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What is the Balance of Knowledge And Technology?: Study on the Path of Enhancing the Core Literacy of University Teachers in the Context of New Engineering

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Abstract

The new engineering discipline will be built with the concept of facing future changes and leading the new industrial revolution, with "integration and innovation" as the new education paradigm, cultivating future-oriented and innovative engineering talents with modern thinking. The "new" engineering education is born out of the contradiction between national industrial development and talent demand. At the same time, the key to the new engineering education lies in the "new paradigm", which lies in using the new "engineering paradigm" to revitalize the "old" engineering majors, not in eliminating the "old" engineering majors. The key is to revitalize the "old" engineering professions with a new "engineering paradigm", not to eliminate the "old" engineering professions. The Fourth Industrial Revolution has already sounded the trumpet of "emancipation of labour" and "integration of innovation". Therefore, the key connotation of the "new" engineering majors should be on what kind of "new" engineering talents should be cultivated, and what kind of "new literacy" should be possessed by university teachers, and how should university teachers be trained in "cross-border integration"? It is urgent to think about and discuss how to balance the relationship between "learning from all" and "specialization and knowledge" in "cross-border integration".

Key words: New engineering; Teacher education; Core Literacy

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1. INTRODUCTION

In 2016, China put forward the concept of "New Engineering" for the first time, which is directly aimed at the competition of education quality and talents (Gu, 2017). In February 2017, the Notice of the Department of Higher Education of the Ministry of Education on the Research and Practice of New Engineering clarified the five layers of "New" of New Engineering "connotation, which means that the concept, structure, mode, quality and system of China's higher engineering education have ushered in a new and significant opportunity (Ministry of Education of the People's Republic of China, 2017). It is also pointed out in the "Planning Guide for the Development of Manufacturing Talents": by 2025, the talent shortage of new generation information technology industry will reach 9.5 million, and the talent shortage of electric power equipment will also reach 9.09 million. Development relies on talent, and talent relies on education, so the key to cracking the "stuck neck dilemma" and "Qian Xuesen's question" still lies in the development of a new type of engineering education. Nowadays, the new industrial revolution calls for a new role for higher engineering education, because higher education is the sharpest vane of economic and social change trends, and engineering education of research universities is an important support and backbone of national industrial structure upgrading.

2. THE "NEW" REVOLUTION: THE ORIGIN OF HIGHER ENGINEERING EDUCATION

Philosophy explains the world, science dis-

covers the truth, and engineering and technical disciplines are constantly creating and changing human civilization in the world. In order to clarify the "new" paradigm and ideological roots of engineering education, it is necessary to review the long and ancient history of higher engineering education in the world. There are mainly four evolutionary histories of engineering education in the world.

2.1 The "Empirical Paradigm" Stage

From the end of 15th century to the end of 18th century, it was the period of the rise of capitalism in the West, which was the era of handicraft industry relying on manual labor. France was the first to consider engineering education as elite vocational education, and has a 300-year history of higher engineering education. They used "apprenticeship" as the main education system to train the next generation of engineers by passing skills from masters to apprentices. Due to the single cultivation channel, the number of engineers in early France was very small.

2.2 The "Technical Paradigm" Stage

In the 1860s, the first industrial revolution broke out in England, which was a technological revolution in which machinery replaced traditional manual labor, and also a profound social revolution. The reason for this was the "apprenticeship system" based on the practical teaching mode, which led to the limited knowledge of artisans, and thus established the dominance of the bourgeoisie over the world. China's higher engineering education was later than that of Western countries, but the defeat of the two Opium Wars made the Qing government pay attention to the industrialization of the country: at the initial stage, it followed the engineering education model of the Soviet Union, and formulated the reform idea of "learning from the barbarians to control the barbarians". At the end of the 19th century, the first new engineering university, Beiyang College, was founded with the philosophy of "Chinese education as the body and Western education as the application", and a number of industrial and military colleges were established one after another, offering engineering courses in civil engineering, metallurgy and railroad.

2.3 The "Scientific Paradigm" Stage

In the 30 years since the reform and opening up in 1978, China's higher engineering education has achieved leap-forward development and written a history of the rise of engineering education as a great nation. 1978 saw the Third Plenary Session of the Eleventh Central Committee, which listed the modernization construction as the central development task of the country and put the cultivation of engineering and scientific talents in the first place.

