

Continuing education in hydrology

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Abstract

The report describes the aims and objectives of continuing education. It puts emphasis on the importance of the trainee's motivation and self-commitment. It discusses the forms and methods applied as well as the supporting techniques. Following these technical aspects the report deals with the role of continuing education in national development and in the overall national education policy. It provides a description of the framework to be used when planning and putting into practice continuing education schemes. It also contains a synthesis of the pedagogical and technical problems related to continuing education.

The first part of the report deals with the general situation of the country and the progress of the work during the year. It is followed by a detailed account of the various expeditions and the results obtained. The report concludes with a summary of the work done and the prospects for the future.

Preface

Although the total amount of water on Earth is generally assumed to have remained virtually constant during recorded history, periods of flood and drought have challenged the intellect of man to have the capacity to control the water resources available to him. Currently, the rapid growth of population, together with the extension of irrigated agriculture and industrial development, are stressing the quantity and quality aspects of the natural system. Because of the increasing problems, man has begun to realize that he can no longer follow a "use and discard" philosophy -- either with water resources or any other natural resource. As a result, the need for a consistent policy of rational management of water resources has become evident.

Rational water management, however, should be founded upon a thorough understanding of water availability and movement. Thus, as a contribution to the solution of the world's water problems, UNESCO, in 1965, began the first worldwide programme of studies of the hydrological cycle -- the International Hydrological Decade (IHD). The research programme was complemented by a major effort in the field of hydrological education and training. The activities undertaken during the Decade proved to be of great interest and value to Member States. By the end of that period a majority of UNESCO's Member States had formed IHD National Committees to carry out the relevant national activities and to participate in regional and international co-operation within the IHD programme. The knowledge of the world's water resources as an independent professional option and facilities for the training of hydrologists had been developed.

Conscious of the need to expand upon the efforts initiated during the International Hydrological Decade, and, following the recommendations of Member States, UNESCO, in 1975, launched a new long-term intergovernmental programme, the **International Hydrological Programme (IHP)**, to follow the Decade.

Although the IHP is basically a scientific and educational programme, UNESCO has been aware from the beginning of a need to direct its activities toward the practical solutions of the world's very real water resources problems. Accordingly, and in line with the recommendations of the 1977 United Nations Water Conference, the objectives of the International Hydrological Programme have been gradually expanded in order to cover not only hydrological processes considered in interrelationship with the environment and human activities, but also the scientific aspects of multi-purpose utilization and conservation of water resources to meet the needs of economic and social development. Thus, while maintaining IHP's scientific concept, the objectives have shifted perceptibly towards a multi-disciplinary approach to the assessment, planning, and rational management of water resources.

As part of UNESCO's contribution to the objectives of the IHP, two publication series are issued: *Studies and Reports in Hydrology* and *Technical Papers in Hydrology*. In addition to these publications, and in order to expedite exchange of information, some works are issued in the form of *Technical Documents*.



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FOREWORD

The International Hydrological Programme (IHP) is composed of three major components: hydrological research, water resource management and education and training and the term *hydrology* refers to both surface water and groundwater. The training programme has become increasingly popular and hydrologists trained through the IHP can be found throughout the world.

UNESCO sponsorship of the first postgraduate courses started with the inception of the International Hydrological Decade (1965-74). And now, through the 32 UNESCO-sponsored postgraduate courses based all over the world, more than 500 postgraduate students are trained annually. Besides establishing the network of courses, an additional bonus has been the compilation of a number of books destined to help course organisers design curricula and syllabi, select appropriate textbooks, and develop suitable teaching aids for classroom and field-based use.

While the efforts made by the IHP with regard to postgraduate training are considered to have reached a certain maturity, very little has been done at university level. The present phase of the IHP (1990-1995) foresees the compilation of a guide to curricula and syllabi in hydrology for university education in such diverse fields as civil engineering, agriculture, physics, chemistry, geology and geography. These will require varying degrees of specialism, ranging from programmes where hydrology is only an auxiliary subject to those where it forms an essential part and those where it is the main subject.

The training of hydrology technicians is extremely difficult as the educational level of technicians, their previous hydrological knowledge, the means of instruction and the purpose of training vary from country to country, from organisation to organisation, and from case to case. For a long while these variations have caused a certain reluctance to embark on the production of educational material for technician training.

Earlier attempts to prepare such material for the local education of technicians have not been entirely successful. UNESCO, therefore, started at the other end and organised or co-organised training courses at regional level, particularly in Africa. This was perhaps only a drop in the ocean but UNESCO gained a great deal of experience and insight into the problems of technician training and three publications were issued.

Lecture notes were published. A review of the effectiveness of technician training has been undertaken leading to guidance material for the assessment of training needs and facilities and for organisational aspects of holding training courses.

It is believed to be more economical and efficient to train teachers and supervisors of technicians in order to enable them to transfer their knowledge to the technicians working with them. Two publications have been issued with this in mind, one containing curricula, syllabi and course models, and the other containing a set of course material for training courses for supervisors. Since technician training rarely occurs in formal courses the publication for supervisors is mainly addressed to continuing education efforts.

The IHP not only provides material for hydrologists at all levels, but also includes special components for hydrological education at secondary school level, for the general public and for planners, politicians and decision-makers. This programme can only serve its purpose if it is conducted in close cooperation with the Member States in order to be able to take into account the very different hydrological, climatic, socio-economic and cultural conditions of each country and the need for using local languages.

While programmes for technicians, university students and postgraduates are designed for those starting or about to start their professional career, a great need for continuing education has been identified.

Continuing education is a world-wide concern and applies to all educational fields.

The pedagogical principles, systematic issues, teaching and learning techniques are almost always identical with only the contents differing. Continuing education is conditioned by previous education and is, in principle, a life-long process. One could say that it is a daily process of which we are barely conscious. There are, however, organised forms of continuing education and the present publication deals with these. Organised continuing education depends on the needs of the person and of his/her employer as well as on the level, the scientific field and the financial conditions of the employment. A distinction should also be made between on-the-job training, that which requires absence from work or even travelling and that carried out during a person's own leisure time.

Project E-4.1 of the fourth IHP phase foresees the compilation of guidelines to describe continuing education in hydrology and water resources. A workshop chaired by Prof. A. Van der Beken (Belgium) was held in Brussels, from 10 to 11 June 1991, to prepare the outline for the planned publication. The second workshop was held in Bergamo (Italy) from 22 to 24 June 1992 and the text prepared between the two workshops was revised. The authors, under the chairmanship of Prof. A. Van der Beken, are Dr. K. Andah, Dr. L. Candela, Mr. W.H. Gilbrich, Prof. P. Kovar and Dr. S. Walker. Dr. S. Walker also undertook the linguistic editing and Prof. A. Van der Beken and Mr. W.H. Gilbrich compiled the final manuscript.

The authors are aware that this report constitutes a first attempt to describe a complicated matter and would be grateful to receive all suggestions for improvements.

1. INTRODUCTION



1. INTRODUCTION

Continuing education (CE) is a comprehensive term referring to forms and types of education pursued by those who have left formal education at whatever level and who entered employment and/or assumed adult responsibilities in whatsoever way these may be defined in a particular society. Thus is a non-formal education and part of the overall learning environment. It encompasses on-the-job training in multiple forms, short-courses, self-learning, seminars, workshops, conferences, technical visits, etc... for professionals at all levels (academics, higher technicians and technicians). Continuing education is not the privilege of a specific level of education. However, at the lower levels it is visible while at the higher educational level it becomes part of normal professional updating duties. A worker who receives instruction will recognise this as a learning process; a professor attending a conference may not be aware of this aspect.

The pace at which technology develops requires continuing education at all levels. Everybody who got a formal education during the pre-employment period will face a decline of his/her knowledge/skill capacities once entering the employment period of his/her life. Life-long learning is enhanced by appropriate forms or types of continuing education.

Figure 1.1 is an attempt to show the interaction of the different forms of education. Mankind started with experimental learning and young children enter into life in this way by observing, imitating and learning-by-doing. The relations between family and child constitute informal education with its steady exchange of information. Family and child normally are not aware that each contact between them is an act of informal education. It is inherited in human beings that, particularly in the childhood, each observation - both acoustical and optical - is part of a learning process however unsystematic. Systematic learning is being introduced into the life of a child through formal education reaching from pre-school classes through primary and secondary school eventually up to university education. It needs to be emphasised that informal education, observing, self-learning, gathering experiences continues during the life period of formal education although people generally do not recognise it as such. The formal education has such a strong bearing on the daily life that the informal part of education often occurs beyond consciousness. Yet it contributes quite essential quantities of knowledge and particularly of skills. It would lead too far to enumerate here all forms of informal education but family, the human environment of the young person, the society, the influence of media and hobbies shall be mentioned particularly.

While school education can be considered a typical case of formal education and while on-the-job training might be the typical form of non-formal education, vocational education usually joins the two forms. As a special form of education with its mix of structured courses and individual learning it deserved special consideration in Figure 1.1. Many elements of continuing education can involve vocational training and this is why any treatise on continuing education must discuss vocational training. Hydrology technicians particularly benefit from this type of learning.

Upon completion of formal education (left section in Figure 1.1), non-formal education becomes dominant (right section in Figure 1.1). As will be shown later in this report, here referred to as continuing education mainly consists of non-formal education but does not excluding occasional formal education.

Non-formal education in contrast to formal education does not follow prescribed patterns, however it is a proactive activity. In contrast, the informal education can be considered as

