Rethinking Distance Education for Engineering Staff

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ABSTRACT

As the backbone of Chinese talent, engineering staff plays a crucial role in enhancing scientific and technological innovation and constructing a moderately prosperous society in China. As Chinese economic and societal development has an increasingly stronger demand for engineering staff, training of high-quality engineering staff has become all the more urgent. Distance education can cover a wide range and scale and have a long-lasting effect; besides, its cost is low while its teaching system design is comprehensive. The on-going distance education for engineering staff has made initial achievements; at the same time, it is also faced with many challenges and opportunities.

Keywords

Engineering staff   distance education   educational practices   Science and Technology Innovation

SECTION 1  Increasingly urgent demand for engineering staff training

With the development of economic globalization, science and technology are developing in leaps and bounds and knowledge economy is in the ascendant. Based on economy, led by science and technology and focusing on talent, competition among nations in comprehensive national strength is getting increasingly fiercer in the world. Human resources have become significant strategic resources and technical professionals are the backbone of talent. Since the 1970s, Chinese technical professionals have been expanding. According to statistics, its total number has reached 46.86 million by the end of 2008, making up 6% of the total number of social employees. China has attached great importance to the training of technical professionals. Since 2011, the Ministry of Human Resources and Social Security has issued the National Plan for Long- and Medium-Term Construction of Technical Professionals (2010-2020) (referred to as the Plan below) and Directive for Technical Professionals’ Knowledge Renewal Project (the “653” Project) (referred to as the Directive below) and demanded that specific directives for the implementation of technical professionals’ knowledge renewal projects be worked out in related industries.

According to the Plan, while construction of Chinese technical professionals has seen
considerable progress, on the whole “its scale, quality, structural distribution, system and mechanism and the environment for its development still lag behind the need for socioeconomic development and the construction of an innovative nation”; “its capability of independent innovation is still not strong”; “there is a shortage of technical professionals on the basic line and the professional skills need badly to be improved”; “training of the talent cannot match the rapidly developing economic and societal need”; “institutional barriers still exist for the development of the talent; there is a shortage of investment and the engineering staff needs to be further motivated”.

The Plan also iterated that large-scale knowledge renewal and continuing education should be carried out in twelve fields including information, finance and accountancy, ecological and environmental protection, energy and resources as well as disaster prevention and disaster relief, training one million technical professionals each year. In nine fields in the modern service sector such as consultancy, accounting, intellectual property and food security, 0.8 million urgently needed engineers should be trained, highlighting knowledge renewal, mastery of advanced technology and enhancement of professional skills. This will fully rely on higher education institutions, research institutions and training agencies of large enterprises, and some national sites for technical professionals' continuing education need to be established.

Given the urgent need for engineering staff to match the economic growth and the demand of training nearly two million annually, short-term face-to-face training can hardly satisfy this need since it is limited by the expenses and can only benefit a limited number of people. Besides, its teaching content has become stale and its effects will be hard to strengthen. As such, it has become all the more necessary to rethink engineering staff training in terms of distance education.

SECTION 2 Exploring the mode for engineering staff’s distance training

Distance training can break the temporal and spatial limits and provide opportunities for more learners in a given time, thus expanding the teaching scale, improving teaching quality and reducing cost of teaching.

Given engineering staff’s occupational characteristics and learning habits, we have trained some engineering staff initially and gained some experience.

Subsection 1

We need to know their motivation and need before designing reasonable and diversified teaching content. Having usually accumulated some working experience, engineering staff have more clear goals for training. Compared with other trainees, they have a stronger problem consciousness. As such, fully understanding the trainees’ motivation and need, the shortage of their knowledge and what is urgently needed for their jobs is the point of breakthrough for developing curriculum of distance training.

Concurrently, when designing courses, we need to cover different fields and categories since engineering staff come from different locales and the natural and social environment also differ even for engineering staff of the same industry. For our ongoing distance training courses of energy conservation management in public institutions, we spent 18 months preparing for it, and much of the time was spent in investigating the regional needs for
learning and giving trial lectures. In the future, this project will gradually facilitate diversified teaching in the major climate zones in China, including bitterly cold areas, cold areas, areas with hot summer and cold winter, areas with hot summer and warm winter and mild areas. As it has proved, the sufficient preliminary investigation and research has facilitated diversified courses, making the courses more scientific, targeted and practical.

