

## Exploration of integration teaching of graduation practice, graduation design and employment for a safety engineering specialty

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**ABSTRACT:** To improve abilities in practice and adaptation to work by students who study the safety engineering specialty, the necessity and significance of strengthening practical teaching was analysed. Also considered was the further improvement in quality of training in skills at colleges and universities. Taking the signing of employment agreements as a prerequisite, the integration teaching mode of graduation practice, graduation design and employment was proposed. This can achieve a *win-win* situation for enterprises, universities and students. The key implementation points of integration teaching were analysed. The integration teaching mode was carried out for students of the safety engineering specialty and the results analysed, which produced a good outcome. The training quality was greatly improved. This research is important as a reference to improving the practical teaching of engineering at universities.

### INTRODUCTION

In recent years, with the reform and development of higher education in China, engineering education has progressed significantly. However, the two important aspects of graduation practice and graduation design in practical teaching are still relatively weak. Practice teaching refers to the teaching of the actual practice of a discipline, e.g. a project, practical exercises or internship. Weak practice teaching leads to poor practice ability, which directly impacts training quality in universities and, thus, affects the employability of students. The professional quality of safety workers closely relate to safe production. Therefore, the innovative and practical ability of students of the safety engineering specialty, should be cultivated.

Graduation practice and graduation design are two important means by which to cultivate a student's practical ability, including the analysis and solving of problems. Surveys at the University and feedback from employers reveal problems graduates of the safety engineering specialty have. These problems are: poor practice ability and work adaptation; poor ability to analyse and solve practical problems, weak practical teaching (especially in graduation practice and graduation design), and a poor match between training targets in universities and the actual demands of employers. Noting the above problems, and learning from the experiences of teaching reform, the integration teaching mode for graduation practice, graduation design and employment of safety engineering specialty students was explored in this research [1][2].

### NECESSITY AND SIGNIFICANCE OF STRENGTHENING PRACTICE EDUCATION

At present, more than 130 universities in China have set up a safety engineering specialty, most of which started teaching this specialty within the past 10 years. Assuming two classes of the safety engineering specialty in each university and each class has 30 students, the number of safety engineering graduates a year is nearly 8,000. The number of colleges and universities with a safety engineering specialty is still increasing and, in the next few years, the number of safety engineering graduates will be more than 10,000. Consequently, in the coming years the employment outlook for graduates of the safety engineering specialty in China gradually will become more competitive.

Given the above background, it is most important to construct a new teaching mode for the safety engineering specialty, to improve training and promote the employment competitiveness of graduates. This will provide the basics for guiding the healthy development of the safety engineering specialty. Practice education is one of the weak points in higher education in China, which affects the quality of the safety engineering specialty graduates [3][4]. Aimed at the problems of graduates majoring in safety engineering, and noting the employers' demand for quality graduates with comprehensive ability, a new, changed teaching mode needs to be constructed.

The new mode must be oriented towards the improvement of the graduate's ability to adapt to employment and reflect the abilities needed by the market. In addition, the guidance and induction of students need to be strengthened, the co-operation of enterprises and universities needs to be developed, graduation practice and graduation design need to be improved and practice ability needs to be strengthened. This should help to improve the students' ability to analyse and solve practical problems, as well as the students' quality and employability. Consequently, there is great significance in constructing a new teaching mode to strengthen practice teaching.

## BACKGROUND TO INTEGRATION TEACHING

Since the 20th Century, universities outside China have begun to pay attention to developing students' practical ability, and have put forward a series of practical education theories. These include co-operative education with a focus on the students' quality, practical ability and employment competitiveness [5-8].

In recent years, the practical teaching of engineering in China, especially graduation practice and graduation design, has been the subject of much analysis and scrutiny. For example, in 2007 China's Ministry of Education published a paper entitled: *Some suggestions on improving the teaching quality by further deepening the reform of undergraduate education*, which reiterated that ...*To improve the teaching quality and students' practical ability, the universities must pay attention to practice education; and strengthen the practice teaching, including experiments, graduation practice and graduation design.* The cultivation of the practical ability of engineering students has become an important research and discussion topic at universities. To solve the problems in graduation practice, graduation design and employment, many experts and scholars suggest the integration of these parts and, therefore, construction of an integrated teaching mode of graduation practice, graduation design and employment.