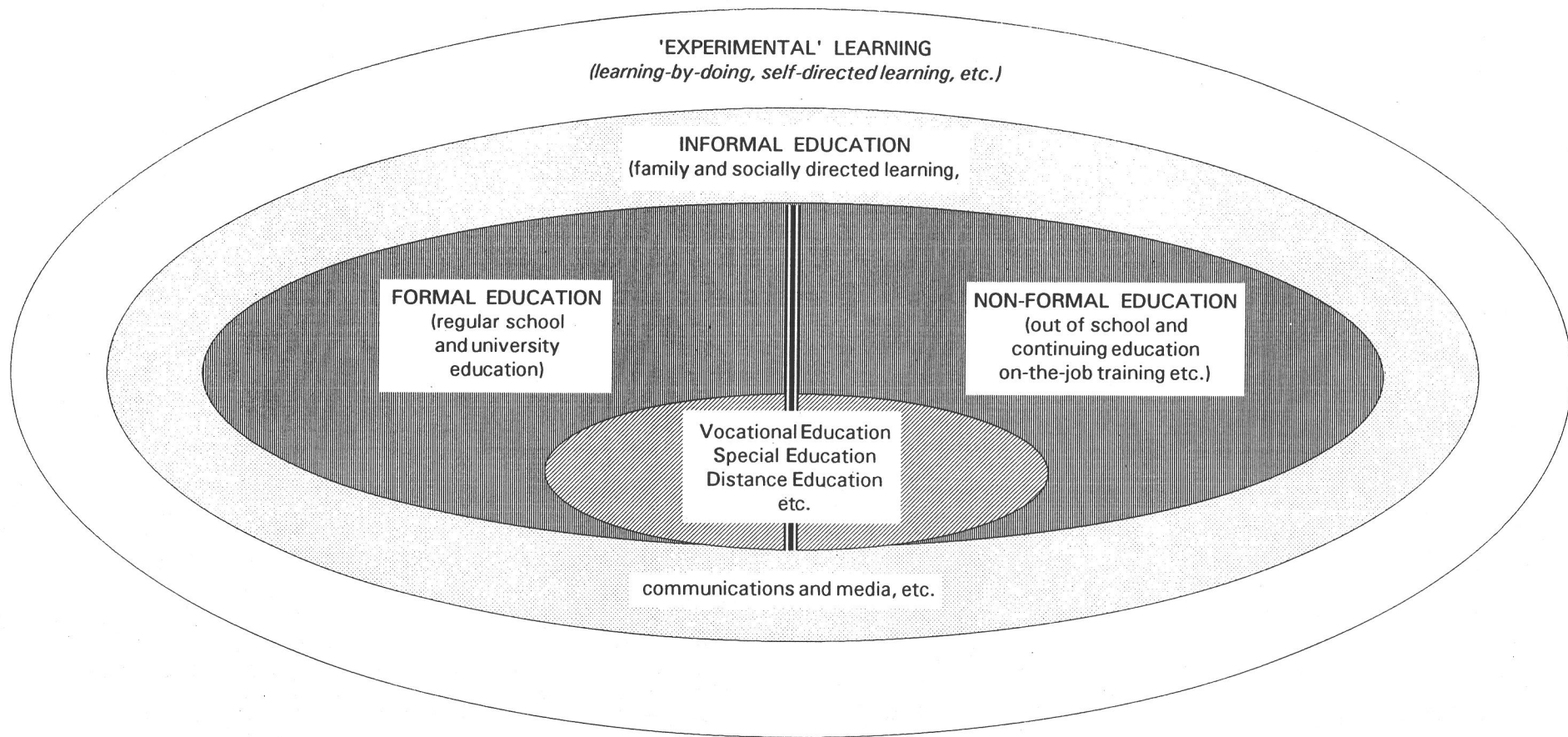


Fig. 1.1 Education and the learning environment (ref. World Education Report UNESCO, 1991).

the contribution of life, reactive, unorganised, steady, independent from work and profession.

The philosophy of Figure 1.1 is that the centre of the educational activities is marked by formal and more or less intended, planned non-formal activities. They are surrounded by the inflow of information from family, society, media, here represented to as informal education. The outer circle largely takes place within the intellect in form of digesting impressions, experiences and problems and in drawing quite individually and unsystematically conclusions and reactions as an expression of the character and personality.

The inner circle consists of planned actions, they can be steered and controlled; the outer circle escapes prescribed ways of learning, it is the private sphere and largely reflects the behaviour, the reactions of the individual within the context of the "Zeitgeist".

Figure 1.2 tries to visualise the development of knowledge and skills throughout life. It is the fate of human beings to enter into life without any knowledge, with only some intuitional skills for taking up food. The helplessness of a new-born baby is impressive and no other being requires such a long time for developing its skills as humans do.

In Figure 1.2, the abscissa corresponds to the life period or to the age, while the ordinate is considered the sum of skills and knowledge.

At this moment the report considers the combination of knowledge and skills as complementary. The distinction between the two will follow below in this chapter.

The pre-employment period is characterised by a steep increase of knowledge, the absolute - however unmeasurable - amount depending on type, duration and intensity of the sum of formal and non-formal education (The reader is referred back to Fig. 1.1 where the importance of informed leaving during the formal leaving period has been emphasised). The entry into the professional life is a break point. Without further learning a decrease of knowledge and skills will be observed. There are several reasons for this.

For example, we all forget, particularly with increasing age. Hence, without continuing repetition and learning towards the end of the professional life, a person will know less than initially (lower curve in the drawing : decline of skill without continuing education). The upper curve shows the increase of knowledge and skills as function of and as a result of continuing education. The hachured section therefore depicts the area of skills and knowledge which continuing education has provided by firstly, helping to decrease the influence of forgetting, and secondly, by adding new knowledge and skills.

The present publication basically has for aim to describe characteristics of and activities within the hachured field of Fig. 1.2, as applied to hydrology.

Continuing education is a learning process with its specific forms, types and quality characteristics. It aims like all learning processes to a transfer of knowledge and skill.

Knowledge is the ability in understanding and rational, scientific and strategic thinking. It is a universal and time independent ability which fulfils the puzzle-solving mind of mankind and allows the individual to adapt more easily to a changing environment.

Skill is the ability in mental and/or physical performance. It is generally a local and time dependent characteristic and strongly linked to the so-called technologies available in a given environment. It fulfils the problem-solving mind of mankind and is essential for the individual to operate efficiently in a given society.

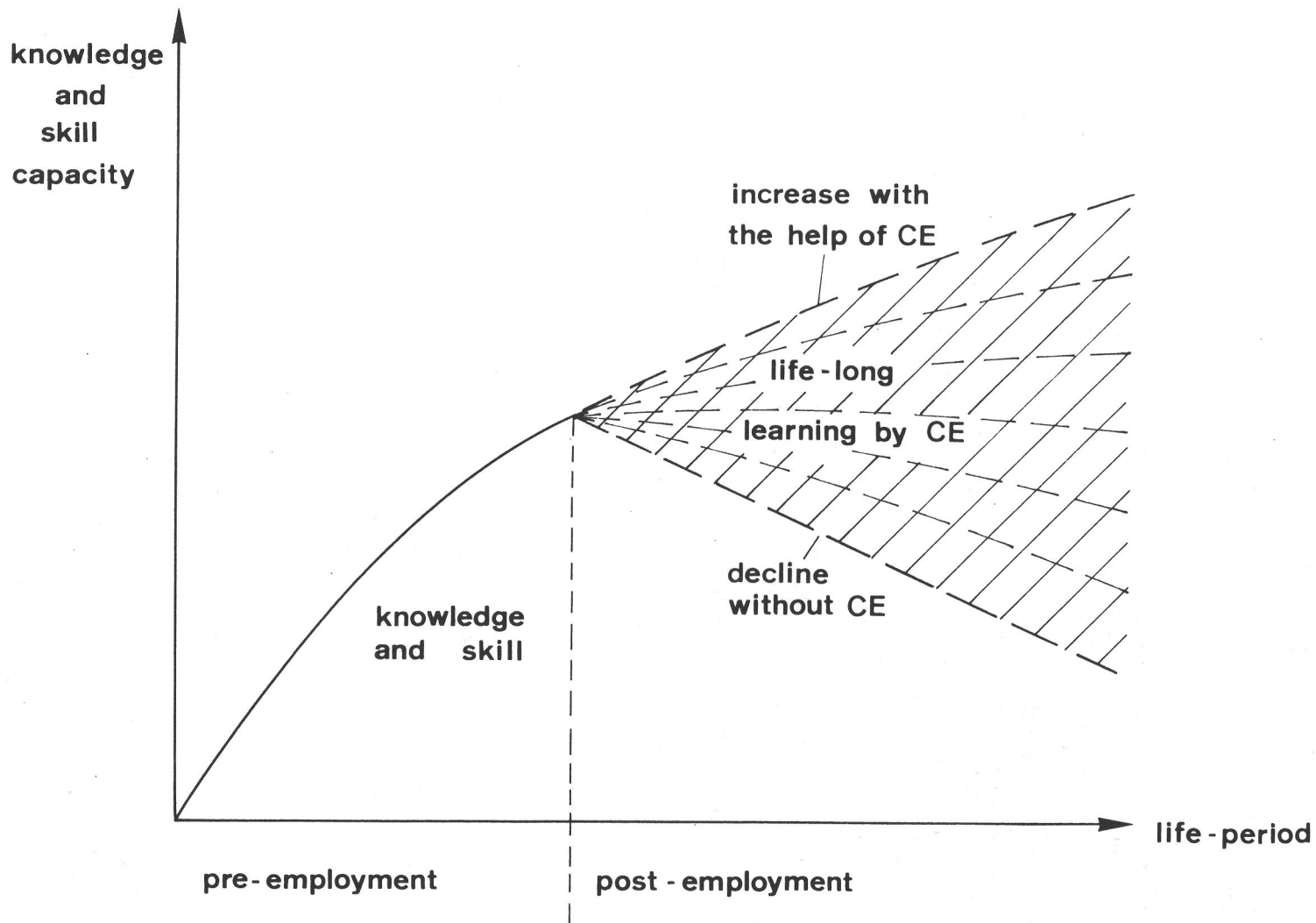


Fig. 1.2 The role of continuing education (CE) in knowledge and skill capacity.

In each learning process there should be a balance and interaction between knowledge and skill. Likewise, continuing education should always provoke this interaction. The sum of both knowledge and skill, being a compound characteristic of someone's education, will allow an individual, at whatsoever level of education, to help in managing the technical/institutional complexity of a democratic society and to live a fulfilling personal life (Fig. 1.3).

Assuming that the ultimate objective of continuing education is the maximal increase of someone's potential 'knowledge and skill' capacities, it is of course not taken for granted that this objective will be easily achieved. Firstly, the objective should be well defined within a given institutional and/or employment environment. Normally, there will be a limited range of 'knowledge and skill' capacities which can be reached by any individual within an organisation or enterprise. It is unlikely that an employer will allow the employee to attend continuing education-forms with a content which does not fulfil the needs of the company, authority or society. Let us call this the **parameter of objectives**.

Secondly, the **motivation** of the individual is the **second parameter**. The highest motivation for the individual to take part in given continuing education-activities is his/her personal commitment, independent of any incentive or pressure from the employer.

Finally, the choice of the appropriate method of continuing education will influence the efficiency and level of 'knowledge and skill' obtained. The wrong method of continuing education in a given environment or for a particular individual may restrict the level of attainment reached. Let us call this the '**parameter of continuing education-method**'.

The harmonisation of these three parameters is the key-issue for a successful continuing education and this report will discuss these issues.

**THE LEARNING PROCESS
IS TRANSFER OF
*KNOWLEDGE AND SKILL***

**is the ability to
understanding
and thinking and
is universal and
time independent**

**COMPLEMENTARY
IN BALANCE AND
INTERACTION**

**is the ability in
mental and/or
physical performance
and is local and
time dependent**

**A COMBINATION OF BOTH IS
REQUIRED FOR *MANAGEMENT*
OF THE TECHNICAL/INSTITUTIONAL
COMPLEXITY OF A DEMOCRATIC SOCIETY
AND FOR A *FULFILLING PERSONAL LIFE***

Fig. 1.3 The learning process as a transfer of knowledge and skill.

2. AIMS OF CONTINUING EDUCATION



2. AIMS OF CONTINUING EDUCATION

2.1. IMPORTANCE OF CONTINUING EDUCATION

Continuing education is the concern of everybody. Unless somebody is independently pursuing continuing education for his own fulfilment, there will always be a tension field between enterprise (employer), employee and the method of continuing education. For the sake of simplicity the report assumes that the user of continuing education is an employee whatsoever this term may mean within a given organisational structure. Any high-level person thus may function as an employee or an employee depending upon the context. An enterprise may be commercial or non-commercial.

