

## **A study on matching the criteria of core courses with job requirements: a case study based on the urban rail specialisation in vocational colleges**

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**ABSTRACT:** The course criterion is the core element of professional teaching criteria. In the urban rail transit control specialisation, there is a serious gap between the course criterion and job requirements. To solve this problem, this article presents a study of four matching modes and the task-based course criteria, according to the flow of trained personnel, core course settings, organisation of the teaching content and course assessment. It is built around an investigation of job settings and ability requirements of communication signal equipment maintenance in urban rail transit control.

### INTRODUCTION

As the construction of urban transit networks is expanding widely, demand for talented staff trained in urban rail transit control has increased radically. A survey concerning the demand of urban rail professionals shows that the demand for technical talent to maintain communication signal system equipment for urban rail transit with a vocational college degree accounts for 73% of total demand.

Therefore, the construction and reform of urban rail professional courses in vocational colleges must meet relevant occupational demand. However, survey data from five metro enterprises including Wuhan Metro indicated that companies' recognition of students' professional certificate gained at school was less than 30%, revealing a serious truth that despite being the core element of specialty construction, the course criteria fail to match with the industry's job requirements.

This article analyses the actual job competency requirements of enterprises and how to match course criteria with these job requirements, and on the basis of the said analysis, presents a discussion about the methods and measures of embedding the job requirements of the rail industry into the course criteria of professional core courses, particularly within the urban rail specialisation.

### MATCHING MODE BETWEEN COURSE CRITERIA AND JOB REQUIREMENTS

The course criteria of vocational colleges refer to the teaching and guiding document for the course nature, course objectives, course content and implementation suggestions of a certain discipline [1]. The matching of course criteria and occupational standards refers to the fact that the course criteria are expected to cover the requirements of occupational standards. To realise the goal of professional training that is to adequately prepare graduates for professional careers in industry, the professional core courses in the curriculum system of vocational colleges should cultivate certain core competencies, which in turn, ensure the matching between the course criteria and the occupational requirements of industry.

The matching between the criteria of professional core courses and job requirements is manifested in the following aspects: the course orientation and design is based on the professional skills and humanistic qualities required to accomplish work tasks and to be qualified for a certain position; the content of teaching is built on the basis of classic work tasks of a certain position or the content of operational activities; the organisation and implementation of teaching is constructed based on the logic of work links and actual situation; the course assessment is conducted according to the working regulations and performance standards of a certain position. The flow of the matching mode is shown in Figure 1.

## DETAILS OF MATCHING PROFESSIONAL CORE COURSES WITH JOB REQUIREMENTS

Taking a signalman, a position that urban rail graduates engage in as an example, and observing Figure 1 as a reference, the matching of core courses with job requirements should be conducted according to the following five steps.

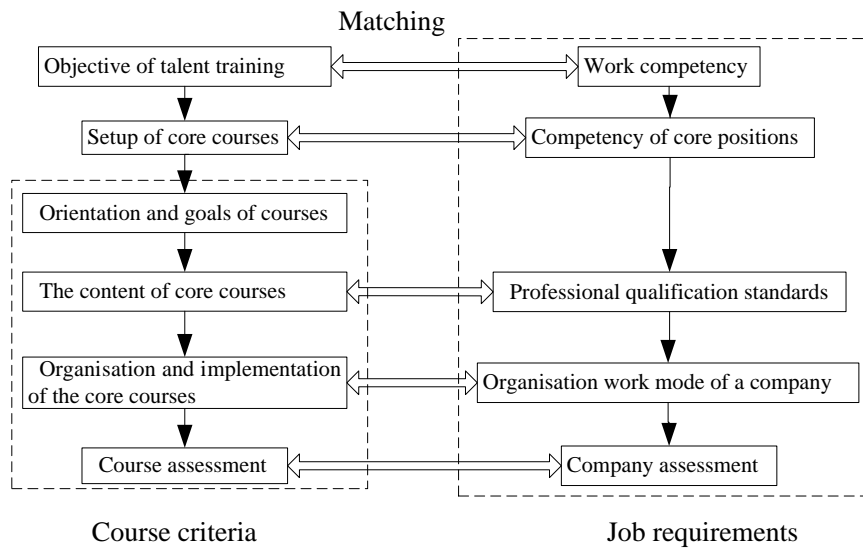


Figure 1: Matching flow between course criteria and job requirements.

