

WATER RESOURCES EDUCATION AND TRAINING

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Keywords engineering sciences, environmental sciences, specialization, employment requirements, postgraduate education and training, degrees, diplomas, educational policies, training needs, quality assessment

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Summary

Water appears in training programs as a focal or only as an auxiliary subject. But even where it is focal, the whole water sector is so diverse that hardly any training institution can cater for all aspects and specialization results. Diversity increases because of employer expectations and because of the various levels of training, up to postgraduate studies, and because of the many educational systems in the world. The article then discusses the various degrees and the problems of their international acknowledgement. Water-related training programs result from educational policies prevailing in a country and they also reflect the need for trainees of a given level and specialization. Training programs must undergo quality assessment procedures. The article finally discusses the interaction with research and current societal developments and it briefly touches the economic aspects of training.

1. Introduction

The other topics under this Theme have the advantage that water can be viewed from a more or less holistic standpoint. Education and training, however, need clear separations with regard to treatment level, the role of water within a major teaching context and, last but not least, broad subject areas.

In earlier centuries water played only a minor role in university life. It would be mentioned in philosophical sciences as one of the major elements of nature and of life; theologians would consider it as a symbol of life, even the eternal one. While water constructions probably are as old as human settlements, the know-how would not be taught at specific schools but communicated from generation to generation or within professional groupings, forming a tradition. Skills would prevail over knowledge.

As compared with other sciences the engineering sciences are relatively young and systematic teaching is more a child of the nineteenth than the eighteenth century with a few forerunner countries commencing in the seventeenth century. From the very outset two options were available for choice—engineering schools or universities. The development largely favored the universities at least in as much as the technical schools tried to become similar in habit, teaching techniques, level requirements and academic performance. Despite this general trend, worldwide the national individual solutions have shown great resistance to global uniformity.

Some of the classical sciences, like medicine and law, within their historical development have agreed on a basic program for all students allowing, however, some specialization. The bulk of specialization would occur during a later phase, often only after graduation. There is a long way from graduation until the day when the young medical doctor can be released to treat patients.

The engineering sciences have gone another way; they specialize early, often already in the starting phase of studies. For water-related subjects the picture is even more complicated. It is acknowledged that the majority of civil engineers have followed a similar path, all over the world. But water usually remains outside the study schedule during the first semesters, which are common for all civil engineers. Water then rapidly becomes the focus. However, the field of water is so broad that no university (or technical school) would be able to cover all aspects well. Very often the universities propose a separation between water resources management, water supply, sanitation, hydropower, and traffic constructions, etc. Consequences of this strategy will be highlighted under item 4.

It would be a wrong assumption to believe that civil engineers, although probably dominating, cover the water field. An equally important group originates from agricultural universities. It is evident that their curricula must be quite different from those in civil engineering. Also in agricultural engineering some study programs would see water as the focal point of their programs while in some other ones water might be almost marginal.

Other important groups are based on meteorology and (hydro)geology and one should not neglect disciplines such as physics, chemistry, biology, climatology, physical geography, economics and law. Even very remote disciplines will deal occasionally with water (pathology in medicine, etc.). A relatively young field is the environmental sciences, like ecology, and in a broader sense town-and-country-planning, recreation, tourism, etc. This list is by no means complete: however, an abundant literature exists with curricula or lists of water-related fields, so these lists need not be repeated here.

A few conclusions can be drawn from the above:

- No study program covers the entirety of water problems; even in study programs concentrating on water, priorities must be defined while other subjects inevitably become marginal.
- Since many disciplines deal with water, no standardized ground program exists, despite the compilation of master curricula for specific groups of users.
- Depending on the major emphasis of the training institution, water problems would be viewed from their own angle.
- No training institution today would be able to train a student immediately ready for entry into the professional life. Follow-up studies and continuing education and training are indispensable.
- Schools are made for the transfer of knowledge. Practice is asking for skills. The debate about the best proportion between practical and theoretical training is likely never to end.
- The diversity of types of training institutions results in a diversity of study programs. Some countries prescribe common minima programs
- While the difference between technical (high) schools and universities in many countries is becoming insignificant there are many levels below the academic one and their relevance for training specific types of personnel is extremely high.
- As will be shown later, study programs are not necessarily only dictated by nature but they also reflect societal developments: the students will follow the *Zeitgeist* and prefer subjects which are promising for their own professional future. The training institutions necessarily must follow the demands and cannot hide behind tradition.

