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A Problem-solving Approach to Environmental Education

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PREFACE

The international and regional meetings held since 1975 as part of the Unesco-UNEP International Environmental Education Programme, and especially the Intergovernmental Conference on Environmental Education (Tbilisi, 1977), have stressed the importance of providing those responsible for education at different levels with the information and conceptual tools needed to foster the development of an interdisciplinary pedagogy geared to the solution of environmental problems. Using this approach, the present study describes several pedagogic procedures that might further educational activities aimed at the solution of environmental problems.

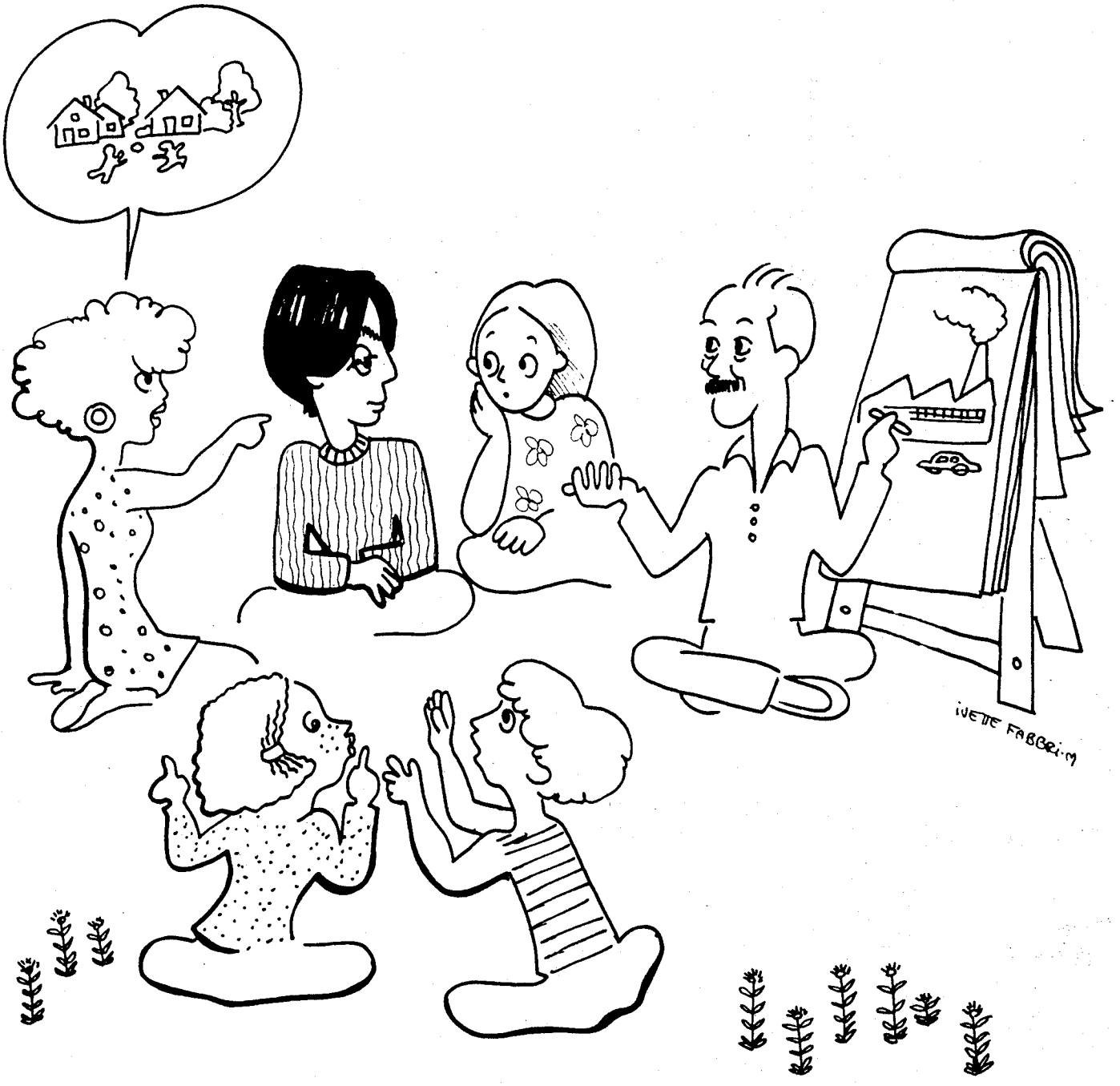
This study does not aim to be exhaustives but invites research workers, educationalists and teachers to consider the multiplicity of possibilities in this field.

The choice of approach cannot be based on reading alone. It must be discussed and tailored to the available resources and, above all, to the needs of the potential students. In fact, there is no universal approach or teaching method adapted to all educational situations, however simple, to all learners and to all countries. The method used must be based on a large number of parameters, which are not always easy to define. The schoolteacher, the educationalist or the group discussion leader are in the best position to choose the most appropriate solution, provided they are in possession of an adequate repertoire of appropriate teaching methods. This paper, although based on international findings, will no doubt have to be amplified and revised in the light of the latest developments in various countries.

The first draft of this paper-was prepared by Richard Quetel, whose job it is to train teachers and who specializes in extramural teaching methods; his experience has been worldwide. The present version has been revised by specialists of the Unesco Environmental Education Programme with the help of Professor Christian Souchon of the teacher training and didactic methods research unit at the University of Paris VII.

SUMMARY

A DISCUSSION GROUP



THE DISCUSSION GROUP APPROACH: GENERAL DESCRIPTION

Function, role of teacher, community, difficulties

Personal experience is largely gained with the help of language and must be translated into language if it is to be conveyed to others; to be shared, experience must be communicated. A discussion group is a specific means of pooling experience through language. It is the function of every adult discussion group to facilitate the communication of experience through language and to foster the formulation of ideas, propositions, counter-propositions, etc.

Moreover, in a discussion group it is possible to assess the degree of participation of individuals, their interest and comprehension by an evaluation of the quality of their interaction in the working group. The exchanges of view involve the whole series of distinctions, instructions, codes and signs contained in the language, which tend to reveal the participants' thought processes. The individual is helped to greater awareness of his own identity, to share in a socially significant experiment, and to gain a deeper understanding of his environment.

While he must not succumb to 'meeting mania' or exaggerate the importance of speech in a group of adults (which would be tantamount to granting language primacy over action, the abstract primacy over the concrete and theory primacy over practice), the group leader must nevertheless play a decisive role, above all in ensuring that everyone has a chance to take the floor.

Before anyone is asked to 'take the floor' in a group, he must meet the following conditions: he must have something to say to someone, must want to say it and have the 'tools' to do so, e.g. a vocabulary and language skills. The discussion group will provide him with a privileged occasion and training ground for 'taking the floor'; in addition it will serve to sharpen these 'tools' through practical exercises in:

- passing on information received,
- describing observed facts,
- formulating precise questions on a given topic,
- etc.

As for those involved, we can assume that adults, simply by agreeing to take part in a meeting or in collective action, show that they have certain 'expectations' of the action under discussion. The discussion group should enable them to express and clarify what is inside them and to find out more about the structure of their environment.

Taking the floor in front of and in the midst of others is often difficult. The first problem as we have seen, is the use of language; the second is asserting oneself in the group through words. To do that requires a degree of self-confidence in expressing oneself in public, which is often lacking. The discussion-group leader will have to resolve all the difficulties we have mentioned and also to surmount such psycho-sociological difficulties as:

- doubts about one's right to speak (some individuals consider themselves to be of inferior social status and hence not entitled to speak up),
- fearing the opinions of others,
- etc.

THE AIMS OF A DISCUSSION GROUP

These aims can relate to knowledge (cognitive aims), values (axiological aims), or to the acquisition of skills or know-how (technical aims).

By discussion, the group as a whole and each individual in it seek to raise their level of 'maturity', to enhance their ability to think things out in different areas, including that of effective common effort.

1 - The cognitive aims

Presence in a discussion group and thinking about it enable the participants to increase their understanding of the interplay between one person and others or between him and the subject under discussion (interactions, interventions, attitudes and roles). This interplay, with all its positive and negative aspects, can be analyzed by various techniques: leading the discussion, evaluating and judging what others say, checking their suggestions and ideas, and making, delegating or thwarting decisions. An understanding of group interaction is likely to foster certain attitudes. Every member will have to try to become capable of:

- recognizing the opinions or 'significations' of others,
- allowing others to expound their point of view (accepting, understanding),
- challenging ideas or arriving at a compromise,
- showing solidarity, imparting information, suggesting, helping to clarify,
- etc.

Another potential cognitive aim of a discussion group and of reflection about it is an appreciation of what may be called the 'cumulative effect': that one idea leads to another and that a group can discover new ideas and 'associations of ideas' no one would have been able to arrive at by himself. The so-called brainstorming method is based on this very fact (we shall be returning to the characteristics of that method in the chapter on technical resources). Once they fully appreciate the cumulative effect, all members of the discussion group will try to:

- treat the discussions as exchanges,
- consider group discussions an occasion for exchanges between speech and response,
- regard discussions as a responsibility, that is, as a personal and social relationship between one individual and another and between one group and another,
- etc.

2 - The axiological aims

These aims of the discussion group are linked to the meaning and value of language, of learning and of power:

- language, because it is by language that man registers and arranges the elements of his observations; it is also by means of language that he identifies and clarifies what is said in a discussion,
- learning, because man chiefly retains and learns what he has been able to express in front of others,

- power, because only by 'taking the floor' can a man express what is inside him, assert himself, or in some cases exist in relation with others. These aims entail helping members to:
  - take the floor in group discussions,
  - express themselves, explain their point of view to others and make themselves understood,
  - increase their vocabulary and improve their language,
  - etc.

3 - The technical aims

These aims involve mastering various technical aspects of discussion groups (preparing and leading discussions, brainstorming and integrating information), aspects that have been described at some length elsewhere. The implementation of these aims depends above all:

- on the discussion leader's ability to ask himself questions about his own role: he must be able to give a clear definition of the role he has decided to play, of the role he thinks he is playing, of the role others expect him to play, of the role others assign to him and of the role he has actually played during the discussion; the various ideas of his role are bound to differ and are unlikely to be regarded in the same way by all the participants in the discussion.

- on his ability and skill to play his role. (In this connection, it should be pointed out that some technical instructions limit the function of the discussion leader to the allocation of roles, e.g. appointing a group secretary, an observer, a co-ordinator, etc.). He should also be able to:

  - understand and accept the attitudes and value-systems of every participant in the discussion,
  - ask questions and evaluate the personal information level of every participant,
  - reformulate the ideas expressed and evaluate the level of information of the group as a whole,
  - lead the discussion back to the central point and detect the influence of trends or individuals likely to hamper the free circulation of information,
  - help to develop discussions and lead them into practical channels,
  - grasp the salient points of the subject under discussion and the connection or relationship between that subject and the interests of the participants,
  - recognize and bear in mind the positive and negative attitudes of the participants towards one another,
  - etc.

INDIVIDUAL AND COLLECTIVE ABILITIES DEVELOPED BY DISCUSSION GROUPS

The individual and collective abilities developed by group discussion are of different types: intellectual, emotional, organizational and co-operative. They facilitate the acquisition of knowledge and changes in personal attitudes leading to greater self-knowledge and greater ease of expression. They are based on observation, experimentation, analysis of data and facts, as well as on the ability to communicate, to co-operate, and to gather information and to pass it on.

Intellectually, constant participation in discussion groups can help individuals to achieve a degree of maturity and to satisfy themselves about their own abilities; for example, they can assess their acquisition of a wider specialist vocabulary by simple exchanges and collaboration with others. As a result, they may begin to ask themselves questions about what they know or about the means of enriching their personal experience.

On the emotional plane, the daily experience by adults of relating openly to others, as they do in discussions, is highly beneficial. Discussions, in fact, offer the individual great scope to become 'outgoing'> to break out of his shell, to express himself freely and to get into the habit of doing so; similarly they lead people to ask themselves questions about the causes of their problems and encourage them to take the floor, to express themselves appropriately, to put thoughts or ideas into words, to distinguish facts from ideas and sentiments and finally to ask questions about the behaviour of others towards themselves and about the personal impact of their interventions, etc.

This whole process of reflecting and improving individual and collective skills takes place at an unconscious level and is greatly helped by contributions from the discussion-group leader, and especially by his clarifications.

The resulting increase in awareness is achieved through and in conjunction with others; it provides the group with a chance to improve their organization, and individuals to partipate more effectively in discussions with a view to taking action. Only the members themselves can tell to what extent discussion groups have transformed their views and how it was that a community of interests, a common approach to given problems, was able to emerge.

MAIN FUNCTION(S) OF A DISCUSSION GROUP

As part of a problem-solving sequence

The effects of the environment on the psychology of human groups are well-known. The inhabitants of an isolated village, of a desert, of semi-urbanized country districts, etc. differ not only in their social and economic situations, their needs, their occupations but, more particularly still, in their ways of thinking, reacting and judging. Awareness of this phenomenon through language and exchanges based on common standards of communication makes it possible to bring out the socio-cultural dimension of man; an essential step if environmental problems are to be identified and solved.

Indeed, the close links between man and his environment can only be felt and shared if there are exchanges, and above all exchanges between human beings. The main function of a discussion group is to enrich and multiply these exchanges with the help of interactions likely to increase awareness of the real roles of each participant. As successive discussions are held, these interactions help to stimulate thought and to change set views.

In a given environment, the group as a whole has access to what information is needed for grasping problems and for formulating them. The group as a whole changes and acts; hence it is the group as a whole that must pass through the following four main stages:

- self-awareness in the given environment,
- analysis of the situation and discussions to identify the main environmental problems and the most effective solutions and remedies,

- the search for improvements after discussion of the means available and the expected results,
- the application of the solutions and the evaluation of their effectiveness by discussion and by a quantitative and a qualitative determination of the results.

Discussion can take place at any stage of the resolution of problems but it is, above all, at the beginning of the process that they are indispensable.

HUMAN, ORGANIZATIONAL, TECHNICAL AND MATERIAL RESOURCES NEEDED FOR A DISCUSSION GROUP

Personal involvement is clearly a prerequisite of the smooth running of a discussion group. Merely organizing a meeting does not ensure a true discussion; for that to happen, the discussion group technique must be part of the group leader's educational repertoire and he must also be determined to use it effectively and appreciate the extent to which this technique can lead a group of people to take appropriate action (e.g. conservation of the environment, solution of increasingly complex and interdependent planning problems). Without that determination and the necessary understanding, all that will happen, at best is the mechanical application of formulae that may as often turn out to be disastrous as helpful.

The group leader's determination and successive corrections and improvements will teach him increasingly how to elicit contributions, to 'give', 'take', or 'yield', the floor, etc. He will be able to stimulate interactions, including clashes of ideas, and hence contribute to the growth of every participant under the influence of the ideas of others. The first step is the acceptance by the participants of the principle of discussion, i.e. the recognition implicitly at least, of the existence and importance of words and ideas.

The gradual perfection of the 'human resources' on which the use and possible developments of the discussion group as an educational tool are based, depends on a number of conditions, namely:

- the ability to make sense by using words, which demands a knowledge of how to speak about things, of how to make others speak about things and of how to combine speech with action,
- the creation of the right conditions for discussion by making people meet and speak about problems they know about and that interest them,
- the group leader's determination not to be authoritarian and self-centred while not falling into the trap of inaction and of letting the discussions run away with themselves,
- the anticipation of information by personal observation, the results of previous experiments, questions, etc.,
- taking the risk of being mistaken about attitudes, roles, interventions, questions, vocabulary, etc., thus avoiding the danger of seeming over-certain and helping to focus attention on the effects produced, the better to correct them and oneself,
- awareness of the motivations of all the participants and solid personal knowledge on the subject under discussion,
- an atmosphere facilitating exchanges to enable everyone to open out, and ensuring that all contributions are real and spontaneous,
- knowing how far to go in the attempt to avoid monologues, personal attacks and all forms of intolerance,

- avoiding the trap of conventional and polite reformulations as a means of concealing one's true convictions from others,
- helping the group to grow by consultations, restructuring of the group, re-allocating roles, etc.,
- ability to evaluate the progress of a discussion, avoiding repetitions, negative tensions, etc., - understanding the exchanges and their deeper meanings as and when they are experienced by the participants,
- welcoming all the sentiments, values and means of expression of others at whatever level,
- the ability by the discussion leader to stand aloof from the discussion, i.e. to understand the exchanges, without 'interpreting' or projecting himself or his personal preoccupations into the situation,
- the ability of the discussion leader to focus attention on the development of contributions without himself intervening in the discussion,
- etc.

As for the technical and material organization of discussion groups, everything depends on the group leader's ability to make distinctions. Much as, on the pedagogic plane, a distinction must be made between listening to one person, a conversation between three or four people, a discussion by ten people, an assembly of twenty or a meeting of more than a hundred people so, on the organizational, material and technical planes, distinctions must be made:

- in respect of space: a small room, a few chairs and a table are enough for a small discussion group; however, it is not impossible to create favourable conditions for an assembly of 100 people by providing mobile microphones and a system for collecting slips on which the participants can write their questions to the speaker. It should also be noted that the seating of the participants can render the discussion easier or more difficult. For instance, it has been shown experimentally that even round or oval tables or sitting in circles, which encourage interaction and are, in principle, best suited to a discussion, do not avoid the prevalence of communications between a participant and the person seated directly opposite him.
- in respect of number: experience has shown that 4-8 is the optimum number of participants likely to stimulate the thought and imagination of the group as a whole and of individual members.
- in respect of time: the duration can vary depending on the type of meeting but should not normally exceed two hours.
- in respect of place: a quiet venue, cut off from external noise, from comings and goings and from telephone bells, obviously helps the smooth running of a discussion group. It is a good idea to provide two or three blackboards or large sheets of paper to keep track of what is being said; this can also be done more discreetly by a session secretary.

Brainstorming sessions make special demands. They are based on the discovery that one idea can trigger off a host of others during a discussion. This technique calls for a group leader capable (in a group of no more than 10 people) of seeing to it that the rules are obeyed (free association, the expression of the greatest possible number of ideas in minimum time, offering no criticisms or self-criticisms, paying attention to the speaker), ensuring that all participants can have a turn unhampered, that the free association of ideas is given priority over logical presentation, that every vague statement is

reformulated (purely in order to clarify the underlying idea and to ensure that it still reflects the original idea, etc.). When duly recorded, noted, classified, developed, studied and pondered, the ideas thrown up during a brainstorming session can have electrifying effects.

EXAMPLE: A LOCAL ENVIRONMENTAL PROBLEM TACKLED BY A DISCUSSION GROUP

Let us now look at a problem involving the grasp of natural balances and methods of maintaining them in a rural environment - an agronomic problem in the solution of which the relative success of a crop can serve as a concrete starting point.

