# An Improved Educating Mode in Electrical Engineering Based on Washington Accord

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**Abstract.** To achieve the goal of developing new engineering disciplines and cultivating students with high moral standards and innovative skills, an improved educating mode in electrical engineering based on Washington Accord is proposed. Firstly, based on the requirements of the Washington Accord engineering certification, the teaching objectives for innovative electrical engineers under the new engineering discipline are formulated. Secondly, a five-stage blended teaching, group-based and layered teaching approach is adopted to promote the progress of all students. Finally, the five-element process indicator is used to evaluate the effectiveness. The students feedbacked that the improved teaching mode promoted their knowledge and skills, and enhanced their initiative and confidence in learning and practicing.

**Keywords:** Washington Accord · electrical engineering · five-stage blended teaching · group-based and layered teaching approach

## 1 Introduction

Anchored by the goal of building a strong education and talent country by 2035, education development is based on the construction of digital and intelligent technology [1–3].The international trend mainly lies in the teaching modes and the rationalization of teaching evaluation [4]. Alammary (2019) studied five different blended learning modes applied to programming introductory courses, and their flexibility can help students achieve better results [5]. Zhang et al. (2021) and Gu (2022) proposed practical quality evaluation schemes for university teaching by improving the prediction accuracy and convergence speed of teaching quality evaluation through neural network improvement [6, 7]. Guo et al. (2021) studied human-machine collaboration, emphasized individual development, adhered to teaching according to students' aptitude, and extended from knowledge imparting to ability shaping and quality cultivation in the upper-level precise teaching[8]. Based on the necessity analysis of personalized teaching in the new engineering education, this paper proposes an improved educating mode in electrical engineering based on Washington Accord.


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## 2 The Framework of Improved Education Mode

In order to implement the fundamental task of cultivating students with high moral standards and innovative skills, and achieve the goal of developing new engineering disciplines, the teaching approach is based on the concept of the Washington Accord. Focusing on problem-oriented, the teaching objectives, process methods, evaluation and feedback are innovated.

**1) Developing teaching objectives based on the Washington Accord**

As a formal member of the international undergraduate engineering degree mutual recognition agreement "Washington Accord", China has formulated the engineering education accreditation graduation requirements standard based on the outcome-based education (OBE) concept.

The 2021 version of the Washington Accord has added new engineering certification requirements, which require innovative engineers to integrate sustainable development values and goals into their work. Therefore, engineering education needs to focus on a wider range of interdisciplinary complex engineering issues, and using disciplinary knowledge and technological to solve problems. The core idea of promoting the reform of engineering education methods is to transform teacher-centered methods to student-centered and use problem-based learning methods. Through the systematic analysis of the engineering certification standards of the Washington Accord, this project carries out the reform and innovation of electrical engineering professional engineering education, and formulates the "trinity" teaching objectives of knowledge, skills, and attitudes (KSA) for comprehensive training of future engineers in the new engineering field of the 21st century.

**2) Innovative teaching mode based on five-stage blended learning**

Fully utilizing the network environment and information technology, the five-stage blended learning is carried out using diversified and information-based learning resources through the Xuexi Tong platform, as shown in Fig. 1.

The first two stages are online video self-study and Tencent Meeting sharing, which focus on basic knowledge self-learning and mind mapping sharing. The next three stages are conducted offline, including experimental practice, flipped classroom, and programming simulation, which aim to verify the learned theories and understanding through hands-on practice and complete the association thinking from theoretical knowledge to practical application.

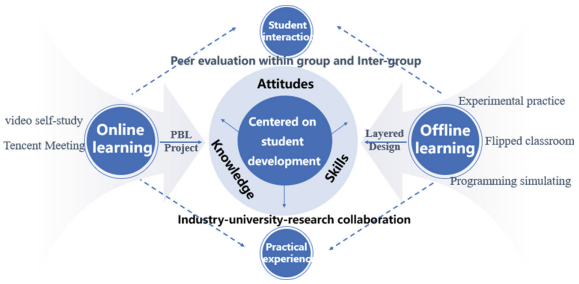


**Fig. 1.** Five stages blended teaching mode

The five-stage blended teaching mode fully mobilizes students to participate in the learning process. Interested students are selected to participate in scientific and technological innovation projects and subject competitions, which comprehensively cultivate their knowledge, skills, and attitudes through deep involvement in the whole process of theoretical and practical learning. Meanwhile, the school also collaborates with relevant enterprises to carry out industry-education-research cooperation. Enterprise mentors explain industry development trends, product application prospects, field demands and problems, further cultivating innovative talents who can apply what they have learned in the new engineering field.

Based on grouping students according to the OBE-oriented teaching, a hierarchical project-based teaching approach has been designed to meet the diverse needs of students, including basic, challenging, and advanced levels. All students are required to complete pre-class preview, group discussion, independent design, hands-on practice in class, and post-class result analysis for basic-level tasks. Students are encouraged to challenge themselves by combining engineering simulation programming with other courses. Students also can optimize control systems to solve the problem of insufficient application of knowledge and achieve the advanced goal of using innovative thinking to solve complex problems.

