

Teaching reform and practice of Engineering Testing Course based on innovation and entrepreneurship ability cultivation

Guanyu Li^{a,*}, Shaohua Zhang^b, Qifan Chen^c

College of Traffic Engineering, Gansu Forestry Technological College, Tianshui, Gansu, China

^a 746977825@qq.com, ^b 447692770@qq.com, ^c 1649151859@qq.com

* Guanyu Li

Abstract: As the core course of road and bridge engineering technology major, the highway engineering testing course is specialized in the curriculum system. It takes curriculum theory and practice teaching as the carrier. The relationship between innovation and entrepreneurship concept and theoretical teaching and practical teaching of engineering testing course is explored through the reconstruction of course content resources, reform of assessment methods, cultivation of teachers' innovation and entrepreneurship ability, innovation and entrepreneurship training programs and skill competitions, and the innovation and entrepreneurship ability of students is improved through curriculum reform and practice.

Keywords: Highway engineering testing, innovation entrepreneurship ability, curriculum reform

1. Introduction

On June 11, 2015, The State Council issued the Opinions on Policies and Measures to Vigorously Promote Mass Entrepreneurship and Innovation with Document Guofa [2015] No. 32. The opinion states that: Promote public entrepreneurship and innovation, is the source of power of development, is also the way of enriching people, fair of the meter, power, to promote economic structural adjustment, build a new engine development and enhance development momentum, the road of innovation driven development is of great significance, is steady growth, expanding employment and inspire millions of people wisdom and creativity. It is a major measure to promote vertical social mobility, equity and justice, and the Party and the state have placed employment first in ensuring social stability and social security. Practice ability, innovation ability and entrepreneurial potential talents is the social need, one of the most important way to cultivate the innovative entrepreneurial talent is through teaching practice, from the current our roads and Bridges engineering technology, urban rail transit engineering technology professional students employment, field work for more than 50% students and recent graduates in engineering testing industry. With the implementation of the strategy of the traffic power, more and more high to the requirement of the highway engineering quality, and highway engineering detection course as road and bridge engineering technology specialized core curriculum, the students' practice ability and innovation ability training play an important role in the process, road and bridge engineering technology specialty in higher vocational schools, showed strong professional curriculum system. In the teaching of the course, the basic professional knowledge of engineering construction, test and testing, statistics and measurement, data analysis and the means of engineering damage and nondestructive testing are combined together. The content is complex and complicated, and the practical training operation accounts for a large proportion in the course of engineering testing. This study explores the relationship between the concept of innovation and entrepreneurship and the theoretical and practical teaching of engineering testing course, aiming to improve students' innovation and entrepreneurship ability through curriculum reform^{[1]-[2]}..

2. Problems existing in the current teaching process of engineering testing course

2.1 The concept of innovation and entrepreneurship is lacking

Failed to combine creative ability training into the teaching system in the process of teaching in the traditional engineering testing, rarely reflects the innovation business idea, mainly students employment

as the guidance, cramming education, innovation idea rarely involved, theory mainly test explanation in the teaching process, and students passively accept, mainly guided by the current rules and regulations, Innovation ideas are seldom reflected. In the teaching process of practice and training, students are often only satisfied with remembering simple instrument operation process, thus neglecting the cultivation of students' innovation and entrepreneurship ability^{[3]-[4]}.

2.2 Teachers' awareness of innovation and entrepreneurship is not strong

Many professional teachers lack of practical experience, although professional teachers have stronger professional theory knowledge, but lack of practical experience, so in the experiment teaching, is the lack of theory with practice and their ability to apply the student often according to the teacher to explain in detail the steps to operate, a lack of reflection to the actual operation process, training report often copying each other, Can not reflect the cultivation of innovation and entrepreneurship ability.

2.3 The course content is not updated in time, and the course assessment method is single

Detection technology with each passing day, the development and application of nondestructive testing technology, especially engineering in the traditional teaching material the content is less, in addition, as a practical course, in the process of examination way tend to be a single, students before the exam by rote learning, also can obtain good scores, often method innovation, understanding and comprehensive application, Overwhelmed by practical engineering problems.

