Implementation and Integration of Extracurricular Practice to Improve Hands-on Skills in a Valve Inspection Course

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Abstract

Background and Purpose: To implement and assess the impact of an extracurricular practice activity on mechanical student knowledge acquisition and perception as an effective study technique in a valve inspection course. Education Activity: Students were separated to several groups and instructed to create, discuss and complete the valve inspection scheme based on the course content. Findings: Most students in the course perceived practical valve testing to be beneficial in learning valve inspection. They have more time to discuss non-confirming valve with company technician or lecturers, to improve hands-on skills as well as understandings of valve knowledge.

Keywords

Vocational Education, Valve Inspection Scheme, Test-enhanced learning.

1. Introduction

The main teaching goal of technical testing courses in higher vocational education is to cultivate students' practical hands-on ability. The purpose of engineering professional testing courses is to train students to master the necessary testing knowledge and skills in the professional field since inspection and quality judgment are indispensable links in engineering technology and guarantee of product quality. However, most of the testing courses for polytechnic students follow the traditional teaching model: teacher demonstrated operations and students were trained in the class. Because of the limited time in class, there are few independent testing and training arrangements for students. After the study, students can only reach part of the ability goals of the course, which is not conducive to the employment in quality inspection positions after student graduation.

During literature reviews, extracurricular practical testing or test-enhanced learning were found appealing, which use practice as a means to promote knowledge acquisition [1, 2]. Some researchers conducted research on improving the physical condition and metal health of college students, to develop good sport habits via extracurricular activities in Physical Education course. The result showed that it promoted students' enthusiasm in Physical Education by improving the learning effect [3, 4]. In addition, test-enhanced learning was also applied for electronic technology course. Students was trained by project-based tasks. They learned theoretical knowledge in class and practiced skills out of class [5].

However, this method was not used in valve inspection course. To our best knowledge, little paper focuses on engineering education study for valve inspection course. Therefore, we take valve inspection course as example to carry out the study. Through reasonable configuration of teaching content of inspection course, we design extracurricular training programs based on real inspection process of the enterprise. Our goal is to bridge a gap between inspection course content and professional position, to effectively promote the development of students' hands-on skills and ability.

2. Method and Education Activity Setting

2.1 Course Description

Valve inspection technology is a core course of valve design and manufacturing for higher vocational education. It is established to train students to master the professional skills of valve testing and inspection. It is mainly targeted to the positions for valve manufacturing companies, such as valve

quality inspection and valve production management. It has strong operability, practicality and applicability because its teaching content is based on the actual inspection task of the valve enterprise. The goal of the course is to provide students with a direct experience of knowledge and skills in a real or simulated teaching environment.

Due to the limitation of time in the class, the course is faced with less hours of student operation training in the actual teaching process, and it is difficult to complete the task designed with reference to the real product detection process of the enterprise.

2.2 Method and Activities Setting

The content of the Valve Inspection Technology includes blank inspection, non-destructive inspection, pressure test, flow test, fugitive emission test, low temperature test, fire resistance test, etc. The theoretical knowledge of the test standards, test equipment, test operation steps and precautions involved in the test project are all independent. The theoretical knowledge is integrated into the testing process of different types of valves by extracurricular training, and students can understand what kinds of inspections and tests industrial valves should do. Through the organic combination of in-class teaching and out-of-class training, students can integrate the learning knowledge and skills they learned. The teaching activity setting and extracurricular training are shown in Fig. 1.