Many research papers have addressed this problem, for example:

*Research and Practice on the Integration Teaching Mode of Graduation Practice, Graduation Design and Employment* [9], *Exploration of Working Practice, Graduation Design and Employment* [10], *Integration Mode of Graduation Practice, Graduation Design and Employment* [11] and *Managing Enterprise Based on Specialty, and thus Promoting the specialty Development - Exploration and Practice of Talent Training Mode of Specialty, Enterprise and Working Practice* [12].

However, not all aspects have been resolved positively. If integration teaching can be implemented successfully, the quality of training will be much improved. But, at present, a series of problems stand in the way. For example, there is a contradiction between the sharp increase in graduates and the limited practical resources available; enterprises are unwilling to accept students for practical experience.

The integration teaching mode of graduation practice, graduation design and employment relies on the graduation design topics, which have three sources:

- Enterprises that employ graduates;
- A bank of titles provided by the University, where students without a signed employment agreement can choose these design topics according to their desired employment;
- Teachers' scientific research projects, which combine teaching with scientific research.

The tutors have overall responsibility for the integration of graduation practice, graduation design and employment. The graduation design topic should be selected, when the senior student starts to look for a job in the middle of the seventh semester. By the end of the seventh semester, most students will have signed an employment agreement and, thus, the employment enterprise can be selected as the practice unit and the design object for the students. Based on signed employment agreement, seniors in the safety engineering specialty pursue the integration teaching of graduation practice, graduation design and employment, as shown in Figure 1.

To be successful, two problems needed to be solved viz.: the teaching organisation of graduation practice, graduation design and the support of the teaching organisation.

## DETAILS OF INTEGRATION TEACHING

The integration teaching mode is based on the senior students' employment. A senior student's enterprise, with which they have a signed employment agreement, will be selected for the graduation practice. The students carry out the graduation practice in the last semester and the senior students who have signed employment agreements with an enterprise must complete the graduation design during the graduation practice. Therefore, there is an integration of graduation practice, graduation design and employment.

The students select graduation design topics from the actual problems in the enterprise. The graduation practice is closely integrated with the graduation design. Under the guidance of tutors from the university and the enterprise, the

students carry out work in the field, as engineers. The students need to apply professional knowledge and basic skills to analyse and solve problems in the enterprise. Hence, the training at the University is matched to the requirements of the enterprise.