A first series of quick discussions is devoted to determining the best sowing time, the success and duration of germination, which frequently varies according to temperature, type of soil humidity, exposure etc. Conflicting views and various hypotheses can be expressed about the crucial influence of each of these variables. On that basis, it may be decided to set up a working party for the express purpose of conducting a number of experiments. The expressed will to overcome specific problems can, in due course and with the help of specialists, give rise to a more complex study of different soils in various plots of land, the selection of seeds and of agricultural practices in general.

A second series of discussions is devoted to the interpretation of the results of each of the experiments (in a natural as well as an artificial environment). These discussions may help to sharpen the discrimination of the participants by the cumulative effect of suggestions and by interactions within the group. From successive discussions, everyone learns that he is capable of expressing what he sees, that his observations or discoveries can help to increase his own knowledge as well as that of the group. Everybody comes to understand that the discussion group is there not to listen passively but to make proposals and suggestions.

The discussions allow everyone to follow his own route of discovering phenomena and of discriminating between variables.

The participants are led quite naturally to making new observations, to formulating them and hence to producing fresh ideas. The specialists or the group leader should intervene during each of these transitions from observation to interpretation; in so doing they help to maintain the thread of the discussion and contribute to a process without which the cumulative effect of the discussions would not take place and the discussion group would be doomed to futility. (Various kinds of intervention are possible: summaries of the various comments on several boards, successive and increasingly detailed classification of various contributions, etc.).

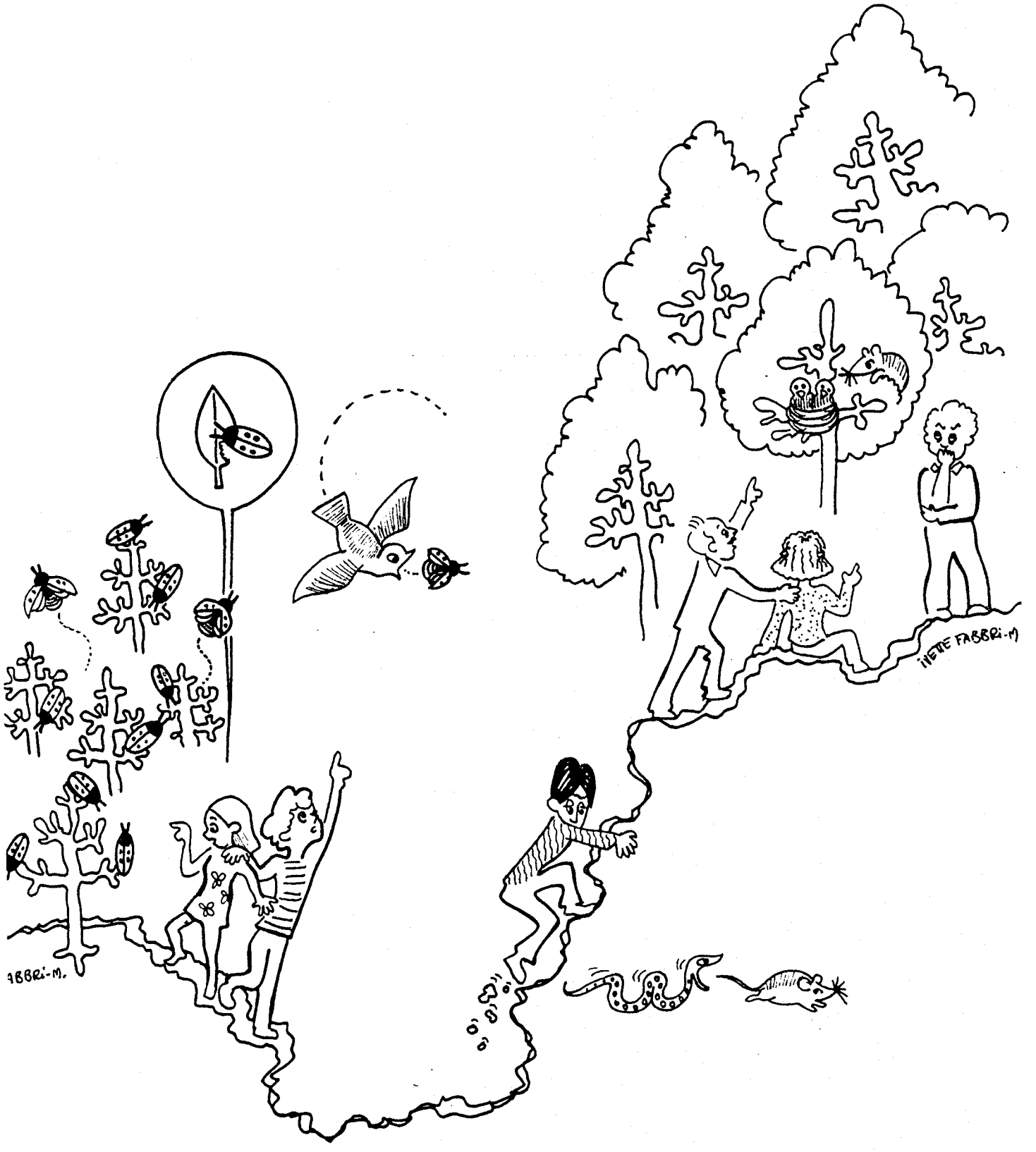
The discussion group must consider the observations reported by every participant. Unless the group has this common ground, imagination and thought cannot develop. However, with the best will, the interpretations proffered may sometimes obscure the overall scheme of the experiments in progress; in that case, the discussion should be resumed at a lower level and all the group interactions reconstructed.

Part of the work is done in the field, on the experimental plots. It involves measuring, counting, observing and discussing on the spot. The experts will, at intervals, draw attention to a particular phenomenon, and suggest

certain measurements and certain observations. There will also be discussions about the need to place markers, etc.

This sequence of discussions leading to new observations and hence to further discussions, and so on, will help to enrich the discussions themselves and to improve the vocabulary of the participants under the pressure of necessity. The discussion group must, in effect, be able to translate the diversity and complexity of the information it has gathered, provide increasingly subtle explanations, frame increasingly pertinent questions and hypotheses and engage in more and more fruitful interactions.

GUIDED ENVIRONMENTAL INTERPRETATION



GUIDED ENVIRONMENTAL INTERPRETATION: GENERAL DESCRIPTION

Function, role of teacher, community, difficulties

Guided environmental interpretation should, first of all, be like a mirror, at least in part. It involves making contact with known external conditions, yet not so familiar as to raise no questions. It is based on a programme of visits or studies, in which what matters is to discover, observe, exchange, and discuss with a view to gaining a better understanding of the environment, of life and of work.

The second function of guided environmental interpretation is to give man greater control of his relationship with his material and living environment at a time of rapid and far-reaching changes. These changes in our mode of life and work are in fact faster than the creation of words and symbols needed to translate and explain them.

Other functions may be envisaged as occasion demands: setting up a group to discuss new realities as they arise, looking at the environment in a fresh light, preparing the ground for more ambitious educational projects, etc.

The teacher or the 'team' must:

- put each individual in harmonious touch with his direct or more remote environment so as to encourage or elicit reponses more in keeping with the demands of new situations and to alter behaviour, conduct and attitudes, - immerse the group of participants in a 'sea of facts' to be observed,
- comment and elicit comments based on several criteria,
- provide for meetings, debates, exchanges and discussions to help everyone adjust or readjust his own system of representations, references and values,
- make everyone face up to the outside world; it is by this type of confrontation that the individual learns to internalize the environment, to make it his own.

The community must first of all examine itself by means of certain solutions, not in order to come up with a recipe, but to gain a better understanding of the environment and of its determinants. People are faced with complex realities: they must not be allowed to become passive objects, to accept without demur the constraints and imperatives of their current way of life. Guided environmental interpretation must help them to greater awareness for the sake of gaining greater control over the environment and hence of a better balance and a richer life.

We have to find a stimulus likely to help people to new ways of thinking and self-expression. Many rural inhabitants have never had the chance or the occasion of putting their experience into words, of analyzing or discussing it. Hence, every meeting should help to foster collective thought and to raise every participant's importance in his own eyes.

The greatest problem is to help the individual to add a fresh dimension to his cultural horizon by an enhanced appreciation of his own potential, sensitivity and common sense; this can be achieved not only under the influence of the pressures the environment exerts on the individual but also of the resources it provides.

One problem is to avoid treating development models as ends in themselves, because doing so detracts attention from the concrete problems posed by people's lives in a given environment; that type of 'model-building' can weaken or

completely undermine the determination to control the environment and to question current modes of conduct, behaviour and attitudes.

THE AIMS OF GUIDED ENVIRONMENTAL INTERPRETATION

The cognitive, axiological and technical aims

The cognitive aims must be in keeping with the prior knowledge, potential involvement and interest of each member of the group. Thus if the guided environmental interpretation is based on a visit to a minor irrigation project, the overall observations and the questions put to those in charge will draw on every individual's knowledge of water management, his grasp of the associated phenomena and his express or tacit wishes in regard to future projects.

In this kind of educational approach, the axiological aims are obviously the most important in that they question established values. the best way of implementing them is to rely on the element of surprise resulting from new situations in which the obvious suddenly looks more complex, or on certain aspects of everyday reality that can be shown to be less self-explanatory than was originally believed. In such situations, positive disquiet can turn into productive curiosity capable of exploding certain a priori assumptions, of demanding new explanations, of stimulating research, of facilitating discoveries in a direction with which those involved are unfamiliar. The axiological aims can also be defined in terms of 'ability to':

- discover or rediscover, starting from past experience, new data likely to foster discussions, a desire for, or an exchange of, other items of information, a clarification of values, etc.,
- evaluate one's intellectual curiosity, powers of observation, desire to act, etc.,
- formulate questions that are known to exist but have not yet been raised explicitly,
- inquire into the foreseen and unforeseen consequences of one's actions (pollution, waste, lack of organization, inadequate technique, etc.) and into various possibilities of environmental action,
- appraise oneself positively, which presupposes openness to situations, listening to others and expressing wishes not so much in respect of greater consumption as of more effective action,
- etc.

There can be no real plan of action without a preliminary examination of all the facts. This alone sums up all the axiological aims; it also imposes a technical aim, namely to facilitate the discovery of the real situation by discussion, observation, information, group activity. The relevant techniques (apart from discussion, which was the subject of a special chapter) should help to:

- develop perception, knowledge and understanding of the environment by a process involving a search for explanations,
- elicit positive attitudes towards others and appreciation of their feelings and personal views,
- process raw data without restricting oneself to those items that reinforce the 'old certainties',
- encourage interactions based on common objectives.

THE DEVELOPMENT OF INDIVIDUAL AND COLLECTIVE ABILITIES THROUGH GUIDED ENVIRONMENTAL INTERPRETATION

Intellectual, emotional, organizational and co-operative abilities

Guided environmental interpretation, especially in an environment that has been stood on its head, indeed is imperilled by man, must help the individual to come to grips with the large number of elements involved, and hence to use his intellect to attain all the technical aims (discussion, observation, information, group activities) described in the last section. Intellectual capacities will, first of all, be mobilized by the use of words to express thoughts. However, it must be stressed that all the visits, studies, etc. associated with guided environmental interpretation cannot be reduced to a search for the right verbal expressions. They must be part and parcel of a more pronounced experimental attitude engaging the sensibility of the adult's mind and invoking his powers of action, observation, thought, learning, questioning, discovery, of ordering the personal knowledge he has acquired... This means that the teacher must himself be able to organize, stimulate, intervene at the right moment, elicit comparisons, analyze and prompt others to do likewise.

On the emotional plane, alerting the mine to 'phenomena' and to the world of facts can only be meaningful if it is attuned to past experience and future prospects. The objects and people a person meets during educational visits generally strike him at first as untouchable and as part of a world outside the scope. By appealing to his sensibilities and then to his curiosity, the teacher can, however, try to involve the 'citizen' by making him feel that he has a right and a duty to understand what is happening around him.

That implies an ability to organize one's world and oneself on the basis of the logic governing the relations between facts, phenomena and sentient beings. The ability to relate to the environment and to space, must go hand in hand with the ability to relate to time and with openness to experience. The teacher must help the group grasp, discover, understand and identify by timely interventions, and by dwelling on what has been newly discovered the better to facilitate its comprehension. One successful approach is to choose situations that invite comparisons with others.

With the help of this approach, the teacher must try to develop the ability of individual members and of the group as a whole to conduct independent experiments leading to patterns of conduct, acts, actions and patterns of behaviour in which the citizen can experience himself while experiencing objects and creatures in a way that gives him a clearer awareness of them.

MAIN FUNCTION(S) OF GUIDED ENVIRONMENTAL INTERPRETATION

As part of a 'problem-solving' sequence

In every form of guided environmental interpretation, the guide's aim must be to encourage individual participants to test the validity and the scope of their observations, explanations, conclusions and actions, more especially by criticism and by group discussions (involving 6 to 8 persons) at the end of each day or after each educational visit.

This approach is indispensable, especially when organizing a group round the identification of the problems of a particular environment: on the one hand it focuses attention on the environment with all its potential and, on the other hand, it places every individual and the group as a whole in a situation that

leaves room for surprise and for self-interrogation. As a result of the latter, the individual is helped to abandon his naive views on different aspects of the environment and, by self-criticism and group interaction, to identify the real problems (or at least some of them).

The guide (or team) should have planned his or their interventions in such a way that nearly all occasions for surprise are brought to the group's attention. These include: the permanence of the laws of nature, the constant transformation of facts and phenomena, the manifestations and forms of life, the importance of health and nutrition, of hygiene and housing, and the role of technological advances.

Later, this approach may lead to an 'analysis of problem'. A journey, a study or a visit are, in fact, so many occasions for discussing one's own problems with people in a similar situation. The 'guide' (or the group) will have planned special meetings during which people can exchange views, question one another, propose solutions or criticize those proposed to them.

After a more or less prolonged and diversified cycle of guided environmental interpretations, say in the form of visits, it will become clear that further visits will serve little purpose and that action, in one form or another, has to supervene, before a new cycle is begun to probe into more specific aspects.

HUMAN, ORGANIZATIONAL, TECHNICAL AND MATERIAL RESOURCES

Needed for GUIDED ENVIRONMENTAL INTERPRETATION

Apart from forming an interdisciplinary team, representing 'human resources' capable of bringing special abilities and essential information to bear on the understanding of given situations, the teacher must arm himself with facts and figures about the environment - culled from demography, geography, climatology, economics, production technology - which will make it possible to seize upon raw, 'invisible' data relating to the environment. This may lead to greater awareness and more objective appraisal of, as well as a grasp of the importance of, environmental information.

Some data may make it possible to grasp phenomena that cannot be known by direct observation alone, e.g. changes in the vegetation and the climate, as recorded over several years in rainfall statistics and temperature curves.

It would be absurd to suggest that the community as a whole should be made to study statistics, but even so, people should be able to compare and interpret figures that affect their lives so intimately.

Guided environmental interpretation is fuelled by human concerns, by questions that have been posed explicitly or implicitly. It has an educational dimension inasmuch as the surprise reactions it elicits go beyond the immediate needs of the participants and help them to grasp relationships between things and men which questions their very life, behaviour, habits, past knowledge, etc.

The organization of a cycle of visits is an essential phase of guided environmental interpretation and must be considered an intellectual activity in the preparatory phase no less than at 'meetings' or the exploitation of 'discoveries'. The criteria used to select and organize observations in the course of a visit, for example, must not be mistaken for interpretations: the latter result from confrontations by all the participants with all the knowledge

they have gained. Hence the need, after returning from a visit, to recapitulate and synthesize all the 'discoveries' and to ensure that the theme of the visit is kept in the forefront of the ensuing discussions.

It is round the recombination of data, of the facts noted by one member or another, and of their subsequent classification that the group can be built up, and that all the necessary correlations needed to solve the problem or problems can be made. The overall conclusions must be 'communicable'. To that end, it is best, after every visit or at the end of every day:

- to set aside a period of deliberation for small groups of 6-8 people,
- to submit a general report, if only orally. That report should be shown to all participants.

The job of synthesizing all the points of view expressed in the various subgroup discussions and of bringing out the various aspects of problem under review fall to the rapporteur.

This 'technical' aspect of guided environmental interpretation is the more important as it can be used to prepare another visit or any other activity. In fact, each individual can at this point establish a 'criterion' for reorganizing his 'perception' of a given problem. This may very well be different from the perception of the problem desired for the next day or in the future. Such a division of a situation into significant components may prove helpful to the analysis of problems.

The sum of all these accumulated bits of information changes our habitual ideas, etc., and helps to set up a new system of relationships (discovery of a cause, of an effect, of a function, of a possibility, of an idea, etc.).

Certain constraints will, of course, have to be taken into account, especially in the choice of visits. It would serve no purpose, for example, to visit a pilot plant entirely dependent on outside technical and financial support, when it is known that such support will not be forthcoming for one's own project. Realities must not be obscured, neither on the factual plane nor on that of personal relationships.

It is not, just a question of honesty but one of effectiveness as well. Being aware of what one is, of what one's possibilities are, of what one is looking for, of formulating the right questions - all this means maximizing one's chances of using this educational approach to best effect.

On the material plane, the approach means combining information with organization. Information, it goes without saying, involves:

- people, their expectations, the development of their expectations, their difficulties, their experiences, etc.,
- the place or places it is possible to visit, the number of participants, the duration and timing of visits, the means of transport available, the programme of the visits, and the best way of organizing and experiencing them.

A supervisory group could be set up made up of just two members, one in charge of the timetable and of meetings with people and responsible for initiating discussions and ensuring satisfactory working conditions - the other observing the group, the spontaneous discussions, the unformulated expectations, the disagreements, the proposals, etc.

It is essential to provide the coherence and rigour needed to ensure that guided environmental interpretation is a creative activity eliciting reactions of surprise, questions, etc., as well as a learning activity encouraging observation, the search for information and the classification of questions and ideas.

EXAMPLE OF AN APPLICATION of

the guided environmental interpretation approach

The example we have chosen is a project in a mountainous rural area.(1) This project was the first of a series of further training education programmes. The experiment has been repeated, the guided environmental intepretation approach having been used over the past five years to alternate with a workshop or action-research approach designed to examine particular points in depth, to raise precise questions relating to projects or work in progress, etc.

Originally, the aim was to use the visits, etc. as a means of gauging the potential of the environment and of the people involved. It soon became clear, however, that before judging the intentions, motives, reasons, and meanings of the acts or actions of others, we must first be made more fully aware of our own.

In the experiment in question, the group devoted one day a month to visiting three or four farmsteads in various valleys. At first, the places to be visited were chosen in a fairly empirical fashion, based on the environmental interpretation guide's knowledge of the surroundings. Every visit gave rise to a number of discussions about what the group had observed, about the way the farms visited were being run, about the problems they encountered and the choices the farmer had made to solve them. As a general rule, the group discussion introduced more general problems and every farmer visited was invited to join the group on visits to other farmsteads.

