THE USE OF SYSTEMS ANALYSIS

Systems Analysis cannot be used effectively unless the persons concerned (teachers, headmasters, school supervisors, administrators, etc.) undergo some relevant training. The use of systems analysis would require both a conceptual understanding of the approach, as well as some

practice in the use of necessary skills involved. This section deals with organization of such training, with one illustration in some details.

Organization of Teaching-learning Procedures

The following general pricniples are suggested for the designing of training in the use of systems analysis at the micro-level in education, in order to optimize teaching-learning procedures.

1. The participants should be unfrozen and stimulated to think about the problems, and be prepared to be more creative in their approach. If the participants come with their convential approaches, and continue to use these approaches in the training programme, the effectiveness of the programme will be highly limited. One useful way of unfreezing the participants and stimulating them is to use some from of a Micro Lab. Micro Lab is a very useful input in the beginning of a programme. Its purpose is to meximise interaction amongst participants on some crucial aspects of the programme, without giving them enough time to discuss various aspects in details. Rao & Pareek (1977) have described the use of the mechanisms of a Mirco Lab. Micro Lab may be used to help the participants examine their understanding of various aspects of a problem, hopes and apprehensions they have about the systems in which they are working, ways of increasing the effectiveness of their systems, etc. Such an exercise is done for about an hour and a half in the beginning of a programme. After the Micro Lab, the participants show enough involvement and their initial hesitation is reduced. Various items

to be included in the Micro Lab are listed in the paper by Rao & Pareek (1977).

2. The participants should have clear understanding of the systems approach and other related concepts. Without prior conceptual understanding, their use of systems approach may be only superficial and mechanical. Enough emphasis should, therefore, be given on the understanding of the concepts. This would require discussion of such concepts, the basic assumptions involved in the systems approach, steps taken in using systems approach in solving problems in education, etc.

3. People learn a great deal if they are exposed to relevant experiences both of successes and failures, with necessary analysis of such experiences. In order to help them learn from others' experiences, case studies on the application of systems approach in various situations may be helpful. This is one kind of simulation which can be used in the training programme. At least one case study of success and one of failure of the application of systems analysis may be useful to help the participants analyse preconditions for success and factors to prevent failure.

4. Participants learn more through experience than through more conceptual understanding. In addition to understanding the concepts, it is necessary that participants also experience what they are learning. For example, instead of only understanding the concepts of systems analysis, if they are able to experience the use of systems analysis it may be very useful. Such experience can be provided in two ways. One way is to take one aspect of the systems approach and simulate

it in the class itself through some game or exercise. The other way may be to help them do something in the programme which they are attending so that the systems approach can be directly used and experienced. In both cases, critical analysis of such experiences will be necessary.

For the use of systems approach in the on-going programme, a few module groups can be formed, each module group having only about four to five participants. Each module group may be required to prepare a systems approach to one aspect of the problem. For example, if the participants are drawn from different cultural backgrounds and the effectiveness of the programme is low due to the cultural heterogeneity, one module group can work on using systems approach to define inputs for dealing with the problems of cultural heterogensity. Similarly, different module groups can take up different aspects after such problems are identified in a general meeting.

5. Effective learning of systems approach would involve learning of relevant skills. In addition to conceptual understanding and insight, various skills are involved in the use of systems approach. Such skills would include preparation of tools forevaluation, intervening, problem solving, preparation of feedback material etc. Such skills can be acquired by proper analysis of various aspects of the approach. Skills can best be learned through practice. In order to help the participants learn the skills in the use of systems approach, enough opportunity may be given in the programme to help them practice these skills. Practice will be possible through the

use of simulation exercises, designing of small inputs in the module groups, designing evaluation methods, designing simulation of a number of subjects, designing systems programmes on which they are likely to work when they return etc. Such practice will give them enough competence to use.

Management of Learning

Training should focus enough attention on management of learning. The main concern of management of learning are: (a) learning is quick, (b) it is internalised and sustained, (c) it is effectively used, (d) it promotes development and creativeity, (e) it builds capability of self-learning.

The various aspects of learning are interrelated. Appropriate technology helps in achieving such linkages. The following principals of management of learning may be kept in mind while preparing the training programmes and learning-teaching technology.

1. A combination of challenge and joint work maximises learning. Challenge can be developed through competition for excellence, and intriguing problems in which students get interested. Equal emphasis needs to be given on collaboration amongest students to solve some problem jointly.
2. Graduated success on challenging tasks ensures effective learning. The learner should be helped to take up more difficult challenges, and he should experience success in such tasks. This principle has implication for designing curriculum and teaching materials.

3. Supportive and non-threatening climate promotes learning.
4. Immediate feedback helps in reinforcement and internalization of learning. Progammed instruction uses this principle very effectively. Review exercises can also be designed for this.
5. Practice, i.e. opportunities to repeat and apply what is learned helps in sustaining learning.
6. Helping learners "discover" knowledge through search and joint effort makes learning more challenging and satisfying.
7. Opportunities for "experimenting" increase motivation for learning.
8. Learning is more effective and lasting if what is practised is consistent with what is taught in thetraining institutions. The institution or team of trainers should realise that much more is communicated by what is done there than what is taught. If a training institution does not use systems approach in working on their own problems, and merely teaches it to the participants, learning will not be effective. The faculty involved in training should sit down and discuss from time to time the extent of what they emphasize in the training programmes is in fact being practised by their group both collectively and individually. The climate of the institute has a lasting influence on the participants.