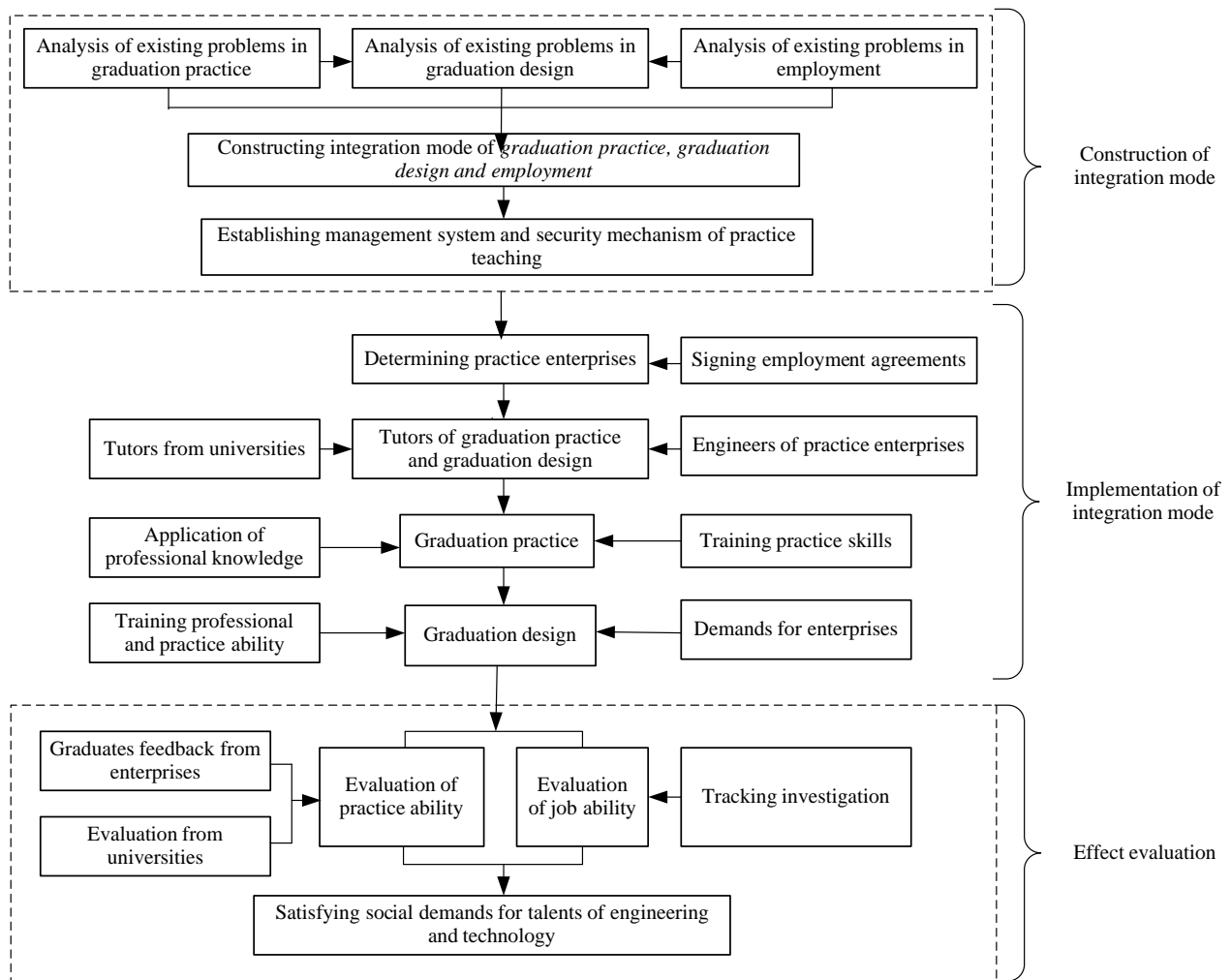


Figure 1: Integration teaching of graduation practice, graduation design and employment.

## IMPLEMENTATION OF INTEGRATION TEACHING

### Determination of Practice Enterprises

One or two enterprises are chosen to be practice enterprises. These enterprises should have the following characteristics:

- The enterprise and the University have set up a practice teaching base or there is a university enterprise co-operation agreement, which includes a practice base.
- More than five students have signed employment agreements with the enterprise.
- The enterprise has a number of practical problems that need to be solved.

When the enterprise has the above three characteristics, the integration teaching mode can be implemented.

### Determination of Tutors of Graduation Practice and Graduation Design

The tutors of graduation practice and graduation design are university and field tutors, who take overall responsibility for the graduation practice and graduation design. Two university tutors are selected from the University, and one or two engineers are selected from the enterprise to be field tutors.

### Topics and Guidance for Graduation Design

The requirements of the practice enterprises determine the field problems that need to be solved. The graduation design topics should be selected based on these problems, provided they accord with the training targets of the University.

University tutors are responsible for the development of a guidance manual for the graduation design, while field tutors are responsible for supplementary material and amendments to the manual. This manual ensures the smooth execution of the integration mode of graduation practice, graduation design and employment.

#### Tutor Responsibilities for Graduation Practice and Graduation Design

University tutors are involved in the selection of graduation design topics, development of the guidance manual, teaching of relevant theoretical knowledge, engineering design knowledge and the *how to* of solving practical problems. Field tutors are involved in daily supervision, the transference of practical knowledge, knowledge of field engineering cases and verification of field design.

### INTEGRATION TEACHING IN PRACTICE

#### Selection of the Enterprise and Students

The seniors of the safety engineering specialty at Hunan University of Science and Technology were the research objects for applying integration teaching to graduation practice, graduation design and employment. The Tanjianshan coal mine was selected as a practice enterprise. The University and the Tanjianshan coal mine have established a university-enterprise co-operation base. Many projects and much practice teaching have been implemented in the coal mine. Six graduates of the 2010 cohort in the safety engineering specialty have signed employment agreements with the Tanjianshan coal mine. In March 2014, six students were accepted by the Tanjianshan coal mine, to participate in graduation practice, as part of integration teaching.