3. INDUSTRY-EDUCATION INTEGRATION CULTIVATES TALENTS

The construction process of new engineering includes curriculum design, professional teaching and other professional connotations, but it is also necessary to build a strong support system through school-enterprise cooperation and industry-university-research cooperation, which is the inevitable choice for modern universities to build "new engineering". For this reason, teachers of universities should be good at linking their own strength and social strength to realise the positive interaction between multiple subjects when implementing the talent training programme (Ding, Guo, and Wu, 2020). At the same time, teachers should also participate in the training and shaping of new engineering students, and provide a multi-layered engineering practice platform for students. In particular, we should take the initiative to establish a new model of output-oriented multi-subjects linkage education, such as school-enterprise, school-local and school-university: students should be guided into production scenes, production and marketing platforms, and specific aspects of management departments, so as to enrich the practical content of courses; students should be guided to discover practical problems, and schools and enterprises should make joint efforts in the practical teaching link, so that students can meet the requirements of industries and enterprises after practical teaching as the goal.

However, it is worth paying attention to the fact that the creation of cooperation platforms is by no means limited to the fields related to engineering majors. Teachers should take the initiative to take advantage of the pre-cultivation of interdisciplinary and cross-border integration, and encourage students to take the initiative to go into new industry fields. In order to achieve a stage change of identity and expand the employment circle to finance, Internet, agriculture and other fields, students will have to take the transformation of results as the focus and actively participate in product development and technological innovation in new fields (Sukumar, 2021). At the same time, teachers also need to integrate the strengths of various fields to maximise resource utilisation and output effectiveness, forcing students to achieve self-enhancement on the one hand, and improving the cross-border adaptability of engineering talents on the other. This is the ultimate development goal of highly qualified and comprehensive engineering talents.

Universities should focus on the advantages of future technological development and new industrial development, and build a long-term mechanism and mode of cooperation between industry, university and research. They should lay out new disciplines ahead of time with industrial needs as the guide, and explore and enrich the connotation of collaborative education between industry, university and research. At the same time, the quality of

engineering education should be continuously improved to cultivate outstanding engineering talents who can adapt to the needs of the times. In this way, we can build a strong socialist modern country and realise the Chinese dream of the great rejuvenation of the Chinese nation at an early date.

4. PROBLEMS AND STRATEGIES FOR CORE LITERACY ENHANCEMENT

Education cannot be separated from knowledge, but it cannot only be taught. Teaching based on traditional logic and concentrating on the details of theoretical knowledge is a "weak connection" to the future of education, while taking into account knowledge and practical learning, stimulating students' internal motivation and innovation and creativity is a "strong connection" to the future (Smith, 2013). In order to cultivate modern and innovative talents for the future, the first step is to start with engineering practice, which is an essential attribute of engineering, and thus return to the ultimate goal of "engineering practice", which is "social demand-oriented".

4.1 Problems Facing the Teaching of New Engineering in China

Engineering mode teaching still needs to be explored. In China's traditional curriculum, the call for "de-teaching and textbook-centeredness" has never abated, but the lecture format limited to books and PPTs still remains in the classrooms of some engineering teachers. Such a classroom has little interaction between teachers and students, and it is difficult to digest the content of the knowledge points in the class, thus leading to only a "weak connection" between students and knowledge.

The effective implementation of engineering practice is closely related to the quality of the construction of the teaching staff. Many teachers in universities are PhDs and post-docs from famous universities. They are not lack of theoretical knowledge and academic training, but they are used to using PPT to engage in engineering education easily, and they are keen on applying for projects, evaluating titles and publishing papers. This type of teachers just take education as a "profession" to make a living rather than a "aspiration" to respect life and teach people (Ogrodzka-Mazur & Gajdzica, 2015). In this contradiction, the team of laboratory researchers in universities is perhaps more prominent.

4.2 Basic Strategies for the Construction of New Engineering Disciplines

The "New Engineering Construction" and the Engineering Education Accreditation are more inclined to the classroom mode of practical ability development (Danko and Duarte, 2009). For example, teachers can take team projects as a guide and build a strong practical education system with innovative projects as the main line (course design, engineering training, production practice, graduation design, discipline competition, results incubation) (Maclaren, 2004). The mainstream engineering teaching model represented by MIT in the United States mostly adopts the CDIO model (conceive, design, implement, operate) (Baidu Encyclopedia, 2022), which means that every student can experience the four links of "conceive a product concept, design, discuss and improve, and produce a shape" in the engineering practice course. "This can effectively enhance the sense of fun and experience of self-creation for engineering students.

For example, teachers of agricultural mechanisation and its automation combine the knowledge of agricultural mechanisation management with carefully designed courses involving laboratory experiments, field trials and virtual simulation experiments. Through specific teaching links, teaching activities and supervision mode, the theory is timely transformed and applied to engineering practice, and at the same time, the adaptability of college students to their jobs is also enhanced. This approach helps college students' career planning and truly realizes students' transformation from "knowledge-based" to "ability-based.

5. ROLE REINVENTION: IMPROVING TEACHERS' DATA LITERACY

In the era of big data, open educational resources (OER) have posed new challenges to teachers' core literacy, requiring them to change from "teaching" to "learning", and at the same time to advance and innovate with the times. At the same time, the Fifth Plenary Session of the 18th CPC Central Committee put forward the implementation of the national big data strategy, and university teachers should couple data literacy with their own professional literacy, build a community of "teaching" and "learning" on the network platform, and become the "gold digger" in the big database.