Preparation of Training Materials

The main training materials for systems approach are in the form of simulation. The main purpose of simulation is to create experience when such experience cannot be provided directly in the field. Simulation has the advantage of focussing on one aspect of the experience. It may be possible to highlight that part, control other

variables so that one aspect comes into bold relief. From this point of view, the artificial nature of the simulation experience becomes in advantage. Various kinds of simulation can be used in the training programmes for systems approach. This can range from the use of other's experiences to creating experience in the situation in which the participants lives. The following simulation experiences suggested the range of this dimension:

1. Case teaching

   The case helps to bring out the experiences in the class-room and it is the beginning of simulation. It recreates other persons' experience and helps participants to look at that experience from various angles.

2. Role play

   Some aspects of a situation can be isolated either to give an insight into those aspects to the participants, or help them to practise some skills. Role play has been found to be one of the best techniques for such purposes. In role play, some aspects of the systems are simulated and the participants have an opportunity to either see them more closely or practice ways of using in intervention. More and more use should be made of the role play in the training programmes on the use of systems approach in education.

3. Games

   While role plays select only one single aspect, a game takes various dimensions into consideration and integrates them into a single experience. Games can be used to help the participants to experience various dimensions of a phenomenon, which otherwise

would be difficult to understand. For example, in order to understand the effect of two ways of dealing with pupils in a classroom (direct and indirect influence styles) two class-room situations can be simulated, details can be given to the two separate class-rooms where roles of teachers can be assigned to two persons, and after a period of 15 to 20 months of "teaching" in these class-rooms, data can be collected on the effect of two different styles of pupils. Comparisons can then be made to show how one analysis may be more stimulating, that is it encourages pupils to ask questions, increases their freedom to be innovative and be creative. The other has the opposite effect. Such a game can help in dramatising the effects of the different variables.

4. Simulation on computers

The advances in quantitative methods have made the use of comuputer more feasible in using some simulation experiences. Where several variables are involved, and quantitative decision have to be taken, the computer simulation may be very helpful. This may be useful in programmes involving financial aspects, or if complex planning is to be done with several variables and with a lot of data.

5. Simulation for problem solving

As already stated earlier, in a training programme, module groups can be formed to work on various aspects requiring solutions. Such module groups can be very helpful both to demonstrate the

utility of simulation, give practice to the participants as well as use the material generated for the improvement of the programme itself.

6. Simulation of local community dynamics and problems

It may be useful to use some local based forms of simulation. Various aspects of community life provide opportunities to develop new simulation material. Local based simulation may not only help people understand some problems in a better way, but may indirectly help them to see new alternative solutions for the problems they have been facing. In order to develop such simulation materials it may be useful to study the various aspects of community dynamics and pick up those which seem to be significant and critical. Then these elements can be brought together to develop an exercise. One such exercise has been developed and used in some villages (Rao, 1977). In this exercise a group of weavers who have learnt weaving carpets on a new type of handloom had to be taught about the advantages of collaboration and the necessity for quality control of their products. A simulation game requiring them to buy plain paper, make paper envelopes out of them and sell them back to the instructor was designed. Cooperation was taught by requiring them to sell their products (envelopes) in bulk to get higher prices and quality control was taught by rejecting or paying low price to the poor quality envelopes. Details of this exercise are presented elsewhere. This very game in modified forms has also been used with highly educated groups.

Students can be used in developing a simulation exercise. They can be encouraged to collect some data, or at least provide some information. For example, in a village having a large number of sheep and milch cattle, a simulation exercise can be developed on the feasibility of setting up a slaughter house or tannery. In order to do this kind of simulation students can collect data about number of animals in the village, their life span, number dying every year, number being sold out for slaughtering, number of dead animals being sold out, at what price etc. After collecting such information students can be divided into small groups and to form small teams representing responsibility of different sections of the community, to work out the details and communicate with each other on the price at which equipment can be bought for setting up a slaughter house or a tannery, etc. The teachers can work as a resource people for any information pupils want to have about the price of machinery, other facilities etc.

Having such a simulation may help them to learn more about animal care, process of slaughtering and tanning such simulation can be done around certain aspects of the curriculum. Before such an exercise is tried out in the classroom the concerned teachers may sit together to discuss how contents of differents subjects can be taught through such an exercise. For example, if the language teacher may want them to do composition on the current status of animals in the village, requirements for setting up a tannery, the advantages and disadvantages of setting up a slaughter house in thevillage etc. Such work can be done as a part of simulation where groups of students, representing sections of the

community, should be asked to prepare memoranda and working papers for the appropriate authority who would like to understand the problems. Similarly, the science teacher if he is interested in teaching about the disceases of animals, habits of animals, care of animals etc. can give assignments on those aspects to the various teams representing different groups of the community. They may be encouraged to collect information by interviewing the teacher or reading books and prepare some documents about such information. Space does not permit to give full illustration of this kind of simulation. If teachers can look for opportunities around them in the community, they may find enough material for simulation in which systems approach can be very appropriate. In various cases even the community can be involved, e.g. the community being available as a resource to the students who want to get more information, survey the attitudes etc.

7. Systems design exercises

As exercise can be used in which the necessary information and data are provided as background and the participants are asked to work out a systems approach in the class-room, and have it critically reviewed by all the participants and the faculty present. Since such an exercise can be extremely helpful, one example of such exercise is given below. For want of space, examples from other simulation methods are not given.

ANALYTICAL BIBLIOGRAPHY OF NATIONAL LITERATURE ON SYSTEMS APPROACH IN EDUCATION

Anand, C.L. and Dave, P.N. An analytical study of some major objectives of teaching social studies and ways of attaining them. Indian Educational Review, Vol. VI, No.2, 1971, 238-249

Presents an analysis of the objectives of teaching social studies as understood by several teachers in four states of India - Points out the gap between understanding of objectives useful for systems analysts involved in improving social science teaching.

Basu, C.K. (Ed.) Programmed instruction in industries, defence, health and education. New Delhi: Indian Association for Programmed Instruction, 1969.

