

Construction and Practice of "Multiple Evaluation" System in Technical Vocational College -Take the Water Supply and Drainage course as an example

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Abstract: As an important part of teaching, evaluation plays an important role in learning motivation, regulating teaching and learning, guiding students' value orientation. Based on the multiple intelligence theory, constructivist learning theory and education evaluation theory, analysis with the current problems of vocational skills courses and aimed at cultivate students' vocational ability, method ability, social ability as the starting point, the research structure the "Multiple Evaluation System" to provide reference and advice for the vocational education teaching evaluation reform.

1. Introduction

In 2019, the "National Vocational Education Reform Implementation Plan" proposed that the task of reforming the "three educations" (teachers, teaching materials, and teaching methods) has become an important guarantee to improve the quality of vocational education personnel training and enhance students' comprehensive vocational ability under the background of China's current economic development and industrial transformation ^[1]. As an important part of the "teaching method", curriculum learning evaluation plays an important role in stimulating students' learning motivation, promoting students' independent learning, and regulating teaching and learning. Education taking knowledge and skills transfer as the main goal is no longer adapted to the needs of informatization and artificial intelligence in the new era. It is particularly important to cultivate students' multi-dimensional vocational abilities such as inquiry and innovation, cooperation and mutual assistance, and independent problem-solving to meet the needs of industrial change in the information age for skilled talents, thereby achieving the restoration of education value to people themselves rather than "tools". Through in-depth analysis of the problems in the evaluation of higher vocational skills courses, this paper builds a multi-evaluation system throughout the course to help students acquire multi-dimensional vocational skills, construct learning methods, and gain sense of labor value.

2. Theoretical Basis for Multiple Evaluation

(1) The theory of multiple intelligences. The theory of multiple intelligences believes that everyone has seven intelligences (linguistic intelligence, logical-mathematical intelligence, spatial intelligence, physical-sports intelligence, musical intelligence, interpersonal intelligence, and

introspective intelligence). Under this theory, each learner has respective advantages ^[2]. The ability displayed by students in the process of meaning construction is not a single-dimensional numerical reflection, but a multi-dimensional reflection of comprehensive ability ^[3]. The theory of multiple intelligences advocates that teaching evaluation should adopt multiple methods ^[4]. Teachers should observe, record, analyze and understand the strengths and weaknesses of students from all aspects, and design classrooms, teaching materials, teaching methods and evaluations that suit the characteristics of students to help students make up for their weaknesses and develop their potential ^[5,6].

(2) Constructivism learning theory. Constructivism learning theory believes that learning is the process of knowledge construction. Therefore, it is more important to evaluate how learners construct knowledge than to evaluate the results therefrom. In teaching design, we should consider the use of diversified evaluation standards and evaluation methods, combine evaluation with the teaching process as much as possible, focus on the evaluation of learning process and learning resources, rather than just evaluate results as in traditional teaching ^[7,8].

(3) Educational evaluation theory. The educational evaluation theory of the school of learning mastery theory represented by Bloom believes that teaching evaluation is an auxiliary means for briefly verifying whether educational goals and teaching goals are achieved. Teaching evaluation should be a kind of feedback and correction system used in teaching process to test whether each step is effective. If it is invalid, remedial measures should be taken in time to improve teaching ^[9].

3. The Status Quo of Higher Vocational Skills Course Evaluation

Through random lectures, professional teacher interviews, student interviews, this paper conducts a survey on more than 30 professional practical skills courses of different majors of a five-year high vocational technical school in Nanjing (including construction equipment engineering technology, environmental engineering, electrical and electronic technology, engineering measurement, building intelligence engineering technology, etc.). It aims to understand the current status of professional practical skills course evaluation, including evaluation content and proportion, evaluation methods, evaluation subjects, etc. The specific content is as follows.

(1) There are mainly five forms of final grades as follows

1. Usual performance 40% (homework, laboratory report manual, usual test) + mid-term exam (theoretical test 50%, operational test 50%) + final grade (theoretical test 50%, operational test 50%). 2. Usual performance 60% (attendance, classroom discipline, practical training manual, normal operation) + final grade 40% (theoretical examination 55%, final operation grade 45%). 3. Usual performance 60% (attendance, classroom discipline, training manual, normal operation) + final grade 40% (final operation grade). 4. (Item 1 operation + item 2 operation + item 3 operation.....+training manual 1+training manual 2+...)/n.