In this way, the group was led to reflect on its own behaviour and conduct in a particular situation, to ask questions about foreseen and unforeseen consequences of its actions (pollution, waste, poor organization and techniques, etc.), to quantify the effects and repercussions, to define the position of the group among other people and in the given environment, to rid itself of certain habits, of certain untested convictions and beliefs and to match thoughts, words and actions. In addition, everyone was helped to define the limits of his freedom and his sphere of responsibility, not only by reference to laws and rules but also to his own opinions.

This approach may be considered cumbersome, but it has proved to be an extremely effective recruiting method: every one of the farmers visited decided to join in the experiment. This is a good way of extending the scope of the group, which must never present itself as a provider of ready-made solutions but, on the contrary, as a forum in which the general application of solutions found to be acceptable here and there can be evaluated.

(1) Comité d'etudes et de propositions - 'Peuple et Culture de l'Isere' - 9 rue de la Poste - 38000 Grenoble - France.

Guided environmental interpretation can reveal the relationships and links between people on the organic, emotional, rational, organizational or legal plane. It can also reveal the various types and modes of communication and exchange used: speeches, negotiations, contracts, co-operation, expressions of solidarity, autonomy, fairness etc. The participants in this particular experiment concluded that this first stage corresponds to a phase in which the awareness of the group is enhanced and the initial differences between the members (between intellectuals and peasants as well as between peasants themselves) fade under the impact of the realization that it is advantageous to 'pull together'.

In the experiment under review, the organizer realized from the very start that the project had to be 'credible', i.e. comprehensible to the majority of the participants and that people must not be 'rushed'. After several visits, the programme of each one being adapted in the light of what had happened during the last, the organizers came to the conclusion that a document should be prepared on the basis of all the observations made and all the questions raised - 'a sort of file, in which every farm visited is entered on a card, usually completed with the observations of several people'. The organizers felt that this document should serve as a basis for the creation of subgroups whose job it was to deliberate on specific problems. In this particular experiment, the formation of such groups proved to be an indispensable extension to guided environmental interpretation.

BRIEF NOTE ON OTHER SPHERES OF APPLICATION of

Guided environmental interpretation

Any guided environmental interpretation can be regarded as a tool. In some cases, it can be applied to man's relationship with the biosphere or certain ecosystems, and give direction to observations of, and reflections on, man's influence on the environment, for instance on grazing land, water, forests, etc.

More localized topics provide alternative applications, for instance the sources of energy in one's region. Visits, say, to thermal springs, can be used to clarify general ideas with the help of such questions as: what is renewable energy?, what is alternative energy? what is a solar panel?, a digester?

Every community, every professional group can use guided environmental interpretation for its own purposes. Local government politicians and planning experts may be anxious to gather technical and organizational data and to compare all sorts of experiments. This 'professional' curiosity, this appetite for solutions, must be kept within limits by emphasis on the need for practical solutions, adapted to the situation under review, rather than seeking ready-made panaceas.

An alternative approach is to make a guided environmental interpretation of a complete range of ecological, social, cultural, legal and political factors, with a bearing on environmental problems and the management of resources.

Assessments have shown that people who used to be reticent about certain subjects before using guided environmental interpretation ceased to be so afterwards; hostile attitudes disappeared and even 'cultural resistance' due to attitudes shaped by tradition, the family and school could be eliminated or

modified. Moreover, it became clear that training in observation and reflection can help adults to form more balanced judgements. In some cases, historical explanations can be used to render the present more comprehensible and to show where current developments might lead.

CLARIFICATION OF VALUES

'CLARIFICATION OF VALUES': GENERAL DESCRIPTION

Function, role of teacher, the community

In its ordinary meaning, the word 'value', when attached to a person, designates all the moral and intellectual qualities we wish to attribute to him. When attached to objects or phenomena, it can refer to their financial or aesthetic worth. Because of its double meaning 'value' has come to stand for what everyone believes to be true, beautiful and good - in people, actions or things.

As far as environmental problems are concerned, value judgements affect the examination and decision-making process involved in the exploitation and control of natural resources, the conservation of ecosystems, etc. Values and preferences, independent of the technical and economic imperatives, play the role of filters. When faced with a particular situation, every man, including the political decision-maker, will try to respond in ways that satisfy him, even if they are no more than the results of 'mental images' built on false or fragmentary information.

- The primary function of the clarification of values approach is to show that everyone has his own way of 'representing' things, persons, situations, etc. - in other words, that every individual has his own 'representations'.

- The second function is to prove by experiment that every person has a tendency to explain or interpret new phenomena by his views on similar phenomena of a more familiar type. It is also to prove that every system of representation can be considered a personal model of the way in which we organize what information we have, at a given moment, about a particular problem. Everybody tends to cling to his 'mental images' based on 'his' own experience and on the things to which he attaches value. The technique of 'value analysis' is derived from this finding. It will be discussed at the end of the section on technical resources.

- The third function involves subjective or psychological forms of dissatisfaction, and, more precisely, individual perceptions, sentiments, beliefs, attitudes, desires and aspirations connected with situations or the system of relationships in which the individual is involved. He must go beyond the stage of simply perceiving facts and actually study them by:

  - differentiating between facts, ideas, feelings, beliefs, etc.,
  - isolating the facts involved in a given situation or project,
  - correlating these facts, - studying the effects of that correlation.

- The fourth function concerns the objective or social dysfunctions of the individual and of the group in their search for real solutions to the complex problems of life, ecology, the environment, planning, the exploitation of energy... and of technological developments from which no one should feel excluded; the corollary is that technical or technological knowledge should not be used to dominate a cultural climate or a given system of values.

This whole approach rests on a special relationship between the teacher and the community. The teacher listens; he tries to identify the prevailing 'representations' and 'values', to tell original ideas from what for lack of information, are false or mistaken interpretations of certain phenomena. His role is to encourage adults to 'ask questions' and to direct these questions at a small number of precise problems posed by a real situation, and to arouse the interest

of most of the people constituting the community. The active work must begin with a phase of autonomous exploration of the various points of view held on a given subject; this will reveal the need to verify certain statements by experiment, by a common search for information, by the acquisition of precise skills, indeed by rigorous but motivated learning.(1)

To enlist community support for further education in environmental intervention, those concerned have to know what cultural, social linguistic values, they themselves hold and what traditions, rites, customs, architecture, gestures, landscapes, etc. they prefer. This realization will affect their wish and determination to be flexible, to formulate projects, to seek solutions and to act. It is, for example, a prerequisite of the creation of an endogenous technology and of a system of values likely to encourage people:

- to feel that they are in control or can take control of issues that concern them,
- to ensure that what is decided and done in their surroundings and on their behalf has or regains a positive meaning in their everyday life,
- to feel that what they are committed to and work for makes sense and that their sense of cultural alienation and of divorce from values is being demolished.

THE AIMS OF THE CLARIFICATION OF VALUES APPROACH

Human culture is built up in somewhat unstructured ways, following encounters with situations, difficulties, differences of opinion, etc. What is thus acquired is not programmed and organized once and for all but gradually assimilated, integrated and questioned, etc.

The primary aim of the clarification of values approach is to give everyone the opportunity of 'discovering himself' and of finding out what 'values' he holds. To do so, he must:

- be capable of thinking out and living his own system of values as a means of tackling the real problems posed by his environment, his life and his future.

The second aim is to increase awareness of what might be called the collective interests of various social groups in an integrated approach to the environment in general, and in the technological choices of the 'decision-makers' in particular. As a result they will learn:

- to negotiate about choices that might prove unfavourable to the type of social structure they wish to preserve or encourage, - to foster the development of an endogenous technology and so prevent society from being split into two antagonistic camps, one steeped in up-to-date technologies and the other following in the footsteps of 'agrobiologists' and other 'friendly craftsmen' rightly or wrongly described as 'ecologists'. The individual must be able to:

(1) This approach is based on the kind of 'popular education' used in such training courses as 'Peuple et Culture', in the project of J. Dumazedier, B. CacÈrès, P. Lengrand (1945) and the values teaching and classwork technique of Louis Raths (1950), of Columbus University (USA).

- consider every type of technology as a 'variable' of environmental action,
- envisage the possibility of choosing between different technological solutions and of studying their consequences,
- analyse and construct materials well-known for their suitability to local conditions.

The third aim of the clarification of values approach is to demonstrate that there are different ways of facing reality, of understanding and recognizing meteorological, biological, physical and other phenomena open to experiment, observation, demonstration and analysis. It endeavours to render everyone capable of:

- reaching some understanding of concrete environmental facts by reliance on his own system of values,
- acting on his environment, e.g. on the physical properties of the soil,
- distinguishing between what is alive and what is not or what has ceased to be alive in a given ecosystem,
- extending his 'mental images' and making connections likely to further the understanding of ever more complex phenomena and mechanisms and hence to develop successful 'mental operations',
- gaining increasingly better access to the relational and quantitative universe in which things happen in a certain order,
- measuring and locating more rigorously, and hence structuring, the concept of space as it affects the environment and, on the other hand, the concept of duration and time as it affects life, etc.

The fourth aim of the clarification of values approach is to demonstrate that all data are useless unless they can be applied to a real problem, unless they lead to the asking of questions, to the better organization of a task or an observation, unless they help one to frame hypotheses or to arrive at better decisions... Above all, it is to demonstrate that without information or the means of finding it on the spot it is difficult to learn how to learn or to make progress. In terms of the ability to learn how to learn, the basic aims are:

- observing in order in learn how to gather information,
- comparing, for example, different materials by their properties, or two results of an identical type of experiment,
- experimenting and isolating variables to modify the quantity of information to be digested in due course,
- collating the results of individual experiments and preserving 'material evidence'.

The clarification of values approach must, in addition, show that the values we hold serve us as criteria of judgement, that everyone 'owns' values which are often contradictory and which might, sooner or later, clash with one another or with our actions, etc. We should therefore try:

- to approach any problem with a will,
- to match our actions to our ideas, while accepting that others may have different ideas,
- to evaluate situations independently, if necessary without allowing oneself to be influenced by the value system of others.

DEVELOPMENT OF INDIVIDUAL AND COLLECTIVE ABILITIES

Intellectual, emotional, organizational and co-operative abilities

Discovering or rediscovering 'oneself' and one's 'values' means re-establishing positive interactions between oneself and one's social and natural environment, between one's personal history and the history of the social group or the society to which one belongs. On the plane of intellectual abilities, it means returning to such key concepts or instrumental concepts as enable one to establish bases of comparison, to enrich the vocabulary of one's mother tongue, to grasp the principle of the interdependence of beings and things, to develop one's powers of observation, to open oneself to information and the search for that information, to broaden one's 'knowledge' by learning to lessen the gap between the information obtained and all the information that is still waiting to be gathered etc. In the 'ecosystem' which is man's living environment many relationships and correlations remain to be discovered, including the explanation of everyday phenomena.

Questioning all methods of classification or description we use unconsciously, methods that always tend to replace actual reality with fallacious notions we have built up round it (or with ideas we once adopted as a result of some existential shock) calls for profound self-awareness. It means challenging all our preconceptions, beliefs, fantasies, defensive and protective rationalizations, indeed all those ideas we have hitherto judged to be the best. This clarification of values helps the development of critical faculties and leads to better understanding of the processes and mechanisms underlying man's conditioning.

Understanding these individual or collective conditioning processes and mechanisms means building an organization that will allow us to conduct independent experiments and opens up the possibility of, for example, creating an endogenous technique or techniques based on greater technical or scientific understanding (ability to discover laws, rules, know-how, etc).

In most cases, once the general system of values has been identified, it is possible to proceed not only to 'deconditioning' but also to personal growth through membership of a group. It will become clear that such groups are neither ossified nor rigid but, on the contrary, versatile and varied (having different sources and levels of information, skills, abilities, etc.).

In moral, ethical, civic and political respects, clarification of values should foster social justice, safeguard the rights of man, lead to respect of others, to the realization that people have different sensibilities and to the appreciation that 'values' correspond to individual and collective experiences in the cultural situational and environmental fields, particularly in respect of education, health, work, life and survival.

MAIN FUNCTION(S) OF THE CLARIFICATION OF VALUES APPROACH

As part of a problem-solving sequence

The values social groups translate into actions through their choices lend meaning to their lives, to the structure of their social relationships, and to the way they think about their lives. All this is reflected in their relationships with others (frequent contacts for some, isolation for others), their self-acceptance and acceptance of others, their respect for nature, their consumption of energy, their conservation of the world's 'ecosystems'... It is all

part and parcel of a complex web of power relationships, interests, working conditions, associations, struggles, manifested in the most banal every-day life situation of the individual no less than in the relations between great States.

Clarification of values is a prerequisite of the identification and analysis of problems. We do not mean the clarification of values by a specialist or expert outside the group, by people who impose their choices without consulting the group, but by members of the group itself. The main function of this approch, then in relation to the complex problems of environmental planning and conversation is to make those involved aware of what M. Seeman,(1) the American sociologist, has described as their lack of power, of purpose and of rules, as well as bringing out their cultural, social and personal alienation.

This awareness, as the proceedings of the Tbilisi conference stress, must be fostered by the teaching of science and by learning to adopt a more scientific approach to problems. Unfortunately, the clarification of values is currently confined to discussions about science to which, for the moment, only adults already capable of performing complex 'mental operations' can have access; further progress can only be made by an insistence on the empirical verification of all interpretations of phenomena and by providing everyone with the ability to engage in a constant exchange between concrete experience and symbolic thought.

In short, the values of different groups have played, play and will continue to play an important role in the decision-making process no less than in the identification and resolution of problems. This is because new environmental values keep being imposed on citizens of all the countries in the world and because, in some countries, more and more effective pressures on the authorities have resulted, for example:

- in restrictions being placed on the discharge of pollutants;

- in the search for 'clean' technologies and in legislative and educational counter-measures.

Only an attentive public, i.e. a public not shut off from realities, can play its full part in the decision-making process.

HUMAN, INFORMATIONAL AND TECHNICAL RESOURCES

Needed for the clarification of values

To create the right background for a clarification of values approach, the teacher concerned with the non-formal environmental education of adults in a given region, must be familiar with the various features of that region, be they anthropological, social, cultural, economic, educational, climatic, pedological, geographic, demographic, political, agricultural, energetic, industrial, etc. Even if he lacks some of this knowledge himself, he can and must obtain it with the help of experts and various sources of information.

(1) M. Seeman in American Sociological Review, Vol. 54.

This role of information is crucial. Individuals may be considered as systems interacting more or less directly with significant elements in their environment. Most experts (sociologists, social anthropologists, etc.) are agreed that all breakdowns in our system of values involve a failure to digest information on the individual level. Conversely, we might put it that personal incapacity is linked to problems of processing information at the value system level, with the result that the behavioural choices of an individual become severely restricted. In that case, information will be misread even if extensive use is made of written or audio-visual materials (television, radio, cinema, newspapers, pamphlets, books, posters). The result is:

- on the one hand, a set of meaningless memories,

- on the other hand, incapacity to use the information for effecting real changes.

Let us recall that information only has value if it car. be applied to some real problem, if it is useful and can be integrated, that is, if it can be identified and correlated with other data and hence used to examine these data and to derive benefits from their correlation. The teacher must accordingly try to create conditions facilitating the search for useful information by helping:

- to discuss, select, assimilate, understand that information;

- to match it to the personal progress of each individual,

- to record it or bear it in mind for future use if that is thought to be important, and to file it away for easy retrieval.

Clarification of values on the technical plane is tantamount to using a 'critical approach' to the specific problems of a given region or country. This critical approach involves:.

- the identification and study of 'representations'; a fairly accurate knowledge of what these are in relation to facts and particular phenomena, whether they are proper merely to isolated individuals or to the whole community; without harping too much on preconceived and false ideas, knowing that these exist and how they arise,

- fostering the discussion, and helping the formulation, of problems; encouraging the presentation, in the simplest form possible, of the practical applications or the facts to which these problems correspond,

- listing and classifying different approaches, eliciting comparisons, creating a theoretical reference frame, eliciting new information on each occasion and proposing practical methods of checking that information,

- agreeing a vocabulary,

- implementing a method of searching for or verifying information, based on hypotheses that are easily formulated by the group,

- initiating a series of 'iterative' and non-linear procedures based on a series of repeated steps ('loops') and the formulation of hypotheses to be verified:

  This involves a two-way, towing and fro-ing between the different interpretations of the various stages we have described and their

implementation; it also involves checking the various interpretations of what one is searching for and of its applications;

There is no such thing as the right moment for everyone to frame hypotheses at every stage of the work; instead there are several moments during which one returns to this task. Similarly, there is . right moment for measuring variables; there are several favourable moments. What is involved here, therefore, is a permanent process of correction, of striving for greater precision, of questioning the data, of exchanging information and of clarifying values.

- making sure that, at all times, everyone is kept abreast of developments; this is important if no one is to be left behind at any of the stages we have described. The student must retain the initiative, must search even while he is learning. He must realize that:

  an isolated idea is not acceptable, because it is impossible to tell whether it corresponds to anything real,

  an isolated observation or an isolated 'fact' tells us nothing unless it is compared with other observations equally relevant to the working hypothesis.

- applying foresight: anticipating the next step, the possible results, the next experiments, etc. If we wish to clarify values (in respect, say, of soil or water conservation, energy production, reduction of various forms of pollution, human nutrition, improving methods for fighting natural catastrophes, etc.) we must allow people to extend their system of values to the reduction of uncertainty about the future. This applies to problems, their consequences and implications, as well as to the choice of solutions, the technologies to be studied or applied, etc.

When it comes to moral, civic and political values, it should be remembered that 'role-playing games', especially in the form of 'dilemmas' are one of the most common teaching aids employed (see 'Other Applications' in the paper entitled 'Gaming and Simulation').

Another technique, based on the finding that every individual clings to his 'mental images is known as 'value analysis'. It is used by companies or firms keen to introduce a new product or service in a given area; all the psychological motives for rejecting the product or service are brought up, every 'mental image' is analyzed and taken to its logical conclusion and counter-arguments are devised before any discussions with potential buyers are held.

A different, more formative, technique, recommended by M. Selman and M. Liebermann(1) for children, but also suitable for adults, consists of imagining conflict situations (a kind of psychodrama) and to act out the conflict between certain values (when applied to the environment, say, the conflict between the individual and the community in respect of pollution, equipment, etc.). The group opens the discussion by debating what decisions must be taken about difficult alternatives, everyone being expected to adopt an attitude, make up his mind, 'project' himself into the situation, and specify his choices,

(1) Quoted by M. Sheralyn and S. Goldbecker in 'Values Teaching' published by the 'National Education Asssociation' (USA).

feelings, etc. The role of the teacher is to watch the attitudes and then to subject them to an analysis, thus helping the group understand how 'values' can trigger off conflicts based on diverging or different standpoints and interests. These have to be reconciled or made the subject of negotiations.

Brief NOTE ON SPHERES OF APPLICATION OF CLARIFICATION OF VALUES

It should have become clear that, if there is such a thing as a clarification of values methodology, it (and incidently all other methodologies) cannot be taught; it must be acquired by practice coupled with reflection about that practice.