The EOLSS Project attempts to cover the life sciences program. The present text must be limited to water. From the above the conclusion can be drawn that training programs exist in which water forms the core with other subjects forming auxiliary information. The opposite also exists; namely, that water constitutes an auxiliary subject only. The present text however must focus on water and therefore on study programs with water as the central theme. Two main groups already have been mentioned—civil and agricultural engineering; hydrology takes a special stand as it is not only based on these two disciplines but also has a strong root in the physical and geographical sciences. Some authors even distinguish between two types, the operational (= engineering) hydrology and the scientific (= physics and geography) hydrology. Looking closer at the problem the distinction appears artificial.

2. Employers

In each country (between countries the differences are enormous) each profession is characterized by a specific ratio between employment in the private and in the public sector. In countries with a high degree of privatization almost all medical doctors can be found in the private sector. Within the private sector independent and employed persons will be found; again, this ratio tends to be profession-specific.

In general, the water sector is characterized by a high proportion of the public sector,

but much depends on the professional speciality. Water resources management normally is the domain of the state; wastewater treatment typically occurs at communal level. Hence, an educational program must cater for the extreme cases of being employed by the state (government) and of being an independent consultant in the private sector. This span is responsible for quite different requirements for knowledge or skills. In many countries the state organizes special programs for graduates willing to join state services while a graduate opting for a job in the private sector will have to undergo follow-up programs and continuing education and training perfectly designed for the professional purposes and requirements of the chosen work environment.

As a matter of consequence, the universities but also other training institutions will try to offer a program which suits the private and the public sector. These programs inevitably must be broad and solid; the different parts of the program must be complementary. Although a frequent demand, the universities cannot and must not train for a special profession or group of enterprises. While the universities should care for frequent contacts with the main groups of employers, one should not forget that even groups of employers (for instance, associations of building companies) rarely will be able to express themselves in a way which satisfies all of their members. The employers must advise the training institutions, particularly when subjects appear obsolete or when new ones are being neglected. Stress has been given to “advise”, not to press. In liaising with the main groups of employers the universities will find out that there is a common denominator for job competences. Only when this denominator is reached can programs in continuing education and training meaningfully supplement the course so that the trainee reaches the job competence for more specific purposes. The reaction of the labor market in a way constitutes a kind of quality control on a teaching program. If a graduate faces problems getting employment it may, of course, indicate a personal weakness; if cases multiply, the respective training institution does not offer market-oriented programs.

Up to now, universities primarily have served the national employment market. The European Union is establishing a Union-wide labor market and this is an enormous challenge for the universities. Much more, the trend stands for globalization and the universities are facing the difficult problem of how to serve the national, regional and global market. The paradigm for the universities has drastically changed. The university can no longer develop curricula entirely on academic ground but it has to communicate with the stakeholders of the employment market.

3. Levels of Education

In principle, water resources education and training does not much differ from other disciplines. In the educational pyramid the lower, bottom layers generally are not too important. Despite some instruction on the value of water in daily life and on water-saving practices, on hygiene etc., schools obviously have other priorities. Schools, particularly secondary schools, however, deliver the tools for later academic studies. The more profound the school knowledge the higher the level of the initial phase of the universities and it should be an iron law of educational policy to discharge universities from subjects which the (secondary) schools could have taken over, and this at lower costs. Almost invisibly, the school forms the entry gate for high-quality university

studies. Figure 1 illustrates the educational tree and it shows how important the stem of the tree is. Vocational training is limited to practical applications, in some professions only.