3. Engineering testing teaching reform and practice based on innovation and entrepreneurship ability cultivation.

3.1 Optimize theoretical and practical teaching resources

Visiting research university-enterprise cooperation enterprises, consult literature material, the new idea, new theory into the detection theory of the course teaching, the construction of curriculum standard, curriculum on teachers through the enterprise pays a return visit, the enterprise exercise and interaction with other brother institutions for discussion, in combination with the actual demand of enterprise work, abundant curriculum resources, optimization of process evaluation, constantly optimize the course content, Will new technologies, new processes and new materials into the curriculum, through the depth of cooperation with school in the factory, the new content into the curriculum construction technology, engineering, nondestructive testing, pay attention to project nondestructive testing technology in the process of teaching and practice, let students grasp the new direction of good engineering testing engineering detection task should have professional ability and technology has made the detailed description, Reclassify course skill points, combine with students' own development law, select course content and formulate specific course standards. For example, ultrasonic method, mobile phone audio frequency, elastic shock wave, radar and other technologies in engineering nondestructive testing are introduced into theoretical teaching of this course. By stimulating students' curiosity and thirst for knowledge in the frontier field of engineering nondestructive testing, students' innovative consciousness and entrepreneurial ability are trained. Deepen curriculum reform, optimize curriculum content, develop new training resources, reconstruct teaching resources according to the construction of college resource database, and build highway engineering testing course teaching resource database. The content of the resource database is shown in the table.

Table 1. Content reconstruction table of highway engineering testing resource database

| Teaching weeks time | (Project and task) | Teaching content and learning requirements |
|----------------------------|--|---|
| 1 | Highway engineering test basic knowledge/test management, test data processing | Content: test and test management, test post responsibilities, data modification. Requirements: understand test significance, job responsibilities, master data modification rules, and be able to perform data modification. |
| | Highway engineering testing basic knowledge/testing data processing, quality inspection and evaluation methods | Content: data processing method, engineering quality evaluation method. Requirements: Master the concept of standard deviation and coefficient of variation, learn to process data, understand engineering quality evaluation methods. |

| | | |
|---|--|--|
| 2 | Subgrade pavement geometric size detection/random selection of points method, size detection . | Content: random selection of points and sections using random table, pavement geometric size and thickness detection method. Requirements: random layout of sections and measuring points, subgrade pavement geometric size and thickness detection |
| | Subgrade pavement compaction degree detection/sand filling method to determine the compaction degree | Content: digging sand filling method to determine the compaction degree. Requirements: be able to measure the compactness of roadbed by digging pit and filling sand, and master the technical points. |
| 3 | Subgrade and pavement compactness detection/other methods to determine the degree of compactness, compactness evaluation | Content: ring knife method, nuclear densimeter, non-nuclear densimeter and other methods to determine the degree of compactness, compactness evaluation calculation method. Requirements: Master the evaluation method of compactness, understand other types of compactness testing methods. |
| | Inorganic bond stable material testing/unconfined compressive strength testing | Content: Unconfined compressive strength obtained test method. Requirements: Master the molding and strength testing methods of unconfined compressive strength specimens. |
| 4 | Inorganic binder stabilized materials testing/Cement and lime dose testing (EDTA) | Content: EDTA titration method for the determination of ash dose in inorganic binder stabilized materials. Requirements: master solution preparation, standard curve drawing, titration method, results analysis |
| | Subgrade pavement strength and bearing capacity test /CBR test | content: California bearing ratio test method. Requirements: Master California load ratio test method, can carry out test operation. |
| 5 | Subgrade pavement strength and bearing capacity test/bending.rebound modulus test | Content: Beckman beam test rebound bending, drop hammer type bending instrument test bending method. Requirements: master the meaning of bending, understand the difference between backman beam test rebound bending and drop weight bending instrument test dynamic bending, bending calculation. |
| | Subgrade pavement strength and bearing capacity detection/rebound modulus test | Content: test method of rebound modulus, bearing plate method, falling ball method. Requirements: calculation of springback modulus, master the method of measuring springback modulus by falling ball method. |
| 6 | Subgrade pavement performance testing /3 meter ruler, continuous flatness meter | Content: flatness definition and test method. Requirements: Master the test method of measuring flatness with 3-meter ruler and continuous flatness meter. |
| | Pavement performance detection/structure depth, pendulum friction coefficient determination | Content: manual paving sand method, pendulum friction coefficient tester determination of pavement skid resistance method. Requirements: master manual sand paving method and pendulum friction coefficient tester test method, friction coefficient calculation. |
| 7 | Pavement performance test/water seepage coefficient test | Content: asphalt pavement water seepage coefficient test method and calculation method. Requirement: Master the test method and calculation method of water seepage coefficient of asphalt pavement. |
| | Pavement performance test/pavement appearance damage test (cement, asphalt) | Content: cement pavement and asphalt pavement damage test and evaluation method. Requirements: cement and asphalt pavement damage will be evaluated. |
| 8 | Bridge and culvert foundation bearing capacity detection/standard method, site plate load test | Content: code method to calculate the bearing capacity of the foundation, site plate load test method to determine the bearing capacity of the foundation. Requirements: understand shallow plate load test method, learn to calculate the bearing capacity of foundation with standard method. |
| | Test of bearing capacity of bridge and culvert | Content: standard penetration test, dynamic penetration test, static penetration test method. |