It should also be said that as the practice of clarifying values develops, obscure points become elucidated; this is because the validity of our approach depends on our preoccupations and presuppositions, the questions we ask ourselves, etc.

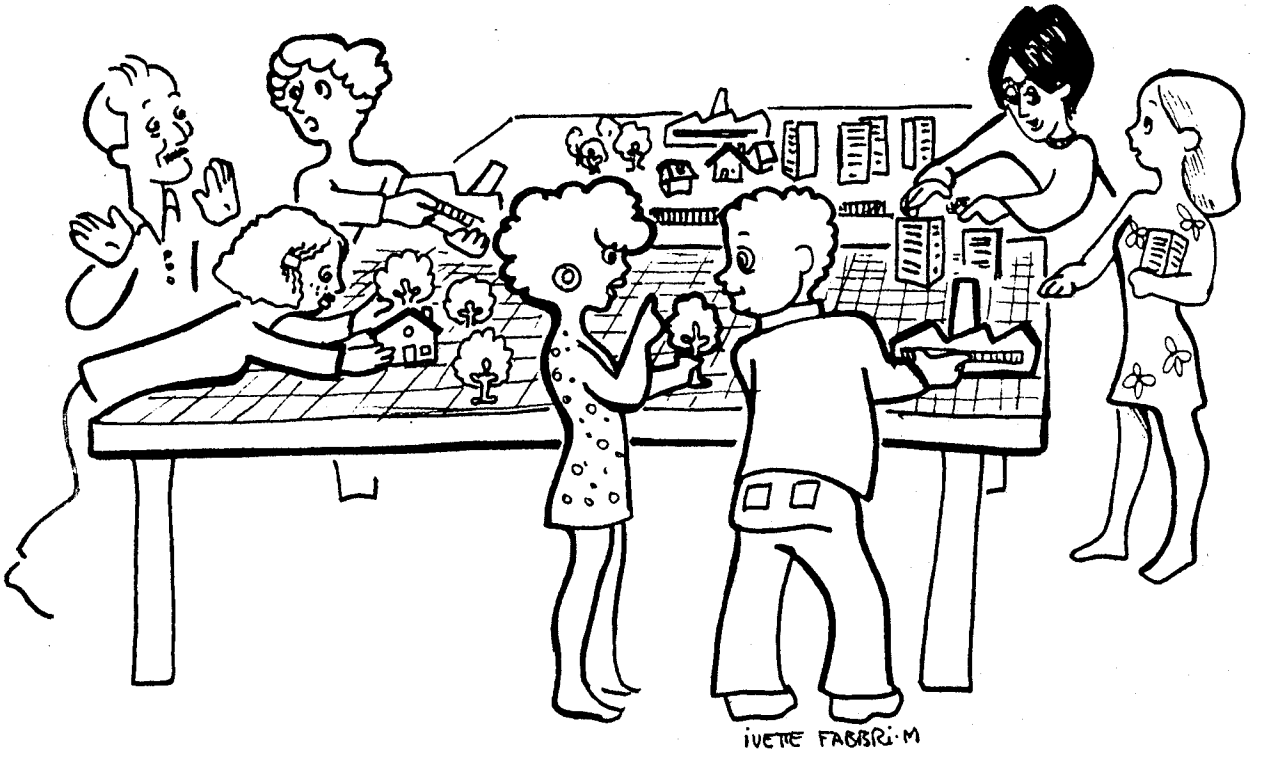
There has been much talk about 'representations'. However, practice alone enables us to draw distinctions, indeed to understand. People differ. No one for example, has the right to kill an artist or to stop him being an artist simply because he says things about the world that others may not understand. If, the clarification of values is applied to, say, the farmers' practice of burning stubble in fields and then extended to the wider environmental problem of bush or forest fires, we might be led to make negative value judgements about the justification of starting fires. However, outside this context, the poet, the chemist, the cook, the blacksmith, the physicist, etc., will speak of fire in other terms , applying different criteria and different values. There is no single truth, but there are fields of knowledge and values that cannot be reduced to one another. The only impermissible thing is to confuse them.

'Clarification of values' is an attempt to establish relationships in a particular field. Of course, the individual acts and expresses himself about a subject at different levels of information. When it comes to concrete environmental problems, the relationships to be established in a given field must be such as to ensure that the solutions to the different problems discussed and analysed can be verified directly or refuted by experience.

Thus if we wish to reflect about the effects of artificial irrigation on a given environment or to act on the problem of newly discovered diseases we must first familiarize ourselves with the facts and the workings of the 'supportsystem'. Next, we must remember that clarification of values does not aim to prove anything; it is simply a means of attaining to a measure of operational empiricism, and hence of escaping from the traps of dreams and sentiments.

The clarification of values can also be applied to scientific questions seen in their historical perspective (e.g., the circulation of the blood, digestion, respiration; the exchange of gases, photosynthesis, reproduction, to mention biological subjects only). It may help us to realize that, the interpretation of a given phenomenon depends on the historical context and the prevailing system of values. It thus leads to a better understanding of our relationship with, and attitude to, science and technology.

GAMING AND SIMULATION



GENERAL DESCRIPTION OF GAMING AND SIMULATION

Function, teacher, community, difficulties

The dictionary defines 'simulate' as 'to make a pretence of, feign; to reproduce the conditions of a situation'. Simulation involves a more or less explicit model.

- The main purpose of some models is to explain, illustrate and clarify - in short, to serve as tools for the acquisition of knowledge; others are mainly guides to action in that - starting with the reality on which we wish to act - they are supposed to provide all the elements needed for effective action;

- There are models for material systems as well as for systems describing situations. However, there can be no material model of the environment without an underlying conceptual model defining the place and role of, and the relations between, men and the environment, the function of the first being precisely to translate the second into concrete terms.

The function of a model, then, is to help us represent reality as we think it is. However, the model itself entails a certain view of reality: we use only such systems as models as we think can serve us as such; reality itself does not appear as a system until it can be 'modelled'.

The function of 'simulation' for instance after entering a number of data into a computer may be:

-to replace full-scale experiments in the field (e.g. on the consequences of a disaster);

-to experiment with real.data (e.g. to make forecasts);

-to set up a model of a real system under investigation (e.g. to study a particular aspect of a situation).

Most organized educational situations, involve an implicit model - hence 'gaming' or Simulation'. The teacher must:

- first, try to explicate the models he uses;

- second, elaborate models for precise ends.

This double procedure will give him greater control of the 'gaming' and 'simulation' inherent in every pedagogic situation; the games and the simulation may or may not be supported by technological or by educational aids specially devised for the purpose.

Among the public at large, the role-playing techniques associated with gaming and simulation, trigger off a host of ideas, feelings, attitudes and patterns of behaviour. Role-playing is mainly directed at the analysis of information about a given situation. The ability to measure and quantify that information is just one of the data of the game: what remains to be done is to evaluate the overall information the group still lacks, and to explain the cause of this lack in accordance with the rules of the game.

One problem is changing from intuitive practice to rational simulation. This calls for the ability to analyse the two great swings of a method of education that keeps moving from reality to the model and back again from the model to reality.

AIMS OF THE GAMING AND SIMULATION APPROACH

A pedagogic situation usually differs from a real one. The overall aim of gaming and simulation is not to mimimize the gap between these two situations but, on the contrary, to optimize it and to ensure that this optimum gap becomes the determining element of this type of education. Its efficiency can be defined as the optimum relationship between the means used and the results obtained. There is simulation when an adequate number of elements can be reproduced, for instance in a driving test simulator. Simple games, too, can be used for testing as well as for training and for imparting practical skills in general. Simple games might for instance be used to teach people:

- to drive screws in rapidly in the dark,

- To judge thickness by touch alone.

While evaluations of training programmes based on simulation techniques do not allow us to establish precisely how long the individual takes to make progress, it is nevertheless clear that simulation achieves one of its main aims quite well: it increases knowledge of a given situation and hence reduces anxiety about it. Simulation, in fact, helps the individual:

- to select priorities based on the importance and urgency of the various steps needed to solve a given problem;

- to adapt himself to circumstances without losing the thread of what he is trying to do;

- to rely on collective effort and not merely on his own;

- to share tasks with others;

- to organize his timetable and to make short-term, medium-term and long-term predictions.

Another aim of simulation is to effect a qualitative change of the educational situation, based on, say, case-studies, role-playing, micro- and macro-economics games, etc., in which the participants are assigned roles and functions as well as a chance of getting to know and analyse situations that may be different from those they are used to. It may produce:

- a change in the value and reference systems underlying certain ways of thinking and reacting;

- a physical and/or psychological response to a new or different situation;

- a change of reflexes and skills through training; a change of attitudes and behaviour patterns in a given situation. This presupposes the ability:

  - to enumerate the aims of a particular action,

  - to increase one's motivation to perform a given task,

- to gain better judgement of one's efficiency in tackling a clearly defined task.

A final group of aims of the simulation method concerns applications of techniques. "Model" presentations are particularly useful for communication. To use them for that end, one must be able to:

- read and interpret background documentation,

- analyse data, interpret them and, later on, compare one's interpretation with that of others.

However, in most cases, the main aim of simulation is to provide students with a rough guide for coping with real situations. To that end they are taught:

- to identify the actual means at their disposal instead of speculating about ideal means,

- to gain a better understanding of their own reflexes, potential and physical, psychological, intellectual, moral, etc., limitations in a given situation, and to make the best of them.

The aims of simulation have been attained when the mechanical, physical or mathematical 'model', built up from experimental data and constantly compared with reality and remodelled, has attained a degree of coherence.

THE DEVELOPMENT OF INDIVIDUAL AND COLLECTIVE ABILITIES THROUGH GAMING AND SIMULATION

Intellectual, emotional, organizational and co-operative abilities

A given situation can be modelled in several ways - depending on attitudes, individual and collective capcities can be variously harnessed.

An honest education should provide control over all levels of thought and facilitate reformulations depending on the situation and the interlocutor. Models based on simple analogies and not verified by experiment, are often made the basis of vague deductions leading to doubtful theories. Models that do not reflect quantitative laws, by which predictions can be checked by experiment, rarely help the intellectual capacities they are supposed to enhance.

On the emotional level, simulation for analytical purposes poses different questions from those raised by role-playing, for instance in the:

(1) elaboration and use of educational models somewhat remote from reality or dwelling on some aspects of reality at the expense of others (e.g. the purely biological side of pollution while neglecting the economic aspects);

(2) transformation of role-playing groups by the participants (often unbeknown to them) into 'diagnostic groups' in which one's self-image as reflected by the others during a discussion serves as a frame of reference for prolonged reflection about oneself.

When it comes to organizing a particular action and also when the proposed model is comprehensive enough, simulation should have a far greater power of integration and prediction than simple deduction.

Finally, simulation fosters the ability and readiness to open up to others, to listen to them and understand them through joint action as well as the ability and readiness to share information with other members of the group.

MAIN FUNCTION(S) OF GAMING AND SIMULATION

As part of a problem-solving sequence

It is quite possible to go beyond the intuitive educational situation in which everyone feels at ease but has no great desire to progress, by creating a natural state of curiosity based on the gap between a model and the real situation. In fact, by setting up some tension or dissatisfaction, indeed by provoking conflicts, it is possible to alter the entire dynamics of educational intervention and hence to change the conduct of the participants. The emotional impact of such situations can cause the participants to veer repeatedly between the simulation and a real-life problem. This leads to a reinforcement of the model and a sort of 'transfer' to the real situation; that transfer may facilitate the introduction of a new (real) situation. Other possibilities then present themselves:

(1) For the identification and analysis of problems outside the circumstantial or contingent framework: a model can be used whenever the demands of the real situation are well known. However, when a model is too complex, its ability to help us focus on important variables becomes too weak, with the result that they remain hidden; hence excess modelling of a situation or a problem impedes analysis. Conversely, when a model is too simple, the gap between it and real life is too great for any useful transfer of information to take place and to aid the requisite analysis.

(2) For the search for alternative solutions. Here, the use of a closed model involving 'simulation' without gaps or unknowns cannot be recommended. This is reassuring as well as disturbing because this type of closed model threatens to confine those who use it to a search for solutions of such simplicity that the experiment can never be repeated in real life. By contrast, an 'open' model, which can be changed and improved by the participants, who are expressly invited to do so, can be a source of creativity and an instrument for discovering alternative solutions.

Some simulation experiments based on the control of environmental resources and involving real environmental data can also serve as educational aids and, when conducted on a reduced time scale, as means of evaluating various hypotheses on the future state of the environment.

HUMAN, ORGANIZATIONAL, TECHNICAL AND MATERIAL RESOURCES NEEDED FOR GAMING AND SIMULATION

To be effective, gaming and simulation call for preliminary work by a multidisciplinary team consisting of, say:

- analysts who might be local experts, agronomists, town and country planners, architects, social psychologists, etc.;

- informants, such as newsmen, politicians, archivists, local inhabitants, etc.;

- technicians, scientists, people who have studied a specific problem and/or have examined alternative solutions.

As far as the organization is concerned, we can initially envisage a linear chain, even though that chain is very much less linear in the world of real tasks. The main links in that chain are:

- definition of general aims,

- definition of specific aims,

- collation of information,

- analysis of contents and specification,

- model elaboration,

- definition of validation and evaluation criteria,

- search for a training and teaching process (algorithm),

- construction of a simulation device based on the specification,

- preparation of a scenario and of rules, definition of roles, etc.,

- preparation of records to be consulted during gaming (photographs, maps, plan, reports) and of the relevant statistics,

- experiments, tests, corrections (to the scenario, rules, roles, etc.).

The elaboration of a model is thus initially based on the deepest possible analysis of the real situation; that analysis helps us to discover the structure of what is to be simulated, and then to organize all its elements and to set up the model. To that end, it is necessary to:

(1) do research on the spot, select and identify the most important aspect of the problem, be acquainted with the 'actors', the decision-making processes, the social and economic costs, etc.,

(2) gather all the facts and significant elements needed to write (and later to improve) the 'scenario';

(3) construct all the pieces of the jig-saw puzzle that will make it possible to reconstruct and analyse the situation.

On the technical plane, the only theoretical difficulty is to create conditions which will allow one to postulate that the model facilitates a positive transfer (on balance) from the simulation to the real situation. The real problem is, in fact, to construct a situation from all the elements that provide a coherent enough reflection of natural phenomena (when we deal with the environment), of the economic interests involved, of the real decision-making processes, etc., all of them expressed:

- on the one hand, by the special roles played by different people,

- and, on the other hand, by the relationship between these roles and the interactions to which they give rise.

Still on the technical plane, the organization of gaming is thus characterized by:

- a simulated construction with more or less close resemblances to the real-life situation,

- the existence of a more or less explicit model,

- the possibility that the participants can familiarize themselves with the proposed model and create another from it.

On the material planes the completion of the model may take from a few days to several months. It involves selecting a suitable subject, collecting and selecting data, experimenting with the model and modifying it repeatedly before its final presentation. It is generally believed that the development of a new model of a business or economic game takes at least 200 days work by economists, computer experts, social psychologists, etc. When educational model-building and simulation are intended for the construction of a technical system, the human, organizational, technical and material resources and, particularly, the costs are considerably higher still: for instance in the case of flight simulators for the training of pilots or of simulators to train petrol refinery staff. Thus collecting the data needed for the mathematical model of the Mekong River, used for flood control with the help of a computer, took several years and three expeditions; it involved 35,000 soundings. In dealing with environmental problems and in country planning, too, simulation can help considerably in elucidating a number of problems and the ecological constraints that must be taken into account.

In practice, simulation for the training of adults involves:

1. Asking the adult to enter into a situation rather than discuss it. In order to enter into it, he must be prepared to run risks, to win or to lose; he must also negotiate with others by using information, statistics, calculations about costs, etc. Entering into a situation does not simply mean expressing oneself; it also means 'acting' through role-playing.

2. Asking the adult to analyse a given situation with others. Here, there may be two possibilities: either the group consists of members who are involved with the model by virtue of their mode of life or occupation, or else it is made up of members bound together by the rules of the game alone. It goes without saying that the involvement of the two groups is not of the same type.

3. Asking the adult to stick to the rules of the game which must either be laid down in writing or else arrived at by a consensus on the basis of a full explanation of:

   the problem or the situation,

   the aims to be reached,

the sources of information and the nature of the files, plans, maps, photographs, statistics, etc., to be consulted;

the gaming cards which, for example, define the possibilities of action in the given environment;

the role cards and cards defining the characteristics of the various social groups and of the interests defended by each;

the relationship cards used for the evaluation of interactions within the group;

the principles of disseminating information (for written communications, public speeches, personal messages, etc.);

4. Asking the teacher to follow the progress and experimental involvement of all the participants. It is possible that some will become so deeply involved as to transform the game into a matter of life and death which allows of no social, ecological, political, economic analyses. In that case the group must be reminded of the original aims of the exercise.

EXAMPLE OF APPLICATION

Description

Simulation game for the study of the socio-economic system of an urban district in Abidjan (Ivory Coast).(1)

Aims:

(i) To draw the participants into a multidisciplinary approach to urban control and district planning allowing for social interference.

(ii) To demonstrate decision-making mechanisms and the influence of public-spirited citizens, not just officials on the control of a city district and its planning.

(iii) To encourage the search for alternative organizational solutions and of the means to be used in the control and planning of a city district.

Analysis of the game

The game in question is a training game, to be completed by 2 survey of the district or by meetings with active local bodies and elected representatives The end result is the design of a game specific to the district and having fixed objectives.

(1) This game was designed by J.P. Perier and played in Abidjan in 1976. It was distributed by Unesco, Division of Human Settlements and the Socio-Cultural Environment, 7, Place de Fontenoy, 75700 Paris, France.

(i) The model is a district of Abidjan with substandard housing allotments in need of development and, inhabited by low- and middle-income groups without industries but with craftsmen and a secondary commercial centre.

(ii) The actors in the game represent such active local bodies and individuals as:

- the various administrations influencing, or liable to influence the district;
- construction companies;
- craftsmen and traders in the district;
- various householders and other people using the district;
- elected district Party representatives.

(iii) The training game is played out like a socio-drama. The participants study their role cards, project themselves into their roles and set their own objectives. A number of confrontations between them are based on a relational model reflecting the local institutional system and the network of possible influences.

(iv) An inquiry conducted among active local bodies and local inhabitants.

It is advisable to arrange meetings between these active bodies and the inhabitants or their representatives, on the one hand, and the actors, on the other. The game is explained to the local people and the development of the district is discussed.

Various animation games can be played inside the district to discover the inhabitants' hierarchy of objectives and their views of the district.

(v) Redefinition of the roles, the relational model, and of the model of the district.

(vi) Playing the new game.

(vii) Evaluation and conclusions.

Using the game

The training game can be used as a simple example of gaming in general or as a preparation for more complex games. The game itself can then be developed out of the training game, as shown above. The playing of the training game takes one day. The complete procedure, as described above, can be completed in six days provided the ground has been carefully prepared. The game may be played by 12-25 players. With the larger number, an additional game leader (animateur) familiar with the area or having prepared the ground for two weeks in advance may be necessary.