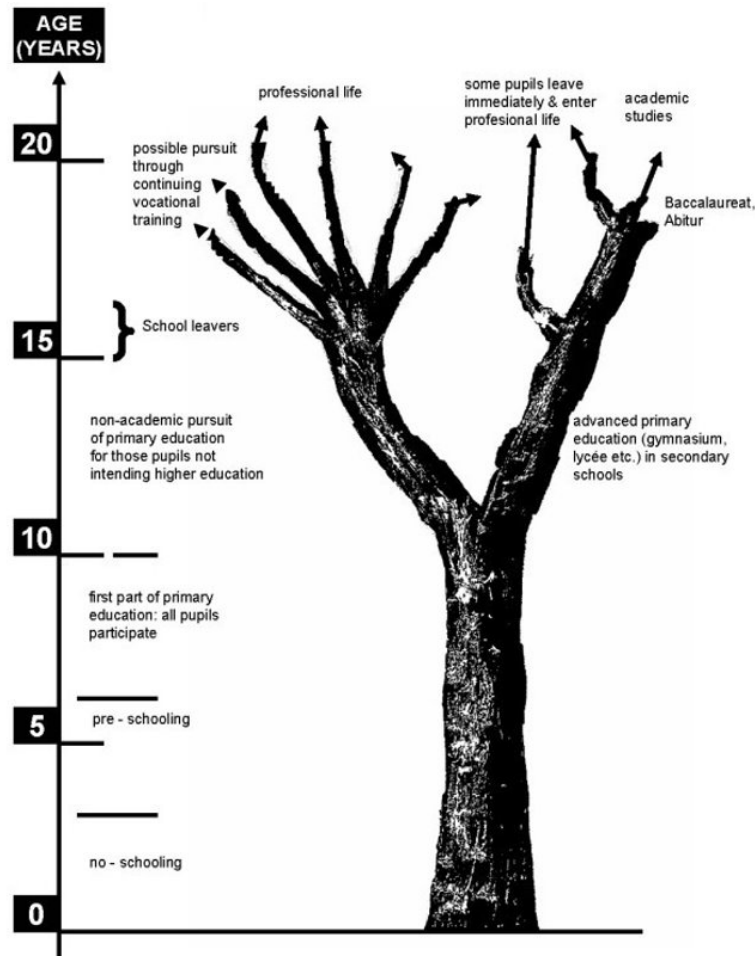


Figure 1. The educational tree (Gilbrich, 1997)

The bulk of water-related education and training can be found at university level and, after graduation, is likely to continue in postgraduate courses and at doctoral level. In this respect water-related education and training is not different from other disciplines, although post-graduate studies have been well established in view of the fact that the deficiencies of the ordinary study programs make such courses necessary. Specialization in the water sector is high because of the multitude of water problems and because of their different modes of appearance. Neither does time permit, nor are enough students interested in, specialized programs during ordinary study so that specialized postgraduate courses automatically offer advanced studies. They are simply a necessity.

In a number of countries institutions of non-university rank run special programs. Since they generally devote more time for skill development, they are popular and the graduates normally enjoy good job chances. Often, the private sector prefers them over university graduates.

Post-graduate courses normally follow ordinary study within a short time span, and many course organizers define relatively low age limits. In contrast, continuing education and training is a life-long venture. In view of its importance in the water sector, a special article will be devoted to it in order to supplement this more general introductory text.

A widespread demand is to raise water awareness within the general public. It seems that the universities are not effective for this purpose nor have governments developed convincing and successful strategies. It appears timely that the water sector finds ways and means to mobilize the media. A good TV spot probably would pay dividends in terms of water savings. However, it seems that the contacts between the water sector and the media in most countries are underdeveloped. The same observations hold true for decision-makers and politicians. The fact that many countries have launched ecological programs at government level does not mean that the majority of politicians have really understood the message. To train them is a necessity; appropriate means have not yet been found.

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Biographical Sketch

The author, **Wilfried H. Gilbrich**, was born in the East of Germany and received the degree of a Dipl. Ing at the Technical University of Hanover (Germany) and subsequently he was there a Principle

Assistant in the Institute of Water Resources. He then joined the Water Resources Administration of Lower Saxons and a continuing education program in water resources law and management, obtaining the degree of an Assessor in 1966. In 1968 he was called by UNESCO and primarily acted as education officer in the International Hydrological Programme (IHP) until retirement in 1995. He took care of more than a dozen IHP working groups and was contributing to their publications; he was also responsible for the network of the (up to 32) UNESCO-sponsored postgraduate hydrology courses and he organized many regional training courses in developing countries, particularly in Africa. He then undertook consultancies for UNESCO, in a number of German governmental projects and particularly in programs financed by the European Commission for development projects in Central and Eastern Europe. He is author of numerous publications in the field of training and education and in hydrological mapping.