

# **Mining and Incorporation of Value Elements in Drainage Science and Engineering Programmes**

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**Abstract:** Previous engineering education only focuses on the training of theoretical knowledge and skills, neglecting the formation of spirit and values. Mining education elements in the process of knowledge transfer is a new educational concept proposed by China's engineering education community in recent years. In order to achieve the goal of comprehensive education, the article suggests that, on the one hand, based on the main channel of classroom teaching, we should scientifically and systematically develop the value resources of the curriculum, and excavate the spiritual elements implicit in the depth of theory. On the other hand, we should make good use of professional lectures, disciplinary competitions and practical teaching platforms to achieve the unity of knowledge and action. We must pay attention to the unity of value formation, knowledge transmission, and ability cultivation, and make good use of the phenomenon teaching method to improve the coupling and fluidity of value elements in professional knowledge. This article provides an example of talent cultivation in civil engineering.

**Keywords:** Water Supply and Drainage; Value Elements; Integration; Cases

## **1. Introduction**

According to the standard for professional accreditation of engineering education, science and technology majors should not only equip students with the skills needed for national and local economic construction and adapt to scientific and technological progress, but also cultivate students' humanities and social sciences knowledge, sense of social responsibility and engineering ethics <sup>[1,2]</sup>. This requires that the professional curriculum

should not only achieve the goals of talent training in the context of the new era, but also return to the original intention of educating people, both knowledge transfer, ability training and value formation of the educational function, that is, we should pay attention to strengthening the education of students in engineering ethics, and cultivate the spirit of the great national craftsmen of the students to strive for excellence, so as to stimulate the students to serve the country with science and technology, and the national sentiments and mission to assume responsibility.

The combination of knowledge-based education and education is a new educational concept. From the perspective of education, the elements of education contained in the curriculum can be transformed and refined into values, ideals and beliefs, ethics in education. As one of the important science and engineering majors, Water Supply and Drainage Science and Engineering (hereinafter referred to as "Water Supply and Drainage") is committed to exploring the value implication of the curriculum, infiltrating ethical and education into the knowledge system of the curriculum, and realising the unity of knowledge imparting and value leading, which is also the proper meaning and inevitable way of professional construction for realising the fundamental task of establishing morality and educating people in the new era of the major. This is also the fundamental task of the profession in the new era to realise education and the inevitable way of professional building. However, the general difficulties in the current teaching of water supply and drainage professionals lies in the lack of effective teaching materials, and the integration path is not smooth <sup>[3-5]</sup>. The reason for this is that the valuable value elements in professional courses have not been fully explored, and the second reason is that the characteristics of

implicit education of value transmission have not been accurately grasped, resulting in the inability to grasp the timing of the integration of value elements and the lack of methods and skills of integration. In this regard, it is necessary to take the professional curriculum as the carrier, focusing on the establishment of education, and sort out the curriculum contents in depth so as to unearth the spiritual elements. At the same time, focusing on the integration of value formation, knowledge teaching and ability cultivation, we should grasp the timing and degree of integration, so that students can naturally accept the value elements taught by the curriculum, thus creating emotional and cognitive resonance. The following author combined with the school, the mining and integration of the value elements of the professional course of water supply and drainage to discuss.

## 2. Identifying the Value Elements of the Water Supply and Drainage Programme Curriculum

In nearly 70 years, the water supply and drainage programme of the author's school has accumulated valuable development experience and brilliant construction achievements, which is the great wealth of the profession, and also contains a wealth of engineering cases and stories [6], thus providing a large number of educational resources for teaching the course. As shown in Figure 1, the author intends to elaborate on the mining of value elements from two channels: curricular and extracurricular.



Figure 1. Mining the Value Elements of the Drainage Programme

### 2.1 Mining the Value Elements of Lecture Sessions

The curriculum is the basic unit of talent training and the foundation for professional development. Statistics show that 80 per cent

of university students' courses are professional courses, and 80 per cent of their study time is spent in professional courses. It is also the teachers of professional courses who have the greatest influence on the development of students at the university stage. Such a set of data shows that professional courses are the main battleground of professional construction [7].

The main courses of water supply and drainage science and engineering include "hydraulics", "hydrology and hydrogeology", "water resources utilisation and protection", "pumps and pumping stations", "biology of water treatment", "water supply and drainage engineering for buildings", "water supply and drainage pipeline systems", "water quality engineering", "fundamentals of civil engineering", "water engineering construction", etc. These courses imply, to varying degrees, the values and meanings of core values, ecological civilisation, national sentiments, national self-confidence, professional ethics, social responsibility, mission bearing and the spirit of science.