**Subsection 2**

We need to extend the teaching content to cultivate engineering staff’s comprehensive quality. With the change of the societal environment, requirements of engineering staff no longer remain at the level of that for “technical workers”. Apart from being a “technical worker”, an engineer also needs professional knowledge of other fields to broaden their knowledge and facilitate better implementation and management of projects; for instance, they need to know more about the cyber, environment, law, economics and security problems. To a certain extent, the breadth of one’s knowledge has become the prerequisites of a qualified engineer, which has been indicated in our current training courses. When designing the distance training courses for food safety coordinators, we also included interpretation of related laws, network public opinion analysis and reflection on environmental problems in addition to the core courses of food security. Like the following mode.

![Diagram](image-url)
Take our training of energy conservation managers as an example. Before designing the course, we investigated into the key areas and difficulties in their institutions and the results are as follows:

Chart One shows the key areas of energy conservation in their institutions and the importance of each area. The vertical axis represents the key areas and the horizontal axis indicates the significance of each area (and also how the surveyed weighed each area).

![Chart One](chart1.png)


Chart Two shows our investigation on the factors that may affect energy conservation. The vertical axis represents these factors and the horizontal axis indicates the weight of each factor.

![Chart Two](chart2.png)

*The vertical axis  Other factors  Professional quality of energy conservation managers  Managerial factors  Fund  Degree of attention paid by the leaders  Awareness of energy conservation of the whole staff  People in charge/ Frontline staff

*The blue columnar  Frontline staff  *The red columnar  People in charge
Subsection 3

Comprehensive and flexible curriculum should be demonstrated. Distance training should set verified, flexible and convenient operation on its learning platform, and the most important representation of this is the design of teaching courseware. As distance training is not a face-to-face one, the teaching courseware will directly influence the learners’ learning experience and effects. In the ongoing training courses, we have taken adults’ learning habits into consideration and designed teaching courseware according to the different teaching contents. In order to give a clear instruction of the operation procedures, our teaching courseware is presented through a variety of outlets including web pages, animation, multi-media and interactive operation so that learners can gain a better experience through the interplay of writing, graphs, pictures and animation.

In addition, given the development of mobile learning, we developed apps that can be used on the mobile phones or iPad for all the training courses we offer, so that our trainees can make the full use of time; for example, they can study when they are waiting for the bus, or during work intervals.
Subsection 4

A comprehensive system for teaching management should be established to guarantee teaching quality. As engineering staff is usually working on the front line and has limited time for learning, a system of teaching management and services should be set accordingly to consolidate and examine their learning outcomes. We have established a strict one in our current distance training courses. The teaching management platform can track, examine and supervise the learners’ learning dynamics anywhere anytime. Each course has online homework and self-examination that require learners to respond in time to show their learning outcomes. There is also a module for questions and answers to facilitate the interaction between learners and their teachers. A whole set of such strictly-designed system has proved useful for controlling and guaranteeing teaching quality.

Interactive learning
Remote communications between learners at the same time
Individual learners will not feel lonely

Q&A online
Teachers are organized to answer the learners’ questions from time to time
Creating platforms for interaction between teachers and learners

Assignments and self-tests
Attached to each compulsory course
Ensuring timely consolidation of what they have learned

Course evaluation
Trainees are free to show whether they are satisfied with their courses
We can learn how our courses meet their requirements and improve our course design accordingly

Online Forums for the learners
Free forums not restricted to any particular topic
Creating an extracurricular platform for learners

Remote teaching management
Learning the trainees’ online study and activities related to our courses
Tracking, monitoring and managing their learning

Ensuring Our Teaching Quality
Subsection 5
A strict examination system should be improved and be related to the certification of qualification in the same industry. A strict system can help make the trainees’ more active and positive. Given the characteristics of engineering staff’s job and industry, the effect of training can be truly enhanced only when training is related to the qualification certification of their industry. It is advisable that complete and strict training be set as the doorstep to gaining professional certification. We have designed a complete and systematic training course for the current project of energy conservation management in public institutions and a strict examination system, aiming to dock with the certification of energy managers in the future. Below are the samples of our Course-completion certificate, which is usually jointly issued by the client organizations and Tsinghua University.