The importance and value of continuing education from the perspective of the employer, the employee and society as a whole is being increasingly recognised. However, as far as individual employees are concerned there may be a reticence to undergo continuing education because of a perception that no-one can tell them how to do their job better. Other employees may feel themselves too old or lack confidence in their learning abilities. They may feel secure and satisfied with their skills and job. Hence, it should not be assumed that there is universal enthusiasm and commitment to continuing education from employees. Nonetheless, good employers and well motivated employees recognise the benefits of well structured continuing education for the organisation, the individuals involved in continuing education (both trainers and trainees) and society in general. If individuals feel reticent towards undertaking continuing education, it may be necessary for the employer to provide incentives in order for the overall objectives of the employer to be achieved. However, as discussed in Chapter 1, the output of continuing education where the employee is not personally committed except by provision of incentives is likely to be less successful than a situation where the employee is personally completely self motivated.

Professionals have typically had lengthy formal education with clearly defined education levels usually of bachelors and frequently of master status. Their education has followed a broadly standardised structure. Continuing education is important to them in keeping them abreast of developments in methodologies and technologies and in providing less formalised training which concentrates on the practical application and aspects of hydrology which are not well covered in formalised education. Significant too is the role of continuing education in development of the interpersonal and managerial skills necessary to allow professionals to develop within an organisational team and ultimately, with experience, become the manager of such a team.

Interpersonal and managerial skills are also an area where continuing education has a vital role to play for technician hydrologists. However, continuing education is also important in providing learning opportunities in technical areas for technical staff who have typically had less lengthy and less structured and standardised formal training than is the case of their professional colleagues. Usually their formal education is also at a lower academic level, often concentrating on the more routine practical tasks, rather than the theoretical basis of hydrology. Typically continuing education is of prime importance in developing the skill levels and aptitude of technician hydrologists.

Whilst the prime concern of this report is with the development of technical training of hydrologists and the role which continuing education plays in this, it would be wrong to isolate this totally from the development of interpersonal and managerial skills which are so necessary in the provision of an effective, well managed hydrological research, academic, consulting, water utility or regulatory organisation.

It should be recalled that continuing education is the only means to reduce the losses caused by knowledge becoming outdated and to cope with the scientific and technological progress. Reference is made to the hachured area in Fig. 1.2.

2.2. OBJECTIVES OF CONTINUING EDUCATION

The objectives for continuing education can be split into two separate categories. The first one reflects the value of continuing education to an enterprise as a whole while the second one is more parochial and indicates the perceived value of continuing education as far as individual manager or employee is concerned. The following refers to the objectives of an enterprise while the motivation of the employee will be discussed in the next section.

The key objectives from the point of view of an enterprise relate to the business objectives. Continuing education can contribute to organisational effectiveness by increasing the quality or the quantity of the output. This may be achieved by continuing education alone, updating working practices, new technology or a combination of all these things. For example, the quality or quantity of hydrometric data collected may improve the ability to manage a water resources system more effectively. In a commercial organisation this may directly translate into an increase in profits. For a research or academic organisation this may enhance the ability to win research funding. In a government organisation, better public service, reduced costs and hence reduced public expenditure may be the goal of more effective operation.

Other business objectives may relate to the image of the organisation. For example, it may be important to be perceived by peer groups as an organisation which has a highly skilled and motivated workforce which is operating at the forefront of technology. This can only be achieved with the extensive provision of continuing education.

In considering the objectives of continuing education, the cost effectiveness of such training must be considered from either an organisational or community point of view. As purely increasing quality and quantity of output is in itself not a valid enough objective, the cost effective improvement of output is the key issue. Therefore the costs of training must be considered carefully. This includes the typically hidden costs such as loss of output of the individual during training, possibility of needing to increase the salary of the employee once training completed, potential loss of the employee to a better job once training is completed etc.

Having decided that continuing education may meet management business objectives an employer may perceive additional benefits or motivations may accrue from providing employees with continuing education.

At the level of an individual employer the following may be considered important motivators for an employer to feel it worthwhile to invest in continuing education for either an individual or group of employees:

1. meet the need for education - this may be defined by government or company policy;
2. fill a gap in basic skills when adequately skilled/trained staff unavailable;
3. lead to an improvement in efficiency/effectiveness;
4. allow the introduction of new working practices or new technology and the ability to cope with change;
5. provide mechanism for regular updating skills of staff;
6. induction of new employees in methods of work and organisational culture;

7. improve staff morale and job satisfaction;
8. allow staff to appreciate how their work fits into the broader business activities of the organisation.

The above defined objectives of an enterprise are the first parameter of the continuing education system. They generally constitute measurable quantities and can be objectively assessed. Normally, they are the driving force for continuing education activities and the departure point for harmonising the three parameters.

2.3. MOTIVATION FOR CONTINUING EDUCATION

The second parameter is the motivation of the employee. Unlike the objectives of the enterprise, motivation cannot be easily quantified.

For continuing education to provide maximum benefit, the employee must provide a high level of personal commitment. In generating personal commitment, an employee may consider the following to be advantages which may accrue from continuing education:

1. improve knowledge skills level;
2. allow greater contribution to the business of the enterprise;
3. increased earnings;
4. better employment prospects;
5. increased challenge;
6. effectiveness production within existing enterprise;
7. learn something new;
8. better job satisfaction;
9. self improvement;
10. broaden expertise beyond existing job;
11. provide a professional accreditation as a scientist or engineer.

If an employee does not perceive there to be advantages or is for some other reason unmotivated to carry out continuing education, it may be necessary for an employer to provide further incentives to encourage the employee in order that he can meet his corporate objectives. However it must be recognised that this approach may be less successful than training self motivated individuals.

Motivation can be generated by the enterprise. In this case the goals of the enterprise and employee are identical and in harmony. If the employer is the initiator for a continuing education activity, the enterprise must offer opportunities to use the increased skills developed by continuing education, otherwise frustration may result. If the employee initiates continuing education he must be clear that opportunities are available to use the new found skills within or outside the enterprise in order to prevent frustration.

While an enterprise can exercise force on an employee and make him/her undergo continuing education rarely the employee will be the driving force unless for his own fulfilment. It should be born in mind that hierarchical structures have their own dynamics.

2.4. CONTINUING EDUCATION AND NATIONAL DEVELOPMENT

The educational system of a country largely depends on its socio-economic development and on the government's policy of human resources development. Such policy will aim at a

balanced absorptive capacity and try to avoid an oversupply of manpower at given educational levels. Continuing education should be an integral part of the overall human resources development policy. Generally, as a consequence of an insufficient capacity building potential, particularly small countries often have problems to provide adequate training ranging from primary schools to universities and in many cases only a limited number of subjects can be offered at universities. Water-related subjects cannot be studied at sufficient depth in all countries and post-graduate education is available only in a few countries.

As formal hydrology education is not necessarily available and since regional training institutions are rare a large number of students is obliged to study abroad. Apart from the fact that the students have to leave their country, their social environment and their family the financial problems are almost insurmountable since the number of fellowships by no means corresponds to the needs. Upon their return, the students may face problems of re-integration. However, for the foreseeable future, study abroad will often remain the only possibility for them to attend hydrology courses. Hence, the national development of hydrological services will continue to depend on external aid. The national development thus depends on the economic situation of the donor countries and subsequently must be considered highly vulnerable. In view of the importance of water - and the importance will increase with economic development and with a growing population - national educational plans should enhance sustainable training of hydrologists and water engineers. The advantage of national schemes is also that the choice of subjects would fully correspond to the country's needs.

The situation is even worse with respect to continuing education. As will be shown later in this report continuing education does not normally follow recognised organisational patterns but has a more spontaneous character and it is often offered by professional associations or training enterprises. They need to be of adequate size to enable them to establish continuing education programmes and carry them out. Sometimes, such programmes come up on a unscheduled basis in connection with development projects or as a by-product of international conferences held in the respective country. However, in order to constitute a reliable tool governments should help hydrologists to create such associations and to render help to their functioning. The economic value does not only lie in the increase of skills of the course participants in continuing education activities, it also reduces costs for travelling abroad. The psychological value of a country becoming self sufficient in training efforts should not be underestimated. The present report as well as other UNESCO publications and those of other international organisations can be used to prepare and organise training activities but the prerequisite for success is that the respective government recognises the importance of educational schemes within already established training institutions and professional associations.

However, in view of the high costs of continuing education activities many developing countries will also have to rely in the future on international training activities. Donors will be called upon to include continuing education in their programmes, even if, at first glance, continuing education may not look as attractive as formal training programmes. Regional cooperation can contribute greatly to reducing costs especially where climatic and hydrological conditions are similar and no linguistic obstacles exist. Other means of facilitating cost effective training activities include partnership arrangements between universities, research institutions, administration, public and private companies. Such arrangements would include the choice of appropriate forms of execution, qualified teaching staff and suitable supporting techniques.

3. METHODS OF CONTINUING EDUCATION



3. METHODS OF CONTINUING EDUCATION

3.1. GENERAL ISSUES

Methods of continuing education is the third and most important parameter to match or harmonise with the other two parameters defined in the Introduction of this report, i.e. the objectives of continuing education and the motivation. By choosing the appropriate method of execution, the level of achievement of the objectives of continuing education may be increased for a given level of motivation of the individual. Likewise the motivation may be raised and costs lowered.

Methods of continuing education consist of a combination of forms of execution and their supporting techniques. An attempt to list and classify these forms and supporting techniques is shown in Table 3.1. The forms of execution are ordered by a decreasing level of monitoring by a tutor and the supporting techniques with an increasing level of educational technology.

In principle, endless combinations and multiple uses of these forms and supporting techniques are possible for any specific action within a continuing-education programme. Educational research in this matter is known (ERAUT, 1989) but the cost-effectiveness of any of these combinations will depend upon the framework of the continuing-education programme, i.e. the objectives, the available resources and expertise, the duration, the expected results. However, some specific combinations have proved particularly useful and the report makes an attempt to systematically describe each form of execution and supporting technique and their advantages and disadvantages. Special attention is given to the use or potential use of ALT-Advanced Learning Technologies.

Closely linked to the methods of continuing education are mobility, monitoring and accreditation, if any at all, within a given continuing-education programme.

Mobility of trainees (and trainers) has been a feature of continuing education in all times: mobility is essential whenever the appropriate environment for a continuing education activity is not locally available. Mobility is a decisive cost factor in the choice of the appropriate method of continuing education. Advanced learning techniques may have a cost-reducing effect.

Monitoring is the activity of following the progress of each learner as he/she moves through the sequence of instruction. In any continuing education activity, three questions may arise:

- what should be the method of the monitoring ?
- what should be the frequency and duration of the monitoring ?
- if a supervisor, mentor or tutor is assigned, what is the limit of the number of trainees monitored by one and the same person ?

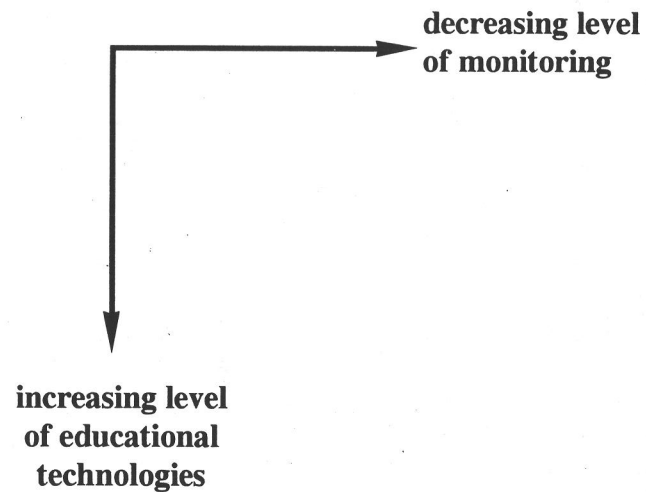
Of course, the quality of the monitoring is another aspect and is linked to the training of trainers and, foremost, to the pedagogical talent of the trainer. The supporting technique for the given form of execution may include an automatic or semi-automatic monitoring, but it is unlikely that a high level of monitoring will be possible without any direct interaction with a tutor or supervisor.