By integrating theory and practice throughout the entire process of participation, it drives students to learn actively with a clear goal and enhances their knowledge and skills based on engineering at all levels.

**3) Accurate teaching feedback based on the five-element process evaluation**

In response to the problem of students' low participation in daily learning, in order to motivate students to participate deeply in the entire learning process, the proportion of process evaluation has been increased to 60%. And the "five-element process" evaluation system is used, which includes attendance, video learning, homework, PBL experimental projects, and flipped classrooms.

With the help of the Xuexi Tong Platform data, the process evaluation is emphasized. The "excellent, good, fair, and poor" four-level evaluation rules are adopted to promote students' high-level learning. Peer evaluation and self-evaluation are fully utilized to create opportunities for peer learning, promote group cooperation and mutual learning. By inviting award-winning students from science and technology competitions to share their experiences in class and awarding certificates, students' work and achievements are recognized, and their learning enthusiasm is enhanced.

## 3 Students' Feedback

Teachers emphasize the process evaluation, with multiple testing stages carried out to grade students on various aspects such as knowledge acquisition, pre-learning attitude, hands-on operation, data analysis, design innovation, and responsibility. Through student self-evaluation and peer evaluation within group and inter-group, opportunities for mutual learning are created, and real-time feedback helps teachers optimize their teaching dynamically, as shown in the Fig. 2. Finally, terminal evaluation is used to verify students' progress, achieving the goal of dynamic optimization of teaching.

In addition to improving exam scores, students' comprehensive abilities are also exercised and enhanced. The traditional video homework scored high with 81 points,

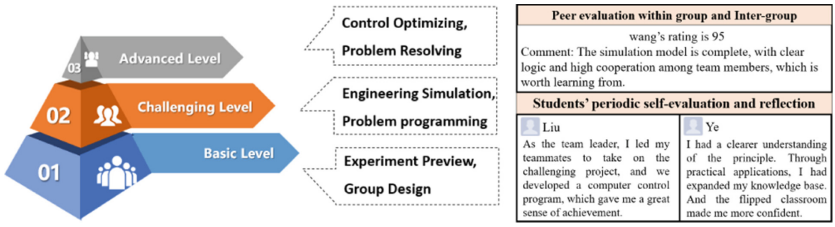


**Fig. 2.** Grouping and Layering Teaching Feedback

while the explanation scores of the flipped classroom classmates were 46 points, indicating that they are not yet accustomed to expressing their own thoughts actively, which needs to be further cultivated. The PBL group homework can achieve a score of 70 points, and everyone was still very active in the group, and was willing to actively prepare and work hard for the group's performance, as shown in the Fig. 3.

The integration of project-based teaching and competitions in the curriculum effectively guides more and more students to participate in scientific and technological innovation projects and subject competitions, with the number of participants increasing from 10% to 23%. Students won many national and provincial-level awards and authored multiple authorized invention patents, that has further enhanced their initiative and confidence in learning. The students' interest in scientific research has grown stronger, and their engineering application skills have also been improved, receiving high praise from employers.

The students highly praised the rich teaching content, the understanding of the frontiers, and the clear direction of the profession and work. The PBL project improved the comprehensive ability of the group to actively learn together, and the layered and diversified assessment stimulated the enthusiasm and creativity of participation.

The improved teaching mode was then gradually promoted both inside and outside the school, through experience sharing at school symposiums, guidance for young teachers' teaching competitions, making course ideological and political demonstration cases on the Zhihui Shu network platform, aiming to actively promote the teaching reform.

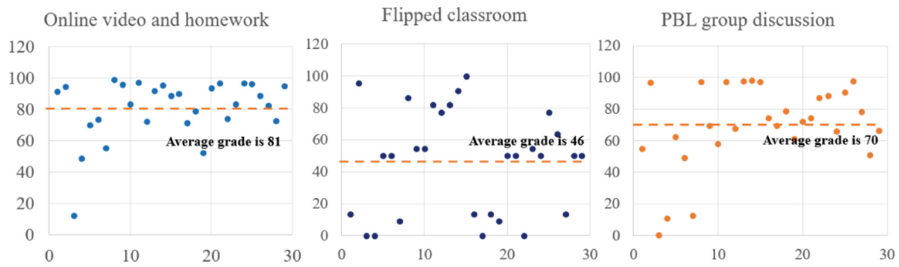


**Fig. 3.** Exam scores feedback

## 4 Conclusions

The basic idea of the improved education model in electrical engineering based on Washington Accord is as follows: ① Design teaching objectives guided by the 2021 version of the Washington Accord engineering certification to meet the requirements of the new engineering education; ② Carry out blended teaching, guide group and layered teaching, and industry-university-research practice, to enhances students' knowledge and skills based on engineering at all levels; ③ Finally, through the five-element process evaluation, timely feedback on the effect of teaching, and further improve teaching methods.

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