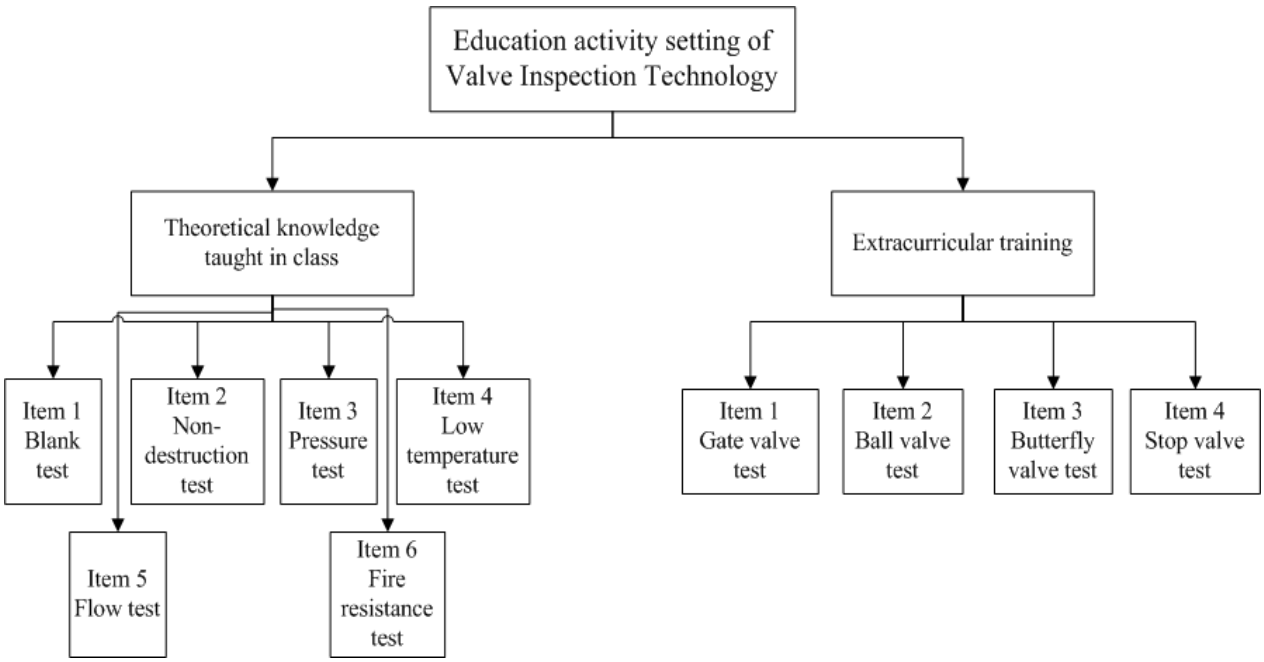

Fig. 1 Teaching activity setting and extracurricular training

3. Implementation

Students take groups as units during extra-curricular training, and each group develops testing plans for different products (such as gate valves, ball valves, butterfly valves, and other types and types of valves), including testing project arrangements, testing instrument selection, and operating process development. The test plan will be implemented after being reviewed by the instructor, and the instructor will participate in the whole process during the extra-curricular testing training. Students are always in a state of exploration and active thinking in extracurricular training, which greatly improves students' learning enthusiasm and professional qualities, and cultivates students' teamwork spirit.

The valve product Z41Y-600Lb-2" forged steel gate valve was used as the test object, with reference to the existing test equipment of the school. After students discussed and they were guided by the

instructor, the test plan of the valve was developed by the students. The test items are shown in Table 1.

Table 1 Inspection items for Z41Y-600Lb-2" forged steel gate valve

Item		Standards
Mechanics performance inspection	Yield strength	ASME A05/A 105M
	Tensile Strength	
	Reduction of area	
	Percentage of elongation	
Dimension inspection	Length	ASME B16.10
	Wall thickness of valve body	ASME B16.34
	Flange dimension	ASME B16.5
Non-destructive inspection	Penetration testing	ISO 3452
	Ultrasonic testing	ISO 4992
	Magnetic particle testing	ISO 9934
Pressure test	Top seal inspection	API598
	Shell strength test	
	High pressure seal test	
Flow test	Pressure loss measurement of straight pipe section	JB/T 5296
	Measurement of flow resistance coefficient at rated flow rate	
	Constant pressure control measurement of flow resistance coefficient	

Before the extracurricular training, the students are divided into several groups, each group with 3-4 members. The instructor numbers each group of valves (Z41Y-600Lb-2" forged steel gate valve), distributing the instruction book for each test item to the students (for example, the portion of operation guide for wall thickness detection is shown in Fig. 2).

Each group uses 8 hours of each week to take turns to test different items, and the instructor guides and corrects errors on the spot. After all the inspection items are completed, each team submits a gate valve inspection report (for example, the partial inspection report of dimensions inspection of valve body is shown in Table 2).

(1) Check the standard ASME B16.34 to determine the minimum body wall thickness of the valve under test.

(2) Operation steps of ultrasonic thickness gauge:

① Check the instrument, install the battery, and install (connect) the probe.

② For calibration, use the 4mm calibration block provided with the instrument.

③ Clean the surface of the valve body and apply proper amount of coupling agent to the measured part on the surface of the valve body.

④ Fully contact the probe with the measured part of the valve body and record the minimum reading.

(3) Compare the measurement result with the minimum value in the standard to determine whether the wall thickness dimension is acceptable.

Fig. 2 The portion of operation guide for wall thickness detection

Table 2 The partial inspection report of dimensions inspection of valve body

Inspection item		Measuring instrument	Measured dimension (unit: mm)				result	Conclusion
Length								
Wall thickness of valve body								
Flange dimension	flange outer diameter							
	flange thickness							
	Centre distance of bolt hole							
	Sealing surface diameter							

4. Results and Conclusions

Testing courses are aimed at cultivating students' testing skills, so the operation training of students in the teaching process is particularly important. Making full use of extracurricular activities in teaching to carry out practical teaching can effectively make up for the lack of training time for students in class and improve testing skills. What is more, students can simulate the enterprise product testing process during extracurricular training to complete various testing items of a certain type of product (such as Z41Y-600Lb-2" forged steel gate valve).

(1) Improve the teaching effect

By exploring new teaching methods for valve inspection courses, we study how to reasonably allocate and coordinate teaching content in and out of class. At the same time, the individual differences of students are considered in the teaching process, and the tasks in and out of class are reasonably arranged to improve the teaching effect.

(2) Improve the professional ability of teachers

Extracurricular training projects must be derived from the real test cases of the enterprise, which is conducive to deepen school-enterprise cooperation, helping teachers to pay attention to the development of new technologies in industry enterprises, and constantly learning new technologies in testing.

(3) Improve students′ professional skills and cultivate students′ team spirit

Extracurricular training is helpful for students to learn valve inspection technology completely. When some testing items are unqualified, students can use their spare time to discuss with teachers or enterprise technicians, to find out the reasons for the nonconformity, which will help students to comprehensively apply knowledge and skills such as valve design, manufacturing and testing.

In summary, the implementation of the teaching reform during Valve Inspection Technology has been supported and affirmed by most students. But some aspects need to be further improved, such as creating a more realistic inspection environment for students, and allowing more technical personnel from companies to participate in guiding students' extracurricular activities, etc. Teachers will solve the corresponding problems in the follow-up practice, to further improve the teaching effect of this course, and promote the teaching methods to other engineering testing courses in the further.

Acknowledgements

This work was funded under the special research grant scheme of higher vocational education (WZYGJzd201701) by Wenzhou Polytechnic.

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