#### Determination of Tutors and Topics

Communication with the Tanjianshan coal mine indicated that problems in the ventilation and gas drainage should be addressed urgently. Therefore, teachers with knowledge and practical experience of effluent ventilation and gas were selected as the university tutors of graduation practice and graduation design, with actual problems in the coal mine as the core of the graduation design. Given the graduation design topics, the heads of the Ventilation Department and Gas Drainage Department were selected to be field tutors; each field tutor guided three students. The students were to carry out tasks of the graduation design, as engineers.

#### Field Guidance

According to the time schedule for graduation design, the university tutors carried out the guidance related to the students' field activities in March and April, 2014. The guidance included basic theory, engineering design drawing, and the problems in the Tanjianshan coal mine. The teachers guided the students by phone, and the messaging systems Tencent QQ and WeChat. The field tutors provided targeted guidance via special lectures on ventilation and gas management, field engineering design and the underground practice. The field tutors needed to timely solve problems that arose in the graduation design, and ensure the design was practical and effective.

### EFFECT OF INTEGRATION TEACHING

To test the effect of integration teaching and the students' practical ability, the graduation practice and graduation design were qualitatively evaluated by the practice enterprise and the University. In addition, the working adaptation of the graduates in their workplace was qualitatively evaluated one year after graduation. The teaching effect of the traditional versus the integration mode was compared. The comparison was in practical ability, work-adaptation and total result. The practical ability assessment was based on feedback from the practice enterprise and from university experts. The results are shown in Table 1.

Table 1: Comparison of the teaching effect of the traditional mode and the integration mode.

	Practical ability		Working adaptation ability	Total result
	Feedback information from practice enterprises	Feedback information from university experts	Work performance one year after graduation	
Traditional mode	Good	General	Satisfied	General
Integration mode	Excellent	Excellent	Greatly satisfied	Excellent

As can be seen from Table 1, the *total result* is general in the traditional mode, but excellent in the integration mode. This shows that the integration mode has a role to play in improving the practical ability and work-adaptability of students. The integration mode achieves the following:

- Greatly improves the quality of students' graduation designs:

After the six students completed their graduation designs, they were evaluated by experts from the Ventilation Department of the Tanjianshan coal mine, who acclaimed the designs. The results show that the six students' graduation designs were successful in achieving the goal of integration teaching, i.e. the designs were practical, complete and met the practical requirements of the coal mine. In addition, in the graduation design evaluation of the 2014 graduating class, the university evaluation experts gave higher evaluations to the six integration mode students' graduation designs.

- Solves students' practice problems and improves graduation practice:

The integration mode solves the problem where the practice enterprise is unwilling to accept the students' practice. Compared with the traditional graduation practice, the integration mode implements guidance by double tutors and the graduation practice time is longer.

- Greatly improves students' practical ability:

The students carry out graduation practice and graduation design in the Tanjianshan coal mine, which creates more practical opportunities for the students. The feedback shows an increase in practical ability.

- Improves the students' adaptability to working:

The integration mode makes students familiar with the enterprise in advance, and they acquire corresponding work skills. According to the results from the work performance one year after graduation, which are shown in Table 1, their work performance was excellent and better than was other graduates'.

- Greatly improves the training quality:

The integration mode strengthens co-operation between universities and enterprises, and makes good use of the educational resources of enterprise and the University. The integration mode broadens students' knowledge, cultivates students' basic skills, and improves their ability to make use of professional knowledge. The integration mode also improves a student's abilities, viz. organisationally; in team working, language skills, social skills, analysis and practical problem-solving, as well as practical techniques.

- Technical support to enterprises and meeting the demand from enterprises for talent:

In the integration mode, students solve practical problems of enterprises. The graduates have, in advance, engaged in work exercises, adapted to the work environment, and acquired professional skills to make them competent in their jobs and satisfy the enterprises' demand for talent.

## CONCLUSIONS

The integration teaching mode of graduation practice, graduation design and employment was constructed to address problems in the teaching of safety engineering specialty courses at colleges and universities. The mode can achieve the optimisation of education resources, promote the combination of engineering education with real production processes, improve the students' practical ability and work-adaptability.

The mode implements a *zero-distance* contact between engineering education and field projects. The integration mode solves the problem, whereby employers are unwilling to accept students' practice ability. The integration mode also can provide a solution to the problems that arise with graduates' employment and enterprise talent shortage. The integration mode provides a reference for teaching engineering at university by reforming the practice teaching to improve the quality of engineering education and technical training.

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