Other procedures are possible. In particular, if the third aim is to be attained there will have to be two excursions to the district, the first to define a plan of action, the second to examine the district in situ. Two weeks will therefore be needed, as well as a larger cast or greater participation by local personalities.

ROLE CARD

PRESENTATION OF YOUR ROLE

You are a group of 220 craftsmen, half of them foreigners. You are: watchmakers, tailors, stone-masons, joiners, carpenters, electricians, bicycle repairers, etc.

You are often helped by one or two people who are members of your family or come from the same village and live with you.

You work for the people of this district because outsiders find it difficult to reach you.

You rent your living accommodation and your workshops. Only in rare cases are you connected to the electricity supply;

You work by the light of paraffin lamps even in your workshops. Your only water-tap is often in the courtyard.

YOUR CONSTRAINTS:

Your income is low because there is much competition. There are no fixed prices for your supplies or for your services. Your tools are often worn out but they are too expensive to replace. You have to pay rent and taxes which reduce your income further.

YOUR ADVANTAGES:

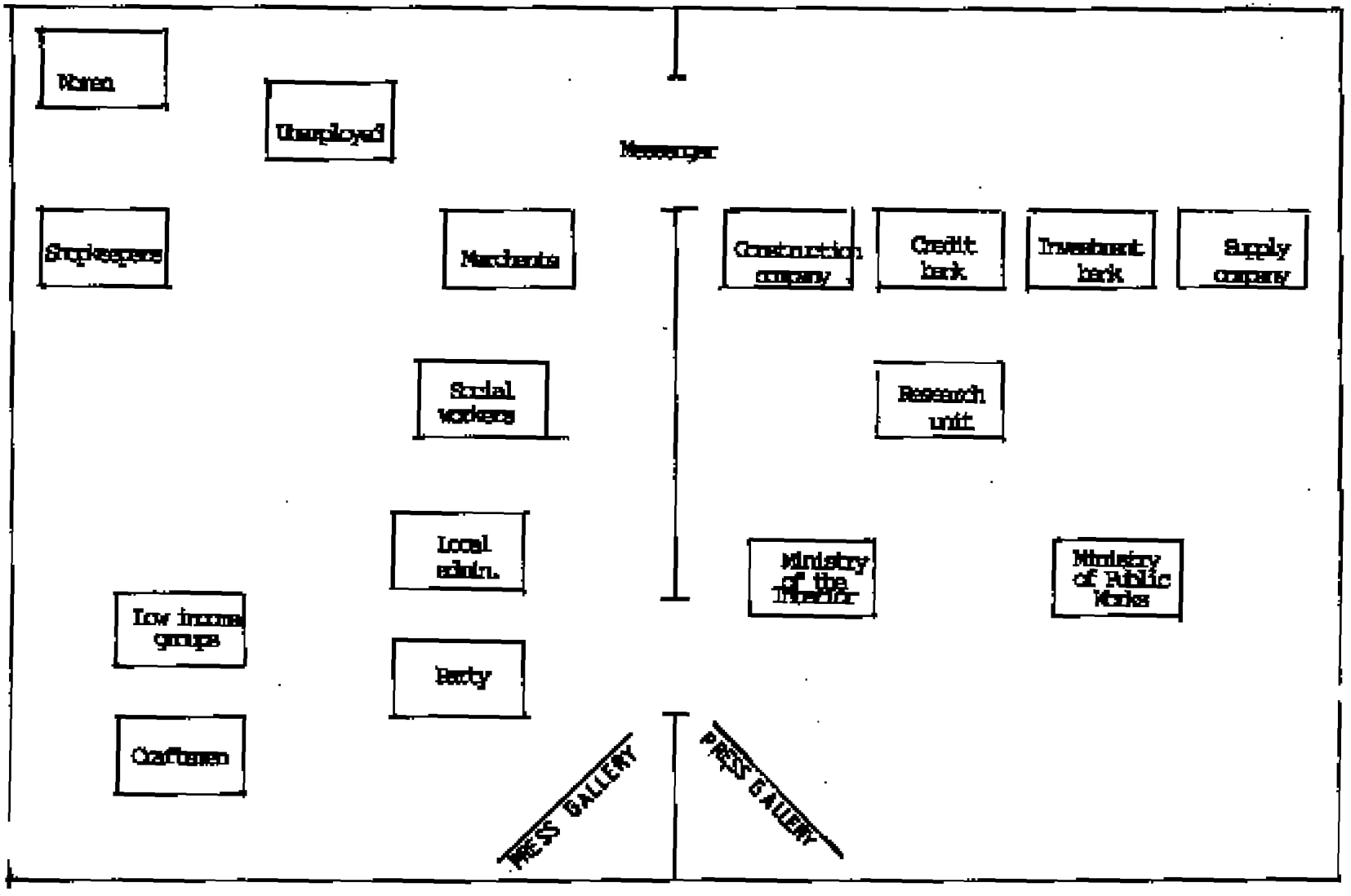
You are a joiner and have a relatively large workshop with six hands or workers. You are of indigenous stock and own the plot on which your accommodation and workshop stand. You are a member of the ethnic committee of a northern region, run by a Party official.

GAMING CARD: Fixing priorities for various amenities

NUMBER OF INHABITANTS PER ROLE:

LIST OF OBJECTIVES	POINTS PER INHABITANT(1)	PRIORITY POINTS(2)
- tarring roads - building a bus station on the market - setting up a taxi rank on the market - street lighting - piping mains water into dwellings - connecting mains electricity to dwellings - fixing water taps every 100 metres - establishing public laboratories every 100 metres - open spaces - children's playground - refuse collection with a collecting point every 50 metres - dispensary - nursery school - new bridge providing vehicular access to Adjame from the market - rainwater drainage - sewerage - large district school - new wash-house - creche - police station		
Total	100	

(1) You are asked to allocate a total 100 points to 10 of the listed objectives.
(2) Priority points = No. of points per inhabitant x number of inhabitants per role.


Women
Unemployed
Messenger
Shopkeepers
Merchants
Construction company
Credit bank
Investment bank
Supply company
Social workers
Research unit
Local admin.
Ministry of the Interior
Ministry of Public Works
Low income groups
Party
Craftsmen
PRESS GALLERY
PRESS GALLERY

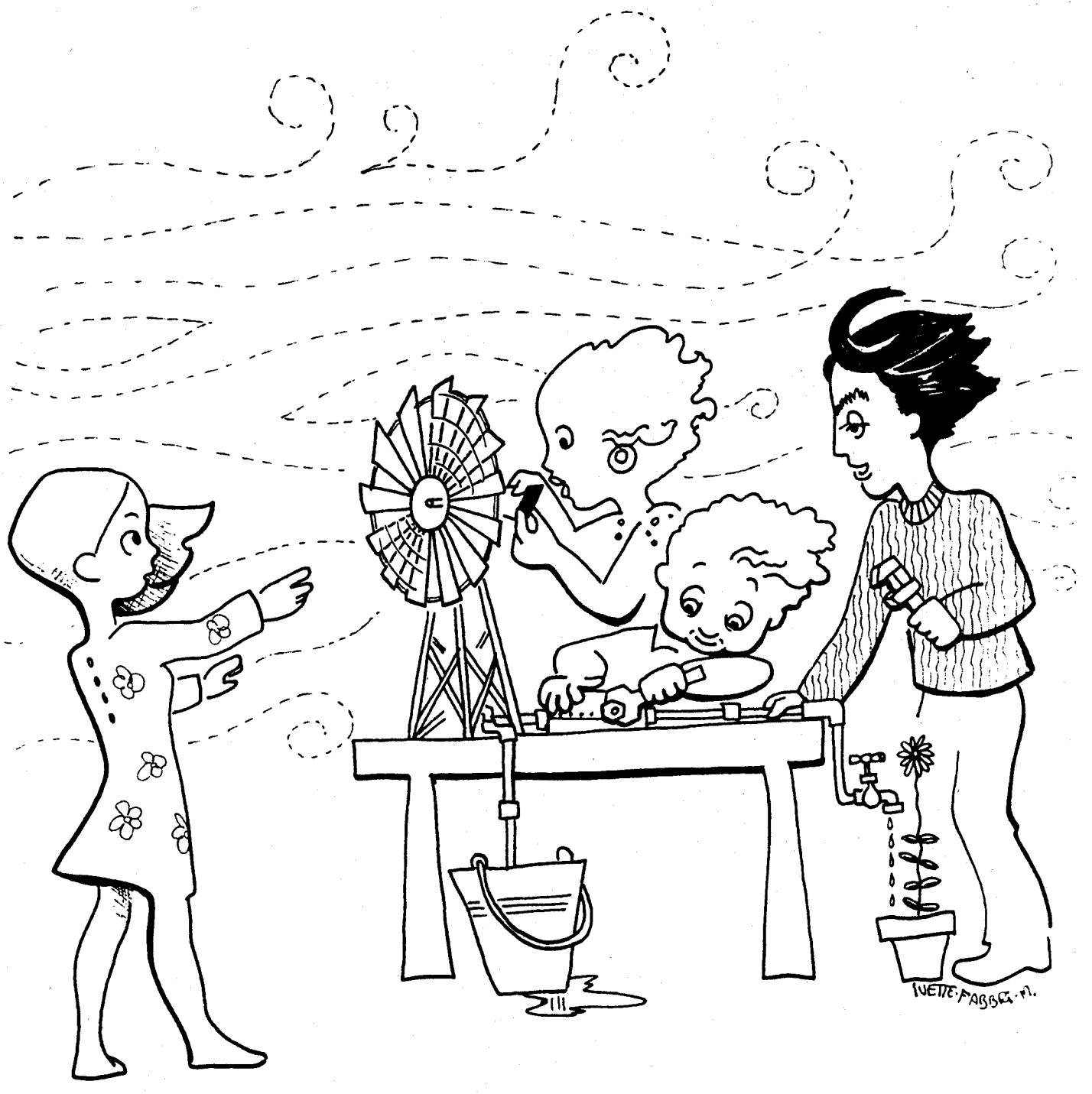
BRIEF NOTE OF OTHER APPLICATIONS

Extract from the Directory of Selected Instructional Simulations and Learning Games listed in John L. Taylor and Rex Watford: Learning and the Simulation Game, Open University Press, Milton Keynes, 1978, which lists several hundred 'Rames and simulations'.

No in list	Description	Operational requirements
152	An air pollution training exercise which is an outgrowth of the Metro simulation model	18-75 players with computer. 9 hours (minimum)
170	World hunger (questions of diet and decision-making)	2-6 players ½-1 hour
190	Social, political and economic problems involved in pollution control	12-24 players 2-4 hours
191	A simple procedure designed to demonstrate that keeping pollution levels below lethal limits, increasing community affluence and optimising property values are incompatible objectives	4 (or multiples of 4) players 1-1½ hours
216	A priming non-computerised game to increase the understanding of formal and informal decision-structures governing the development and build-up of a Sweedish region	16-20 players 3-4 hours
243	Problems of atmospheric pollution (game for city adminiatrators)	2-4 players ½-1 hour
250	Reactions to the route of a proposed motorway through a village	24 players 2-3 hours

283	Water management (impact on the public of decisions about the fight against water pollution	15-30 players (optimum) 4-5 hours
285	Water cycle	9-12 players 1-2 hours
286	Unpredictable elements of atmospheric depression movements	individuals, pairs or groups of players 1-2 hours

EXPERIMENTAL DEMONSTRATION WORKSHOP



EXPERIMENTAL DEMONSTRATION WORKSHOP: GENERAL DESCRIPTION

Function, role of teacher, community, difficulties

The basis of any experimental demonstration workshop is the immediate or the broader environment. It must be used as a point of reference at every stage of the procedure. Workshop activity is intended mainly as a training exercise; it needs to be broken down into component units, thus facilitating the teaching of elementary mechanisms. It means allowing adults, sometimes at their place of work, to use techniques and technologies with a bearing on the natural environment, the world's biological resources, sources of energy, amenities, etc.

It would be Utopian to think that such partial activities bearing on different aspects of a problem will spontaneously combine into a coherent whole. That needs organization, and organization can assume different forms, depending on the aims of the workshop. Here, the teacher has an important double role: to organize and to control. In addition, he often supplies the technical and technological expertise. In practice, the teacher asks for an explanation, helps to clarify a detail, suggests that additional information is needed, invites the participants to look again, to repeat an action, to re-read the programme, plan scheme or map, a given document, newspaper article or pamphlet; he encourages the participants and makes them reflect on the work in progress, etc. He is associated with every step of the training process, in which he plays a different role at different times. He is, in turn co-ordinator, inspirer, analyst, even 'specialist' in some cases ...; his task is to prevent discouragement, marking time, thoughtless waste of material, serious and irreparable errors that might result in setbacks and even refusals to continue the work, indeed anything that might discourage initiative.

As for the student, he must have the will to learn and keep abreast of the general progress made, and be aware of how much he already knows, how much he still needs to know, and of obstacles that block his path. He could be compared to an athlete: he runs because he likes running, he perfects his technique, corrects his movements, follows a training programme that will enable him to reach a precise goal, etc. It is his learning of elementary mechanisms that helps a man to gain mastery over tools, techniques and technologies and to turn that mastery into an extension of his potential, something to be used not only for its own sake but as a means of enhancing his general efficiency. The acquisition of such mastery is essentially a volitional act.

In principle, this collective endeavour can be channelled and its progress foreseen. This requires:

- definition of the subject-matter to be taught or practised,
- presentation of data,
- a systematic apprenticeship or training,
- evaluation of progress, and of performance,
- assessment, by the learner, of his own progress,
- reflection about the work done,
- review of contents and methods in order to improve the training, etc.

The main problem is to run a workshop as a practical training course that replaces the traditional lecture method.

AIMS OF THE WORKSHOP

Cognitive, axiological and technical aims

To acquire a skill, one needs to see it practised. Beyond that, one must try as best one can to grasp how a system or object (ecosystem, heat-pump, solar panel) is made or works. The acquisition of new knowledge demands a change in mental attitudes and in one's mode of 'representation'. Let us take an example: mathematical formulae alone will not help us to appreciate the slope of a hill; if the student has not had occasion to climb mountains and to make comparisons, the idea of a 30 degree gradient will remain an abstraction. As a general rule we might say that, in a workshop, understanding of what one is doing, together with reflection and discussion before and after 'practice very effectively replaces mechanical drills; hence the need to get the individual to explain and demonstrate repeatedly how he 'views' the work he has to do.

It is very important that adults should learn, but not like performing animals. Man endeavours, discovers, learns and corrects. First he must observe, then reflect and decide to adopt rules, standards, skills and actions with all the effort and active commitment that entails. He must become capable of:

- designing, creating and manufacturing the objects he intends to use;

- mastering a technique or a tool and taking pleasure in doing so;

- perfecting his knowledge, skill, ability, reflexes, etc., and gain personal satisfaction from the result or share his satisfaction with all the members of the working group.

A major aim of every training workshop is to foster the intellectual comprehension and representation of motor behaviour, to elicit the participation of every individual and to bring out the stimulating power of the group. Moreover, the transmission of theoretical and practical information, and the acquisition of new techniques, new knowledge and new abilities, demand a proper appreciation of the importance of language, manual skills, ideas and the pleasures inherent in the mastery of a technique, technology, etc.

There is a form of teaching manual skills that goes far beyond mere training in manipulation (agility, skilfulness) because it forms part of a series of acts in which thought, the correct handling of tools, object and experience are all as one. On the plane of technical objectives, the hand is an indispensable instrument for the transformation of materials, for processing them, for assembling components for adapting or transforming objects. Ultimately, it is from experience of what the hand constructs and transforms and from the constant exchanges between manual activity and the mechanism of thought that many discoveries, inventions and useful objects are derived; and maintaining this constant interchange between manual activity and thought is the main objective of the experimental demonstration workshop. The workshop must further encourage:

- individual endeavour and provide experience of situations that induce personal research or, more simply, set people thinking about particular practices;

- the use of co-operative work with allocation of responsibilities and tasks; the splitting up of difficult techniques into component steps; the organization of the various stages of the work, etc.;

- the rational use of space and time (planning, organization, methods of storage and control, care of materials, etc.);

- the adoption of safety regulations and attempts to improve working conditions;

- etc.

ABILITIES DEVELOPED BY EXPERIMENTAL DEMONSTRATION WORKSHOPS

Intellectual, motor, emotional, organizational and co-operative abilities

Every learning step in an experimental demonstration workshop draws on the intellectual, sensory and motor abilities of the individual, on his motivations, emotions and his mental representations.

Thus, from the assembly and dismantling of objects and from looking for faults, people will go on to look for logical methods and discard hypothesis that fail the empirical test. The individual and the group should be placed in situations demanding individual or collective research, based on a clearly understood real problem; they must be shown how to frame hypotheses, measure, compare, observe results, etc.

In general, action is intimately linked with feelings, and emotion is often the key to motor behaviour. Faced with a problem, man makes decisions based on his subjective state, his training, his personality and his personal appraisal of the situation. Because his emotions can distort his perceptions and in some cases interfere with the scope of this training, mastery over his emotions can often improve his motor behaviour and allow him to make much greater progress than he would have thought possible. This explains why the teacher must be alert and encourage all those who are having difficulties by positive appraisal and by dwelling on their past successes. The functional importance of the workshop does not derive from actions alone but also from the projection of needs, of interest in, and the wish to proceed to, action, which is part and parcel of man's nature. Work in groups (of less than 10) encourages the active exchange of ideas, stimulates co-operation, fosters mutual aid and the cumulative effect of ideas that lead to new inventions.

MAIN FUNCTION OF THE WORKSHOP

As Part of a problem-solving sequence

In the general context of further education, the experimental demonstration workshop is a very useful device for involving several people in a joint analysis of problems with a view to solving them. It facilitates research involving a sequence of exercises, experiments, observations, measurements and readings, the sole purpose of which is to provide a better grasp of an existing phenomenon or state of affairs (e.g. the study of an ecosystem, of a particular type of pollution, problems of plant nutrition, etc.). What is characteristic of this type of workshop is that there is no training or apprenticeship in the usual sense of those words; instead there is recourse to a special training process.

As a general rule, to be useful in the search for alternative solutions and their evaluation, a workshop must be flexible and able to cope with real situations. It may, for example, allow:

- the experimental study of various solutions,
- training in the use of various techniques,
- all sorts of permanent improvements in proficiency (knowledge, skills, abilities),
- setting limits to the permissible technological complexity needed to arrive at a solution,
- the study and transmission of technical and technological information,
- the learning of a new procedure,
- the production of objects needed for the kind of solution proposed,
- mastery of a tool, a technique, a technology, a machine or local skills,
- the discovery of tricks of the trade capable of providing solutions or of helping towards a clearer understanding of a technology,
- 'seeing' and understanding the implications and the complexity of a task or action,
- a review of a professional practice based on the use of a particular material, the study of a subject or the analysis of the effects of a practice on the environment.