(2) Teacher interview records

1. The course evaluation subjects are:

A. Teacher (80%)

B. Teacher-based, combined with students' self-evaluation as a supplement (14%)

C. Teacher-based, combined with student self-evaluation and mutual evaluation as a supplement (5%)

D. Teacher-based, combined with student self-evaluation, mutual evaluation and company evaluation as a supplement (1%).

2. The reason why you do not choose to let students and enterprises participate in the evaluation

A. Too much trouble, waste of time, format outweighs content (55%)

B. Students have disputes about the results of mutual evaluation and self-evaluation (40%)

C. There is no requirement, I never thought about it (5%)

3. What is your standard for scoring students' usual performance?

A. It is mainly based on operation grade, attendance, experiments, and training manual records the usual performance, final exam grade. (33%)

B. Final operation grade, attendance, hygiene (52%)

C. Attendance, homework, class performance and unit tests, students' learning attitude or other abilities are scored based on impressions (15%)

4. What is your view on the existing evaluation model for higher vocational skills operation courses?

A. The existing evaluation methods pay more attention to usual performance (25%)

B. The existing evaluation methods are mainly result evaluation, and students mainly pursue the final grade (53%)

C. The existing evaluation methods rarely involve multiple parties in the evaluation (22%).

(5) Student interview records

1. What do you think is the most important factor that affects the final evaluation of the course in the skill operation course?

A. Class attendance, usual performance (34%)

B. The degree of skill mastery, the quality of the final operation product (61%)

C. Progress in the learning process (5%)

2. What is the main learning method in the learning process of skill courses?

A. Operate and practice in accordance with the method taught by the teacher (90%)

B. Group cooperation and independent exploration (4%)

C. Discussion and exchange, mutual learning (6%)

3. When you encounter difficulties in the skill learning process, you usually

A. Proactively solve it and strive to do the best (5%)

B. Passively respond, just pass is fine, rely on luck (71%)

C. Give it up and do it casually (24%)

4. At what stage is your skill operation problem discovered?

A. The final assessment and evaluation link (73%)

B. The teacher finds it out during the operation (23%)

C. Self-discovery during operation (4%)

(6) Defects in the current evaluation of skills courses

Seen from teaching and research, the current higher vocational skill courses show the following characteristics in the content, form, implementation process, scoring aspects of the evaluation:

(1) The evaluation target is single. The purpose of the current skill course evaluation is to test the mastery of knowledge and skill learning, and the evaluation focuses more on whether it can be done and whether it meets the teacher's demonstration and standard norms. However, as for finding problems in the learning process in time, making timely adjustments, solving problems, promoting students to optimize learning, and improving teaching and learning in time; discovering the characteristics of students and fostering the development of their potential through evaluation, it is rarely or basically not considered in teaching evaluation goals.

(2) The evaluation process is separated from the teaching process. At present, teaching evaluation is mainly conducted after the end of the teaching, which is regarded as an inspection of the learning results. Through investigation, it is found that even if it is a skill operation course, as a teacher faces dozens of students, when a student shows operation problems and learning difficulties, it is not easy to point out and give instruction in time. Therefore, examining the students' learning situation through the final results is considered as the easiest way to operate, but this directly leads to missed opportunities for the best teaching, learning adjustment and improvement. Students tend

to focus on results and neglect process. In most cases, when students encounter difficulties and do not receive timely guidance and supervision, they simply give up solving and learning ideologically. Seen from the third and fourth questions of student interviews, such case is not a minority. How to guarantee the timeliness of evaluation in the teaching process is also a key problem that we should try to solve in the reform of teaching evaluation.

(3) The evaluation subject is single. When evaluating students' classroom performance, teachers are almost the only evaluators. Students often only accept questions and react passively. There is a lack of communication and discussion between teachers and students behind the scores. Even if the student evaluation link is designed, students' mutual evaluation is often a mere formality, either failing to reflect the problem or being perfunctory. The reason behind it is that on the one hand, students lack active thinking spirit, on the other hand, as teachers generally adopt teacher-led teaching method in the teaching process, students are used to passive acceptance and imitation, lacking the habit and ability of active thinking.