Accreditation within a continuing education programme is not a regular and typical feature. In many cases a simple "certificate of attendance" is issued at the end of directed training. However, in some countries, e.g. in UK, professional accreditation is strongly

Table 3.1 Classification of methods for continuing education.

METHODS OF EXECUTION

SUPPORTING TECHNIQUES	on-the-job-training person-to-person apprenticeship in-house training or coaching	classroom education person-tailored courses	open or flexible learning	workshop crash course seminar (roving) summerschool	speciality conferences technical visits	self-learning
<ul style="list-style-type: none"> - paper/pencil and blackboard - pictural and written material - self-instructional material (correspondence courses) - learning packages - software packages - audio-visual aids (transparencies, slides, video-tapes) - radio and television broadcasting (RTB) - distance learning systems (DLS) * satellite broadcasting * computer conferencing - CAI or CAL - CD-ROM - VIDEODISC - HYPERTEXT - CD-I 						



structured beyond the formal educational programme and may include several methods of continuing education.

3.2. METHODS OF EXECUTION

3.2.1. *On-the-job-training*

On-the-job-training, also called in-house-training, is the most common form of continuing education since it ranges from a short oral instruction by the supervisor to formal training activities within the enterprise. It varies in intensity and in time demand (from one sentence to a few years). Normally, no mobility is incurred and the bulk of teaching can be done by the own staff of the enterprise.

This method of continuing education is normally highly monitored and often encompasses a person-to-person relationship. This is especially the case in the **apprenticeship** and **coaching**. While the former often leads to a recognised qualification and may even encompass a part-time formal education (e.g. evening or week-end education), the latter is more an informal arrangement whereby the trainee works alongside and under the supervision of a mentor. The advantage of coaching is that it is not seen as imposition by either the trainee or the tutor; it is cheap and easily obtained on the job.

On-the-job-training is not exclusively a person-to-person activity. Cost-effectiveness may increase if more persons are trained at the same time. Therefore, enterprises may appoint trainers in-house or they may hire professional trainers from outside to train in-house people. However, the employer may also wish to send the employee to another enterprise, possibly even abroad, for an on-the-job-training.

Since the methods of instruction varies within a very wide range practically all types of supporting techniques can be applied.

The advantage of on-the-job-training is the great flexibility. Oral instruction often can be given spontaneously on the spot. Training can be arranged as and when needs arise and only longer training activities require some sort of planning. This great flexibility however necessitates much initiative from the side of the supervisor and the spontaneous instruction is difficult to quantitatively measure in terms of effectiveness and performance. Instruction by the supervisor is cheap, however is limited in its level by the level of knowledge of the supervisor.

3.2.2. *Classroom education*

Given the limitation of the number of trainees who can undergo a continuing education programme by the apprenticeship, the classical classroom-education and training is in many cases more cost-effective. At a given period for a given duration, teacher(s) and trainees are brought together and fulfil a continuing education activity which can be adapted to the needs of the average trainee. Classroom education can range from formal lecturing instruction to open seminar type of contact learning. It may be entirely theoretical but can be practice oriented. The course may be individually tailored to the immediate needs of the enterprise or it may be a course open for the general public. The duration may vary from about one hour to a couple of weeks, part-time and full-time. In classroom education group training characteristics are always prevailing over individual requirements. In contrast to specific training needs for example; following introduction of new equipment or new administration procedures, classroom education often has repetitive character. Classroom education may be only part of a major programme of training activities which include laboratory work, field work etc.

The advantages are that a relatively high number of trainees can be trained and monitored in an intensive way. If local conditions as well as supporting techniques allow, the teaching and monitoring can be spread over a longer period : typically in the evenings or week-ends as is popular in adult education programmes. Such contact education may eventually take a combined form of open learning and short courses/workshop/seminar form.

The supporting techniques include all classical tools developed for schools. An indispensable requirement is that all course participants can see and hear all demonstrations at the same time and in full clarity.

A disadvantage is the formal structure of the classroom which necessarily will not respond to all individual needs of the trainees. Also monitoring will be limited or at least will involve the use of common evaluation procedures not always adapted to the individual trainee. Of course, a combination of the apprenticeship form and the classroom-education form is feasible if mobility problems can be solved and individual tutors are available. Classroom education requires long-term planning, it cannot be organised spontaneously and therefore satisfies only requirements of the enterprise well known long time before. While lacking flexibility it has the advantage that the training event is well known beforehand and that the expected result can be well defined.

3.2.3. Open learning

Open learning performs well in refreshing instruction and also in acquiring new knowledge. It is particularly flexible in its handling. It can be applied for large groups as well as for the individual. It requires a high degree of initiative from the side of the trainee and it is freely chosen or established by the trainee taking into account the supporting techniques available to him/her. Open learning makes use of correspondence courses (CC), Radio and Television Broadcasting (RTB) and Distance Learning Systems (DLS) and other self-instructional materials (learning packages, software packages). Unless the trainee is only interested in the pure self-learning process without any monitoring, open learning will involve some level of monitoring by face-to-face counselling, workshops, roving seminars or also monitoring by correspondence. For instance, the British Open University 'summer schools' provide opportunities for extended tuition and field work. At present CAI (Computer-Aided-Instruction) and CAL (Computer-Aided-Learning) is being developed with a view to facilitate individual open learning.

The advantages of open learning are the following:

- freedom of use of time
- no mobility required
- independent of the number of trainees
- most supporting techniques allow for repetitive learning
- supporting techniques can be prepared to suit the needs of the enterprise.

Among the disadvantages one can list:

- no direct contact among trainees and teacher unless special contact sessions are organised
- higher personal efforts requested
- danger for decreasing motivation with time due to lack of personal contact
- individual programmes chosen by the student may lack coherence.

Therefore if this form of learning is to be efficient, it should show a quite high level of structure and organisation, involving well-prepared monitoring schemes and advanced learning technologies. In this respect it differs essentially from self learning which, although utilising similar supporting techniques, is the most unorganised form of learning.

For cost-effectiveness this means that a large group of trainees must be targeted since the development of appropriate supporting techniques is very costly. This has resulted in limited use of open learning in hydrology.

3.2.4. Workshops, crash courses, seminars

Workshops, crash courses, seminars, roving seminars and summer schools are modes which have the common feature of being of short duration (2 or 3 days up to a few weeks). Their objectives may differ and they may use a wide range of supporting techniques. In general, one could say that these methods are of a more intensive nature than any other form of execution. As a result, the scope of these forms is often narrow or limited to some special topic within a given discipline or area.

The following methods are defined:

workshop : meeting that offers opportunities for persons with a common interest or problem to meet with specialists to receive first-hand knowledge and to undertake practical work.

crash course : an organised body of instruction designed to meet urgent requirements in the shortest possible time by high utilisation of resources.

'refresher course' : activities intended to revise and renew previously learned attitudes, knowledge and skill patterns which have deteriorated through disuse or which need updating.

seminar : a short course or conference making extensive use of participative methods and devoted to the exclusive study of one subject with the object of furthering knowledge in that area.

roving seminar : the high cost of a seminar can be reduced by organising roving seminars where the instructors travel from one training site to another and repeat the course. Audience and purpose must be similar at each site.

summer school : this form has been created to make use of leisure time to train generally higher academic staff and instructors for purposes of refreshing, up-dating and innovative studies. One special appreciation is monitoring within open-learning programmes.

Some advantages of all these methods are:

- clear objectives
- topics abreast with the scientific progress
- high level of interaction and contacts possible
- published proceedings can generate an extra audience
- high learning efficiency
- minimum leave of absence.

Some disadvantages are:

- high mobility and therefore travel costs involved
- reduced efficiency if audience too heterogeneous
- requires high degree of preparation and conditions availability of qualified lecturers.

3.2.5. Speciality conferences and technical visits

A speciality conference does not have a typical training objective nor is it involved with practical instruction of participants: it is a transfer of knowledge and may complement other continuing education methods.

Participants normally cannot interact as they are passive listeners. The benefit to the participant cannot easily be monitored. Nevertheless, discussions and personal contacts can be considered individual enrichments. Often conferences provide a catalyst and an incentive regardless of the intensity of personal involvement.

Technical visits and study tours are continuing education activities which illustrate practical application of the knowledge or skill gathered by other continuing education methods of execution.

Continuing education in hydrology benefits enormously from technical visits and study tours. In hydrology and water resources it is essential to demonstrate the translation of theoretical knowledge into practice. Technical visits must be organised to ensure that all participants are able to grasp fully the intended message. Technical visits and study tours will not be successful unless they are well prepared from a didactic point of view. The size of groups must be geared to the location visited. Social aspects are not to be overlooked as they add little to the costs but have a great impact.

Hydrology as an environmental science is much concerned with visual observational activities and therefore field studies form an essential part of general hydrological education.

The costs for study tours are relatively high and the output from study tours is difficult to assess. However visual impressions have a long-lasting effect on the trainee and often revive theoretical knowledge. Many theoretical findings, perceived by the trainee only in an abstract way, become life, better understood and a really integral part of the trainee's understanding. If the purpose of the study tour is to demonstrate applications, the trainee will become inspired for his/her own work. As a matter of consequence a study tour, if well prepared, despite the costs, becomes a valuable asset to continuing education programmes.

3.2.6. Self-learning

Self-learning must be considered the lowest degree of organised learning and also involves minimal monitoring. Yet, its value in continuing education should not be under-estimated as it involves the highest degree of personal initiative and commitment. In its widest sense it is close to acquiring knowledge as a hobby and thus enjoys fullest self-identification of the trainee. But even where self-learning is being undertaken as complementary or supporting measure in order to improve the professional capabilities the trainee will feel fully committed and even will be prepared to invest money of his own. A lot of self-learning is subconscious; a newspaper, a TV performance, an excursion may initiate consulting books : self-learning without that the person recognising it as such. There are however also forms of higher consciousness when a person without the support of the

employer wishes to obtain further knowledge or more perfection. Self-learning then becomes a means for better professional performance, be it to remain competitive or to advance. Many people feel the necessity to up-grade themselves without waiting for an initiative from the side of the employer. On the contrary, they might consider the employer's initiative a warning that their job is in danger. Hence, it might be concluded that self-learning besides overall on-the-job instruction is the most frequent form of continuing education.

Self-learning or self-instruction is a technique which involves self-study materials such as books, learning packages, CAI and other ALT, so that the learner can learn either without teacher intervention or with a minimum of teacher guidance. The learner is fully independent and can choose his/her own pace of study. As such self-learning differs from open learning : the latter normally requires a well-prepared schedule of training and monitoring/counselling.