Finally, in the very context of the 'performance of an action', certain programming 'sequences' can be based on a training process akin to that used in 'workshops'. Such actions may be:

the preparation of a building site,

a life-scale reconstruction of a complicated model,

the manufacture of tools or essential objects,

the mass production of elements needed to continue the action,

RESOURCES NEEDED FOR EXPERIMENTAL DEMONSTRATION WORKSHOPS

Human, organizational, technical and material resources

The unique character of an action performed in an experimental demonstration workshop is ensured by the cohesion of the team. This presupposes that the general aim of the action is defined by the team as a whole, which means making provision for joint discussions in the overall time-table of the team. The team necessarily includes local people (engineers, technicians, artisans, agricultural training officers, doctors, health workers, etc.) and cannot be made up exclusively of teachers or adult education experts. Moreover, to function properly, all those participating in a workshop must be able to meet on equal terms.

Their involvement must be reflected in that of the students. Moreover, the students 7 involvement in the group must also help to involve each one of them more fully in a project, the results of which he will have to assess and to compare with the results achieved by the group as a whole and by others.

As soon as the advisory team is set up, it must examine all the possibilities of assembling revelant reference material for use by the students (pictures, photographs, drawings, brochures, technical instructions, scale models, etc.). If, after discussion, it should turn out that no useful or suitable teaching material can be found, then it will have to be specially made. The organization of the workshop must be based on concrete features of the work and in the lives of the participants and not vice versa: several types of organization can be envisaged depending on the number of students and their availability. With fewer than 10 persons, workshop activity can be organized fairly easily, but with more than 10 persons, it might be better to set up several subgroups:

- So-called 'alternating' groups, making it possible to use material resources in rotation and ensuring that everybody has the necessary tools and the best conditions of work.

- So-called special interest groups, every subgroup doing work with specific objectives, means, techniques, etc. The organization of such subgroups or working parties must be governed by strict rules:

  there must be a relatively large and highly qualified teaching team;

  splits or rivalries between groups must not be allowed to surface, and individual members must be allowed to transfer from one group to another;

  information must be circulated from group to group, provision must be made for regroupings and for joint activities by several groups to encourage better communication and exchanges;

  when the work groups are divided into alternating and special interest group, provision must be mde for the reallocation of tasks, based on differences in competence and skill, etc. This division into 'teams' (to use another term) must allow for natural affinities, but also provide for adequate mixing. Attention must be paid to behaviour that offends some members: it may be best not to interfere provided that does not exacerbate matters. Competition between teams may be resorted to on very rare occasions;

  competition between individuals must be strictly avoided.

What technical form does the involvement of individuals in these 'workshop' activities take?

- One answer is to ask each individual to perform a task, or to share in an observation or action of the whole group. This may encourage competitiveness but makes it possible to turn the group into 'a facilitating group' whose ideas and criticisms help every member to progress.

- Another answer - when the object or theme of the workshop allows it - is to invite every participant to formulate a personal study, research or manufacturing project based on work already started collectively, and in tune

with the aims of the workshop; this method requires more frequent attendance but gives each individual greater freedom to develop his ideas and his imagination and thus to educate himself.

- A third answer is a combination of the first two. Some piecemeal workshop activities can be run in such a way as to allow the participants of each to pool their efforts at all times.

Other technical aspects may also have to be taken into account, but it should be remembered that a workshop cannot be run like a convey belt. These aspects include:

time scheduling to predict roughly how long it will take to reach the desired result with the technical means at one's disposal,

learning to use new tools;

work allocation based on time-scheduling, tool use, technical resources and successive work phases;

assessing the results;

assessing the quality of the finished article or of the assembly;

assessing the quality of the theory behind the practice at all levels of the process.

On the material plane, everything needed for smooth progress must be anticipated and the following preliminary provisions made:

collecting data and preparing the necessary documentation;

listing and storing all the materials that will be needed;

setting limits to permissible technological complexity;

establishing operational rules while paying due regard to the availability of the necessary materials;

treating some materials in special ways;

preparing machines, tools and accessories for measuring, tracing, perforating, sawing, cutting, turning, assembling, etc.;

providing adequate storage space, work surfaces, cupboards, utensils, etc.;

providing simple, even basics equipment but of adequate quality and quantity (for the number of people involved);

using economical and, if possible, re-usable, materials;

etc.

EXAMPLE: AN APPLICATION OF AN EXPERIMENTAL DEMONSTRATION WORKSHOP

From the analysis of problems to the search for solutions through the decision to set up a workshop

This example is of a workshop concerned with drying plant products in the

The established facts:

Normally, the produce to be dried (plants, fruits cereals) is spread on the ground and exposed to the sun. It takes a great deal of time and a large number of people to move the product to the large drying area and back again when the drying process is completed. Storms may damage the produce during the process, and drying is slow, while fruit, for example, needs quick drying. Insects often cause considerable damage when drying is not fast enough, etc.

Hypothesis:

Drying by a device that uses solar energy to better effect may help to produce good results under better conditions and very much more rapidly than by the open-air drying method; the time needed to dry grain may be reduced by 50 per cent-75 per cent.

Plan to establish a workshop:

- Presentation of the workshop system
- What is a workshop?
- Distribution of documents (example: the technical data sheet prepared by the Groupe de Recherche et d'Echanges Technologiques (G.R.E.T.)).(1)
- etc.

Nature of the information to be examined and discussed:

The workshop is intended to make theoretical and technical contributions to:

- an elementary study of the physical phenomena associated with the heat and light provided by the sun,
- an examination of the possibilities of using solar energy in an active form (heating or hot water production by solar panels) or in a passive form (drying in glasshouses or by the bioclimatic design of buildings).

All these ideas will be examined in depth or simply broached with a view to arriving at concrete solutions.

(1) G.R.E.T. - 34 rue Dumont d'Urville, 75116 Paris (France).

Elaborating a project:

- A number of sessions are organized in the form of round table discussions to examine and discuss the known facts and the technical data sheets that have been distributed. Question-and-answer exchanges are organized, first with the students asking the questions and the consultants providing the answers, then with exchanges between the students themselves and finally between students and consultants but with the roles reversed, all this, after division into groups if necessary.

- The 'rules of the game' are that all questions and representations concerning the drying of objects in the sun and solar energy must be reviewed not only for the purpose of developing a solar energy drier but also to clarify the significance and the principles of the preliminary experiments and to explain the nature of the work to be done to the largest possible number of participants.

Preliminary experiments

- First series of experiments. This series begins with experiments and observations of the kind that everyone will have made spontaneously. A length of watering pipe or a vehicle with closed doors is left in the sun. The group quickly discovers that the water in the pipe and the objects placed in the vehicle will have become warmer and that some of them will conserve their heat for quite some time, etc.

- Second series of experiments: identical small boxes, their inside painted in different colours, are placed in the sun. A thermometer is placed in each box and a control thermometer outside. The different readings are recorded and discussed. Other ideas for experiments of the same type may be used to maintain interest and to lead the group to the conclusion that the temperatures recorded, and hence the quantities of heat retained, differ with the colours. Black, causes the greatest absorption of heat and generates a higher temperature, while white reflects (turns back) more heat, etc. These findings are discussed and noted.(1)

- Third series of experiments (in conjunction with the project to be implemented and the technical data sheets to be interpreted). Use and/or construction of simple apparatus (e.g. sun dials, or cardboard boxes) to explain and encourage discussions of the following phenomena:

  - orientation and motion of the sun,
  - examples of the effect of glasshouses with:

    (a) single, double or triple glazing
    (b) differing glazing materials
    (c) various distances between two glazing layers
    (d) various distances between the glass and the heat-absorbing black base

  - examples of the effect of concentration,
  - examples of the insulating properties of certain materials,
  - etc.

(1) These two series of experiments were suggested by Madame Jeannine Chapelet to the workshops of the 'Club des Pleiades', J. Valeri College, Nice.

Progress of the project:

- Elaboration phase. It may prove necessary to revive flagging interest and to encourage people to pass on to the stage of personal involvement.

- Maturation phase. The technical data sheet is studied and the implementation of its suggestions examined. There must be discussion and reflection, followed by a revision of the data sheets, drafting and redrafting of reading lists, and the sharing of the results of one's reading with others, so as to provide the group with the (theoretical and technical) means needed to achieve its objectives.

- Consolidation phase. Review of the available materials dimensioning, establishing the general principle with the help of the equipment used in preceding experiments, decision to construct an initial experimental model.

- Implementation phase. The decisions having been made, the initial model of an experimental drier must allow for the division of tasks and for all the parameters brought out during the discussion of the technical data sheet and the trials, viz.:

- the loading of the products to be dried,
- the lining of the drier,
- ventilation,
- the general layout,
- etc.

At this stage, depending on the size of the group and its human, organizational and material resources, it is possible to conceive of several experimental models and to assign them to various sub-groups.

- Evaluation phase. Once the construction of a first experimental drier (or of several models) has been completed, the drier has to be tested. Arrangements are made for the group to record all observations, comments and measurements relating to:

  - the construction of the various experimental models,
  - the loading of the driers,
  - the orientation and declination of the sun,
  - the operating conditions (temperature, ventilation),
  - the capacity of the drier (quantity of vegetables, cereals or fruit to be dried and the time it takes to dry them),
  - the results (quality of the drying process compared with traditional methods, amount of work required, etc.),
  - the group's conclusions and decision about possible improvements (especially based on a comparative study), if several "experimental models" have been used.

BRIEF LIST OF OTHER APPLICATIONS OF THE WORKSHOP APPROACH

The many fields in which workshops can be used are listed in the technical data sheets issued by the Groupe de Recherche et d'Echange Technologique (G.R.E.T.). All that needs to be done is to ensure that the methods described are applicable to the problem identified and examined by those concerned.

Here then, by way of example, is part of the encyclopedic index of technical data sheets issued by the G.R.E.T. It should be remembered that every heading and subheading of the table of contents covers dozens of data sheets:

Use and production of energy

- human energy
- animal energy
- solar energy
- hydraulic energy
- wind energy
- electric energy

Environmental conservation

- soil protection
- humus preservation

Water supply

- drinking water
- use of river and spring water
  - (a) systems of seasonal storage
  - (b) systems of permanent storage
  - (c) use of roofs
- use of underground water
- raising water
  - (a) manual systems
  - (b) systems using animals
  - (c) systems using wind energy
  - (d) systems using methane gas
  - (e) systems using hydraulic energy

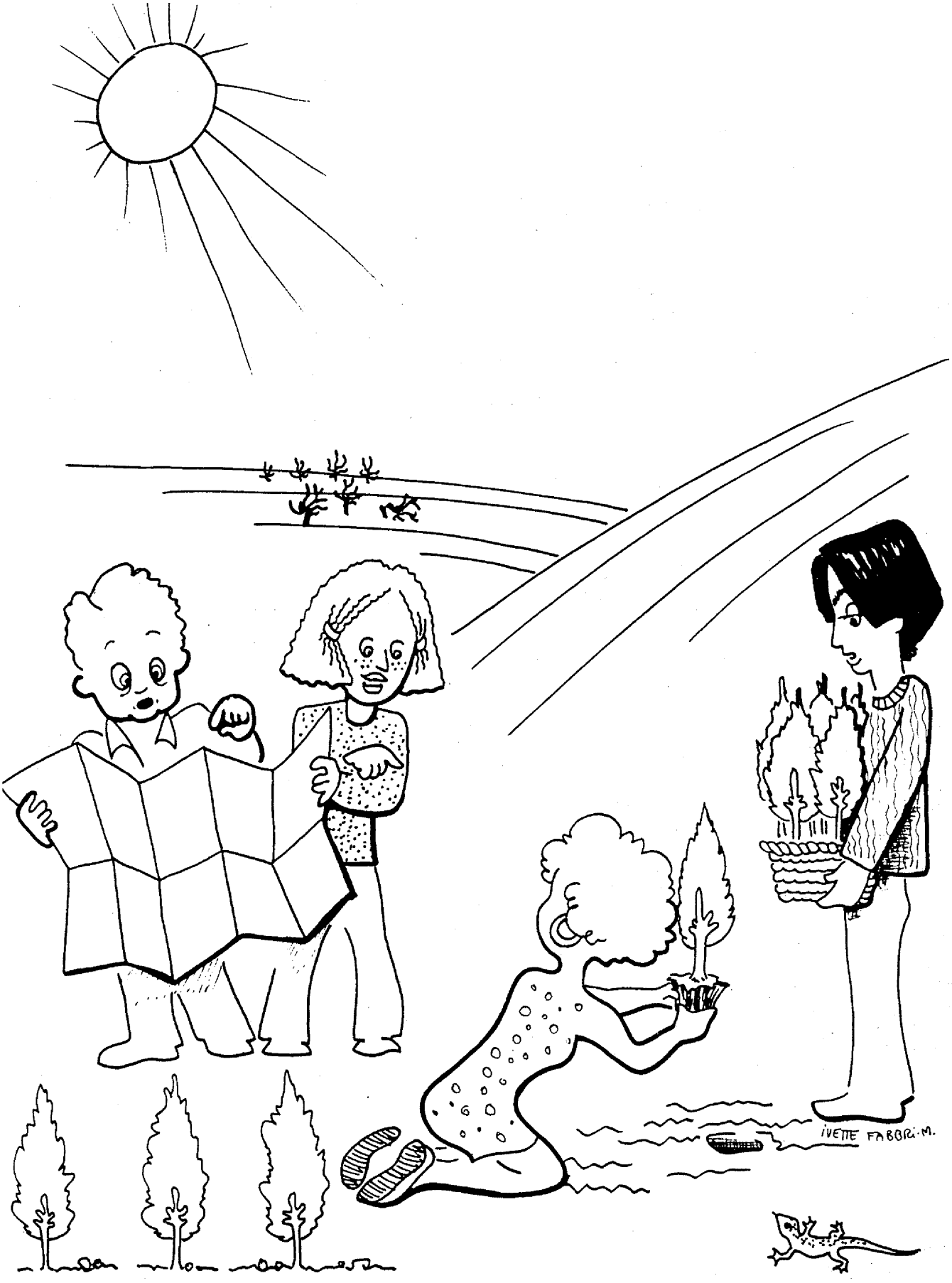
Transport of water. Systems of saving water for irrigation

- choice of crops
- choice of system of cultivation
- control of plant irrigation

This is a simplified extract from the section of the G.R.E.T. catalogue headed 'Energy, Natural Surroundings and Water'.(1) It shows how many fields lend themselves to the workshop approach; every field calls on dozens, nay hundreds, of different techniques and technologies, all of which can be taught, provided the right conditions for 'reading', 'comprehension', and 'reflection' are created.

(1) The table of contents of the G.R.E.T. index also has the following headings: plant cultivation, stock-rearing, food-processing, conservation, transformation, storage facilities, habitat, nutrition, hygiene, health. The G.R.E.T. file is intended to facilitate the search for appropriate technologies particularly in developing countries. In industrialized countries, workshops can be run on the do-it-yourself principle and geared to various trades (Building: plumbing, sanitary engineering, tiling, electricity, painting, decorating, glazing, carpentry ... Motor trade: panel-beating, minor mechanical repairs ... Electricity: repairs, heating ... Gardening ...). They are meant, not only to impart practical knowledge, but also to lead to the elimination of waste and to a re-allocation of working and leisure hours.

A PRACTICAL ACTION PROJECT



A PRACTICAL ACTION PROJECT: GENERAL DESCRIPTION

Function, teacher's role, community, difficulties

In his Critique of Dialectical Reason, Sartre states that 'a project is the sign of presence and of freedom. It projects us into a field of possibilities, some of which we fulfil to the exclusion of others; we also call it choice or freedom'. A practical action project, too, is to some extent, a manifestation of freedom; it is primarily a commitment before others and with others. Moreover, as part of environmental action, a 'project' reflects the wish to control the environment and to take appropriate steps.

Apart from all the learning that may result from a practical action project, its main functions are to:

- ensure that the individual becomes aware of his social environment: a practical action project is always the result of an overall analysis,
- select a course of action,
- lend purpose and meaning not merely to the action, as it must do, but also to further education in general, to the understanding of environmental problems and, in some cases, to the very life of a given community or environment,
- help the individual to project himself, alone and with the group, into the proposed action. This act of anticipation will help him to reduce the uncertainty of the future and may even produce a fundamental change in the system of values of people exposed to harsh realities, all of whose endeavours are likely to be brought to naught by, say, rains, storms, drought, etc., which frequently produce a fatalistic attitude,
- give everyone the chance to put something of themselves into the action,
- give a stamp of authenticity and purpose to the action.

The teacher's role is, above all, to create the right conditions for a successful 'practical action project'; to that end, he must:

- encourage a general analytical approach, based on discussions, guided visits, the clarification of values applied to specific subjects, etc.,
- organize working parties, experimental demonstration workshops, etc., to enable everyone to see the possibilities of the proposed action,
- provide the group with information and the means of finding further information (through experiments, documentation, etc.),
- remain in permanent touch with the community, rather than engage in confidential work with a few privileged persons; indeed, the teacher must structure the environment in such a way as to foster self-regulation, self-enhancement, reflection and the feed-back of information.

The community, for its part, should be helped to mature, to increase its capacity for dynamic action and its mobility and to reshape its conduct in accordance with a better understanding of itself and its knowledge of its potential and its limitations. A practical action project must encourage the active participation of the greatest possible number of people and bring every individual into genuine contact with his existential problems, thus helping him to grasp the whys and wherefores of the proposed action.

Under certain conditions, every community is able to take stock of its situation and to change it in accordance with the objectives it has set itself

and with the new conditions the launching of the 'project' introduces. The project as such, involves the following phases:

- analysis of the situation to bring out the main problems and the most effective solutions.
- choice of solutions or improvements, with due regard to the means available and the expected results.
- setting up the project and planning the action (time, space, means, roles, responsibilities, etc.).

The major problem is to bring out the full potential of a group and to allow the expression of conflicting views during discussions while avoiding such clashes as may endanger the whole project.

AIMS OF PRACTICAL ACTION PROJECTS

The cognitive, axiological and technical aims

The practical action projects call for active pedagogical intervention. They involve two main phases:

- a preliminary phase during which all the cognitive aims are attained more or less completely,
- an implementation phase, during which the group, the individuals (or the working parties) give concrete evidence of their efficiency.

In the preliminary phase, the ground will be prepared by various methods of analysis, discussion, research, information... This basic knowledge must be put to practical use by a process enabling the participants:

- to analyse a situation,
- to hold discussions with experts,
- to search for solutions, to gather information, to plan their work, etc.

In the realm of values (the axiological aims), practical action projects are bound up with the problem of voluntary change: they set a stamp of authenticity and purpose on actions by virtue of an analytical process; practical action projects in fact, enable the participants to:

- foster solidarity between individuals involved in the same project,
- lend meaning and purpose to actions rooted in everyday life, in its concerns, in the future and in environmental developments,
- avoid errors due to the complexity of the environment, to excessive concentration on isolated aspects, to inadequate research or analysis, or to hasty reactions when more careful deliberation and a wider view are needed.