(4) The evaluation method is single. Evaluation mainly adopts test questions, test papers, skills operation and other standardized theoretical test questions and skill test questions. The author judges from the feedback results of the school's supervisors and lectures that there are problems such as incomplete evaluation standards, lagging behind the new technologies, new norms and new standards in the actual engineering application. At the same time, due to excessive pursuit of standardization, qualitative evaluation is ignored, and all students are measured with a unified evaluation standard. As a result, students' potential is not easy to be discovered and stimulated, and it is difficult to gain self-recognition and recognition from the study itself rather than grade. Grade directly affects the degree of students' self-affirmation.

(5) The evaluation content is single. The evaluation is mainly oriented to the knowledge and skills operational level. There is insufficient attention to the improvement and changes in emotions, attitudes, strategies, etc. shown in the learning process. Teachers more emphasize the results of knowledge and skills learning, and students emphasize more the final grade. The lack of links and in-depth communication between teachers and students is not conducive to the guidance and cultivation of students' will quality.

4. The Construction and Practice of the System of "Multiple Evaluation of the Whole Course" in Higher Vocational Education

This paper takes the "Water Supply and Drainage Installation and Commissioning" course in higher vocational education as an example, combines the characteristics of the course, focuses on the cultivation of multi-dimensional capabilities, and examines the entire learning process to build a multiple evaluation system.

4.1 Set up Multiple Evaluation Goals

The essence of teaching evaluation is a process of value judgment, which reflects the value orientation of education. The multiple evaluation goals also reflect the multiple educational values. In practice, we should establish multiple evaluation goals in the following order: 1. Adjust teaching and learning strategies; 2. Discover individual differences among students and promote their own potential; 3. Establish a sense of self-worth; 4. Test the mastery of knowledge and skill. When determining the order of teaching evaluation objectives, the feedback, adjustment, and motivation functions of evaluation should be given with priority, and the last is the function of inspection and assessment, so that evaluation is not a goal, but as a tool for learners to optimize learning.

4.2 Construct Multiple Evaluation Content

In the formulation of evaluation content, based on teaching practice and investigations of students and industry enterprises, there is need to focus on the achievement of curriculum goals, promote the cultivation of students' multi-dimensional vocational abilities, formulate contents for knowledge, skills, method ability, and social ability, set the weight according to the impact on personal development (Table 1).

Table 1: Multiple evaluation content

| First-level index | Second-level index | Evaluation standard |
|------------------------------|---|--|
| A knowledge and skills (30%) | A1 Comprehension and mastery of basic theoretical knowledge of building water supply and drainage | Theoretical test score |
| | A2 Mastery of the basic skills of building water supply and drainage graph identification and drawing | Atlas of sanitary equipment standards, building water supply and water design code |
| | A3 mastery of plumber's operating skills | The scoring standard of the skill competition, and the technical regulations for the operation of water supply and drainage pipes |
| | A4 Mastery of installation, commissioning, and acceptance skills of water supply and drainage equipment | Construction quality acceptance specifications for water supply and drainage and heating engineering, skill operation test results |
| B Method ability (30%) | B1 independent learning ability | Pre- and post-class course network learning platform behavior data statistics, classroom behavior data records in class |
| | B2 Ability to apply learning resources. | Network learning platform behavior data records, self-collecting learning resource usage |
| | B3 Ability to regulate and control learning conditions | Reasonably regulate the learning process, consciously plan personal time for independent learning, and complete course tasks |
| | B4 Analytical ability | The depth of learning experience in each lesson, ability to reflect the problems and gains in the learning process, actively think, and use appropriate methods and strategies to solve problems |
| C Social ability (40%) | C1 Standard Application Ability | design, construct and install in accordance with national and industry standards |
| | C2 Creativity and Innovation Ability | Dare to explore, dare to propose different design schemes, and dare to innovate methods |
| | C3 Communication and Collaboration Ability | Work in small groups, have a harmonious relationship, actively communicate, discuss, and share with teachers and classmates, and be willing to help each other between groups |
| | C4 Ability to face mistakes | proactively clarify respective problems, |

| | | |
|--|---------------------------------|--|
| | | actively make rectification and reformation, and strive to do the best |
| | C5 Will quality of perseverance | not give up in front of difficulties, having a sense of responsibility, and complete all tasks |