Presents several articles on the application of programmed instruction in industries, defence, health and education. Articles on systems analysis of teaching-learning process, programmed instruction as applicable to industrial training, programmed instruction for health programmes, and for defense services are presented. Research reports on applications of programmed instruction are also presented.

Basu, C.K., Basu, S, Tuli, K.C. Effectiveness of language laboratory in teaching English sound system to secondary school students of Indian origin. Shaikshik Takiniki, Vol. 1, No.1, 1974, 52-60

Presents an outline of the language laboratory and its effectiveness in teaching English sound system to secondary school students. Useful for application of systems analysis to effective English teaching.

Bhattacharya, S.P. Towards mathematical models of teaching, Indian Educational Review, Vol. VII, No.2, 11-19

Reviews significent research on mathematical models of teaching. Factor analytic models, stochastic models, and cybernatical modela are outlined briefly and suggestions are made for future research.

Kulkarni, S.S. Teaching learning process: A systems analysis. In I J Patel et el (Ed.) A handbook of programmed learning. Baroda: Indian Association for Programmed Learning. CASE, M.S. University, 1970.

Presents a systems analysis approach to teaching-learning situations. This is a general reading on systems analysis.

Kulkarni, S.S. Application of educational technology in pre-service and in-service training of teachers. Shaikshik Takniki, Vol. 1, No.1, 1974, 1-16

Discusses the application of programmed instruction techniques to pre-service and in-service training of teachers. Users of systems analysis to teacher training would find this useful.

Kulkarni, S.S., Dewal, S.S. The use of programmed learning procedures to improve televised instruction. Indian Education Review, Vol.2, No.1, 1976

Presents an analysis of the use of programmed instruction procedures in televised instruction.

Kulkarni, S.S., Mullick, S.P. Correspondence course and programmed learning approach. Journal of the Regional College of Education, Bhopal. Vol. 3, No.1, 1976.

Use of programmed instruction to correspondence courses are outlined. Experiences in this are reported.

Limaya, T.N. Systems approach to technical education. Tilak College of Education, Pune - 411 030, Maharashtra (Unpublished manuscript), 1977.

Presents an outline of systems analysis approach to technical education.

Griffin, W.H., Parrek, U. The process of planned change in education. Bombay: Somaiya Publications, 1970

Outlines the process and dynamics of planned change in education. The concept of planned change, the setting of planned change, the readings required for change, the dynamics, role of leadership and support in planned change and the role of agents of change are outlined in detail in different chapters. Several incidents and caselets are presented in different areas. Meant for all systems analysts and change agents in education.

Jagdale, M.H. Examination reforms: A plan for action. Department of Chemistry, Shivaji University, Kolhapur, 1977.

Presents an action plan for changing the examination system in Chemistry. Uses in a general way the concepts of systems analysis in presenting the action plans.

Kerba, R.M. and Bruce, M.H. Examination and evaluation in Science education in India: A new approach. Indian Educational Review. Vol.VIII, No.1, 1973, 37-56

Since Bloom's initial study of the examination system in India, studies and practical experience have further confirmed the need for adopting a new approach in evaluation. Evaluation requirements of proper system of science education lie in stressing objectives other than the achievement of right answer alone. Necessary for this is decentralization of responsibility for programme development down to the class room level. This paper elaborates the implications of a new approach of evaluation. Systems analysts working in examination and evaluation systems would find this article useful. Several models are presented.

Kalla, Asha. Report of practice teaching w rk at Gandhi Shikshan Bhavan, 1976-77. Quest in Education, Vol. XIV, No. 1, 1977, 76-86

Reports a systematic analysis and description of practice of teaching work used in a college. Systems concepts have been used in a general way.

Matthai, R.J., Pareek, U. Rao, T.V. (Eds.) Institution-building in education and research. New Delhi: All Indian Management Association, 1977.

Presents several papers on planning educational and research

institutions. In several cases the processes point out the use of systems concepts in a lay way. Some papers are experience based, and some papers present theoretical models of macro systems like universities. Decision-making strategies and institutional designs are highlighted in several papers. Useful for higher education.

Mehta, Prayag. Managing motivation in education. Ahmedabad: Sahitya Mudranalaya, 1976

Presents detailed designs, theoretical bases and mechanisms of motivating students. Teachers and other agents in education. The training designs presented are based heavily on McClelland's achievement motivation programmes. Several materials for use in organising and conducting training programmes to improve student or teacher motivation are presented. Helps those interested in designing motivational interventions.

Mullic. S.P. Validation testing of programmed instruction materials. Indian Educational Review. Vol. VII, No.2, 1972, 20-35

Presents methods of validation testing of programmed instruction materials.

Pareek, U. Rao, T.V. Motivation training for mental health. New Delhi: National Institute of Health Administration and Education, 1971.

Presents details of an experiment conducted on fifty schools in Delhi to improve student personality through changes in

classroom behaviour of teachers. Feedback on Flander's interaction analysis was used in a training programme designed to help teachers gain insights into their own behaviour, and plan future strategies of interaction. This is an example of use of systems approach in feedback based interventions for improving classroom behaviour. Report presents in detail the total study.

Pareek, U. Rao, T.V. Behaviour modification in teachers by feedback using interaction analysis. Indian Educational Review. Vol. VI, No.2, 1971, 11-46

A system of feedback to change classroom behaviour of teachers through training is presented. Detailed training design with results of its use with ten teachers are presented. Designers of effective teaching behaviour would find this useful. Evaluation of the study is also a part of the paper.

Passi, B.K. Becoming a better teacher: Micro-teaching approach. Ahmedabad: Sahitya Mudranalaya, 1976

Presents the use of micro-teaching approach to improve teaching skills.

Patel, B.N. Leadership for better instruction. Ahmedabad: A.R. Sheth & Co., 1977

Discusses various aspects of leadership role for improving teaching.

