Exploration of Reverse Assessment Mode Design for Engineering Courses Based on OBE Concept

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Abstract. In order to solve the shortcomings of traditional teaching design based assessment models in comprehensively evaluating student learning processes and outcomes in the context of the new engineering era, this paper proposes a reverse assessment model for engineering courses based on the OBE concept and establishes a corresponding assessment model. On the surface of teaching practice and student evaluation, this assessment model has a significant assisting effect in stimulating students' intrinsic passion for self-directed learning and guiding them to form a spiral growth model of comprehensive abilities.

Keywords: OBE; New Engineering; Design of reverse assessment mode; Assessment model.

1. Introduction

With the continuous development of technology, engineering problems are becoming increasingly complex, and innovation is no longer limited to a single discipline or profession. In the collision of "new" and interdisciplinary coordination and sharing, "new engineering" is entering a new stage. It can be said that the introduction of the concept of new engineering has led the entire engineering field into an era like the hundred schools of thought of pre Qin philosophers[1, 2]. At the same time, the development of new engineering disciplines is also influencing the talent cultivation concepts and teaching models of universities. The assessment mode, as an important part of the teaching process, plays a crucial role in inspiring students' learning enthusiasm and guiding their comprehensive growth. However, traditional assessment models are mostly based on subject oriented teaching models, which cannot meet the current demand for versatile talents to have both a solid foundation, broad caliber, high quality, and strong adaptability while also possessing innovative potential[3]. Therefore, this article proposes a reverse assessment model based on results orientation and with training objectives as the starting point of assessment, so that the assessment results can objectively evaluate the learning process and results of students comprehensively.

2. Limitations of the current assessment model

Assessment is a set of evaluation systems and rules established to evaluate the condition of students and promote their comprehensive development. From the perspective of talent cultivation, it should be a comprehensive evaluation of knowledge, abilities, qualities, emotions, and other aspects. At the same time, through assessment, students are encouraged to work hard to learn and self-cultivate, thereby achieving comprehensive growth. During this process, schools and teachers can also form a comprehensive evaluation of the teaching process based on the assessment results, and then conduct teaching and management more scientifically and objectively.

At present, with the advancement of teaching reform, the diversified cultivation goals of "knowledge, ability, quality, and emotion" have been included in the teaching plan, and the assessment method has also introduced formative assessment for evaluating the learning process of students. However, there are still some limitations in comprehensively evaluating students in multiple aspects and encouraging their independent growth.
2.1 Assessment focuses on diversification objectives in teaching content rather than talent cultivation needs

In the design of teaching plans for traditional engineering courses, teaching content design, teaching strategy design, teaching method design, and assessment and evaluation method design are all part of it. However, the writing of teaching plans for most engineering courses is aimed at determining the teaching content based on the characteristics of the training plan and curriculum system, and then designing teaching strategies and methods around the teaching content. Therefore, when designing assessment and evaluation, the focus is mostly on how to assess students' mastery of teaching content. From the perspective of the concept of new engineering, even the growth expectations of students after completing a certain engineering course involve the cross learning process of multiple subject contents, which makes the traditional assessment model unable to objectively evaluate the comprehensive growth of students in terms of knowledge, abilities, qualities, emotions, and other aspects after completing the course.

2.2 Assessment focuses on achieving "professor oriented" objectives

Due to the fact that the teaching plan of traditional engineering courses revolves around teaching content, this teaching design model will inevitably lead to a shift in the balance of assessment design towards "professorial" objectives that can be guided and taught by teachers. These are often explicitly listed in the teaching plan as the teaching objectives that need to be achieved, which can be called "explicit objectives", such as mastering knowledge points, applying knowledge, and using tools. However, some other teaching plans do not explicitly list the knowledge, abilities, and qualities that students should possess in the process of growth, which can be referred to as "implicit objectives" and are often marginalized in assessments. Under the new concept of engineering, these are precisely important evaluation indicators for the comprehensive growth of students.

These limitations lead to an incomplete comprehensive evaluation of students in the assessment results. At the same time, the assessment mode cannot match the diversified teaching mode, which also makes it difficult for students to receive corresponding evaluations for their diversified efforts in the learning process. Over time, this is not conducive to stimulating students' interest and enthusiasm.