### Match the Objective of Talents Training with Work Competency Requirements

After investigating rail transit companies like Wuhan Metro, Shenzhen Metro and Chongqing Metro, it can be concluded that most of the urban rail transit graduates work at the communication signal workshop in the maintenance departments of urban rail transit companies, and serve as signalmen and communication workers. As a result, it could be determined that the training goal of the specialty should be to cultivate high-quality and high-skilled professionals who can work for urban rail transit companies, and engage in the maintenance and management work of the communication signal system at the production line, mastering professional theoretical knowledge and practical skills about rail equipment maintenance, while having good professional ethics and foundation for professional career development.

### Match the Setup of Core Courses with Competencies Required in Core Positions

According to the corresponding work positions and position groups in the urban rail industry, teachers of the relevant specialisation and professionals of metro companies have analysed the work tasks and content of rail equipment maintenance in order to select the typical work tasks.

The area of action is, then, determined by concluding typical work tasks. Following the basic law of cultivating students' professional ability, the core learning field curriculum is decided by extracting, selecting and transforming relevant and basic knowledge that is common in the area of action [2]. Taking signalmen as an example [3], the correspondence relationship among professional position, typical work task and core learning field is explained (see Table 1).

After determining the courses for professional core learning areas, the goal is to cultivate the core professional abilities required for target work positions, like secondary signalman and communication worker, and thoroughly analyse the professional ability of each position to extract the knowledge and skills of basic ability, core ability and sustainable development ability to match the core courses closely with the professional ability and, as a result, design the curriculum system as follows:

- Course of Basic Professional Quality - Practical English, Applied Mathematics, Basis of Law, etc.
- Course of Basic Professional Ability - Basis and Application of Electrical Engineering, Basis and Application of Analogue Circuits, Basic and Application of Digital Circuits, etc.
- Course of Core Professional Ability - Maintenance for Basic Equipment of Rail Transit Signal, Maintenance for Automatic Control System of Train Operation, Maintenance for Automatic Control Equipment of Station Signal, Maintenance for Equipment of Data Communication System, Maintenance for Specialised Communication System of Rail Transit, Maintenance for Equipment of Wireless Trucked Communication System, Bench Worker Operation, Professional Skills Authentication and Training (for signalman or communication worker) and Post Practice.
- Course of Professional Extended Ability - Graduation Education, Engineering Construction of Railway Signal, Communication Line Construction, etc.

Table 1: The relationship between professional positions, typical work tasks and core learning fields.

Typical work task	Area of action	Core learning field
<ul style="list-style-type: none"> <li>Maintenance for signal and point machine</li> <li>Maintenance for turnout and axle counter</li> <li>Maintenance for the track circuit of the car yard</li> </ul>	Maintenance for signal infrastructure like turnout, track circuit and signal	Maintenance for infrastructure of rail transit signal
<ul style="list-style-type: none"> <li>Status test, fault diagnosis and switch of trackside equipment of ATP (automatic train protection) system</li> <li>Monitoring and maintenance of the working condition of vehicle-mounted ATP/ATO (automatic train operation) equipment</li> <li>Daily equipment inspection and message response to equipment alarms at the ATS (automatic train stop) centre and station</li> <li>System maintenance and data backup of ATC (automatic train control) software</li> </ul>	Maintenance for train control system of rail transit	Maintenance for the automatic control system of train operation
<ul style="list-style-type: none"> <li>Prepare interlocking table and check the interlocking relationship</li> <li>Equipment maintenance in computer room and electric relay room together test of electrical characteristics and trouble shooting</li> <li>Maintenance for LOW (local operator workstation), peripheral and trackside equipment together with trouble shooting</li> <li>Maintenance for SMC (system management centre) workstation and computer room equipment of Station Controller together with trouble shooting</li> </ul>	Maintenance for the signal control equipments at the station	Maintenance for the automatic signal control equipments at the station