Systematic approaches for self-planned learning or "individualised learning systems" can be found in ERAUT (1989, p.313 and 418). A particularly well-structured system of learning is the Personalised System of Instruction (PSI) method summarised also in UNESCO/TWRA (1975). To implement the PSI method, course material is divided into units, each containing a reading assignment, study questions, references, study sequences at the rate, time and place determined by the learner.

The basic features of the PSI method are:

1. Self-pacing, which permits a learner to move through the course at a speed commensurate with his ability and other demands upon his time.
2. The unit-satisfaction requirement for advance, which lets the learner go ahead to new material only after demonstrating mastery of that which preceded.
3. The use of lecturers as vehicles of motivation, rather than sources of critical information.
4. The related stress upon the written word in teacher-student communication.
5. The use of proctors (tutors), which permits repeated testing, immediate assessment, almost unavoidable tutoring, and a marked enhancement of the personal-social aspect of the education process.

The advantage is obviously the minimum of costs and that the learner will organise his/her learning in the most efficient and effective way. Time and methods will be optimally exploited, the programme is ideally personally-tailored and is supported by the learner full-heartedly. The learner may be able to improve his/her career potential or to secure his/her position.

However, there are also disadvantages. Modern learning techniques, such as CAL may exceed the learner's financial possibilities. The human environment of the learner may involve too many distractions so that the pace of learning progress is insufficient. Self-learning which will not be acknowledged or at least recognised by the employer may ultimately result in frustrations. A self-learner must be always aware that unless supported by the employer the increase of knowledge may not result in a higher professional reward but in a higher quality of life.

3.3. SUPPORTING TECHNIQUES

Choice of the appropriate continuing education method should be relevant to the form of teaching and to the adequate supporting techniques to be used. If these three factors are in harmony the optimum study atmosphere can be foreseen. In addition, if the trainee gets some opportunities in a selection of the best suited teaching techniques, his study results might positively reflect this situation. Well known techniques which support a teaching/learning process in a continuing education are described below. These techniques are expressed in the text as the supporting techniques.

3.3.1. *Elementary material*

In its requirements for training materials continuing education does not differ from any other training activity in schools, enterprises and university. Thus black boards, paper pads, pencils etc. are indispensable and shall be mentioned here only for the sake of completeness.

3.3.2. *Textbooks and Printed Materials*

Textbook or other printed study material is undoubtedly a principal source of study material for a given course. Its important role is unquestionable and it certainly forms the basis of instruction at any level. Self-learning with the use of a printed material is an individualistic form, fully depending on the individual reader, his study habits and capabilities. It is important that the sought information is available whenever required. Often it becomes important to compare information or approaches in order to understand the complex relationships between the different study fields.

Textbooks and other printed material have the following advantages for an effective study programme:

- Repetition; a book is available for repetition at any time.
- Concentration; the trainee can select the time to study when he is alert and attentive
- Association; new knowledge merges with old knowledge
- Unit steps; the trainee can freely select the size of a unit step in the structured text according to his intellectual capacity.

On the other hand, some critical remarks should be made on the account of study using exclusively printed material. Many text-books are designed to summarise a subject and it is said that "they do not encourage in - depth learning" (FLANAGAN in ERAUT, 1989). They often do not respond to the needs and abilities of individual learners. Textbooks, in general, also tend to become soon outdated or show a bias of inertia or a bias of omission (WESTBURY in ERAUT, 1989). Therefore, teachers have a special responsibility to use the textbooks creatively and effectively. Criteria for the evaluation of textbooks should namely include:

- Level treatment (to whom the textbook is addressed)
- Content of subject
- Structure in which the subject is presented
- Creativeness of examples or exercises.

It must be borne in mind that no so wonderful as an ideal textbook exists. Any textbook has been written within a given environment for a selected target group of readers. Either it will be too general and does not fulfil the expectations for detailed information of the individual reader or it will be too specialised for the general reader. Moreover, the

feedback from the author(s) is missing unless the teacher is himself the author. Therefore, teachers often prefer not to use textbooks but to prepare handouts targeted to the specific group of students in the classroom.

Any learner is advised to consult an experienced person as to the textbook(s) best suited for his/her intended purpose.

The simplest but often the most updated forms of printed study material are handouts usually disseminated during lectures. The set of handouts if regularly distributed gives usually the first information to a student. If the character of subject is more practically-, or laboratory-, or computationally-oriented, then such a set of lecture notes appear as a user's manual where technological features prevail. For instance, the text on Surface Water Hydrology can be written as a lecture note while the text on Hydrometry can rather be designed as a conventional user's manual. Use can also be made of user's manuals prepared by manufacturers of equipment.

An advanced step in study-printed material are reference books or professional books which might serve for a deeper study of the matter. There are many organisations issuing periodicals in the field of hydrology and water resources.

3.3.3. Correspondence courses and self-instructional material

Correspondence education is characterised by a systematic exchange between teacher and learner(s) of learning material sent by mail. It is a typical supporting technique in adult education. Courses designed for this particular form of distance learning may consist of the same textbooks/workbooks used in classroom education but the books are generally not suitable and not sufficient.

The correspondence courses should be prepared in a "self-instructional" format, including self-tests or self-assessment exercises and with some provision for alternative routes and by-passes through the material.

The procedure is that a course sub-set is mailed to the trainee for reading and for replying to questions on solving exercises. The trainee returns his/her assignment to the distant tutor who checks it and replies, eventually with a new sub-set and the procedure recommences.

The trainee must conform to the pace given by the tutor. This pace must be determined by the tutor in a reasonable way so that postal delays can be absorbed and that the trainee has adequate time to work on the sub-set.

The procedure is somehow heavy and slow and is generally suited to only basic subjects. There are however also examples where the method is being applied successfully for postgraduate studies.

Nowadays, correspondence courses form often an integral part of the multimedia approach (audio- and video-cassettes, RT, etc...), described below.

So-called "learning packages" are promoted as combining the best in print and non print technologies. Reference is also made to the PSI method described in section 3.2.6.

3.3.4. Multimedia techniques

It is understood that multimedia techniques enhance the learning process at all levels and reinforce the value of each type of learning material. Constraints are imposed by finance, time limit, experience and technological development in a given environment.

The simple media include graphics, board-displays, photographs and slides, overhead transparencies, sound resources, films, video-cassettes. They may be used in all forms of execution but some of them are more intensively used in distance learning systems and individualised learning. The telephone is another technique which is of great importance to these systems. Very little development was made of the Dial Access Information Retrieval Systems (DIARS) which allowed students to dial up audio tapes from remote places. Computers prove to be more powerful and flexible devices for the distance learning process. Computer-Aided Instruction (CAI) and Computer-Aided-Learning (CAL) belong to the group of Advanced Learning Techniques (ALT) and described in Section 3.3.5.

The Audio-Tutorial Approach (ATA) is a learning program briefly mentioned here. The program should be organised in such a way that the students can proceed at their own pace, filling in gaps in their background information and omitting the portions which they have covered at some previous time. It should make use of every educational device available and attempt to align the exposure to these learning experiences in a sequence which will be dependent on the nature of the subject matter under consideration. In the audio-tutorial system, the instructor's voice is available to the student to direct and supplement his study effort. This does not mean that a taped lecture is given. It refers to an audio programming of learning experiences, logically sequenced to produce the most effective student response. Each study activity has been designed to provide information or a skill leading to a proper performance of the next activity or else to build on the foundation of knowledge previously laid.

3.3.5. Advanced Learning Technologies

Advanced Learning Technologies (ALT) introduce computers in education and training but they can be also limited to video-supported educational systems only. Computer Aided Instruction (CAI) or -Learning (CAL) is a typical ALT-development as is tele- or computer-conferencing. Both techniques offer large and good perspectives to further continuing education especially when distance education is involved.

Firstly it must be recognised that CAI or CAL is a new approach of programmed learning. Its development is slow and requires expertise on different levels. Hence, it is very expensive. However, once good products are available, CAI and CAL may be a perfect tool for continuing education because it allows for high interactive participation of the learner. Automatic tutoring may be integrated.

Moreover, the most recent hardware technologies such as video-discs, but especially Compact Disc Interactive (CDI) may integrate all types of multi-media techniques as well as simulation and gaming.

The ALT in its higher version makes use of the "electronic classroom" with the facilities of computer conferencing systems. It is preferably used for distance teaching. The computer conferencing system allows to set up a learning situation that simulates the well known classroom situation (JACOBSEN, INGESMANN, HESTEHAVE, 1991).

The electronic classroom combines effectively the use of the computer with the distance learning approach and allows for individual work at the learner's pace but with regular

contact for exercises, evaluation or discussions through the "conference system" with the tutor as well as with the other trainees. It avoids isolation of the learners from their tutor and each other.

The advantages of such a system are:

- the trainees can follow their own pace of learning, i.e. they can focus on those aspects of the material that are particularly relevant to them at a specific point in time;
- the trainees can follow their own learning style, thus if they learn better from working through a lot of examples, they can do so. If they prefer a more theoretical approach, they can do a lot of reading etc.;
- the trainees can be tutored individually, i.e. they can receive individual attention to a much higher degree than is possible in a normal classroom situation.

The electronic classroom allows to integrate various media to achieve the best possible learning situation:

- traditional written material (lecture-notes or special hand-outs)
- interactive video
- computer-based training and simulation programmes
- traditional face-to-face seminars.

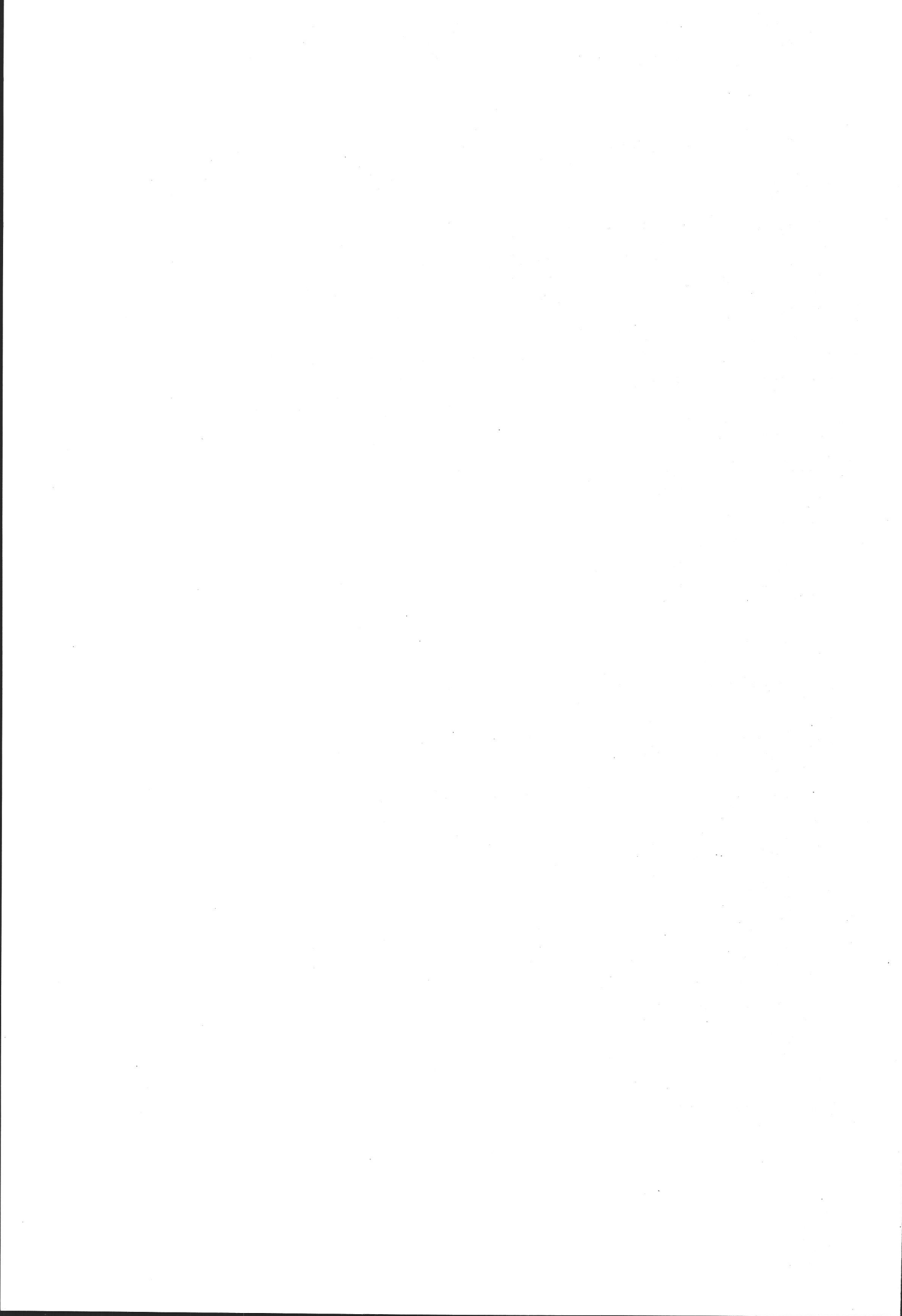
The choice of technical concept is important not just as a medium of communication, it is important in a much wider sense in so far as it conditions pedagogical possibilities.