4.3 Establish Student-based Multiple Evaluation Subjects

According to the degree of participation, the evaluation subjects are: students, teachers, and enterprises (society). As the designer, organizer, observer, and recorder of evaluation, the teacher should retreat to the background, grant the evaluation power to students, encourage students to discover problems from self-evaluation and mutual evaluation, improve learning, adjust status, and force students to proactively think and learn. Enterprise evaluation serves as a supplementary means of evaluation. In the evaluation of this course, students' design drawings and finished products are sent as photos to the technical staff of Switzerland Geberit Water Supply and Drainage Company, a cooperative enterprise, to seek enterprise evaluation and better link the teaching content with the work content, keep up with the needs of the industry and enterprises, thus avoiding the separation of learning from application.

4.4 Construct Multiple Evaluation Methods for the Whole Course

Considering the characteristics of skill operation courses, we should focus on timely evaluation and feedback in class, supplement it with platform recording of behavior data before and after class, deeply integrate course teaching and evaluation, thereby gradually facilitating the fulfillment of course goals.

1. Multiple rounds of reports and on-site evaluation. The course consists of multiple sub-projects including the formulation, design, construction and installation, and acceptance of the building water supply and drainage system installation plan. For the development of each project, the classroom adopts multiple rounds of reports and on-site evaluations including learning-reporting-mutual evaluation, teacher evaluation-learning-reporting-mutual evaluation, and teacher evaluation.... to break up the whole into parts, and gradually facilitate the fulfillment of teaching goals. Teachers should give necessary explanations to the arising problems and difficulties, so that students will not give up or stop as problems cannot be dealt with in time, thus gradually achieving the course goals. Also, teachers should pay attention to different characteristics of students, and motivate students to develop their own potential.

2. Process tracking + standardized evaluation of results. In skill operation, operation process evaluation is both the key and difficult point. In this regard, in each class, "tracking evaluation" should be adopted to record the skill operation process in time, and provide materials for students' review, self-inspection, mutual evaluation and enterprise evaluation. Regarding the operation results, "standardized rating scale" can be formulated in light of the national industry standards and the scoring standards of the vocational college skills competition, with emphasis on the awareness of "standards" in engineering (Table 2).

Table 2: Process tracking + result standardization evaluation

| | Evaluation method | Evaluation subject | Tracking content |
|-------------------|--------------------------------|--------------------|--------------------------------------|
| Operation process | Process operation record sheet | Students, teachers | problems during operation, solutions |

| | | | |
|------------------|---------------------------|---------------------------------|---|
| | Video recording | Teachers, students, enterprises | Key operation steps, error-prone operation steps |
| Operation result | Standardized rating scale | Teachers, enterprises, students | Standardization degree of operation results/finished products |

3. Evaluation of electronic portfolio. The formative evaluation contents reflecting students' thinking process and learning process such as: students' homework, report situation, finished products of operation, learning experience, teacher observation and conversation records, discussion and operation process photos and videos, etc. can be made into electronic portfolios to train students' ability to make reflection and help students experience the sense of gain and accomplishment in learning. For teachers, it also provides important materials for carrying out education and teaching research and further improving teaching.

5. Conclusion

It can be seen from the formulation of the evaluation objectives in this research that more attention is given to students' invisible learning outcomes, such as higher learning enthusiasm, higher professional devotion, better learning methods, establishment of sense of self-worth in labor learning, deepened teacher-student communication, better will quality, and other changes in method, social abilities, etc. These changes cannot be evaluated by standardized tests. However, these changes can be felt from teachers' observation of students and the communication and interaction with students. The author extracts high-frequency words from the learning experience of each lesson (Figure 1). It can be seen that these unquantifiable learning outcomes such as the acquired sense of accomplishment, sense of value, sense of cooperation, awareness of norms, perseverance and other will qualities gradually grow within the students.



a. At the beginning of the mission

b. At the end of the mission

Figure 1: Word cloud of learning status

On the one hand, the subsequent research should conduct multiple rounds of practice in other practical skills courses of the construction equipment major in order to continuously improve and perfect the multiple evaluation index system; on the other hand, in the multiple rounds of practice, the survey data of teachers, students, and enterprises should be collected to thoroughly study and evaluate the weight distribution of first-level indexes and second-level indexes to provide reference for higher vocational evaluation reform.

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