Pillai, J.K. Basic teaching model. Department of Education, Madurai University, Madurai, Tamilnadu (Unpublished paper, 1977).

Presents a basic teaching model outlining the seqqence of teaching-learning process. This paper is meant of teacher-trainees.

Ramachandrachar, K. A plan of action for secondary schools for 1976-77 - A suggested model. Department of Extension Services, St. Ann's College of Education, Mangalore, Karnataka, 1976

Presents a plan of action for improving school practices Detailed suggestions for schools are presented with examples.

Rao, T.V.,Mehta, Prayag. Classroom interaction analysis: A report of training and research in India. Indian Educational Review. Vol. VIII, No.2, 1973, 39-53

Reviews the work done in classroom interaction analysis in India upto 1971. Most of the researches and trainers have used Flanders' interaction analysis techniques in their attempts to help improve classroom teaching behaviour.

Santhanam, M.R. Research on teachers' verbal communicative behaviour in classroom. Indian Educational Review. Vol. VIII, No.2, 1973,177-184

Presents a review of researches on classroom verbal communication of teachers. Most of the researches used Flander's interaction analysis techniques.

Shah, G.B. Educational technology and systems approach. Shaikshik Takniki, Vol.1, No.1, 1974, 65-69

Outlines the role played by 'systems approach' in educational technology and programmed instruction.

Shah, G.B., Dewal, O.S. Technology knocks at the door of education. Baroda: CASE, M.S. University, 1970

Presents the total process of programming instruction. Presents various techniques and ideas, in the use of programmed instruction.

Sharma, K.K., Syag, R.N., Sidhu, P.S. A comparative study of the effect of microteaching under simulated condition with microteaching with varying source feedback upon general teacher competance. Abohar: D.A.U. College of Education, 1977

This is an experimental study on microteaching testing the role of various sources of feedback on its effectiveness.

Sharma, M.L. Diagnosing school personality. Baroda: CASE, M.S. University, 1975.

Presents detailed outline of an adapted version of Halpin and Craft's Organisational Climate Descriptive Questionnaire (OCDQ) in India. This instrument could be used to diagnise school culture and personality on various dimensions. Details and uses of organisational climate studies are presented.

Singh, M. Raghuram. A perspective view of teaching and learning. Indian Educational Review, Vol. VII, No.2, 1972, 194-208

Briefly reviews various teaching models, tehories of teaching instructional procedures, classroom interaction etc. and presents an over all view of teaching and learning.

Yadav, M.S., Govinda, R. Research task in instructional technology: A systems view. Indian Educational Review. Vol. X, No.2, 1975, 14-23

An attempt has been made to indicate the area of instructional technology in broad perspective, taking instructional process as a total system. Several studies have been outlined as research task in relation to various components of this system, Evaluation procedures have been indicated with a view to bringing about internal improvement in the functioning of each component as well as to establish the effectiveness and feasibility of the system.

USE OF SYSTEMS THINKING IN INDIA

Systems thinking is being used increasingly in India. This was brought by the movement on programmed instruction a decade ago. Several teachers and teacher-trainers have been trained in techniques of individualised instruction by bodies like the National Council of Educational Research and Training and the Indian Association for Programmed Learning and Educational Technology. As training in these techniques exposed them to systems thinking, many of these trained in these techniques use systems thinking in some way or other. Most popular uses include development of teaching materials, designing school time-table and activities, lesson planning and designing assessment systems. Names and addresses of educationists using systems thinking and thesituations where they are applying are presented in this section. This list is based on responses to a mailed questionnaire sent to about 400 teacher-training institutions and other educational bodies in the country including the

state Departments of Education. Members of the Indian Association for Programmed Learning and Educational Technology are not listed here due to space limitations.

While several enthusiastic educators are not using systems techniques due to lack of training and exposure to these techniques, several of those using also have problems. A list of these problems obtained from our survey are presented following the list of institutions.

In our mailed survey of 400 institutions, only 70 responded. Of them about 33 stated that they are not using systems thinking but indicated their interest in using systems thinking. Among those reported to be using systems thinking most of them state that they are using it without any formal training and in their own indigenous ways. The respondents were very positively inclined to use systems thinking and wanted more training and literature. Hence, workshops to educate interested educators in systems thinking would go a long way in helping people improve teaching-learning situations in different ways.

List of National Institutions and Persons Practining Systems Analysis at Micro Level [redacted]

The name and address of each institution (a) is followed by (b) the names of persons involving in the use of systems thinking, and (c) a short abstract of the work in which they are involved.

1 a. Regional College of Education, Ajmar, Rajasthan.

b. Professors P N Dave, Professor P O Bhatnagar, Dr. S D Roka, and Dr. (Mrs) A Kaur.

c. This institution is using systemsthinking to organise internship programme for their students, to allot students to hostels, in the summer school-cum-correspondence courses, and in correspondence-cum-contact programme. Their application of systems thinking lies in systematic planning and analysis of the various processes related to the above mentioned dimensions. The faculty work as team and also at individual levels. Cost-analysis is used along with several other criteria including social costs and benefits in planning their programmes.

2 a. Gandhi Shikshan Bhavan, Juhu, Bombay-400 054.

b. Mr. Vajubhai Patel, Mrs. Safiaben Ankolvi, Miss Ashaben Kalla, and Dr. (Mrs) Kamalaben Patankar.

c. This institution has been using systems thinking in designing and evaluating their practice-teaching programmes... Organising social-work and adult education programmes and organising work experience programmes. They do not use cost analysis. They publish annual reports on the different aspects of their college-work.

3 a. S.N.D.T. College of Education for Women, Karve Road, Poona-4.

b. Dr (Miss) V.B. Mehta (Principal), Mr. P S Purandare, and Mrs. M. Mahajan.

c. This institution is in the process of defining aims and objectives and relating them to teaching and examinations. Work-load is being analysed. They are planning to organise courses on systems thinking.