#### Match the Course Content with Professional Qualification Standards for Signalman

The course content is determined according to the required knowledge, skills and quality of signalman, while the integrated learning situations are created according to the knowledge built on actual work tasks and work processes. The learning tasks of each learning situation are designed according to the required typical work task in the area of action and the complexity of the design follows the cognitive law of learning from easy to complex.

Taking the core course, Maintenance of Control Equipment of Station Signals as an example, corporate investigation confirms that over 90% of the equipment maintained by urban rail transit car signalmen, and signalmen on-the-spot between intercity railway station and section is computer interlocking equipment. The course, therefore, focuses on computer interlocking equipment.

The four learning situations and leaning tasks of the course are shown in Table 2, in which checking interlocking relationships in Situation 1 is a crucial means to ensure traffic safety within the station area; Situations 2 to 4 show four types of computer interlocking systems that are produced by different manufacturers and stand for three (3) typical systems. After learning the four situations, students will be able to reason beyond the facts at hand and be qualified for work positions according to a range of types of equipment.

Table 2: Learning situation and tasks of maintenance for control equipment of station signals.

No.	Learning situation	Learning tasks
1	Compiling interlocking table and checking interlocking relationship	Compiling interlocking table and checking interlocking relationship
2	Maintenance of equipment of TYJL- II and DS6-K5B computer interlocking system	Maintenance of equipment of console, relay room and computer room together with test on electrical characteristics and trouble shooting
3	Maintenance of equipment of station control	Maintenance of workstation and equipment of station control together with trouble shooting
4	Maintenance of equipment of SICAS (siemens computer aided signalling) computer interlocking system	Maintenance of LOW, interlocking cabinet and trackside and peripheral equipment together with trouble shooting

#### Match the Organisation and Implementation of Core Courses with Work Mode of Communication and Signal Workshop

The matching between the organisation and implementation of the course with corporate work mode is conducted by simulating actual work environment at school, so that students can experience the content of work in advance and their

applicability to the job can be raised. A course could be organised by focusing on a certain learning situation, fault case or project and use *work task* as a means to guide students to mastering the skill of self-study and keeping exploring [4].

The course can be conducted by letting students play different work roles according to the features of rail transit occupations. Further considering the course of Maintenance for Control Equipment of Station Signals as an example, the actual work environment can be built on simulating the daily work environment of rail transit signalmen and, thus, the work mode of communication signals workshop of underground can be introduced to a class as shown in Figure 2. Under the simulated corporate environment teaching mode, the teacher is the head of workshop, technician and station watcher. Students need to finish their tasks in groups. The head of the group is both signalman and monitor of signalmen who is in charge of five to six (5-6) signalmen played by students [5]. Through the teaching system that simulates the work of signalman at school, students will be able to engage in the real working environment and experience each post of signalman. After repeated practice playing head of the workers and signalman, students' post awareness of the job will be reinforced and they will master job knowledge and develop position competency.