From a technical point of view the electronic classroom is fairly easy to set up: a small mainframe (e.g. Micro VAX 3100), a computer conferencing system such as PortaCOM and a number of PCs, Macs or even dumb TTY terminals with modems form the infrastructure of the electronic classroom.

Seen from the point of view of the participants, all they need to follow a course is some kind of computer equipment (a terminal, a PC or a Mac), a modem and a telephone line - and they are ready to take a course in the electronic classroom.

Until now, applications of ALT exist only in a very limited number of cases because of very high production costs. Hence, there is scope for exploring development in cooperation and partnership. One single organisation is unlikely to be able to develop and use cost-effective ALT-based continuing education. Programmes can be expected only where large sales numbers are likely. Therefore, the future may probably show products primarily related to practical applications.

In view of the very high costs for CAI and CAL an economic application requires a large number of copies to be sold. Car producers, for instance, will supply their workshops. Hydrology with its relatively low number of learners (as compared with car repair craftsmen) is less favourable for the introduction of CAL and probably only basic courses will be prepared while more sophisticated lessons will remain with the domain of the more classical teaching techniques.



4. ROLE OF CONTINUING EDUCATION WITHIN THE GLOBAL EDUCATION SYSTEM FOR HYDROLOGY



4. ROLE OF CONTINUING EDUCATION WITHIN THE GLOBAL EDUCATIONAL SYSTEM FOR HYDROLOGY

4.1. BACKGROUND

The educational systems at many universities providing knowledge in hydrology and water resources show a large diversity depending mostly on the field to be studied (civil engineering, agricultural or forestry engineering, geography, geology, etc.) and only few universities give the opportunity of a complete undergraduate training as professional hydrologist (full-fledged study). Considering the curricula of a number of universities and other institutes or centres for the teaching of hydrology, it appears that the level of diversity corresponds to the basic goal - to educate a generalist with a broad problem approach and background.

The extent of a "general knowledge" in hydrology is still questionable but the curriculum should allow development of a high degree of a professional adaptability. This requirement could come a short or long time after graduation. Such a situation can come in any professional career enhancement but it is common in hydrology and in other water-related disciplines. Therefore a continuing education system is a necessary follow-up activity after graduation.

A similar situation exists also on the level of education for technicians. The diversity in education in the world also comprises the secondary school system. In educational programmes it is even greater than in the subject matter itself due to differences in regional conditions. The different systems for teaching hydrology follow the pattern of the existing facilities from which they emerge and also reflect the specific natural, economic, social and administrative conditions of a given country. The necessity of adapting hydrological education to the particular needs of the region or the country is obvious.

4.2 CONTINUING EDUCATION APPLIED TO HYDROLOGY AND WATER RESOURCES

As has been stated in previous paragraphs, we may assume that the ultimate objective of continuing education is the maximal increase of someone's potential knowledge and skill capacities within the enterprise environment and considering his/her personal commitment and motivation. Hence, the main aim of training is to improve the work performance of individuals and groups and so to promote personal effectiveness and satisfaction, and to increase the efficiency of organisations without losing personal commitment and motivation fulfilment.

Depending on personal commitment and motivation and company requirements, continuing education in hydrology and water resources may imply all or part of the following aspects:

- *Training and diffusion of specialised tools to be used in hydrology and water resources.*

A plethora of sophisticated new emerging technologies, ranging from the most advanced instrumental techniques through chemical biological and optical sensing devices to powerful interfacing computerisation for data collection, storage, manipulation and interpretation, are nowadays available. To cope with this, basic concepts of simple measurement techniques, such as accuracy, resolution, installation operation characteristics, data capture and their storage in a computer system are necessary to cope with the day to day technological changes.

Apart from other well-known methods and techniques it seems that computer-assisted training is the most important vehicle for the effective dissemination of information and should develop further in conjunction with advances in computer hardware. Well written programs should contain comprehensive instructions, no matter how sophisticated they are. Specific requirements may be: easy to use; written material must be easily reviewed and updated and should allow for an extensive use of graphic utilities.

Computer software and hardware are becoming pervasive; they not only render their older versions obsolescent, but also affect other scientific and technological disciplines which incorporate older versions of them. In new initiatives in this area account should be taken of the experience gained on special topics such as testing of available programs; performance evaluation of the existing software and its application to personal computers and ensure that users are aware of requirements and limitations of models -conclusions drawn from unverified models are likely to be misleading (HERRERA and YATES, 1983).

The final aim is to introduce to the international state of knowledge and know-how in the field of hydrological instrumentation and their maintenance; to learn proven techniques of data processing and retrieval and analysis and the application of standard computer programs.

- Education and updating in specialised topics.

One of the main complaints made by professionals and some sectors of society is the slow diffusion of knowledge from research to practice. This is a key issue in fields such as electronics, communications and computer industries. Some authors speculate that the technical half-life of information learned by computer and software engineers is three to five years. This implies that six to ten years following graduation, up to three quarters of the university-learned material may have become obsolete, and the latest generation of information must be learned if the employee is to remain up to date. To adequately utilise technological and scientific developments a link is necessary between initial training, research and the latest developments in relevant disciplines.

The growth in demand for an improvement in the quality of life makes it imperative for professionals to maintain their skills at a high level of proficiency and periodic review of the new scientific achievements is a way of attaining the goal of proficiency. The usual means for professionals to acquire a more and detailed knowledge of hydrology and water education is continuing education, e.g. short courses, seminars and workshops. This will enable such personnel to deal with new and emerging issues.

There are different points of view on what must be taught in continuing education, depending in the particular social, economical and geographical situation. However, several common areas of interest and priorities can be indicated. A complete description of subjects is not relevant to this paper since their selection is fully dependent on the objectives of the continuing education and the associated specific information needed for their implementation. An extensive list of relevant topics is presented by AYIBOTELE et al, (1988).

Nevertheless, in view of the growing importance of environmental issues in water resources development, some consideration should be given in adjacent fields to hydrology not normally considered in established curricula, as for example climate change.

- Broadening the qualification for managers

Quality technical professionals and managers require a broad range of experiences and a multi functional approach, to maintain technical competence, to be innovative and efficient in their problem solving, and to develop their careers to their full potential. This also implies the ability to master access to and management of necessary information to cope with technological changes. Unfortunately, professionals tend to take fewer courses as their service time becomes longer and this adds to the likelihood that their technical knowledge will become a narrow speciality.

Two different types of managerial activities must be considered : within public service and within private enterprises. Both have similar roles but their procedures are different.

Managers of water resources and hydrology are responsible for administrative regulations, planning, to some extent policy making and in some cases for day-to-day operations and management. Sometimes, the hydrologist or water resources engineer needs to perform a new job due to promotion or when the service adopts new procedures.

This target group is responsible for the work of their subordinates and work carried out by contractors. In both public service and private enterprise the organisational objectives need to be transformed into work plans. Any identified gaps in skills need to be filled with on-the-job training, because most postgraduate training programs tend to be educational rather than professional training-oriented, i.e. they upgrade academic knowledge in order to enhance the understanding of the hydrological system but not necessarily job performance.

Sometimes, professionals from public service are in charge of enforcing some new aspects of hydrology following the legal directives (i.e. Water Act, land disposal monitoring, application of guidelines of regulations from the EEC, WHO, etc). The only way to know what and how this must be done is through the regular updating of this personnel.

To develop and implement their tasks, it is necessary that graduates keep continuously abreast of scientific and technical developments. Continuous internal education is vital in order to maintain the levels of quality in the enterprise and to ensure its very survival. In this case, refresher courses are highly recommended, generally prepared by national hydrological services in order to introduce new instrumentation or procedures to the staff.

- Specialised training

Special consideration must be given to the ways of dissemination of knowledge through training of trainers and researchers. Teachers and researchers as members of the High Education System are responsible to a certain extent, if not totally, of the dissemination of knowledge to the society.

Because hydrology and water resources is a very practical and applied discipline, the academics who lecture in it must be continuously exposed to practice by means of industry sponsored applied research. For this reason, increased attention should be paid to the implementation of general strategies worked out to enhance the ability to transfer knowledge and skills efficiently and effectively in the field of hydrology. The main purpose is to raise the self-sufficiency of academic institutions with the aim that these institutions are capable of running new courses on their own and without external impetus.

If the most important instrument of knowledge dissemination are lecturers, a specific aspect of continuing education is the updating of the teacher, since in many cases it is quite difficult for the individual teacher to keep up with new developments in practical education. Some emphasis should be given to the continuing education and training of lecturers to teach and to carry out research. This is especially the case in developing countries, where there is a lack of teaching expertise, up-to-date knowledge, as well as basic educational facilities. The programme of summer schools for hydrology professors in the practical studies should be encouraged as one of the most important ways to achieve personal up-to-date knowledge (GILBRICH, 1991).

Requirements in the field of hydrology include the mastering of more sophisticated laboratory instrumentation and office equipment, the increasing scientific character of daily problems and the needs of instructors. This last target group requires an up-dated education, including not only high level theoretical instruction, but also the practical aspects of the field and the laboratory.

Another perspective is required for the specialised training of research students. In some countries, this is catered for by formal graduate programmes offered by Universities, leading to advanced academic degrees. In other parts of the world, no such programmes exist and specialised training for research students occurs individually on a case-by-case basis rather than in an organised fashion. Universities have resources and organisational and operational characteristics which differ from those of industry. One of the conspicuous merits is the immediate access to expert groups teaching many different disciplines; thus, curricula formulation and adjustment of course contents can be continually incorporated and improved even in the process of execution.

