

# Research on the Teaching of Specialized Basic Courses in Engineering Based on the Concept of Evidence-Based Teaching in the Information Age

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## ABSTRACT

In the current era of information technology and big data, evidence-based teaching advocates the organic integration of teachers' subjective experience and wisdom with rich teaching evidence, which provides scientific and effective support for teaching decision-making and teaching action. Its teaching philosophy and characteristics have a good fit with the teaching reform of specialized basic courses in engineering. This paper discusses the application value, advantages, implementation strategies and other issues of evidence-based teaching in the specialized basic courses in engineering, so as to provide useful reference for teaching reform and Talent Training.

**Keywords:** *evidence-based teaching, specialized basic courses, information age*

## 1. THE CHALLENGE OF TEACHING REFORM IN THE INFORMATION AGE

With the rapid development of science and technology, information technology has penetrated into all aspects of society, especially in the recent years, with the rise of "Internet + Education", the new teaching forms such as Blending Learning, MOOC and Flipped Classroom have been widely applied in the teaching of colleges and universities. It has expanded the teaching objects, contents, time and space. The integration of these new teaching forms and the traditional teaching not only changes the educational ecology, but also requires educators to examine the teaching reform from a new perspective [1].

With the combination of information technology and education, we have to face the following challenges: The first is the change of the teachers' role. With the popularization of the Internet and various information platforms, the sources of knowledge for the students have been greatly enriched, and the teachers are no longer the unique source of the knowledge for students. Therefore, in the teaching process, the teachers should jump out of the past empirical teaching and subjective teaching, make the teaching decisions in a more scientific way, and carry out more effective teaching

actions. The second is how to play the role of teaching data. The use of educational information technology can provide the whole process data records for the whole education and teaching activities, including the students' academic background, personality characteristics, learning experience, achievements, subjective and objective evaluation, etc. These rich data sources and massive data will become important teaching resources. We need to focus on how to make good use of these data resources to provide decision support for teachers to carry out scientific and accurate teaching work. The third is the change of teaching mode. With the support of information technology, the traditional teaching mode of relying on classroom and books in the past will be changed. Instead, it will be a new teaching mode characterized by the online and offline mixed forms and the diversified knowledge sources, which can respond to students' personalized and differentiated learning needs[2].

## 2. THE CHARACTERISTICS AND ADVANTAGES OF EVIDENCE BASED TEACHING

In the 1970s, Archie Cochrane, a British doctor, first put forward the concept of "evidence-based". The core of the concept is that doctors should collect reliable

clinical evidence and conduct detailed analysis when diagnosing diseases, so as to improve the effectiveness of treatment with evidence as the guide. In 1996, David Hargreaves, a professor of education at Cambridge University, put forward the idea of "evidence-based teaching", which came into being under the influence of evidence-based medicine. He believed that the teachers should make teaching decisions and conduct teaching activities based on evidence, just like the doctors. In recent years, the academic community has put forward many new ideas for the teaching in the information age, among which the idea of evidence-based teaching has attracted much attention. With the deepening of evidence-based teaching research by scholars at home and abroad, it can be seen that the core of evidence-based teaching is to implement teaching based on evidence, emphasizing the organic combination and comprehensive application of teachers' subjective experience and teaching evidence, teaching situation, so as to highlight the scientificity, pertinence and effectiveness of teaching[3][4]. As we step into the information age of education, a large amount of data will be generated from the teaching elements related to the educated and their time, space, resources, environment, etc. These data will be a powerful basis for the teachers and the educators to make the teaching decisions and carry out the teaching behavior. The characteristics of evidence-based teaching can be summarized as the multi-dimensional evidence description based on the teaching object and the teaching decision and practice based on the evidence portrait.

Based on the existing research, it is not difficult to find that evidence-based teaching as a new teaching paradigm, its advantages are mainly reflected in mining the evidence related to the teaching object, guiding teachers in the teaching process, combining personal professional quality and teaching experience with the object reality and personalized needs of the teaching object, improving the pertinence and scientificity of teaching decision-making and teaching behavior. It is undeniable that the information age provides abundant resource advantages and environmental support for evidence-based teaching, and the teaching based on evidence-based concept will become a new trend.