5.1 What Is Data Literacy?

Data literacy refers to the ability of teachers to collect, organise and manage, process and analyse, share and collaborate on data (Ruppel, Winstead Fry, & Bentahar, 2016). Teachers collect test scores, learning behaviours and other data from students to enrich their knowledge and skills in using data, and to develop data-based strategies for school and student development. In the United States, the National Science Foundation (NSF), the Spencer Foundation, the West Ed Consortium, and many other organizations and institutions have invested a lot of money to promote teacher data literacy capacity enhancement projects. Training has also been provided in the UK, Australia, South Africa and other countries. The US Department of Education and the State Boards of Education have launched the Data Quality Campaign since 2005, which requires states to annually update

semester-by-semester transcript data, college entrance scores, student family information, and learning records from basic education to higher education[1]. The Data Quality Campaign promotes efficient use of data by providing real-time updates on student transcript data, college enrollment scores, student family information, and academic records from basic education through higher education. In its 2014 Data Quality Survey, the US Department of Education found that states had not yet empowered teachers with student data, and this led to the release of advocacy pieces such as Empowering Teachers with Data: Using Policy and Practice to Improve Educators' Data Literacy and A Policy Roadmap for Teacher Certification with a Focus on Data Literacy: Focus Areas for Quality Assurance, which called for the inclusion of data literacy in teacher certification standards.

5.2 Significance of Data Literacy

The US DQC data system has three implications for enhancing teachers' professional literacy (Xiong, 2018). Firstly, teachers have access to the analysis of students' achievement tests from primary school onwards, so that they can analyse and compare the data to see through it and use it to inform their classroom practice. Secondly, teachers should develop a cycle of inquiry, a closed-loop approach to identifying difficulties - hypothesis - data collation - decision making - feedback and evaluation - cycle of research, to efficiently guide teaching practice and help students improve their performance. In addition, a formative assessment network is built to provide wings for the sustainable development of students and teachers in both directions. In the process of using data such as 'process growth', 'early warning feedback' and 'value-added', teachers can also enhance their own understanding of 'teaching' and 'learning'. It is worthwhile to try and learn how to understand and generalise about "teaching" and "learning" to achieve the development of teaching and learning.

5.3 New Needs for Development in the Era of Big Data

The current situation of cultivating data literacy among university teachers in China is still in the development stage. Firstly, data literacy has not been regarded as an important part of the pre-service training for university teachers. Secondly, relevant scholars in China have emphasized the importance of data literacy evaluation, but it is still at the exploration stage for how to promote the improvement of teachers' data literacy through evaluation, while a truly better evaluation system for teachers' data literacy in colleges and universities is yet to be explored and mined. In the era of knowledge economy, knowledge renewal and technological innovation will become the central part of economic growth. Instead of passively adapting to society, universities will drive economic development and promote overall social progress with new ideas, new knowledge, new technologies and new industries created and new talents cultivated. For this reason, university teachers should have a sense of innovation and pioneering spirit, and also absorb and learn from the world's advanced scientific and technological achievements in time, so as to improve data literacy and broaden the boundaries of professional literacy.

[1] China education information networks Us "data quality action": ensuring the effective use of educational big data. *New Curriculum Research* (last ten days), (7), 91-91

CONCLUSION

The famous "Question of Qian Xuesen" has asked "Why do our schools always fail to produce outstanding talents? The main problem lies in the rather obvious professional merit in the construction of new engineering disciplines. The main problem lies in the obvious professional utilitarianism and technocracy in the process of the construction of new engineering disciplines. On the one hand, it is the confrontation between teachers' "profession" and "aspiration" inspired by materialism, and on the other hand, it is the singularity and conflict of interests in the assessment criteria of teaching and scientific research, which are both the real dilemma and the growth situation of university teachers. The nature and ultimate purpose of teaching is to educate, and the "profession" of engineering teachers should not become a tool for chasing papers, projects and patents. The essence and ultimate goal of "teaching" is "education", and "aspiration" is the natural pursuit and spiritual call of education. At the same time, in the specific aspects of the construction of new engineering, the core quality and aspirational behaviour of engineering teachers and engineering students' craftsmanship, practical ability and sense of social responsibility will promote each other's growth, so that improving the quality of the cultivation of new engineering talents will continue to inject continuous momentum into this great industrial transformation. For university engineering teachers, it is important to cultivate talents who can keep up with the times in line with the requirements of the new industrial revolution, and at the same time cultivate their own sense of educational aspirations and enhance their own core literacy, so as to realise their own value-added while taking students' growth and success as their fundamental goal.

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