For example, "ecological civilisation" and "importance of environmental protection and pollution control" can be extracted from the course "water resources use and protection". In the course of teaching, we can focus on the current situation of China's water resources, the importance of water resources protection, the integration of national environmental protection laws and regulations, national pollution control and other aspects of the content. Interpretation of the specific connotation of ecological civilisation, how to implement in the protection of water resources and water environment governance work. On the basis of a clear understanding of the current situation of China's water resources and ecological environment, in-depth elaboration of the significance of the construction of China's ecological civilisation, the main ways and objectives, in order to grasp the future development trend of the industry, in the future work can be actively integrated into the professional objectives of the national strategy of ecological protection and environmental governance, and make appropriate contributions to the cause of the country's ecological environmental protection. In the "water quality engineering" course, you can show the development of China's water

treatment technology, leading technology and cases in the international arena, so as to refine the "national self-confidence, patriotism" and other elements of the spirit, so that students feel the development of the motherland's technology, the great process of the country's weakness to become strong, and enhance the national self-confidence.

Courses involving water engineering equipment and water engineering construction, such as "Water Pumps and Pump Stations", "Fundamentals of Civil Engineering", "Fundamentals of Water Process Equipment" and "Water Engineering Construction", can be combined with the historical process of China's manufacturing development to tell how China's construction started from scratch and caught up with the advanced. Courses on water engineering equipment and water engineering construction can be combined with the historical process of China's manufacturing development to tell how China's construction started from scratch and caught up with the advanced. Through the vivid stories and details of the people behind the equipment and buildings, explaining China's construction and the spirit of the great national craftsmen, students can develop a strong sense of national pride, feel the great process of the motherland's technology from weak to strong, and develop a sense of patriotism.

The "Building Water Supply and Drainage Engineering" programme, which focuses on "Indoor Water Supply, Indoor Drainage and Fire Protection in Buildings", has the important task of creating a better living environment and safeguarding the lives of residents. When teaching Chapter 5 "Building Fire Protection System" in the "Building Water Supply and Drainage Engineering" course, we can try to explore the value elements from the perspective of "people-centred theory". Explain the importance of fire protection facilities in safeguarding the lives and property of citizens. When introducing the layout of the internal fire pipe network, the distance between fire hydrants, the water pressure guarantee, the water consumption of the swimming pool, focus on explaining the implementation of the code provisions of the concept of "prevention first, prevention and elimination of combinations", and convey the value of "life is paramount" in the

transmission of knowledge. The pursuit of value in the transmission of knowledge.

## **2.2 Mining the Value Elements of Extracurricular Activities**

In order to create a comprehensive pattern of education, the extraction of the value elements of the water supply and drainage course should break through the classroom boundaries, seek the growth point of the course from the disciplinary competitions and innovation and entrepreneurship competitions, and piggyback on the value resources through the medium of professional lectures and extracurricular practice.

### **2.3.1. Academic competitions**

In recent years, due to the transformation and upgrading of national development strategy, the number of events with the theme of "energy conservation and emission reduction, green and low-carbon, and sustainable development" has been gradually increasing, which provides a broad stage for students to show their talents. Water supply and drainage professional services in urban and rural residential water, industrial water, water resource management, water pollution control and building fire, etc., is committed to the realization of a virtuous social cycle of water, and ecological civilization, energy conservation and emission reduction, green and low-carbon, sustainable development and other concepts have a natural fit, you can participate in a number of disciplines events. For example, students can participate in the "Challenge Cup", "National Energy Conservation and Emission Reduction Competition", "Sham Shui Po Cup", "Water Supply and Drainage Innovation Competition", "Guanghuiyuan Cup", "Guangdong Province" and "Guangdong Fire Protection Competition", which are held by national, provincial and municipal youth league committees. "Guanghuiyuan Cup" Intelligent Water Competition, "Pumps and Pumping Stations Knowledge Competition" organised by the National Water Supply and Drainage Teaching Guideline Committee, "Internet+ Competition", as well as innovation and entrepreneurship platforms for students at all levels, etc. Students can participate in the above competitions. By participating in the above competitions, students can explore the growth point of the curriculum from the hotspots of

sustainable facilities construction, such as "rainwater reuse, low-carbon wastewater treatment, sponge city, smart water, comprehensive pipeline corridor, green building".