4 a. Regional College of Education, Karnataka.

b. Rev.P.C. Eapen and team

c. They have been using systems thinking in relation to the internship in teaching programme. They have reorganised their tutorial systems recently.

5 a. Indian Institute of Management, Ahmedabad- 380 015

b. Chairmen and Activity Heads in this institution concerned with Admissions, Post-Graduate Programme, Management Development programmes etc. The Education Systems Group consisting of Professors Udai Pareek, Ravi J. Matthai, and T.V. Rao help educational institutions in planning, designing and renewing various sub-systems.

c. Cost-benefit analysis, PERT, CPM, etc. several techniques are used. There are specialized disciplines in this area.

6 a. Centre for Advanced Studies in Education, M.S. University, Baroda.

b. Dr M B Buch (Head), and all faculty.

c. Programmed instruction, microteaching, motivation programmes etc. are being conducted. The centre, besides using these techniques in their curriculum, helps local schools in the practice of systems thinking.

7 a. 3 Department of Extension Services, St. Ann's College of Education, Mangalore - 575 001

b. Dr. K Ramachandrachar, Co-ordinator.

c. Using systems approach to introduces good school proactices in schools. Facing problems of schools not implementing the recommended practices.

8 a. School of Education, H.P. University, Simla 5

b. Dr. Anand Bhushan

c. Uses systems analysis for educating a contact programme in correspondence courses. Working individually.

9 a. P.V.B.T. College of Education for Women, i, Nathibhai Thackersey Road, Opp. Maharshi Karve Road, Bombay 400 020

b. Miss S K Mehta, Dr (Miss) M T Lakdawala, Dr (Miss) B C Shah, Dr (Miss) R R Ashar, Dr (Miss) Y M Mahta, Miss A A Dabhalkar, Dr A W Oak, and Mr. R M Gangal.

c. Using systems analysis techniques in most administrative tasks and in some teaching-learning activities. Facing problems of focussing on evaluatinn and feedback stages.

10 a. Bombay Teacher's Training College, Kittridge Road, Cuffs Parade, Colaba, Bombay-5.

b. Dr B P Lulla

c. Using systems analysis procedures in (a) organization of practice-teaching programme, (b) organization of tutorial discussions, and (c) organisation of lectures improvement.

11 a. Kapila Khandwala College of Education, Santacruz West, Bombay-54

b. Professor M Y Bhide and all faculty.

c. Using systems analysis in the assessment of tutorial work, assessment of lesson plans, and assessment of practice lessons.

12 a. Department of Education, Birla College of Science & Education, 2 Moria Street, Calcutta-17

b. Dr G J Dubey

c. Using systems approach in improving practicals and tutorials.

13 a. B.D. Shah College of Education, Madasa, District Sabarkanta, Gujarat-383 315

b. Professors C G Chandhari, N D Shelet, and G N Patel

c. Using systems techniques to organise student teaching programes in schools, to organise work-experience in colleges and for the in-service training of teachers.

14 a. Department of education, Madurai University, Madurai-625 002

b. Dr (Mrs) J K Pillai

c. Teaches a course on systems thinking to M. Phil. students.

15 a. Government College of Education, Belgaum, Karnataka.

b. Mr. P Oba Naik and other faculty

c. Uses systems thinking in (a) designing effective programme of lectures, tutorials, practicals, work-experiences, etc. (b) improving achievement in mathematics, (d) guiding practice-teaching, and in (d) project work.

16 a. Government Training College, Vellore 632 006, Tamil Nadu.

b. Mr P S Bala Subramanian and Mrs. Nalini Raman

c. Uses systems thinking in designing time-table, teaching practices, library work, and terminal examinations.

17 a. College of Education, Post Box 31, Jalgoan, 425 001

b. Dr. G L Bhirad, Mr. S M Tiwari, and Mrs. L K Jain

c. To improve teaching through group work.

18 a. S.S.V.S.S. College of Education, Osmanabad-413 501

b. Mr. M D Rane (Principla)

c. For designing and improving practice teaching, psychological experiments, attendance ,and tutorials.

19 a. Rajasthan Shikshak Prashikashan Vidyapeeth, Shahpure Bag, Amer Road, Jaipur (Rajasthan)

b. Mr. V B L Mathur, Principal

c. Designing time-table, and to improve practice-teaching.

20 a. B V College of Education, Post Banasthali Vidyapith-304 022

b. Mr L K Dad (Principal), Mr Virender Sabharwal, Dr K Kumar, Dr R P Singh, and Dr (Mrs) Vimla Mahesh.

c. Using systems analysis for improving (a) tutorial system, (b) micro-teaching, (c) teaching English as second language, (d) open internal assessment scheme, and (e) block practice-teaching.

21 a. N S S Training College, Changanasherry-2, Kerala

b. Mrs. N Sumathy Kutty Amma

c. Designing objective-based lession plans, improving achievement in educational psychology, improving science teaching in Kerala schools.

22 a. Government College of Education, Latur, Dist. Osmanabad, Maharashtra.

b. Professors K V Kulkarni, and V P Didhamande

c. Using systems thinking for (a) developing teaching skills, (b) preparing lesson plans, and (c) evaluating content knowledge.

23. a. Department of Education, Meerut University, Meerut, Uttar Pradesh

b. Dr R S Pandey, and Dr J P Srivastava

c. To train teacher-trainers, to improve classroom relations, for preparing teacher-training curricula, and for improved lesson-planning.

24 a. Lawrence School, Sanawar, Simla Hills, Himachal Pradesh.

b. Mr. Shomie K. Das (Headmaster)

c. For the effectiveness of tutorial system, and self renewal of the school.