| | | |
|----|--|---|
| | foundation/standard penetration test, dynamic penetration test, static penetration test | Requirements: Master relevant test points. |
| 9 | Foundation pile detection/acoustic transmission method to test the integrity of foundation pile | Content: Test method for measuring the integrity of foundation pile by acoustic transmission method, arrangement of acoustic tube. Requirements: Master the acoustic transmission method to determine the integrity of foundation pile, the arrangement of measuring points. |
| | Test foundation pile/low strain test foundation pile integrity | Content: Test method and test principle of low strain test of pile integrity. Requirements: Master the basic principle and test method of small strain test pile foundation. |
| 10 | Foundation pile detection/Result analysis and treatment | Contents: Waveform analysis obtained from low-strain reflected wave method of foundation pile, and defect classification of pile foundation was determined according to waveform analysis. Requirement: will judge pile foundation defect according to waveform analysis. |
| | Concrete structure material condition determination/rebound method determination of concrete strength | Content: rebound method determination of concrete strength method. Requirements: master the test method of springback method to determine the strength of concrete, calibration method, carbonation depth test method, test surface correction and strength conversion. |
| 11 | Concrete structure material condition measurement/concrete defects and cracks testing | Content: impact elastic wave method to determine concrete defects and cracks. Requirements: impact elastic wave method to determine the principle of concrete defects and cracks, master phase inversion method. |
| | Concrete structure material condition measurement/steel bar thickness and protection measurement and detection | Content: steel bar position and protection layer thickness measurement. Requirements: Master the test method of electromagnetic induction method to determine the thickness of reinforcement protective layer, |
| 12 | Bridge testing/static and static load test | Content: bridge static and static load test basic operation steps, Requirements: master static load test method of bridge beam |
| | Bridge detection/prestressed concrete structure detection | Bridge detection/prestressed concrete structure detection content: prestressed concrete structure effective prestress, grouting compactness detection method. Requirement: Master the method of reverse law and equivalent mass method to detect effective prestress and grouting compactness. |
| 13 | Tunnel detection/bolt detection | Content: bolt length, grouting density, bonding force detection. Requirements: Master elastic wave method, pull out method of detection, bolt quality method. |
| | Tunnel testing/section testing, lining structure testing | Content: tunnel lining structure, section excavation quality testing. Requirements: Master the method of detecting tunnel quality by radar and laser section meter. |

3.2 Reform the practice assessment mode

In order to improve students' practical ability and creative ability, desalination rote learning, formulate corresponding practice training teaching measures, specific measures refer to 1 + x certificate system assessment method of nondestructive testing (NDT) methods, set up the rank appraisal system, the specific way for the highway engineering test items according to the difficulty of operation, result analysis and so on will pilot projects have been set in different options and alternatives, Mainly to practice operation, analysis of results, principles of comprehensive assessment, to avoid the original rote memorization^{[5]-[6]}.

3.3 Carry out innovation and entrepreneurship training programs based on the courses

In highway engineering detection course teaching on the basis of professional education, course education, to practice training, classroom teaching as the carrier, so as to cultivate students' innovative consciousness, thinking, spirit, creative points in the mining course and organize students to take an active part in training courses of innovative entrepreneurial project, combined with actual engineering detection, to develop innovative entrepreneurial project training plan, Two of these programs were supported by the college, and one training program for innovation and entrepreneurship was approved by the National Innovation and entrepreneurship training Program. By promoting teaching and learning through competition, students have changed from passive acceptance to independent learning, and their practical ability and innovation and entrepreneurship ability have been greatly improved.