At the school level, for example, Zhongkai Agricultural Engineering College, where I work, organises the "Flying with Dreams" water facilities design competition and the "Rural Revitalisation Cup" micro-redevelopment design competition once a year under the theme of "Developing Innovative Technology and Building a Harmonious Countryside". Under the theme of "Developing Innovative Science and Technology and Building a Harmonious Countryside", the College designs and renovates green, energy-saving and low-carbon municipal pipeline networks, rural roads, water supply and drainage facilities and sewage treatment plants, and carries out innovative design or renovation of relevant areas in Guangzhou. By participating in the "Flying with Dreams" competition, students can actively pay attention to national and regional regulations and policies on ecological environmental protection and water pollution control, learn cutting-edge energy-saving, green and low-carbon technologies, and be guided to pay attention to the concepts of ecological civilisation and sustainable development.

Campus is the place where dreams begin, and young students represent the future and hope with boundless passion, inspiration and creativity. Through participation in various thematic competitions, we will introduce the concepts of "energy saving and carbon reduction", "green development" and "intelligent water" to the group of people responsible for the future development of the industry, stimulate the creative inspiration of students, integrate the programmes of various parties, collect excellent works, stimulate the thinking of future water technology, grasp the future development trend of the industry. By participating in various competitions, we will introduce the concepts of "energy saving, carbon reduction", "green development" and "smart water" to the groups responsible for the future development of the industry, and stimulate the creativity of students, integrate the programmes of various parties, collect excellent works, and stimulate them to think

about the future of water technology, grasp the development trend of the future industry, and be able to take the initiative to integrate with the national development strategy in the future.

### 2.3.2. Professional lectures

Professional lectures complement classroom teaching and can help students understand the history of the profession, professional figures, professional achievements, water characteristics and technological advances.

Tell the history of the profession - Water supply and drainage science and engineering is developed along with the continuous development of society, the accelerated process of urbanisation, the purification and disinfection of drinking water for residents, the pipeline transmission of municipal water supply, sewage collection, water resources, water resources and discharge of the continuous progress of engineering technology. In recent years, the profession has gradually developed into a research field that solves the problems of process technology and engineering design, construction and operation management in the water supply and drainage industry with the concept of realising a benign social water cycle. The history of the profession clearly introduces the historical background and lineage of the profession's formation and development, which can enable students to have a preliminary understanding of the history of the profession, its fields of research and its role in the economy and society, so that they can recognise the importance of the profession.

Introduction of professional figures - to take professional famous figures Xu Baojiu, Li Guibai, Zhang Zijie, Gu Xia Sheng, Qian Yi, etc. as the object of publicity, to tell the history of the predecessors, to set up a model for learning.

Introduction of professional achievements - from the first modern urban wastewater treatment plant in New China - Shanghai Yangshupu Waterworks - Gaobeidian Wastewater Treatment Plant to Asia's largest wastewater treatment plant with a capacity of 2.8 million tonnes per day - Shanghai Bailonggang Sewage Treatment Plant, marking China's great progress in the field of drainage engineering<sup>[8]</sup>. Along with the emergence of a variety of large-volume, ultra-high-rise buildings such as mushrooming,

the development and application of new technologies and techniques in the fields of building water supply, building drainage, building fire protection and so on. These professional achievements can effectively build up professional self-confidence, so as to establish professional goals and learning motivation among junior students, and then expand the history and process of the country's development, feel the great process of the motherland from backward to advanced, from weak to strong, and develop patriotism.

Professional lectures are used to introduce the urban water crisis and the characteristics of China's water situation, so that students can strengthen the sense of concern, understand the development of the industry is a long way to go, and enhance the mission to bear. At present, China's water resources and water environment in the field of outstanding problems are: water scarcity (per capita possession of only a quarter of the world), water pollution is serious (80% of the water body is in the category of 5 or less), urban flooding is frequent, low reuse rate (less than 20%), and part of the lakes eutrophication is serious, etc.<sup>[8]</sup>. All this is closely related to the profession. Only by focusing on these issues can students of water supply and drainage be motivated to consciously expand the breadth and depth of their studies and research.

