

Research on Teaching Reform of Soil Science Technology and Soil Mechanics in Western Applied Undergraduate Colleges

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Abstract: The implementation of China's "One Belt, One Road" initiative and the construction of the Xinjiang Core Pilot Area have presented both opportunities and challenges for the development of applied undergraduate colleges and universities. These initiatives have also provided a catalyst for the reform of geological engineering education. The essence of building applied undergraduate institutions lies in nurturing high-quality applied talents. This requires an urgent shift in teachers' teaching methods and concepts. In the process of developing these high-quality talents, the adoption of the Outcome-Based Education (OBE) teaching philosophy is crucial. This approach, combined with blended learning that focuses on real-world engineering problems, aims to enhance student ability development as the primary goal. Establishing a progressive and dynamic evaluation system that covers the entire nurturing process is essential. There is a pressing need for a large number of highly skilled dual-role teachers, such as engineers who participate in teaching basic and professional courses, both in theory and practice. Increasing the involvement of enterprise engineers in evaluating student performance is also important. Emphasizing the entire process of practical teaching in geological engineering is vital. This focus on practical teaching aims to improve the seamless integration between theoretical instruction and hands-on practice, continually enhancing teaching to create a more systematic knowledge structure in undergraduate training.

1. Introduction

In 2014, the Ministry of Education clearly pointed out that 600 of the nearly 1,200 ordinary colleges and universities across the country would be transformed into application-oriented universities. This transformation of colleges and universities is a re-division of academic and technical skills talents, and is an inevitable trend of China's higher education development to a certain stage. Transformation and development will inevitably drive the quality of talent training to the application-oriented, practical transformation of the skills training of students and the practical

ability to serve the industry as the standard of talent training, is bound to urgently need to strengthen the connotation of the curriculum construction and enhance the practice of teaching reform, in order to achieve a seamless match between the training of talents and the needs of industrial talents.

Xinjiang is in the core area of "One Belt, One Road" construction, and behind a large number of projects, there are many opportunities and challenges of co-existence of development and geological disasters. Combined with the "14th Five-Year Plan" of the Autonomous Region and the major risks and challenges faced in the construction of projects, the implementation of the national "Belt and Road" strategy and the construction of the core experimental zone in Xinjiang have brought new development opportunities to the western colleges and universities located in the construction of applied undergraduate colleges and universities and provided impetus for the reform of the geological engineering teaching profession. The reform of geological engineering teaching profession has provided impetus. Applied talent training to improve teaching quality as the main body, to comprehensively deepen the reform as the focus, closely around the stage of key tasks and important teaching links of the outstanding problems, to carry out theoretical research and teaching reform practice, combined with engineering education certification, reform of talent training mode, teaching content and teaching methods and means is imperative.

2. Teaching Reform Direction

Engineering majors, particularly those in geological engineering, should prioritize practical teaching and skill training. These programs should focus on engineering planning, construction, and the prevention and mitigation of geological disasters such as collapses, landslides, mudslides, and mine-related issues. This focus aligns with the current national development strategy and the needs of the Xinjiang autonomous region. It ensures that geological engineering education serves both the country and the region's development needs. Furthermore, this approach is beneficial for clarifying the direction and goals of discipline construction reform, promoting the establishment and implementation of geological resources and geological engineering disciplines.

Applied undergraduate colleges and universities play a crucial role in meeting the diverse demands of society for engineering students, especially in local geological engineering. Emphasizing the skill advantages of local geological engineering professionals aids in driving the economic and social development of Xinjiang. This approach also accelerates the resolution of challenges in training localized geological engineering professionals, promoting substantive employment, and stabilizing the professional talent pool. Consequently, it provides strong talent support and contributes to the long-term sustainable development of Xinjiang's economy and society, as well as technology reserves. The integration of industry and education is vital for cultivating applied talents. Given the higher practical ability requirements in geological engineering, years of lecturing in professional courses and research on employment trends have shown that a systematic cultivation model combining industry, education, research, and application is more suitable for geological engineering majors in western applied undergraduate colleges and universities.