25 a. National Council for Educational Research and Training, Shri Aurobindo Marg, New Delhi 16

b. Professor C K Basu and Dr C H K Misra

c. Training systems analysis to various institutions.

26 a. National Institute of Bank Management, 85 Nepean Sea Road, Bombay-6

b. Dr S S Kulkarni

c. Teaching Systems analysis to various institutions.

27 a. Department of Education South Gujarat University, Surat, Gujarat

b. Dr B Shah and Dr. M L Sharma

c. To improve organizational climate of schools through feedback on Halpin and Crafts OCDQ, and

Besides these several educationists trained in programmed instruction use systems thinking. Lists of these are available from the membership list of the Indian Association for Programmed Learning.

Difficulties in the Use of Systems Approach

Several difficulties faced by the educationists in India in using systems analysis approaches are presented below. These are based on a survey.

1. Lack of systematically trained staff in systems thinking.
2. Failure of client systems to implement suggested plans.
3. Non-acceptability of systems techniques by all the faculty.
4. Lack of forward looking and reviewing attitudes by teachers
5. Too much of work involved in this.
6. Lack of communication among those working for a common goal
7. Lack of support systems and facilities.
8. Delays in implementation.
9. Lack of time for systematic evaluation and feedback.
10. Lack of initiative in students.
11. Lack of commitment in students.
12. Paucity of guiding literature on systems thinking.
13. Constraints imposed by steriotyped courses.
14. Difficulties of assessing performance.
15. Crowded classes.
16. Lack of special training for staff in statistical analysis.
17. Falling short of time to complete lessons.
18. Lack of flexibility to use one's own schemes.
19. Strict and rigid government rules limit the choices of solutions generated.
20. Busy teachers.

21. Feeling of loss of freedom by students.

22. Getting alternative solutions accepted by the functionaries.

23. Receptivity to monitoring mechanisums generated.

24. Difficulties in involving all teachers due to time requirements.

25. Getting additional funds.

26. Resistance of teachers to innovations.

27. Lack of adequate staff members.

The problems and difficulties indicated in the survey need not deter people who want to experiment with end follow systems approach. Some suggestions are given below to overcome these difficulties and problems.

1. <u>Building support in the faculty and the clients system</u>

One main way to deal with the problems is to build enough support in the group of teachers and those who want to use the systems approach. Lack of understanding, also resulting in lack of appreciation, may produce threat to people when such an approach is being tried by others. Therefore, one way to reduce the threat is to spread the knowledge of systems approach amongst the client system as well as the faculty. Small orientation programmes and appreciation programmes can be organised, and it may be made clear that everyone can learn and use the systems approach. The mystery may be taken out of the systems approach. It should not appear as the privilege of the few only. Appreciation programmes may help people understand the systems approach in a broad way.

2. Building up reference system and resource centres

Another difficulty experienced by people is that they do not have any resources centre to which they can refer when there are problems or when they want some special materials. The following suggestions can be considered for this:

a. Those who are working on systems approach may pool their resources, and form a kind of consortium of such resources.

b. A specialist group of systems approach may be formed in a country, or in a country is too large, in each state or province of the country, or even in each city. Such groups may meet from time to time todiscuss the problems.

c. Enough attention should be given to diffusion of information about use of system approach. This can be done by a central agency undertaking the responsibility of such information diffusion.

d. Information diffusion can be accelerated if a newsletter or a journal is started. The newsletter or journal may give enough space for sharing informating about the use of systems aporoach, reporting, experiences, and giving suggestions for new developments in this regard.

e. Periodical meetings should be held to share experience gained by people, difficulties experienced, innovative ways of overcoming difficulties. Such meetings can be annual conferences, or occasional seminars and meetings.

f. Arrangements may be made for publication of experiences and other types of literature on systems application in education. This central agency can undertake this task. It may be useful to publish self-instructional books on systems application.

3. Building basic values needed in making the systems approach effective.

Systems approach like any other activity can be affective only if people have some basic skills needed in the approach. The following training programmes can be organised to meet these needs.

a. Training in basic concepts and skills in systems approach.

b. Training in methods and procedures of evaluation.

c. Training in simple research methodology and statistical analysis.

4. Building systems approach in curriculum construction.

This is the most important area requiring attention. The systems approach may not succeed in education unless the curricula are accordingly framed or worked out in details. By building this approach in curriculum construction the problem faced by teachers not having enough time to devote to curricula may be solved. Similarly, students would then be able to see the utility of the systems. approach. The following suggestions are given for this purpose.

a. National bodies of policy formulation and others concerned with curriculum development should discuss this as a useful approach for reducing curricula and introducing systems approach as an approach to integrate various parts of curricula, build linkages amongest various steps and contents in order to achieve the thrust which they want to achieve.

Systems approach should, therefore, be seen as a help in achieving the objectives of the curricula.

b. Systems approach should be stressed and understood as an "approach rather than additional work to be done by teachers. Teachers should not get an idea that systems approach would involve additional work; they should understand that it would mean a different way of looking at designing the curriculum.

c. Curricular modules should be prepared as illustrations about the application of systems approach. The modular approach in curriculum using system approach may help in suggesting linkages among various elements of the curriculum and how feedback can be used to continuously improve instruction.

d. Enough stress should be laid on local initiative, and it should be made abundantly clear that systems approach does not mean conforming to a set prodcedure. Systems approach implies understanding and applying the spirit with enough scope for innovation and local initiative.

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Rao, T.V. Working together for quality control: An educational game for weavers. Ahmedabad: Indian Institute of Management. Unpublished note, 1977, 4pp.

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Figure 2

Sequential process of Developing Mathematics Curriculum Relevant to Community Needs.