As regards the technical aims, it should be recalled that practical action projects bear on real situation; they face individuals and groups with facts; they call for decisions that must not be arbitrary; they demand pragmatic strategies and planning methods. Finally, they necessitate a systematic check of the results of an action with a view to making possible corrections or changes and taking decisions about the next steps. This means that the participants must be able:

- to arrange, structure and organize the results of observations and experiments,

- to devise accurate methods of collecting, interpreting and eliciting such data as are important and useful for the preparation of the project,
- to set up working parties and to be able to work in them,
- to arrive at situations that facilitate and justify a decision-making process and concerted action,
- to establish aims to be reached by clearly defined stages,
- to set levels of equipment and skill,
- to establish the rules of the 'conceptual game' needed to accomplish the task or the work (example: because of local supply problems, a particular technical difficulty will have to be solved in a particular way or by ruling out the use of a particular material, etc.).

THE DEVELOPMENT OF INDIVIDUAL AND COLLECTIVE ABILITIES DEVELOPED THROUGH PRACTICAL ACTION PROJECTS

Intellectual, emotional, organizational and co-operative abilities

As we have seen, the educational process known as the practical action project involves and encourages independent experimentation, interest, free choice, anticipation, activity, etc.

On the plane of intellectual abilities, what matters most is to allow the individual to assert his personality through the determination to act on the environment, a determination that is given concrete form in the series of decisions and actions we call a 'practical action project'. That project therefore reflects his ability to invent, conceive and create in the company of others. By doing individual and collective research into clearly identified real problems, the participants are forced to act, to feel their way, to frame various hypotheses about the expected result or results, the advantage or advantages of a particular technique over another, etc. This helps them to set realistic goals and define the actions by which these goals can be reached.

Emotionally, this type of 'experiment' is known to involve the individual deeply. The value of a practical action project on the emotional plane, lies not in the action itself but in the projection of the need and desire to proceed to action which is part and parcel of thought.

As for organization, it is from the examination of the system of values and options of every participant that a programme, various hypotheses about the results, a project, a strategy, the rules of the 'conceptual game', a distribution of tasks, etc. can be elaborated.

This process, in which all the participants are involved, must spring from a collective adoption of a plan of action. If we define a practical action project as an occasion for 'commitment before others and with others', it becomes obvious that co-operation is a prerequisite of success. Moreover, co-operation on environmental questions is, in any case, a matter of the utmost importance, in view of the plight of rural populations throughout the world, shaken as they are by industrialization and the spread of vast conurbations.

MAIN FUNCTION(S) OF PRACTICAL ACTION PROJECTS

As part of a problem-solving sequence

Practical action projects are among the most comprehensive and complex educational experiments but should not be attempted unless the community has

first been alerted to them by a number of experimental activities leading to a clarification of values and by information based on the analysis of problems and of their elements.

The application of a practical action project, therefore, proceeds from the result of a general analysis, through the framing of hypotheses on possible actions and their foreseeable results, to the project itself. This educational approach is intended to break down engrained habits and to open people up to themselves, to others and to the future. This perspective provides the best chance of gaining greater independence and of changing one's system of values, of opening one's mind, the better to struggle against passive acceptance of the status quo and to discover a different way of life, aimed at improving the environment and the life of the community.

In a problem-solving sequence the teacher alone cannot play an adequate role. He will have to act in conjunction with other concerned people or groups, overcome the general dearth of environmental information and fight against the concentration of information in the hands of a few specialists; he must seek to create conditions for meetings and co-operation between the community and the specialists. Reflection about information useful in the planning of an action may reveal deficiencies which militate against the use of that information, e.g. the inability to read maps, plans, diagrams, statistics, etc. The teacher must not try to substitute himself for the people concerned; he must, by a rich and diversified training programme, provide them with the means of completing every stage of the project by themselves. He must refrain from imposing his choices or decisions on the group; indeed, he will have failed if he has not proved capable of creating conditions that allow the group to take their own decisions, even if that delays the project, given the time it takes to digest new information.

The various problem-solving sequences will not prove effective in a practical action project unless they are based on motivations in tune with the lifestyle of those concerned.

HUMAN, ORGANIZATIONAL, TECHNICAL AND MATERIAL RESOURCES NEEDED FOR PRACTICAL ACTION PROJECTS

The teacher cannot help the success of a practical action project unless the community and the group with which he works are determined to reach a positive result with all the individual and collective sense of responsibility and effort to learn that this entails. The teacher should be a sounding board for the group, not its leader; a fixed point from which the group can go out to explore. However, if he is left to his own devices, his contribution will be circumscribed; he must bring in outside consultants and these, too, must avoid creating 'dependents' or, worse still, dominating others by a show of their own 'superior knowledge'.

Teachers and consultants must not, then, seek to impose their own analysis of the situation, their own objectives or their own strategy. They must not be manipulators; they must proffer no pet theory or solution; their task is simply to organize a 'transfer of information'.-As the repository of this information, they are 'mediators' between the group, the analysis of the situation and the decision to be taken. They must help the group to surmount fears based on inadequate information. They must contribute to the gradual redimensioning of the problem to be solved, by successively introducing new elements. The community, for its part, must bear in mind that:

- The dynamics of a group or of a community do not obey the strict rules of logic, and emotions may well jeopardize all the information acquired and thus impede formal progress.
- Every one of the consultant's attitudes conveys values, the consultant's very presence lending a concrete meaning to his intervention.

As regards organization, these are two complementary aspects - an internal and an external, which ensure that the project runs its proper course.

The internal aspect involves:

- a clarification of the values attaching to subjects with a bearing on different aspects of the environment.
- involvement of the group in specific, identified problems, and hence
- the creation of a deliberative body capable of discussing and devising a practical action project. This project must draw on the relevant documents, material and expertise, and have the aim of encouraging the untrammelled expression of ideas. The field of possible experiments must not be restricted, nor should it be expected that every possible proposal will be put forward or, indeed, that everyone makes proposals. It would also be mistaken to expect all the experiments and underlying ideas to be presented in orderly form - at this stage the main emphasis should be on purely practical matters.
- encouraging all participants to take the formulation and presentation of their ideas as far as they can, and setting up working parties for the purpose of reaching agreement on hypotheses about actions and the results,
- arranging for meetings between the working parties and specialists to seek alternative solutions and to help in outlining the project, once all the members of the working parties have expressed their views,
- creating conditions for experimentation with, and the evaluation of, some of the proposed solutions (technical aid, development and grading),
- helping the working parties to elaborate the various phases of the action project and encouraging the emergence of people capable of implementing decisions, initiating the proposed actions, and taking charge of various aspects of their work. The working parties might later become permanent structures for the purpose of reflecting on, and resolving, problems.

When it comes to the external aspect, the main technical and organizational problem is to circulate the available information to the greatest number of persons and authorities or anyone likely to be associated with the project. If the project should be part of a national campaign, then the mass media will probably be involved in any case and contribute towards its success. If the project is purely regional, the team (working parties, teacher, consultants) must themselves shoulder the task of disseminating the information. To that end they will organize:

- visits to all the authorities concerned (e.g. elected representatives, administrative and technical officials, etc.),

- explanatory meetings in every locality concerned,

- free debates using visual aids (maps, drawings, etc.,) if possible,

- local press campaigns to announce dates and venues of local meetings, to report on every meeting, or to publish articles giving general information about the environment and the proposed practical action project,

- the preparation of exhibition material (six or seven detachable and transportable panels or posters) to be displayed in the various halls where the project is discussed. These panels are intended to draw maximum attention to the action project, and also to drive the facts home to those involved in their preparation,

- the compilation of flash cards (to illustrate, say the special features of the given ecosystem, of various sources of energy, etc). These cards could also take the form of transparencies projected on a screen (if the projector is available),

- the preparation of material for general distribution, e.g. an ecological map of the region, etc.,

- competitions in schools, e.g. for submitting the best irrigation plan for the region (supply, pollution, recycling, etc.).

It should be clear by now that the success of a practical action project will depend on the combined efforts of sociologists, the 'technical advisers' and the teacher as the driving force behind the project. The resulting flow of ideas, hypotheses, debates, experiments, and conclusions is likely to produce moments the participants will remember long after the project is over; a practical action project, in fact, confers inner coherence on an 'educational situation' because it is structured, leads to structuring and gives rise to restructuring processes. However, much as a technical adviser does not transform the head of a state into an engineer, a surgeon, etc., so the information held by a community which has to make decisions and take actions affecting certain aspects of the environment cannot turn every inhabitant into a scientist or engineer.

Finally, the human, organizational and technical aspects we have mentioned, must be complemented with:

- financial resources needed for planning or implementing the project,

- ways of co-ordinating the work and of eliciting the participation and collaboration of technicians and specialists,

- ways of arousing interest in the project and furthering studies connected with it.

EXAMPLE OF THE APPLICATION OF A PRACTICAL ACTION PROJECT

This example concerns the production of methane gas from farmyard manure as part of a search for alternative energy sources. It is based on a practical action project in the French countryside(1) and also relies on data sheets issued by the Groupe de Recherche et Echanges Technologiques (G.R.E.T.).(2).

(1) R. Quetel, 'L'education permanente dans le Monflanquinois', article in Pourquoi? (3, rue Recamier, 75341 Paris), No. 166, june 1981.
(2) Groupe de Recherche et Echanges Technologiques, 34 rue Dumont d'Urville, 75116 Paris. Tel. 502 1010.

Presentation

The project involves the production of methane gas from manure and waste in order to render a rural hamlet self-sufficient in energy. The hamlet contains three families and is part of a district with several similar hamlets. The 'biogas' project was chosen as the first practical action project in order to demonstrate that new sources of energy can help people to think about and to experience the environment in new ways and so lead them to new solutions of the energy problem.

Launching the project

The first decisions concern the setting up of working parties (and agreeing on who is to join which), the choice of site for the 'digester' and the nomination of the first beneficiaries of the project. The imnportance of the last step must be stressed, as must the fact that the nominations must be endorsed by the whole community at a general meeting at which everybody has an equal say. Moreover the nominees must keep in close touch with the rest of the community, which they must keep fully informed at public meetings where everyone can express his views and suggest alternative procedures.

The aims

A second series of decisions concerns the ultimate objectives of this practical action project, based on studies, information from technical experts, visited and experiments. In the case under review, for example, two aims might be adopted:

- the first aim: rendering a hamlet self-sufficient in energy by means of gas obtained by the fermentation of stable manure.

- the second aim: designing and operating a digester suitable for a mixed farming region and meeting a certain number of criteria; the data needed to evaluate these criteria are introduced as the community gains a better understanding of the way the digester works.

In both cases, the following criteria must be satisfied:

- simple and effective operation,

- plant of medium capacity (6-12 cubic metres) capable of supplying three families with gas for cooking and lighting,

- design of a plant needing minimum maintenance and using readily available materials such as drains, PVC pipes etc.

Technical choices

The need to establish trust between the different groups or individuals involved (the community, working parties, teachers and specialists) and the competence of the specialists (or, in their absence, the quality of the technical documentation) combine to render the making of technical choices crucial to the success or failure of the whole project. Correct choices will not only ensure success but will also save time, money and material and, above all, will strengthen the motivation and determination of the group. For our particular project the following technical choices have to be examined:

- Production of biogas from manure in continuously or in discontinuously charged digesters.

- Storage of gas in a pressure chamber or in a 'gasometer'.

- Purification of biogas by one of several methods.

- Use of the methane to supply one of several possible energy converters.

- Use of one of several mixers.

- Use of one of several water recuperation systems.

- Construction of one of several types of manure chamber.

Some technical choices are more directly influenced by the technical expert, while others are more subject to discussion and decision by the community acting through the leaders of the working parties, for instance, the siting of the digester:

- near homes,

- near the manure heap or tank,

- at least ten, fifteen or more metres from the nearest well, depending on the type of soil, to avoid contamination of water,

- in a hot and sunny place,

- near water,

- etc.

All the initial data are presented, discussed and their advantages and disadvantages weighed up, so that all interested parties can make their decisions in full knowledge of the facts. The running of this particular plant is easy to understand; it can be used anywhere in the world and the underlying principles taught by any teacher. All that is needed is the will to use it: that must be fostered by the teacher's dedication.

BRIEF LIST OF OTHER APPLICATIONS OF THE PRACTICAL ACTION PROJECT APPROACH

The pamphlet summing up the results of the Unesco 'Man and his Environment' campaign, draws particular attention to public ignorance of natural systems and of mechanisms helping to maintain life on earth; it mentions 'neglect of the unforeseen effects of technology', of pollution, of mismanagement of the soil, of forests and of water resources; it also refers to energy problems, to the destruction of habitats and the disappearance of traditional crops. If we take each of these points in turn and decide to deal with them constructively, we should have hundreds of opportunities of designing further education programmes in which the exchanges between specialist research workers, technical experts and (rural or urban) communities might well take the form of practical action projects. In just three fields, namely water management, crop cultivation and do-it-yourself construction, it would be possible to conceive of the following projects:

1. Water management

   - boring wells,
   - water piping,
   - drainage,
   - irrigation.

2. Crop cultivation

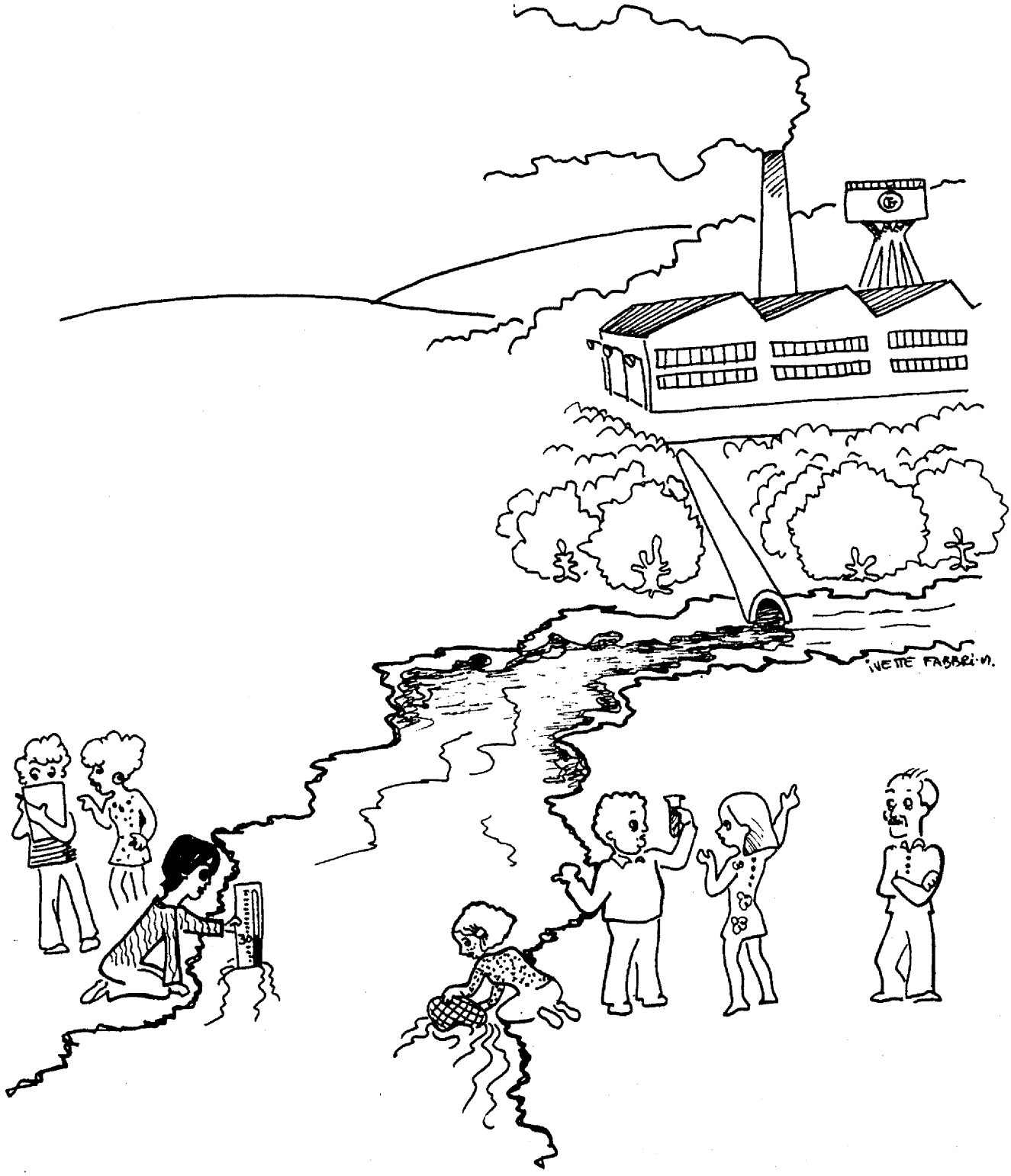
   - improvement of crops,
   - increasing the unit yield and improving seed selection,
   - opening up barren land,
   - fighting soil erosion,
   - improving the physical properties of the soil by maintaining the humus level and particularly by making and using compost,
   - improving plant nutrition and growth,
   - etc.

3. Do-it-yourself contraction of

   - small-scale agricultural equipments,
   - houses, farm buildings,
   - etc.

A number of practical action projects have already been applied in the fields of animal husbandry, reafforestation, co-operation, increased commercial efficiency, health, etc. We might say that wherever a problem can be formulated by the interested parties themselves and whenever the teacher is capable of bringing out the full potential of the human and natural resources of the environment in which he is working, all the conditions for a successful practical action project are present.

ACTION-ORIENTED RESEARCH



ACTION-ORIENTED RESEARCH: GENERAL DESCRIPTION

Function, role of teacher, community, difficulties

Action-oriented research is an integrated and interdisciplinary educational method facilitating an overall and integrated approach to concrete problems, based on research into their causes and consequences and leading to action in the form of solutions to these problems. The socio-psychological origins of action-oriented research might suggest that it is simply a method of changing human behaviour. However, under certain conditions it can also enable man to improve his environment, provided it is treated as a novel experiment in cooperation and in the combination of various skills in a given environment.

Action-oriented research is not a form of fundamental research undertaken by laymen, i.e. a usurpation of the functions of university research workers. It is simply a method of deciding, wherever there is a determination to formulate environmental theories and put them into practice, to what extent a particular research project, recognized as such by those involved, will substantially further the aims of adult education. Now, action-oriented research can undoubtedly be of considerable help to teachers of environmental studies, and hence facilitate the examination and particularly the solution of concrete problems in an area where life and work are in close interaction.

From the principle that man learns what he wants to know at a time when he needs to know it, it follows that the process is bound to be slow yet cumulative, involving as it does the participation of the largest possible number of people from the same background (rural community, inhabitants of the same valley, etc.).