In recent years, the water supply and drainage industry has broken away from the traditional disciplinary framework of civil engineering, and has absorbed a large number of modern scientific and technological achievements such as microbiology, materials science, information science, etc., and has gradually moved towards equipment, instrumentation and intelligence<sup>[9]</sup>. Taking the water plant as an example, the intelligent water plant introduces process intelligence algorithms to achieve fine control of production, reduce the influence of production, and increase the efficiency of production, and has gradually moved towards equipment, instrumentation, informatisation and intelligence [9]. Taking the water plant as an example, the intelligent water plant introduces process intelligence algorithms to achieve fine control of production, reduce the influence of human factors, make production more reliable, and significantly reduce the cost of water plant production medicine consumption. For example, through image

recognition technology, the establishment of water quality - dosing - alum flower mathematical model, the development of AI algorithms to achieve accurate intelligent flocculant dosing. Using AI algorithms to optimise the dosing pump to achieve intelligent dosing of sodium hypochlorite. In the water supply and sewerage pipeline system, underwater robots and industrial endoscopes are widely used to detect pipeline leaks. Through the introduction of professional development trends, students are guided to consciously pay attention to new technologies such as artificial intelligence, big data, cloud computing and the Internet of Things, and then combine them with this profession to cultivate innovation awareness and innovation ability.

### 2.3.3. Practical teaching

Practical teaching links can be on the one hand through visiting local waterworks structures, waterworks relics, feeling the spiritual power behind them. On the other hand, it can improve the understanding of local water engineering culture through consultation materials and investigation visits. With the help of local water engineering cases, feel the sense of professional achievement and professional mission of the water environment management project. Feel professional dedication, patriotism and national pride from excellent water engineering cases.

During the awareness exercise, our school organised a visit to the Dongshen Water Supply Project Phase II Pavilion for the drainage students to understand the touching story behind the project. The background of the story is that in 1963, X City was hit by the worst drought in a century, the public was supplied with water once every four days, the lives of 3.5 million people were put in jeopardy and more than 200,000 people fled their homes. At this critical moment, 84 senior students from the Department of Agricultural Water Conservation and Civil Engineering at the Guangdong Institute of Technology (GDIT), under the leadership of Professor Mak Yun-yu, the then Dean of GDIT and a renowned expert on water conservation in China, decided to postpone their graduation for one year, They fought hard for more than 7 months and made an indelible contribution to solving the drinking water problem of millions of X City people, and one of them even sacrificed her precious life. One student even

gave up his precious life. Nearly one hundred graduates of the Guangdong Institute of Technology wrote the most important thesis of their youth on the great project of Dongshen Water Supply, setting a shining example for future generations. By visiting the case of the Dongshen Water Supply Project, we felt the spiritual power of the pioneers of the water industry who defied difficulties and dangers, selflessly devoted themselves and overcame difficulties, which will inspire students to fear no challenge, take on heavy burdens and dare to dedicate themselves to their future studies and work.

In the process of internship, we should make good use of local historical and cultural resources, take local water engineering culture as the starting point, and achieve the benign interaction between the goals of professional knowledge and the goals of education. The integration of water engineering culture is also in line with the requirements of humanistic qualities of water supply and drainage science and professional personnel training system. The accreditation standard for engineering education based on the UWCCU framework requires that graduates of water supply and drainage science and engineering should have "good humanities and social science knowledge, engineering ethics and a strong sense of social responsibility" [9]. Incorporating the local water engineering culture into teaching helps students to understand the development of the region, the current situation of development and value recognition, feel professional pride, mobilise students' motivation and gradually cultivate students' sense of social responsibility.

### **3. Incorporating Value Elements into Water Supply and Drainage Programmes**

The transmission of values is different from the traditional professional education, which requires teachers to have the ability to run through different disciplines and fields, to be able to trace the same essential principles through different phenomena, and pay special attention to the interdisciplinary organisation of resources [10]. In the teaching of professional courses should be good at applying the phenomenon of teaching method, build an effective integration channel, to ensure that the entry of the subject is ingenious and natural, smooth transition; must deal with the timing of

the integration of value elements and teaching organisation and other aspects of the relationship, not to be too blunt and turn into a sermon, but also not to affect the inherent logic of professional knowledge expression. The following author discusses the drainage professional course value elements in the specific method.

#### **3.1 Creating Problems**

Problems can be created in relation to the world view and values involved in a certain knowledge point of a course to stimulate students' thinking. For example, "environmental microbiology" course "bacteria and algae symbiosis" this knowledge point, about the bacteria and algae through the mutually beneficial symbiotic relationship degradation of organic pollutants in water, so the teacher can create "win-win", "community of human destiny" and other topics to guide students to think: man and mankind, the community of human destiny. Through the relationship between bacteria and algae, the teacher can create "win-win", "community of human destiny" and other themes, leading students to think: how to get along with nature, how to get along with people and the environment, how to get along with different people in different regions. Through the relationship between bacteria and algae in nature to explain the principle of mutual benefit and win-win situation in human society. Another example is the ozone-bio-activated carbon process in the Water Quality Engineering course, in which ozone, microorganisms and activated carbon work together in wastewater treatment (ozone is responsible for decomposing large-molecule, hard-to-decompose organic matter, bacteria further decompose small-molecule organic matter, and activated carbon adsorbs the excess microbial residue) to provide services to each other and work together to treat water to a drinkable standard. This process fully demonstrates the importance of teamwork, only the division of labour in several departments to work closely together to give birth to the craft of excellence. Through the "ozone bioactivation" joint process of knowledge to explain to students to illustrate the logic of win-win cooperation.