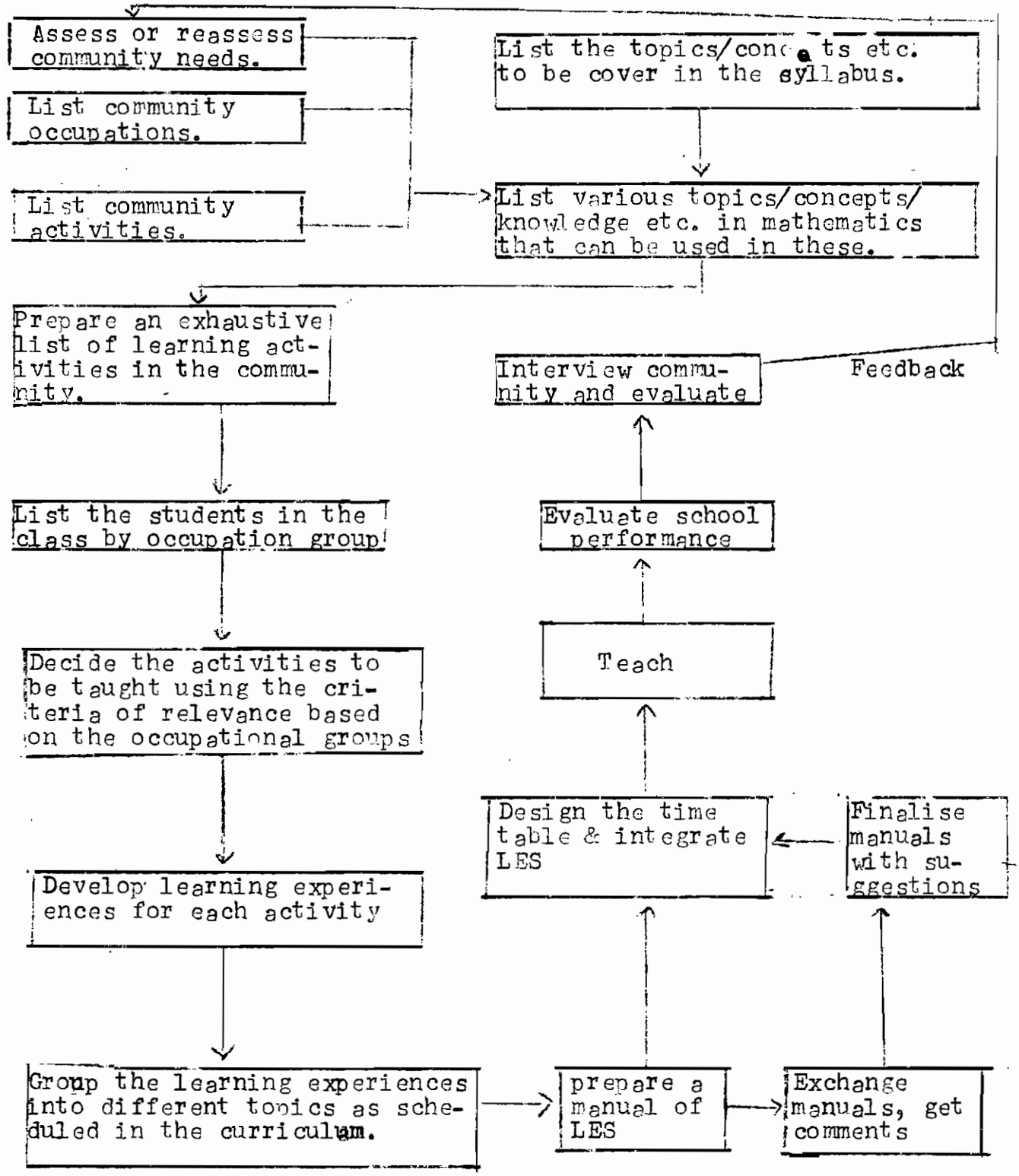

Figure 3

Steps Involved in the problem Analysis and Solution Designing Used for the School faculty.