### **3. THE APPLICATION VALUE OF EVIDENCE-BASED TEACHING IN THE SPECIALIZED BASIC COURSES IN ENGINEERING**

In the traditional teaching mode of specialized basic courses, most of them adopt the teaching mode with teachers as the main body and textbook content as the center. The teaching decision-making is mainly dominated by teachers' subjective experience and relatively fixed content setting, and the implementation

of teaching behavior is more in the form of step-by-step assembly line. This kind of teaching mode is obviously incompatible with the needs of learners in the current information age, and the deficiencies are mainly manifested in the following aspects: Firstly, the evidence awareness of teachers is not enough, they are not sensitive to learners' information, teaching process information and evaluation feedback information, and their ability to extract effective information is not enough, the guiding role of information evidence in teaching is not obvious, and the continuous improvement of teaching is slow. Secondly, the accuracy of teaching is not high, the teaching design, content arrangement and teaching methods and means are not suitable for the personalized and differentiated needs of learners, so it is difficult to improve the teaching effect. Thirdly, the closed-loop feedback regulation mechanism of teaching and learning is not perfect. In the process of teaching interaction, there is a lack of timely response, diagnosis and evaluation is not in-depth, and measures and methods are not flexible. Based on the above reasons, under the background that the current information technology and means are widely used, and all kinds of data and information collection and analysis are more convenient, it is of great significance and value to integrate the evidence-based teaching concept into the teaching of specialized basic courses in engineering.

After our research, we believe that, first of all, evidence-based teaching can effectively promote teachers to combine the subject's experience and wisdom with evidence, and break the limitations of teachers' emphasis on subjective experience in teaching design. At the same time, teachers have sufficient initiative in teaching, and can reasonably use teaching evidence to guide teaching design and implementation, so as to further improve the pertinence of teaching work[5]. Secondly, evidence-based teaching can effectively support the student-centered teaching mode. Evidence based teaching focuses on the comprehensive analysis of students, including their growth background, personality traits, interests, habits, and all the relevant information generated in the learning process, which will become the evidence for guiding teachers to make teaching decisions and implement teaching. Therefore, the teaching under the guidance of evidence-based concept will be developed by teachers according to the individual characteristics and development needs of students, which is no longer a fixed form. Moreover, evidence-based teaching can effectively construct the feedback regulation mechanism of teaching and learning. With the help of information technology, teachers can monitor the generation and development of the knowledge, skills, emotions, attitudes and values of students, and record the whole process of interaction between teacher and student, personal input of students, team cooperation and important events in the teaching

process. Therefore, there is a good fit and application value between the concept of evidence-based teaching and the teaching of specialized basic courses in engineering.

#### **4. IMPLEMENTATION STRATEGY OF EVIDENCE-BASED TEACHING IN SPECIALIZED BASIC COURSES IN ENGINEERING**

Based on the realization of the concept of evidence-based teaching in the specialized basic courses in engineering, the following aspects should be focused on.

##### ***4.1. Promoting the recognition of evidence-based teaching in professional basic courses***

To promote the evidence-based teaching of specialized basic courses in engineering, the key lies in the consistent recognition of the concept of evidence-based teaching by all parties involved in teaching. First of all, teachers should have a clear understanding and high recognition of evidence-based teaching. Evidence based teaching is just to break the experience and subjective teaching thinking and practice commonly used by teachers in the past, and urge teachers to think about new teaching decisions and implement new teaching behaviors, which requires teachers to coordinate their own experience and teaching evidence and form a scientific and reasonable judgment, so as to guide teaching. Secondly, students should support and cooperate with evidence-based teaching. Students' recognition and desire for teaching reform is the driving force to promote the teaching reform. Evidence based teaching advocates individualized and differentiated teaching, which coincides with the characteristics of students' expectation of self-design and diversified career pursuit. At the same time, students are also the most active group in the campus. Their online and offline learning, communication, life and other state and behavior produce a lot of information and data, which greatly enrich the evidence base of evidence-based teaching. It is an important guarantee for the development of evidence-based teaching that students could maintain an open and cooperative attitude towards the collection of evidence related to themselves, including the collection of data and information that may be related to privacy.

##### ***4.2. Improving the ability of teachers to carry out evidence-based teaching***

Evidence-based teaching pursues the best integration of teachers' professional ability, experience wisdom and teaching evidence, and carries out evidence-based teaching exploration and practice.

1) *The ability to explore and discover teaching problems.* Teachers need to abandon the conventional thinking, maintain an open and inclusive attitude, constantly explore and strengthen the awareness of problems in curriculum teaching, accurately study and judge the deficiencies and problems in teaching, and establish a rational thinking of "teaching evidence", so as to find and solve teaching problems as the first step of developing evidence-based teaching.