Although normal PhD and postgraduate education should not be considered as continuing education, because they are part of a formal qualification, research students should be considered as a part of the target group in hydrology. Particularly as the benefits of this specialised education are tailor-made in addition to nuclear courses. Seminars and workshops on specialised topics are an important part in their development.

- Broadening the knowledge for other specialists

It has to be recognised that, because water resources management is not confined to pipes and channels, the true managers in a global context are not only hydrologists and water engineers, but also economists, sociologists, lawyers, etc, and all those who take decisions on water management. Unless these professionals understand basic concepts of water use and protection, it will be very difficult to manage our resources. Training, education and updating in the field of hydrology is the most urgent need for them.

4.3. A FRAMEWORK FOR PLANNING OF CONTINUING EDUCATION

4.3.1. The key-issue for successful continuing education: the parameter harmonisation

Successful continuing education can be considered a function $CE(X_1, X_2, X_3, X_4)$ which is to be optimised. X_1 is the starting point, namely the knowledge and skill capacity at a given moment while X_4 is the objective or in other words the expected outcome. The expected outcome normally will be defined by the employer (enterprise) to meet objectives of the job requirements within the staff policy of that enterprise. This is a function of the role of the enterprise within society, and the catalyst generating the training need, a change in activity in a consultant company, higher standards in a training institution, new objectives in public service, changes induced by new scientific or technological

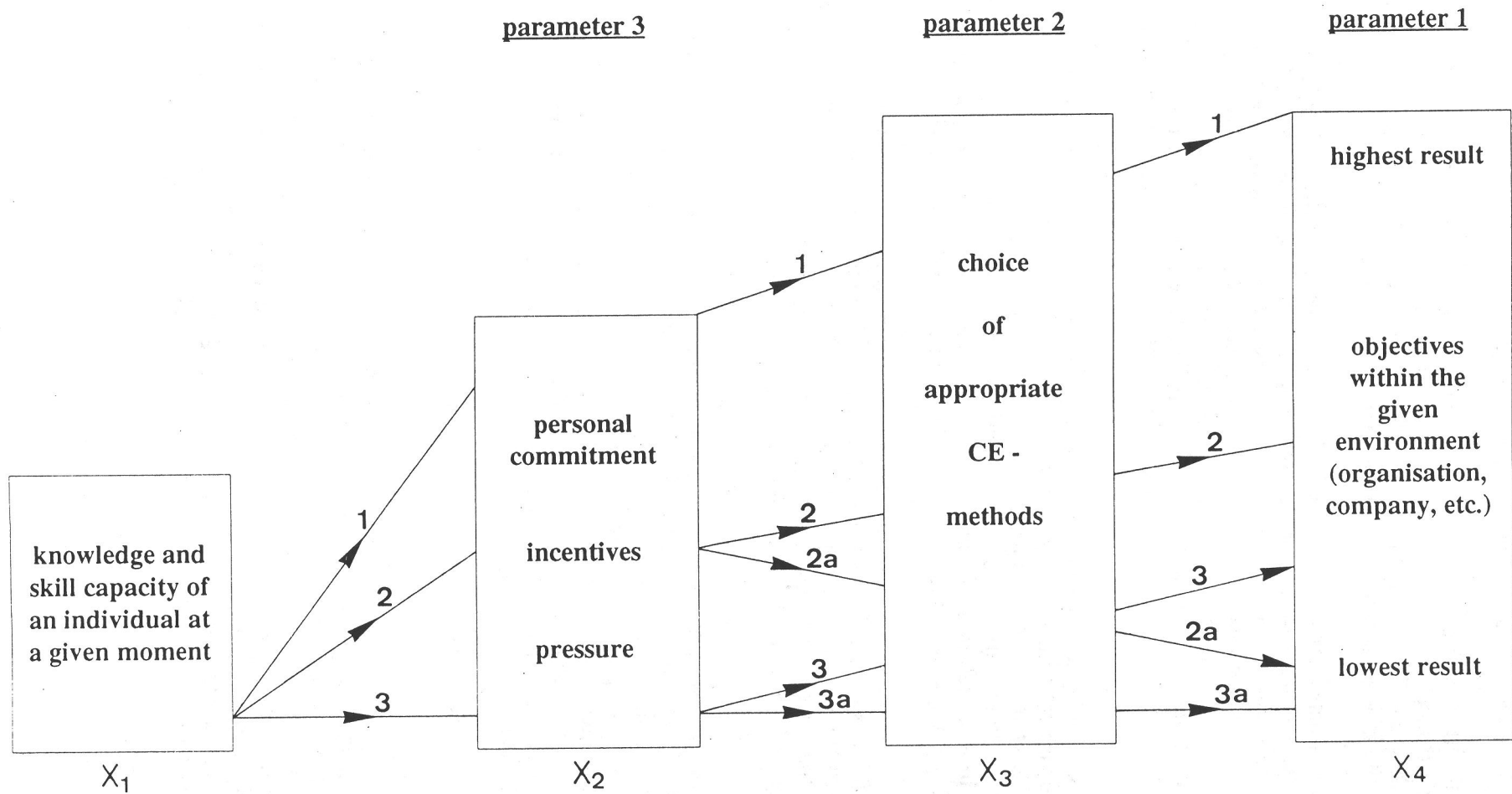


Fig. 4.1 The key-issue for succesful continuing education : the parameter harmonization.

developments. To sum up, a staff member or staff members need to be up-graded from the (lower) position X_1 to the higher position X_4 .

The vehicles for the transfer from X_1 to X_4 are the parameters "motivation of the individual" and "choice of the continuing education method". They cannot be viewed at separately as they are linked together. The wrong choice of the continuing education method may well result an insufficient commitment of the individual.

Fig. 4.1 tries to visualise these relationships. X_1 shall be assumed the starting point : of lower knowledge and skills than is the objective within the enterprise : $X_4 > X_1$. The graph shows (line 1) that personal commitment and the appropriate method will yield the best results. If in X_2 instead of personal commitment the only incentives are the motivation (line 2) the expected outcome will be lower. Pressure (line 3) will yield even lower results. If in addition a wrong method is applied (line 2A) the result will not be satisfying. Pressure and wrong method combined together will show (line 3A) no result at all.

While X_1 and X_4 can be defined independently X_2 and X_3 have to be treated as a unit. If the enterprise consider training abroad as the best method for a given case the result will be good if the absence from home meets with the personal commitment. If the candidate will absent himself only under pressure, expectations should be lower. The same person, however, may have a high commitment if another training method can be offered at his home place. This example shows the interdependence between motivation and method.

Any training programme should take into account the aspirations and motivations of the trainees and it follows from the graph that a high personal commitment automatically will lead to a higher output. If the appropriate method is offered, the result is optimal. Each interruption in the system will reduce the result and it is for this reason that the report avoids speaking of "recommended best methods" but prefers to speak of "harmonisation of parameters".

It should be borne in mind that continuing education does not concern children, hence the classical forms of children education (pedagogy) are applicable only partially and in a limited manner. Continuing education is a typical type of adult education (andragogy) which follows different pattern and where the psychological element has an enormous bearing. The parameter of motivation is decisive for children, it is even more important for adults and often difficult to determine as it is part of the complicated human nature. Adult training can be only successful if fully supported by the trainee and the method should be adapted to the trainee and not the other way.

4.3.2. The choice of the method of continuing education

The methods of continuing education with its many different forms of execution and supporting techniques presented in chapter 3 can be discussed from the point of view of planning and selecting the appropriate combination. Of course the point of view may differ for the employer with his objectives, or for the employee with his motivation or for the continuing education organiser in charge of the continuing education methods. Cost-effectiveness of the selected method will not be the only guidance because the expected benefits are seldom well-known and soft-benefits may be very important but difficult to measure. The local environment and available human resources are often critical in the planning and selection of the continuing education method, regardless to the financial issue.

Table 4.1 shows the most likely combination of supporting technique(s) and forms of execution, bearing in mind that a feed-back from trainers as well as from trainees about the effectiveness of the method is as important as this theoretical approach.

4.3.3. Role of Professional Associations

Professional associations and learned societies have a key role to play in the implementation of continuing education. This may be by encouraging people to take advantage of continuing education by the organising of workshops, seminars, courses, technical symposia, etc. or by requiring new or existing members to undergo continuing education as part of the membership requirements or to maintain their accreditation as a professional engineer or scientist. This may be achieved by ensuring that members keep a log recording their attendance at appropriate events or even a renewal membership interview/examination after a certain number of years experience. The importance of the involvement of professional associations is that they provide a formality and structure to continuing education which may otherwise be diffuse. They may provide a catalyst for both employers and employees to press for involvement in continuing education activities.

Whilst not necessarily leading to recognised qualifications, the involvement of professional organisations allows an element of standardisation which is unlikely to prevail without their overview. The role of the professional associations as accreditors of professional or technician competence within some countries takes over where formal education finishes by allowing the practical on the job training of professionals and technicians to be monitored and assessed.

Table 4.1 Combinations in methods of continuing education.