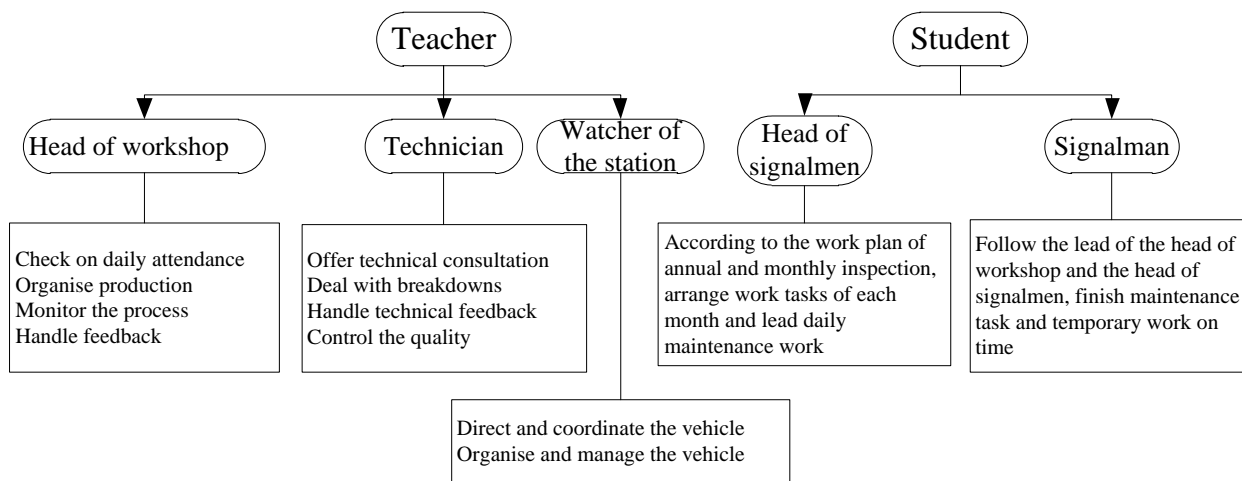


Figure 2: Simulate the organisational work mode at the communication and signal workshop.

#### Match the Course Assessment with Company Assessment

The professional ethics, professional skills, awareness of team work and safe production required to perform in the rail transit industry should be introduced to the assessment system in the urban rail specialisation. A target system and assessment criteria that assess knowledge, ability and skills should be established to evaluate students, using multiple criteria of success so that every student can have an opportunity to experience success [6]:

1. Professional ethics and awareness should be assessed on the basis of practical activities: use activities as career, guide students to experiencing it through holding lecture of underground safety alerts and alumnus reports, cultivate students' passion to their job, work attitude and responsibility by organising metro social practice during summer vacation together with communication and signal equipment maintenance skills competition.
2. Professional skills and performance should be assessed based on assorted evaluations of the learning situation: student's professional skills and performance is cultivated step by step. The assessment on rail transit professional skills and performance is completed by evaluating each learning situation; namely, learning attitude and the performance of usual assignments (work task). The assessment of the learning situation can refer to the following formula: assessment on achievement = attendance (10 points) + assessment on actual operation (25 points) + assessment on oral theory associated with practice (20 points) + assessment on the process of self-study (30 points) + others (15 points) (personal conclusion). The total achievement of students can be assessed in two ways: assessing the learning processes of students by averaging the values of several learning situations, which accounts for 70% of the total achievement; and via a final examination that reveals students' learning results, which accounts for 30% of the total achievement.
3. Assessment on the basis of job requirements and results of the certificate: in the course of building the curriculum system, an authentication of skill course should be set after the student's finish the core professional courses, and the course result will be determined by the mark of students' certification examination. The result of the authentication course of professional skills in the urban rail transit industry will be based on the results of the certificate of secondary communication worker or signalman. Failing the course will affect a student's qualification for graduation.

#### CONCLUSIONS

The development of course criteria requires that several issues are considered: the industry specification, operation standard and professional ethics, cognitive characteristics of the students of vocational colleges and the law of

occupational progress, so that achievable course criteria that meet the job requirement of urban rail industry can be produced.

The course criteria should effectively match itself with relevant professional positions to enhance students' actual working ability, enabling students to transform from learner to worker sooner, master production and technical skills, get to know the quality requirement of each service link and gain the ability to adapt to the production and service environment, as well as solve actual problems while improving moral cultivation and establishing comprehensive professional qualities.

Following the aforesaid course criteria, the comprehensive professional ability of students will have been greatly improved. Survey data have shown that companies' recognition of a student's professional certificate gained at school has increased from about 30% to nearly 73% and companies have reported that the excellence rate of graduates has increased from 60% to above 89%.

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