Action-oriented research as applied to the environment has the following

- to help identify recurrent natural phenomena in a given environment that cause identifiable difficulties (human, plant and animal disease, soil erosion, a drift from the land especially of the young, disappearance of traditional energy resources, etc.),

- to establish such simple general relationships between these phenomena as can be grasped by the community,

- to initiate a process of interactions with one or more research workers intended to help the community or group to cope with their own problems.

The attitude the teacher must adopt to ensure the successful application of this method is one of permanent 'curiosity' about the facts and of readiness to share this curiosity with others through increasingly systematic questioning, observation and discussion. The teacher must not impose his own ideas; if he did, he would be short-circuiting the most important stage of action-oriented research; the formulation of the problem. Together with those interested in the project, he must try to discover under what conditions they and the community can collaborate on an equal footing, so that either side can follow the logical processes of the other and so by-pass the usual hierarchies. In other words, the teacher must discover appropriate means of communication, exchange and joint decision-making. From the very first meeting there must be perfect candour; everybody (the teacher included) must feel free to admit their mistakes, and a clear and simple set of rules must be agreed, e.g.:

- Meetings shall be held near where people live or work.

- The subjects discussed shall be as concrete as possible.

- Only one subject shall be discussed at any one time.

- Successive stages of action-oriented research shall be clearly defined.

- There shall be no progress to the next stage until the last stage has been fully assimilated.

- The group shall agree a programme of visits and a list of experiments.

- etc.

Basically, 'action-oriented research' is a social activity. Its prerequisite is good communication, inasmuch as discussion is an essential tool for challenging set ideas, for stating facts, for expressing views and feelings and for marshalling thoughts.

The ability to question certain situations or to challenge set views about certain phenomena can be encouraged by inciting curiosity, organizing visits, and clarifying ideas and values in a propitious atmosphere. The underlying element of gaming and invention appeals to men the world over. The basic assumptions are that:

- knowledge is part of man's practice,

- the appreciation of other people's knowledge can lead to the pooling of knowledge,

- the expert's knowledge may differ from that of the interested parties and is not necessarily the only knowledge that matters.

People's ideas about research, on the one hand, and the transmission of information, on the other, are often the main obstacles to action-oriented research. Traditional methods of adult education, are based on the illusion that everything can be identified and discovered by rubbing the magic lamp of established educational practices (formal lessons, workshops, simulations, etc.). In action-oriented research, by contrast, the teacher allows adult students to reorganize a multitude of data reflecting complex situations that can only be mastered after discussions, experiments, meetings with experts, studying documents, etc. All this makes it essential, however small the resources, to combine the data into a coherent system of relations guiding the action. It also means:

- guarding against manipulation;

- producing tangible effects;

- forming recognizable groups, especially in countries where the need for permits or subsidies makes it essential to adopt a high profile;

- resolving the problems of 'power' and the division of powers;

- reconciling the various problems of various persons or groups in a given community;

- etc.

THE AIMS OF ACTION-ORIENTED RESEARCH

The technical, axiological and cognitive aims

The technical aims of action-oriented research are:

- to establish a clear and precise basis of collaboration between the research worker and the community;

- to identify and define genuine problems;

- to frame hypotheses on research and action;

- to place the action or research in the context of their respective development, i.e. define moments, stages, places, means, etc.;

- to give interested parties access to the relevant scientific data;

- to reconcile two approaches, namely purely theoretical research often divorced from real life and hence of little practical value, on the one hand, and an over-zealous desire for action for action's sake, on the other.

- etc.

The list of further technical aims includes all those that help the group to progress by encouraging its members to become more articulate or by group dynamics.

The axiological (value-related) aims of action-oriented research are to increase awareness and hence control over the knowledge an individual has accumulated. This involves:

- learning to arrive independently at the solution of various problems after having created the appropriate conceptual and material framework;

- using research in order to develop an independent experimental method of grasping environmental developments and taking appropriate action;

- making strenuous efforts to acquire information, to increase one's skills and to build up a body of knowledge with the help of actions taken to solve problems defined on the spot;

- questioning some of one's own ideas by research and action; surmounting obstacles in the path of knowledge and enabling every individual to fit his personal experience into the context of the experience of his society;

- etc.

Adults live, move and act in an environment. In theory, their movements are the result of free and deliberate choices linked to their responsibilities. The aims of action-oriented research necessarily imply communication and cooperation between free persons - settled views are unlikely to change unless they are challenged by those holding different views. The procedure is not taught to adult students: it is the natural result of the course of discussions in which the consultants (teachers, research workers, technical experts) ensure that everybody's opinion is respected and that people are allowed to express themselves in their own way.

Several cognitive aims can be defined in terms of abilities:

- to differentiate between facts, ideas and feelings;
- to participate in discussions, debates, committees, etc.;
- to describe observations;
- to verify data obtained by observation;
- to intrepret the results;
- to organize for action: planning interventions, making provision for future needs, etc.
- etc.

Participating in the decision-making process presupposes the ability to use formal thought. This means accustoming the mind to going beyond the immediate data; people must be rendered capable of:

- reasoning about possibilities;
- combining variables;
- allowing for uncertainties;
- etc.

The aims of action-oriented research make it an important initial phase of professional training because this particular educational approach leads to the acquisition of effective techniques through interactions between 'know-how' and the imagination of a stimulating group engaged in research, anxious to take action and hence compelled to experiment, and keen to arrive at practical answers and hence drawn into creating an environment propitious to learning.

THE DEVELOPMENT OF INDIVIDUAL AND COLLECTIVE ABILITIES THROUGH ACTION-RELATED RESEARCH

Intellectual, emotional and organizational abilities

We can only tell what we want to do and what we can do once we start trying to make our wishes come true. Action-oriented research is not a means of gaining abstract intellectual knowledge; it is a way of turning our recognition of reality into actions or thoughts the better to grasp the cause-and-effect mechanisms of certain problems. It should help us to pinpoint, challenge and formulate problems as well as to change our ways of adapting to the environment. It does

so by eliciting the active, collective exploration of that environment, by fostering awareness of the concrete impact of an action, by helping people to decide the scope of, and the necessary modifications to, the actions they propose to take. To that end, they are invited to participate in collective experiments in the field - in increasingly complex and ever-changing areas. On the individual plane, the intellectual capacities of every participant in action-oriented research are developed most of all by communication, the confrontation of ideas and the acquisition of:

- technical information,

- methods of recording, measuring, organizing, receiving and transmitting information, etc.

- setting aside enough time and providing the means to reflect on the practical work done to introduce and discuss new ideas based on identifiable facts.

On the emotional level, action-oriented research lends meaning to man's work and restores its fundamental purpose in relation to the environment and human needs. The importance of research is that it not only fosters knowledge and action but that it also constitutes an emotional source of the desire for action. Everyone must rediscover the basis of action in his own practical life in a given environment, and go on to reflect about the conditions under which action can take on even deeper meaning by fostering the following:

-a sense of surprise and the desire to see the environment in a new light,

- the will to discover concrete answers and solutions, once the 'problem' has been identified and formulated,

- involvement based on acceptance of a 'contract' with the team of consultants (teachers, research workers, specialists) and a clear definition of the aims of action-oriented research and of the concrete changes it may be expected to bring about.

Action-oriented research is a group activity and a shared reflection about action, about the constructive attitude of the group and its ability to produce scientific analyses, not just lists of facts. It should enable everyone to organize experiential data and to predict events; it should act as a spur, forcing people to enter into a transforming and creative relationship with their environment, having the idea of conservation constantly in mind. By thus acting on the environment, man will be acting on himself; environmental action, therefore, is a means, not an end. Arising as it does from a research project (eliciting inventiveness, imagination, will, group endeavour), such action must also be born out of interest and develop by enhancing the ability to think critically about one's own activities and to learn from them.

MAIN FUNCTION(S) OF ACTION-ORIENTED RESEARCH

<u>As part of a problem-solving sequence</u>

Action-oriented research is an educational approach which demands that the group and the team of consultants (teachers, research workers) pass through all the stages of the so-called 'problem-solving procedure', namely:

1. Identifying and posing the problem

Action-oriented research begins with a clarification of the problem; it is not enough to get students to ask themselves questions - they must also learn to frame them in such a way as to elicit a flow of data,

- either as a result of spontaneous observations in their normal environment,

- or as a result of observations made during experiments.

2. Analyzing the problem

In the context of environmental problems, action-oriented research is a form of exploring nature; it uses the method of the so-called 'observational sciences' and concerns itself with facts. However, it does not merely amass facts but co-ordinates and interprets them, thus forging the tools needed for action, learning and 'invention', that is, for building methodically but also for improvising.

3. Seeking solutions

Action-oriented research involves an alternation between the search for solutions and the taking of action, with a continuous feedback between the two.

4. Evaluating the proposed solutions

Action-oriented research is also a form of evaluation. The discussions between the research workers, the teachers, and the group lead to greater awareness. Moreover, the communications and interrelations associated with co-operation and exchange facilitate the evaluation of the solutions the action is expected to produce.

5. Planning the action

While 'action-oriented research' is an answer to questions or needs, it must also be the result of a wish and of a concern. All mature students have a wish to see and to know, a wish to control their environment. This implies that they must be able to choose between various possible actions.

6. Performing the action

Even if the performance of the action is not an end in itself but rather a means of going beyond a situation, it is above all an occasion for going beyond oneself and for facing up to one's surroundings.

HUMAN, ORGANIZATIONAL, TECHNICAL AND MATERIAL RESOURCES NEEDED FOR ACTION-ORIENTED RESEARCH

Experience has shown that there is not just one method of using action-oriented research but a multiplicity, depending on the models and the situation

of the group involved (its numbers, cohesion, level of civic and political awareness, etc.). Broadly speaking, experience seems to show that action-oriented research fares best with a relatively large group, able and willing to act. Now, this will is reinforced by achievements which, in turn, demand a large and determined group. To help it arrive at results as soon as possible, the 'Study Proposals Committee' of the department of Isere(1) recommends that every small group formed round a project should start a regional propaganda campaign for the purpose of attracting a large number of people to work and research meetings, even if the character of the group should change perceptibly as a result of its enlargement.

The initial analyses must be made by an expert team (teacher, research workers, technical experts) which must contribute the necessary rigour and operational methods but whose views and understanding of the environment may differ from those of the group. In particular, the experts will intervene in, and help, the progress of projects and studies, the search for information, etc. This will facilitate a transition from spontaneous or elicited curiosity to action in response to specific questions (where?, how?, why?, when?, and by what means?). To that end, the mature students must become involved heart and soul in the research, which will not happen if they are outnumbered or swamped by the specialist team (teachers, research workers and technical experts). It follows that the student participants must constitute the absolute majority in the group. In most cases full-scale experiments are needed to decide whether an action should be continued, or abandoned on the grounds that its usefulness has not been established. Thus it would have been quite wrong to abandon the digester experiment (see above) before making an attempt to turn the farmyard manure into compost and so determining whether or not the project was practicable or desirable.

Action-oriented research makes it possible to organize experimental data and to foresee events in much the same way as scientific research does. It helps every one to realize that people apply rigorous research principles in their daily lives whenever they go beyond simple intuition to perform a repeatable, measurable and objectively verifiable activity.

In a purely technical sense, some facts cannot be fully comprehended by mere observation. Other sources of information must also be consulted, including engineers, technical experts and documents (written texts, maps, etc. .) . In addition, it is advisable to determine the relevance of such forms of representation as help one to visualise and to evaluate:

the scope of a problem or the relative importance of its elements;

the best use of an area or a piece of land (which cannot necessarily be deduced from a mere look at the landscape);

the distances and proportions of the area;

etc.

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(1) Comite d'etude et de proposition - 'Peuple et Culture' de l'Isere (France) 9 rue de la Poste - 38000 Grenoble and 130 rue de Rivoli-75001 Paris.

Little by little, technical rigour improves; a drawing, or a sketch - be it only a couple of lines on a sheet of paper to indicate a dimension, a relationship, a distance - may change the nature of an explanation or of a discussion and hence of the possible course of an environmental campaign. In time, the habit of using measurements, figures, graphs, statistics, etc., will enable students to read the plans or technical data sheets devised by others. Understanding technical data sheets is tantamount to being able to make, to unmake and to remake plans, and progress can only be measured by what one makes or does.

On the material plane, the organization of action-oriented research in a rural environment will first of all lead to an assessment of the level of equipment, of the skills of local craftsmen (blacksmiths, mechanics, carpenters, etc.) and then to setting limits to the degree of permissible technological complexity.

The rules of the 'action-implementation game' are now fixed: in order to construct a machine, the group knows what material can be used, and that the solution must allow for the replacement of some unobtainable material with another. All such rules are bound to be felt as so many constraints, but obeying them will avoid setbacks and unpleasant surprises.

To do research, we need a working hypothesis, preliminary figures, the ability to put data into formal shape, to control variables, etc. Many research workers tend to despise popular knowledge; in action-oriented research by contrast, research stands in the service of the validation of that knowledge.

EXAMPLE OF THE APPLICATION OF ACTION-ORIENTED RESEARCH

Action-oriented research is probably best suited to a clearly defined small rural setting (village or community). It should enjoy the support of adults and possibly of adolescents as well. Country folk are heir to a very rich secular culture which is not necessarily recorded or expressed in words, but nevertheless reflects a way of living and thinking, generally in perfect tune with the biological rhythm of nature.

In the example we shall be using - action-oriented research as part of the fight against socio-economic and ecological degradation in Upper Volta.(1) - the team thought it best to eschew a 'scientistic' approach and to pay careful heed to what the peasants themselves knew and believed about soil erosion and what means they had to counter it, because 'they are the main agents and beneficiaries of environmental planning'.

This first approach took the form of informal inquiries. On the assumption that no action to combat soil erosion had any hope of success unless the peasants were associated with it, the large team - which, apart from teachers, included ethnolinguists, geographers, geomorphologists, historians, botanists and forestry experts - first of all tried to alert the communities to their major problems by involving them in the research project. They also used the opportunity to explain a number of phenomena with the help of observations made with the peasant's participation (precipitation, local rainfall, agricultural price mechanisms, etc.). This quickly demonstrated to the team that the peasants often knew more about their environment, if only empirically, than the team.

(1) This experiment was part of the Unesco programme on Man and the Biosphere and was reported at a conference held in Djerba (Tunisia) in December 1979.

Far from being a 'token' or 'fictitious' piece of research, this particular action-oriented research project resulted in what the rapporteur called 'precise proposals and concrete actions'. He concluded that another aim, too, was achieved, namely 'giving fresh hope to the indigenous communities which had several times been cheated by specious promises from various research workers'.

The report of this experiment shows rather well how action-oriented research succeeds in placing problems into their environmental context and in finding solutions in harmony with that context. The first, purely empirical phase, involves establishing the necessary and sufficient conditions for fruitful use of the data by the team working in close conjunction with the interested parties. During the second phase these parties have their attention drawn to an observation, to a phenomenon, or to several phenomena. As a result, each participant will be able to say: 'If I do this, that will happen in my environment'. The individual needs to be able to establish this type of law, to develop theories about wholly practical problems in which he feels involved. This must occur from the very beginning - even in the identification and definition of these problems.

The third phase takes the form of a conference around a huge round table. The interested parties are given plenty of time to describe their situation, their environment, their methods of cultivation, pollution, the machines they use, the dangers they face, accidents, diseases, etc. This knowledge drawn from life is very much more concrete than that of research workers or of administrative and technical officials.

During the fourth phase, their intimate knowledge of the situations described, their experiences and observations all lead them to ask questions. The scientists, research workers or instructors present must provide the answers but be careful to avoid all academic turns of phrase. This particular confrontation with reality often forces the research workers to revise or complement their information in the light of the problems raised. Facts are nobody's exclusive preserve; they do not speak for themselves and while questioning facts is an essential part of action-oriented research, it concerns everybody alike; discussion is the technical basis of this method. The problems discussed lead to practical answers centred on interactions.

The fifth stage involves a search for new data; there are many data sources all of which fist be exploited. The most relevant data are often derived from field studies conducted with the local participants, from accounts of experiments or from reports of exchanges and interviews with people grappling with the same problem.

As the project develops, interdisciplinary teams are formed, possibly including some professionals. At that point, while eschewing discussions of the mathematical theory of dimensions, which would be too academic an approach, the team may find it useful, under the pressure of necessity, to teach the use of new techniques, to help in the acquisition of 'concrete' knowledge about a new technology, and explain the best way of comparing, classifying, categorizing, forming series, etc. The team will also ensure that the method and the results can be explained to others, described stage by stage, and written up in readable form.

Action-oriented research is intended to help people organize the data on which they can base an action and to explain, at all stages of the operation, what is happening, not in the form of a sequence of disparate facts, but of a series of easily recognized 'signposts'. The individual himself must learn how to improve his knowledge of the interaction between his work and his natural

environment; he must be able to examine all the elements of action-oriented research that could be applied to the environment, to determine by whom this can be done, to discuss the possibilities of action-oriented research with others and to join them in studying the best ways in which it can be used to improve the conditions of life and work.

BRIEF SUMMARY OF OTHER APPLICATIONS OF ACTION-ORIENTED RESEARCH

An action-oriented research approach to the environment must be centred on men in their local environment, and must reflect their interests, their lifestyle and their work. It must also involve representations of certain phenomena, of value systems, rites, traditions, customs, problems and:

- the anticipation of foreseeable changes,
- the search for solutions specific to each problem,
- the study, construction and adaptation of materials on the spot where they will be used.

It must be stressed that familiarity with modern agricultural methods is a relatively recent development in many parts of the world, where progress is still gauged by comparing one year's harvest with the next, or the yield of one field with that of another. The sudden introduction of new practices without adequate preparation can result in additional setbacks, a disadvantage that action-oriented research may help to avoid.

Important consequences of action-oriented research on the spread of knowledge and on effective environmental action may be looked for especially in the following areas:

- restoration of eroded soils and protection of zones previously subject to harmful exploitation,
- fertilization of land and the development of agrobiology,
- layout of grazing strips and protection against the over-exploitation of the best grazing lands,
- creation of tree nurseries and launching reafforestation schemes,
- protection of the fauna and flora,
- creation of green belts and open spaces,
- the fight against forest fires and intensive and irrational tree felling,
- home construction of specially designed small-scale agricultural equipment,
- etc.

Action-oriented research can also be directed at the (harmful) consequences of certain agricultural practices, of environmental pollution by the thoughtless use of insecticides and fertilizers, and at the optimization of water or energy resources. In f act, anything that involves environmental changes lends itself to this approach. Here are some other examples:

- hydro-agricultural works: construction of dykes and irrigation and drainage systems; establishing head limits; provision of drinking water; channelling permanent and temporary surface water and using underground water,...

- exploitation of various renewable energy resources (solar, geothermal, hydroelectric, household waste, biomass, etc.); assessing the potential of various types of energy (e.g. the wind energy needed to drive home-made windmills or the biomethane needed to run home-made digesters)...