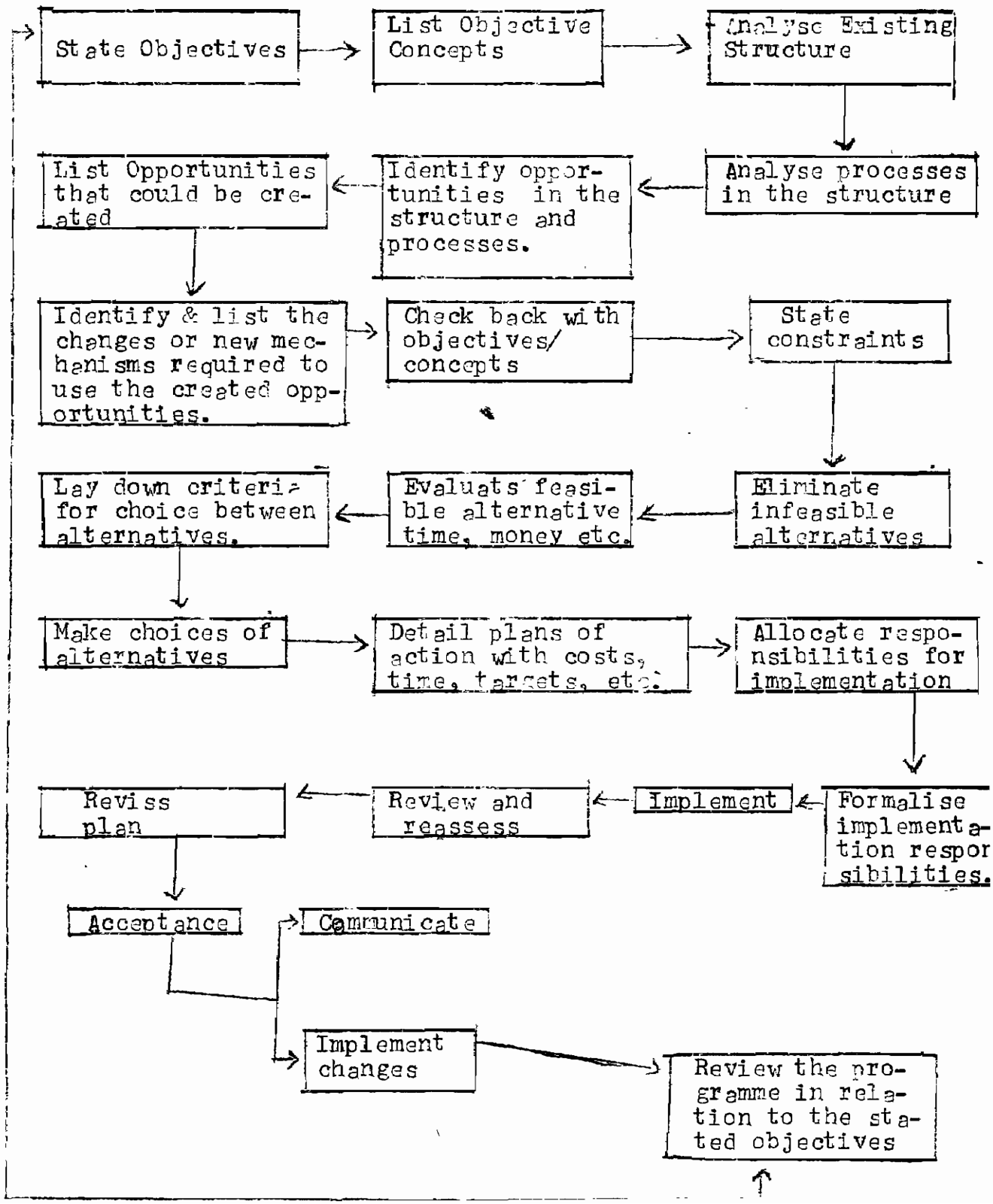

Table 1

List of Opportunities Where Knowledge of Mathematics could be Used in the Village

Occupations in the village: Agriculture, pottery, weaving, diarying, sheep-breeding, poultry, tea-stall, etc.

1. Agriculture

Crops include tomatoes, chillies, cotton, wheat and rice. All these are sold in the market after retaining a portion for daily use.

The following activities involved in agriculture require the knowledge of mathematics:

a. Many farmers borrow money from money lenders and a few from banks. An understanding of interest rate and other financial implications of borrowing loans.

b. To be able to calculate their earnings per acre of land the farmer should know the cost and should be able to understand the net earnings on his land after deducting the cost, including interest rates on money borrowed, fertilisers, transportation costs in selling the produce, labour costs, and other costs.

c. To be able to understand the use of savings in a bank.

d. To decide on the quantity of fertilizer to be put into the field, number of labourers to be engaged, etc.

e. To decide the source of finance.

f. To decide home consumption and to sell the rest.

2. Weaving

The weavers purchase cotton from the market and make sarees in their handlooms and sell them back to the market or in the village for consumption. Sometime the weavers purchase cotton, spin it, and later use it for weaving cloth. However, the former practice is more common. Some weavers get raw material from city cooperatives, weave the cloth and sell back to the cooperatives. The cooperatives give cotton on the condition that the weaver sells the cloth he weaves back to the cooperative. Knowledge of mathematics is required for the following reasons:

a. To determine the daily net earnings of each weaver under the different systems and on that basis to decide whether to buy from mills or from cooperatives or spin at home.

b. To determine whether spinning is highly profitable or weaving is more profitable when a cotton mill is present next door.

c. To maintain a record of sales and to determine the profitable products.

d. To understand interest rates in cases where the weavers borrow loans from cooperatives.

e. To understood the earnings of cooperatives.

f. To understand the earnings of middlemen.

g. To understand the advantagesof buying in a group and working as a group.

A similar list can be prepared for other occupations. The lists presented here is in no way exhaustive. The teachers can add several methods depending on the local situation.

Table 2

List of Samples of Activities in the Village and Mathematical Concepts for 5th Standard Mathematics that are Applicable to the Activities

Activity	Concepts applicable
1. To borrow a loan from bank	Percentage, interest rates
2. To determine the amount of fertiliser required for given acreage of land.	Proportion, division, multiplication
3. To predict the average selling rate of a given product for a given year.	Averages
4. To determine the labour cost for a given land at a given time.	Multiplications, additions
5. To decide whether to put the money in bank savings or not.	Interest rate
6. To calculate the net profit of purchasing material for weaving in bulk.	Profit and loss
7. To calculate labour costs for a weaving of a particular type and quantity of cloth etc.	Percentages, additions, multiplications, substractions.

Table 3

Use of Tutorial Activities in Different Interactions

Activity	Interactions where the activity can be used							
	Individual work	Pupil-tutor	Pupil-pupil	Pupil-house	Tutor alone	Tutor-tutor	Tutor-house	Pupil tutor
1. Self checking	x				x			
2. Mediation	x				x			
3. Observation	x	x	x	x	x	x	x	x
4. Discussion		x	x	x		x	x	x
5. Seminars		x						
6. Visits						x	x	x
7. Feedback		x	x	x		x	x	x
8. Training		x		x		x	x	x
9. Cooperation		x	x	x		x	x	x
10. Evaluation	x	x	x	x	x	x	x	x

Table 4

Interactions that can use different mechanisms

Interactions	Mechanisms that can be used					
	Diary	Discussions	Record	Review	Thinking	Assess-ment
Pupil alone	x			x		x
Pupil-tutor	x	x	x	x		
Pupil-pupil		x				
Pupil-house		x				
Tutor-tutor	x					x
Pupil-tutor		x	x			x
Tutor-tutor		x		x		x
Tutor-house		x			x	x