3.4 Competition promotes teaching, competition promotes learning

The highway engineering testing interest group was established. The group members were formed in the form of two-way selection in road bridge engineering technology and urban rail transit engineering technology. About 30 students from freshmen joined the group every year. Engineering inspection team in team in learning to the teachers to guide and invite enterprise technology professional training, lectures, such as the old with the new way based on the research of the practical problems and practice, cultivate the students' ability and double gen, since 18 years of engineering, the author team has three consecutive terms in the well in the national contest of college students' engineering nondestructive testing, It has won 3 first prizes, 8 second prizes and 6 third prizes in total. It has won 1 second prize in provincial engineering Nondestructive Testing Competition. One innovation and entrepreneurship project training plan has been approved by national innovation and entrepreneurship training plan. By promoting teaching and learning through competition, students have changed from passive acceptance to independent learning, and their practical ability and innovation and entrepreneurship ability have been greatly improved.

3.5 Cultivate teachers' ability of innovation and entrepreneurship

To carry out the creative education in professional education, first requires teachers to have a strong entrepreneurial concepts of innovation and the corresponding knowledge reserves, many professional education teacher is engaged in road and bridge engineering technology directly from graduate, background of a single, lack of practice, so in the usual teaching and practice guidance in the process of it's hard to do for the cultivation of students' innovative entrepreneurial ability consciously, In this case, the college organized teachers to communicate with the College of Innovation and Entrepreneurship, actively organized the teaching and research office to apply for innovation and entrepreneurship projects, and let teachers lead students to participate in innovation and entrepreneurship projects, entrepreneurship, innovation and development. Innovative entrepreneurial team of experts from the institute of innovative entrepreneurial practice in innovation of entrepreneurship education, entrepreneurship has a wealth of experience, participate in the teachers under the guidance of outside experts, consciously cultivate the creative consciousness, creative concepts learned to mining, market investigation and study method, the protection of intellectual property rights, deeply understand what is innovation entrepreneurship. So as to cultivate students' ability of innovation and entrepreneurship.

4. Conclusion

The formation of the concept of innovation and entrepreneurship is a long-term and systematic project, which should be based on professional education by optimizing the curriculum structure resources, optimizing the assessment standards, improving the innovation and entrepreneurship level of teachers, and carrying out targeted innovation and entrepreneurship training programs based on the characteristics of the curriculum, actively organizing competitions, and carrying out long-term and continuous training. In the process of practical teaching, students should be trained to combine theory with practice, improve their ability to find, analyze and solve problems, so as to enhance their ability of innovation and entrepreneurship.

Acknowledgements

Innovation and entrepreneurship project of Gansu Forestry Technological College(2020)

References

- [1] He Xuhui, YU Maohui. *Construction and Practice of Practical Ability Training System for Innovation and entrepreneurship in Applied Universities* [J]. *Journal of Hubei Second Normal University*, 201,38(07):100-104.
- [2] SUN Peina. *Reflection on The Employment Status of Students in Higher Vocational Colleges -- A Case study of Henan Vocational College of Quality Engineering* [J]. *Journal of Jinan Vocational College*, 2021(03):17-19.
- [3] Dai Shiyu, QI Pengyuan, Wang Gang. *Research on practical teaching reform of composite materials Science and Engineering specialty based on innovation and entrepreneurship ability cultivation: A case study of polymer Chemistry course* [J]. *Shandong Chemical Industry*, 201,50(03):182-183.
- [4] Wu Huabin, Wang Zhen. *Research on the cultivation mechanism of college teachers' innovation and entrepreneurship ability from the perspective of collaboration theory* [J]. *Future and development*, 2020,44(12):101-104.
- [5] Guo Zeng, Luo Shaoyun. *The task-driven model leads the curriculum reform of "Engineering Testing Technology"* [J]. *Journal of zhangjiakou vocational and technical college*, 2017,30(03):70-71.
- [6] Wu Liping, WANG. *Exploration on teaching reform of highway engineering testing technology course* [J]. *Ruixue. Heilongjiang science*, 2014,5(02):237.