SECTION 3 Difficulties and challenges facing engineering staff’s distance training
When preparing for and carrying out distance training for engineering staff, we have also gradually realized some problems. These problems are the current difficulties in distance training for engineering staff, but at the same time they may also provide opportunities for making breakthroughs in the future.

Subsection 1
Change and improvement of engineering staff’s awareness of receiving training. Currently, the majority of the trainees receive training mainly because “I was asked to”; in most cases, they are arranged by their superiors at their work place. Only a few voluntarily decided to receive training after they met with some obstacles in their work. In addition, many enterprises and institutions have not attached enough importance to training. As training seemingly costs money merely but does not make profit, it is especially disfavored by enterprises. Consequently, the budget for training their employees is very small.

These various factors have contributed to engineering staff’s low motivation for receiving in-service training. Through extensive publicity and education, we may change and raise the enterprises’ awareness of having engineering staff receive training and the awareness of the engineering staff themselves. Concurrently, we can gradually set up strict qualifications for engineering staff in different industries and link professional training with qualification certifications.
Subsection 2

Courses should be more scientific. The current curriculum development and setting is heavily dependent on the investigation into the trainees’ posts and the advice of experts from related fields. Research into engineering staff, however, has shown that their own experience alone can hardly yield satisfactory results, which is especially true with engineering staff on the front line who, due to their limited working area, can seldom have a good mastery of the overall situation and the prospect of a project or its relation to the development of the whole industry. Meanwhile, as training of engineering staff is highly professional, it has high requirements for its implementers, whose reserve of professional knowledge will affect the quality and prospect of engineering staff training to a large extent.

In addition, the current course setting in most cases still follow the traditional education pattern and most courses still focus on teaching professional knowledge. Among the extant knowledge training, skills training as well as emotional values and attitudes training, the last part needs to be strengthened since it is a weak point in the current engineering staff training.

Concurrently, we can also carry out research on helpful topics relevant to our training programs. We will try to improve our research projects through scientific and systematic investigation and research in the long run.

Subsection 3

The method of learning and examining the teaching effects should be changed to enhance engineering staff’s capability of solving practical problems. While trainees are expected to learn basic technics, technical operation and equipment operation, the higher aim of training is enabling them to apply what they have learned quickly. As such, it is especially important to design actual experience so that the trainees can gain comprehensive and direct experience from the whole process of implementing a project. Therefore, training in the future needs to go further into a project and provide the trainees with more opportunities to think and solve practical problems. As such, theories will be applied faster in practice and the knowledge they gain from the books can be turned into practical knowledge in operation, rendering the training more effective. The examination of the training effects should also take their problem-solving ability into consideration. As distance training has numerous trainees, it is not quite easy to have on-spot tests of all the trainees; this task can be commissioned to their workplace instead. This will facilitate the combination of engineering work and learning. Moreover, by examining their learning effects, their employers can work out more scientific plans and goals for training staff in their enterprises and even the whole industry.

Subsection 4

Establishing a comprehensive system for training evaluation. At the present time, the old system for teaching evaluation is followed where the trainees are asked to give their objective evaluation of their courses and teachers after their training has been finished. More than ten indexes are used and their total score will come out as the overall evaluation, which has provided scientific evidence for updating courses and resources of teachers. However, the current evaluation mainly highlights teaching; for distance training, evaluation of the need for training, forms of teaching, teaching aids and teaching effects should also be included. Evaluation and distance education should be a systematic project. The exploration of a
comprehensive, all-encompassing evaluation system is therefore an important task facing distance training of engineering staff in the future.

**Subsection 5**

Building a platform for international exchange. Distance training, due to its large content and wide scope, has provided engineering staff a splendid platform for exchange. However, to a certain extent, this platform is still currently limited to China. A platform for international exchange needs to be built so that engineering staff’s concepts and awareness may meet with their international counterparts’ and the capability of knowledge innovation and project innovation may be promoted. This can be gradually realized by accumulating experience through international exchange and cooperation and large-scale international forums.

**CONCLUSIONS & RECOMMENDATIONS**

Engineering staff training is a systematic project and “systematic” here has two connotations. First, a project covers all the industries in the system; second, any individual training is in itself a cubic system. Now we have tried carrying out distance training for energy conservation managers, line managers in enterprises and food security managers, gradually accumulating experience. In the future, we will extend our training to project management, automotive engineering staff and architects, contributing to the national construction of high-quality engineering staff.