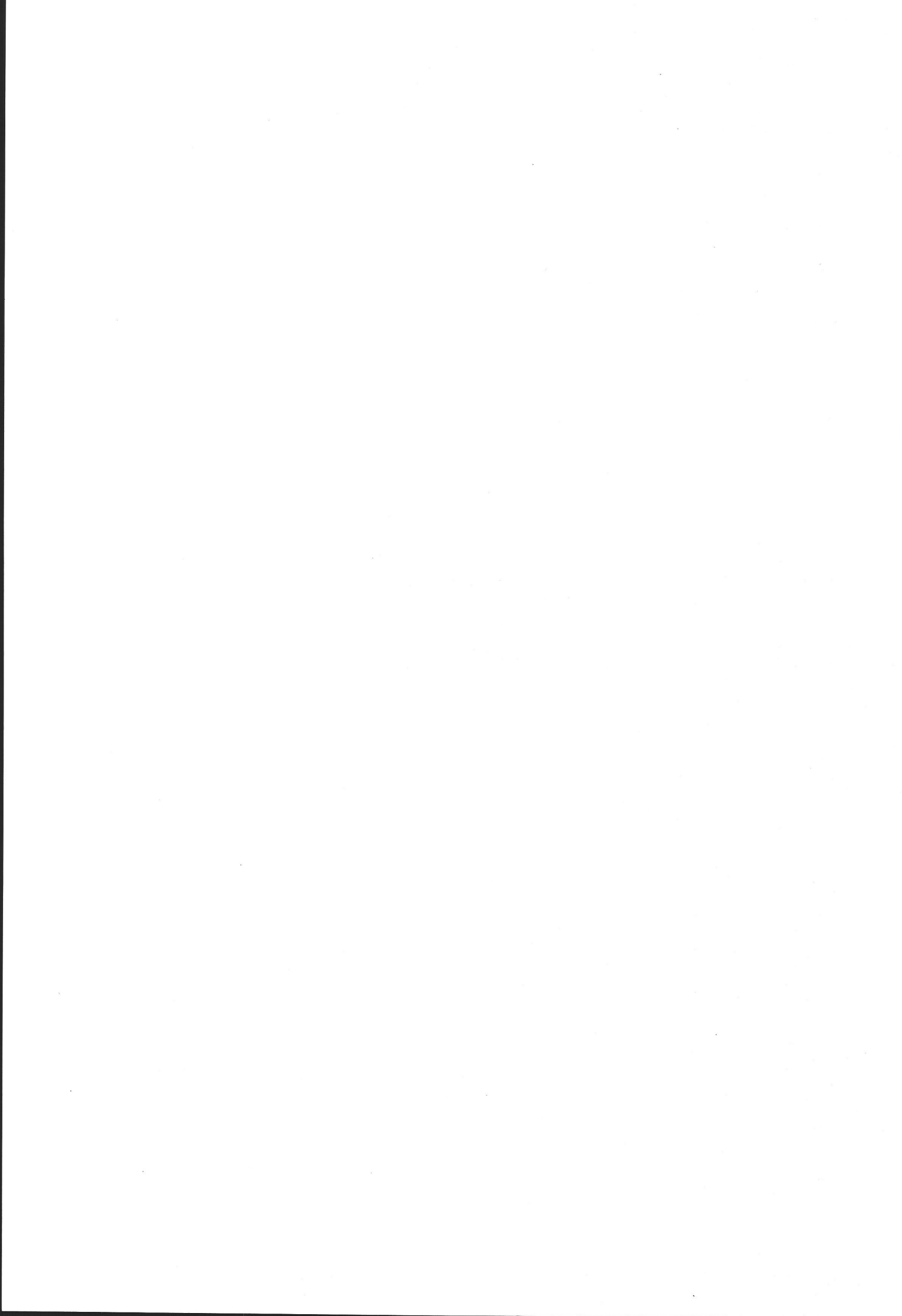
SUPPORTING TECHNIQUES

METHODS OF EXECUTION	Elementary material	Textbooks and printed material	Correspondence courses and self-instructional material	Multimedia techniques	ALT Advanced Learning Technologies
On-the-job training	+++	+++	++	+	+
Classroom-education	+++	+++	+	+	+
Open learning	+	+++	+++	+	+
Workshop a. o.	++	+	0	+	+
Speciality conferences a. o.	+	0	0	+	+
Self-learning	+	+++	+++	+	+

Legend :

- +++ absolutely necessary
- ++ highly recommended
- + useful
- 0 not applicable

5. AN APPRAISAL



5. AN APPRAISAL

In the conduct of continuing education activities three parameters need to be considered.

First, the trainee and his/her commitment ranges from passive participation because of pressure from his/her employer through expected or promised incentives to full dedication. It is apparent that full dedication will yield higher results, however only if harmonised with the other parameters.

The second parameter is the mechanism for the transfer of knowledge and/or skills. These methods of continuing education have been described in chapter 3.

Generally, the driving force is the third parameter, i.e. the objectives of the employer. The enterprise - regardless whether a governmental body or a commercial company - is supposed to permanently assess its staff capabilities with a view to optimising the output of the staff members. Even an optimal composition of the staff requires upgrading of skills because of scientific - technological progress, increasing requirements of the enterprise, competition among companies, different responsibilities of public service.

Hence, the enterprise will develop a schedule for improving the performance of the staff. One means is the replacement of staff members by more capable (or younger) ones. Another mechanism is an upgrading of the skills of the existing staff.

In contrast to the first education of a person (formal education from primary school to eventually university) the second education - designated here as "continuing education" - cannot follow the patterns of formal education but needs to be individually tailored.

The enterprise is greatly responsible for monitoring its staff to recognise at an early stage those who need further training and which skill is to be enhanced. A training schedule will foresee continuing education and put the necessary funds aside. In other words, the enterprise will define the training objectives of each individual. In doing so, it will try to generate the interest of the potential trainee who should ideally agree with the policy of the enterprise and generate a high degree of commitment and dedication. If the potential trainee objects the enterprise may try to offer incentives or prefer another candidate. As shown in Fig.4.1 a low commitment will not yield high results, even if the best mechanism is chosen and if the training objective are high.

The commitment of the trainee is certainly connected with the training objectives of the enterprise. If both coincide good results can be expected. While the training objectives can hardly be changed without reducing the efficiency of the enterprise the degree of commitment of the trainee can be manipulated or the trainee can be replaced.

Full harmony between trainee and enterprise will be achieved only through the adequate choice of the form of training. The consent of the trainee is indispensable as well as his/her capability to making use of the form of training under discussion. For one person a training course abroad may be a personal award. Others may decline because of personal circumstances. Hence, only a discussion between the two partners can lead to full harmony and to an agreement on the training path chosen.

One and the same aim can be reached through different means and only the local circumstances can help deciding which one is the most appropriate. In normal cases, the procedure will take the following steps:

- definition of the training objectives
- choice of the trainee and discussion with him/her
- choice of the most appropriate training mechanism
- training
- assessment, to judge success and in order to draw consequences for future programmes.

It must be underlined again that each case is individual and that no general rules can be established for the choice of the form of training.

It is assumed in the above that the enterprise is the driving force. However the opposite may also be true where a staff member wishes to improve his/her skills and is requesting training. If the enterprise can accommodate this request there is no problem. Sometimes, the aim of the staff member exceeds the objectives of the enterprise and the conflict is born, particularly when the staff member ask for (paid) leave of absence and participation in the training costs. While commercial companies can more easily absorb higher qualifications the more rigid system of grades and promotion rules of governmental services can create enormous problems with the worst situation being when a dedicated and capable person quits the service. As a general rule, a trainee will accept a less attractive form of training if initiated by him/her rather than by the enterprise. There is some temptation in enterprises to suggest to the trainee that he himself should initiate continuing education in order to save money.

Parameters for the choice of forms of training are the objectives, the amount of knowledge/skills to be transferred, the availability of funds, the availability of training opportunities and the possibility for the enterprise to release the person for training purposes.

It should be borne in mind that many trainees expect promotion or higher salaries after a successful training. The expectations of the trainee should, however, be realistic as very often only increased skills will enable him/her to survive in the enterprise. Short and occasional training - particularly on-the-job - should be considered as part of the normal ordinary performance of work. Even a lengthy training course should not necessarily result in promotion. The trainee should bear in mind that he/she has to follow the pace of the enterprise and that higher qualification is not only an asset for the professional life but also constitutes a higher quality of life. It should be added that, as a general rule, formal education is the privilege of youth and that continuing education is the chance of the ageing generation to compete with younger ones.

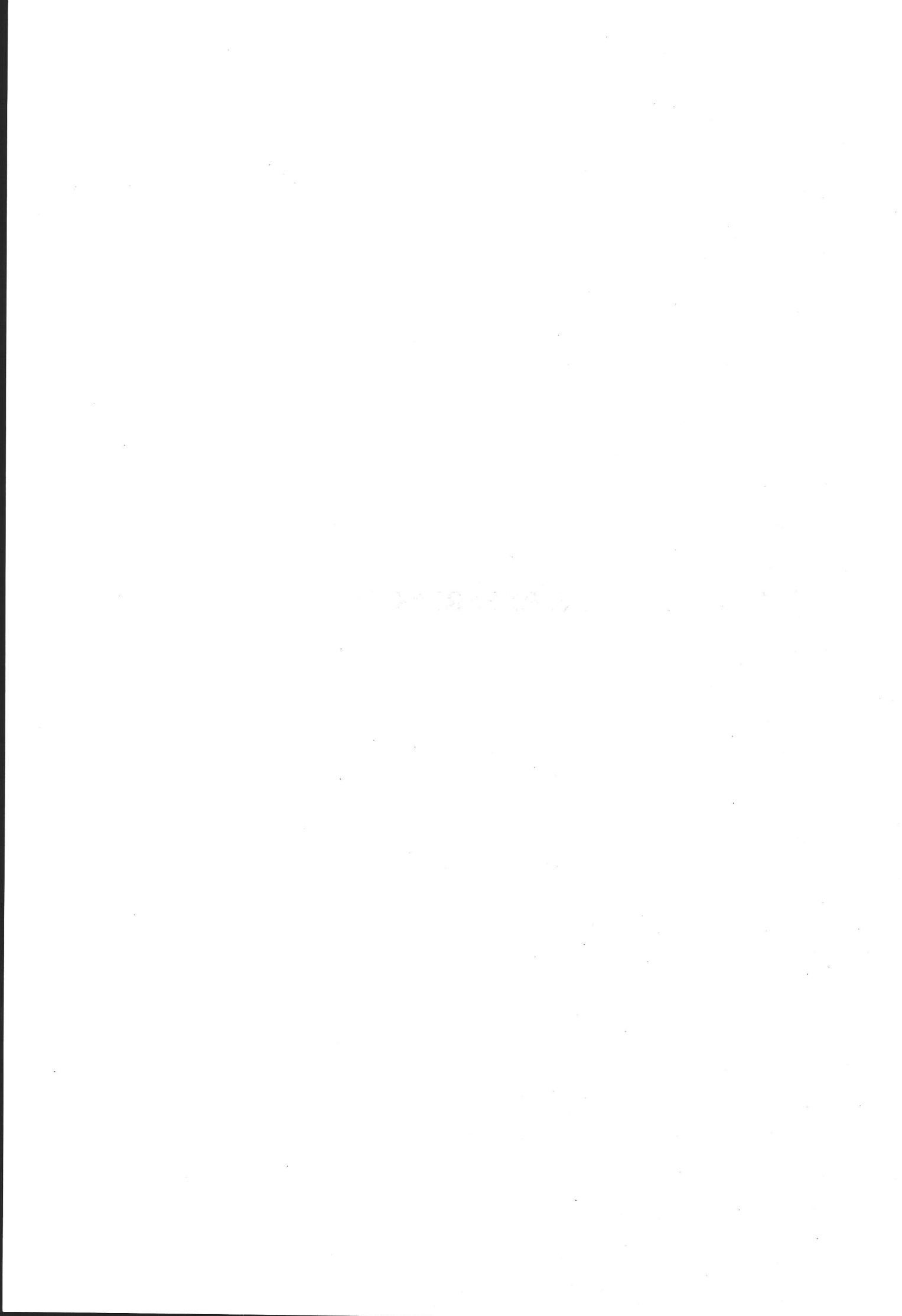
An essential difference between the formal education of the young student and the continuing education of the employee needs to be emphasised. Formal education is the entire responsibility of the student: he/she chooses the discipline, he/she selects the subjects, he/she dictates the speed of their studies (of course within certain limits), he/she decides up to which point (level) he/she wishes to pursue their education (secondary school, technician, B.Sc, M.Sc, PhD). As an employee, he/she is subjected to the policy of the enterprise and no longer free in the choice of the training method as time, money and learning aim are no longer in his/her control. While formal education of the young person is a individual affair, continuing education is the result of the interaction of two partners, with sometimes conflicting objectives.

The reader may be disappointed not to find here a cookbook from which he/she could choose the appropriate recipe. It lies in the very nature of continuing education that it ranges from a brief on-the-job instruction to a longer training course, that continuing education is not a singular event and that each day may offer an opportunity to learn. The

informal and not-structured methods of continuing education allow for endless combinations and sequences of learning opportunities.

Hydrology and water resources, with their wide range of applications in economy, administration and public service, offer wide opportunities for continuing education which can respond flexibly a wide variety of needs.

6. REFERENCES



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