3. Design of reverse assessment mode

3.1 Design ideas for reverse assessment mode in engineering courses

OBE (Outcome Based Education) is a construction concept that is student-centered and adopts reverse thinking to build a curriculum system. Its core idea is that students can gradually achieve predetermined stage results through learning and accumulation, and ultimately reach the final result step by step[4]. This concept is entirely aimed at the ultimate comprehensive growth of students, and the reverse assessment model based on this concept is also based on the ultimate talent cultivation objective of students, which is the comprehensive evaluation of their knowledge, abilities, qualities, emotions, and other aspects. By refining and breaking down the diversification objectives in talent cultivation needs into target elements, and then reverse inferring what kind of assessment and evaluation model should be established to objectively and comprehensively evaluate students' knowledge, abilities, qualities, and emotions, and provide comprehensive evaluation conclusions, as shown in Figure 1.
3.2 Assessment mode design based on the molecule-like ball-stick core prism model

In response to the limitations of traditional assessment models, this article proposes an assessment model based on the results oriented concept of OBE, which is based on a prism style assessment model, as shown in Figure 2.

![Fig. 2 Prism style assessment model](image)

Among them, the "core" of the prism is a comprehensive evaluation of students, the "vertices" are various goals in the training needs, and the "surface" of the prism is the "perspective" required for comprehensive evaluation of students. According to the different chemical reactions of the interaction between various objectives, it can be summarized into four aspects: professional, thinking, value, and moral.

Due to the complexity of human characteristics, each major category of goals can be decomposed into small feature goals, namely target elements, which require different assessment methods to objectively evaluate. Therefore, this article combines the characteristics of engineering courses to summarize and screen the target elements required for the cultivation of new engineering talents, and introduces a molecular like club model, as shown in Figure 3.

![Fig. 3 Model of Teaching Objectives for Molecular Club](image)

This model imitates the process of atoms forming molecules, small molecules forming large molecules, and large molecules forming substances to classify and organically combine various target elements, and then analyze which assessment method should be chosen from different perspectives. Taking the professional aspect of the prism style assessment model as an example, the perspective of this prism style assessment mainly focuses on the growth of knowledge, abilities, and
qualities related to the discipline. Starting from this, it selects target elements related to it, such as various knowledge points related to the course, the use of knowledge and tools, coordination and collaboration, and effective communication in the process. Then, it selects an assessment method that can objectively evaluate these target elements, as shown in Figure 4.

Fig. 4 Design of Assessment Method for Prism "Professional Surface"

This assessment model can form a comprehensive evaluation of students in a comprehensive and three-dimensional manner. In addition to helping teachers teach students more accurately according to their aptitude, it also provides feedback on students' diversified efforts and independent learning and self-growth in the learning process, forming a positive incentive loop that helps guide students to form a lifelong spiral growth model.

4. Results and Analysis

After constructing an assessment model for electrical theory and experiments using a new assessment model and implementing it through teaching, the teaching team organized a survey questionnaire for a total of 151 people in four majors. The comprehensive survey results are shown in Table 1.

<table>
<thead>
<tr>
<th>Question</th>
<th>The proportion of students(%)</th>
</tr>
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<tbody>
<tr>
<td>You have achieved the learning expectations you set for yourself</td>
<td>agree: 96.02, basically agree: 3.98, disagree: 0</td>
</tr>
<tr>
<td>The relevant theoretical knowledge has been deepened and consolidated</td>
<td>agree: 97.81, basically agree: 2.19, disagree: 0</td>
</tr>
<tr>
<td>Your learning methods and efficiency have been improved</td>
<td>agree: 90.73, basically agree: 7.28, disagree: 1.99</td>
</tr>
<tr>
<td>You have acquired some abilities beyond classroom teaching</td>
<td>agree: 92.72, basically agree: 3.08, disagree: 4.2</td>
</tr>
<tr>
<td>Your self-learning ability has been strengthened</td>
<td>agree: 90.2, basically agree: 8.48, disagree: 1.32</td>
</tr>
<tr>
<td>You have increased your interest in learning and expanded your knowledge base</td>
<td>agree: 93.57, basically agree: 0.62, disagree: 5.81</td>
</tr>
<tr>
<td>Improved knowledge transfer ability and innovation awareness</td>
<td>agree: 89.4, basically agree: 7.95, disagree: 2.65</td>
</tr>
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</table>

Table 1. Comprehensive Survey Results on Teaching Effectiveness

From the survey results, it can be seen that students are highly satisfied with the use of the prism model as an assessment method. It is generally believed that this assessment method has an
effective motivating effect on their growth in areas such as self-directed learning, interest expansion, and innovation awareness.

5. Summary

The construction of new engineering disciplines is a trend in talent cultivation and a necessary path for teaching reform in higher education engineering disciplines. In response to the shortcomings of traditional teaching design models, this article proposes a reverse assessment model design scheme for engineering courses based on the OBE concept, which explores teaching reform in the context of new engineering disciplines and provides ideas for interdisciplinary construction.

References