#### **3.2 Story Introduction**

Combined with the stories or cases related to the professional knowledge points of this lesson, from the specific dimensions of quality education to the elaboration of the spiritual elements behind it, leading students to explore. For example, when telling the story of the development of China's water treatment technology, the deeds of Mr Xu Baojiu can be introduced. Mr Xu Baojiu, received a Ph.D. degree from the University of Wisconsin in 1951, in the early years of the founding of the country in the context of abandoning everything, resolutely give up the generous treatment of foreign countries, return to the motherland, engaged in education and scientific research, became the founder of the field of China's water quality engineering for China's water cause to train a large number of outstanding talents [8]. With the noble deeds of our forefathers, we inspire students' patriotic feelings and professional dedication.

In the sewerage system chapter of the Water Supply and Drainage Network course, students are shown video material about the transformation of urban black smelly water bodies in Guangzhou. The main content is: In the 1990s, Guangzhou's urban water environment was plagued by problems such as unregulated sewage discharge, the proliferation of black smelly water bodies and serious pollution of the Pearl River water body, which became an important factor that disturbed people's lives and affected the city's brand. Through historical images, students are guided to think about how to plan and build urban drainage systems from the perspective of urban livability and sustainable development. What are the measures to control black smelly water bodies in cities? Through historical images, students are guided to think about how to plan and build urban drainage systems from the perspective of urban livability and sustainable development. What are the measures to control black odour water bodies in cities? Students are asked to divide into groups to investigate examples of river rehabilitation projects in Guangzhou City through information access and site visits to learn about the methods, effectiveness and experiences of treating black odour water bodies. Investigate the problems of the city's existing drainage system and find solutions, and select some feasible solutions from the student groups. Such investigative visits not

only enrich the students' knowledge, but also serve as an important channel for instilling a sense of professional pride in them.

As mentioned above, through the "Dongshen Water Supply Project", students can learn the touching stories behind the project and feel the spiritual strength of the pioneers in the water industry who braved difficulties and dangers, made selfless sacrifices and overcame difficulties. Through lectures, discussions and field trips to major cases, students can have a comprehensive and deep understanding of the important role of professional knowledge in national construction and social development, and feel the driving force of values in professional development and service to society.

### **3.3 Comparative Introduction**

By talking about professional and technical aspects of the ancient and modern comparison, China and the world, and then into the "sense of professional achievement", "sense of responsibility and mission" or "national spirit" and other themes. Such as the example of modern times more than 100 years in China's urban and rural water and sewage treatment engineering development data. From 1883, when the first tap water plant was built in Shanghai, China, to the end of 2018, the total annual water supply of China's cities and counties reached 70.445 billion m<sup>3</sup>, the length of water supply pipelines reached 1.441 million km, the water supply serves a population of 620 million people, and the national urban water penetration rate reached 98.3% [8]. From this set of figures, we feel the great changes in China's urban water industry, so as to appreciate the country's great efforts to improve the living environment and improve the quality of life of the people.

### **4. Conclusion**

The teaching of professional courses should achieve the unity of value formation with knowledge transmission and ability cultivation, and this process is a systematic project of exploration, excavation and processing. In practice, it is necessary to grasp the systematic nature of developing curriculum value resources and the scientific nature of integrating spiritual elements. Value element mining can not be randomly grabbed, disorderly accumulation, must be based on the

overall perspective of the discipline for systematic mining. Since each course contains value elements, the spiritual resources of different courses must reflect certain differences. On the path of integrating value elements and knowledge points, it is necessary to deepen the understanding and control of the theoretical logic and cognitive logic of the discipline, and to realise the articulation and correspondence of the fundamental principles, humanistic feelings and spiritual elements on the basis of the inherent logic of the discipline. In teaching, it is necessary to grasp the balance between explicit and implicit education, focusing on the integration of value elements and the degree of coupling and smoothing, as well as the learning experience.

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