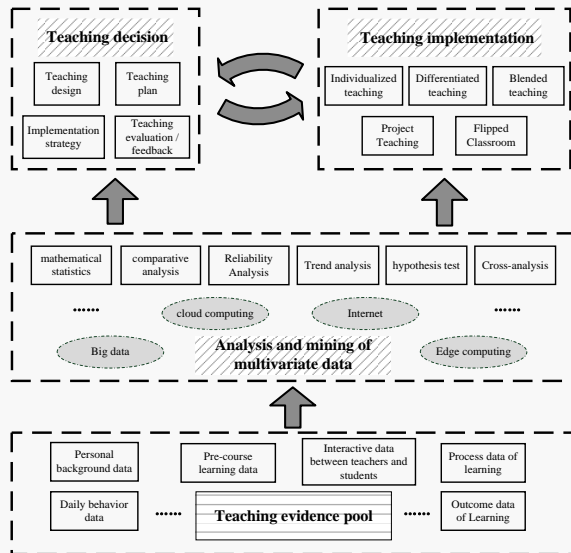
2) *The ability of obtaining and screening teaching evidence.* At present, the educational information and big data can provide us with abundant evidence, but in front of massive and diversified evidence, it is very important how to extract and screen real and effective evidence resources. At the same time, teaching activities also have the characteristics of humanity, sociality and artistry. Teachers should focus on how to fully tap the role and effectiveness of teaching evidence in different levels, such as quantitative and qualitative, subjective and objective, reasonable assumptions and scientific verification. Therefore, teachers should master the research methods commonly used in scientific research, such as literature research, experimental research, big data mining, system science, action research, field research and so on.

3) *The ability to optimize teaching using evidence.* Teachers should have the ability of evidence-based teaching design, decision-making and implementation, and be able to use teaching evidence to make scientific and reasonable teaching decisions and guide teaching practice. They should give full play to their own experience advantages and subjective initiative based on the evidence from different angles of teaching objects, teaching contents and teaching situations, and comprehensively consider the pertinence, scientificity, personalization and differentiation of teaching. In the process of teaching, teachers should combine process-based assessment and conclusion based assessment, keep the optimization and adjustment of all elements of teaching dynamically, and timely feedback and correct the deviation between curriculum teaching and talent training objectives, students' growth needs, etc., so as to constantly improve the teaching effect.

##### ***4.3. Constructing the teaching mode of specialized basic courses in engineering based on evidence-based concept***

Evidence based teaching emphasizes the use of information technology and the combination of teachers' experience and wisdom with teaching evidence. Therefore, the teaching mode based on evidence-based concept should be based on abundant teaching evidence, with the help of relevant data analysis and data mining technology, to carry out quantitative or qualitative analysis on all kinds of evidence information, so as to

form data information with reference value in different stages of teaching decision-making, teaching implementation, teaching evaluation and feedback. Based on these data information, teachers can carry out differentiated, personalized and accurate teaching oriented to teaching object and teaching content. The design block diagram of evidence-based teaching mode for specialized basic courses in engineering is shown in Figure 1.



**Figure1** The evidence-based teaching mode for specialized basic courses in engineering

**4.4. Strengthening the construction of campus environment and resources to support the needs of evidence-based teaching.**

The implementation of evidence-based teaching of basic engineering courses also needs the support of information conditions, campus environment and education administrators. The advanced information conditions, such as Internet, digital campus, smart classroom and online classroom, can provide teachers with the massive teaching evidence related to the teaching objects, course contents and teaching actions, which is a strong guarantee for evidence-based teaching. In order to create a favorable environment for the development of evidence-based teaching, we should create a research atmosphere of "evidence-based concept" in campus, encourage more teachers and students to participate, promote teaching and research cooperation, encourage bold innovation and allow appropriate fault tolerance. Education administrators should also support the evidence-based teaching of

professional basic courses from the aspects of system design, incentive measures and guarantee investment, support the reform of evidence-based teaching through the reform and improvement of policies and regulations, strengthen the overall coordination of funds and resources, and strengthen the construction of campus software and hardware conditions, so as to provide a good support platform for the development of evidence-based teaching.

**5. CONCLUSION**

This paper discusses the advantages of evidence-based teaching from the perspective of value and application of the combination of evidence-based concept and specialized basic courses in engineering. We put forward the relevant strategies from the aspects of strengthening the cultivation of evidence-based awareness, improving teachers' evidence-based teaching ability, designing scientific and reasonable evidence-based teaching mode and building the environment and resources required by evidence-based teaching, which provides new ideas and useful reference for the teaching of specialized basic courses in engineering colleges.

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