With the revision of geological engineering personnel training programme, higher practical ability requirements have been put forward for the required talents. In the teaching of Geology and Geotechnics and Disaster Geology courses, the teaching reform has been explored since the 2015 grade, piloting the teaching reform by lecturers to explain the basic concepts, computational fundamentals, engineers to explain the engineering examples and engineering problems, associate professors, laboratory technicians combined with the boutique course and other online resources, offline laboratory operation classes, professors to explain the practical application of engineering in the blended mode of teaching with the concept of OBE [1-3].

3. Endeavour

In alignment with the goals of applied undergraduate colleges and universities, there is a focus on enhancing the comprehensive quality of students during the teaching process, particularly in cultivating their practical abilities in the field of geological engineering. This approach is guided by the regional development strategy of the Silk Road Economic Belt's core pilot area. Specifically, it involves engaging with projects like the geological engineering construction of the China-Pakistan Economic Corridor, transport and urban infrastructure development, and the mitigation and prevention of avalanches, landslide disasters, and mine-related geological issues. Considering the unique characteristics of Xinjiang's arid zone, such as ecological fragility, vast area, and variable geological conditions, geological engineering education and research are conducted. This includes engineering geological zoning, ecological geological engineering, and evaluating the multifactorial interactions of major projects. The aim is to cultivate local geological engineering professionals and technicians who can effectively serve Xinjiang's socio-economic development needs. This includes addressing issues related to mountainous rural construction sites and ensuring the safety of people's dwellings. The focus is also on studying the coupling of flow-solid interactions and the response to power disasters during creep-surge processes. This leads to the development of a geological hazard prevention and control program, primarily focusing on mudslides, landslides, and mine-related geological hazards. To support this, internship bases are established, integrated with fields like transport, geology and mining, water conservancy, urban construction, land development, and geological disaster prevention and control.

According to the tracking survey and research on the last three geological engineering graduates, it is found that there is still a shortage of talents in geological disaster prevention and control, engineering geological survey, engineering construction planning, investigation, construction and management in the territory. At present, the existing professionals are mostly from mainland universities, local colleges and universities of specialists are still far from meeting the needs of the development of the autonomous region; on the other hand, in recent years, Xinjiang traffic, railway and water conservancy and hydropower demand for geological engineering professionals is relatively large, watering down the professional and make the students' hands-on ability is weak, the decline in the quality of the professional problem is more prominent, geological engineering professional practice teaching links, skills education needs to be Reform. Especially some comprehensive and high, relatively complex geological conditions of the work area, it is difficult to recruit geological engineering graduates, which also to a certain extent, constraints on the technological innovation and sustainable development of transport, urban construction, to a certain extent, affecting the balanced development of the economy. Therefore, to carry out research on the teaching reform of geological engineering can better adapt to the needs of social and economic development situation, cultivate geological engineering professional and technical talents who are in short supply in the autonomous region and quick to start, and better serve the needs of engineering construction and disaster prevention and mitigation nowadays [4-8].

4. Instructional design reform

In the exploration of teaching methods and the reform of teaching design for geological engineering majors, significant progress has been made across the last nine courses. The development of laboratory guidebooks and syllabi has led to teaching methods becoming more attuned to the learning needs of students, resulting in year-on-year improvements in teaching effectiveness. The focus on summarizing and thematically lecturing on examination and research findings, coupled with personalized enterprise training, has facilitated the ongoing integration of theory and practical lectures. This approach involves transitioning from explaining basic concepts

to engaging in experimental, computational, or design sessions. Centered around the student, it aims to solve real-world project problems through scientific research projects and design outcomes.

In teaching courses like Geology, Soil Mechanics, and Disaster Geology, a method of reverse design and forward implementation is applied. This approach allows for the adaptation of teaching methods to suit different classes, whether they are ordinary or non-ordinary. In ordinary classes, there is an emphasis on the depth and breadth of knowledge. Here, integrated designs are used to solve engineering problems, and there is appropriate tracking of the results of proposed calculations or the engineering effectiveness of the design scheme. This promotes the use of blended teaching methods based on the Outcome-Based Education (OBE) concept.

In non-ordinary classes, after explaining basic concepts, various exercises and practical training are immediately implemented. Before experiments, a comprehensive explanation of the experimental method is provided. In computational classes, example problems are explained after conceptual discussions. An extra points-type of sampling is used to stimulate students' enthusiasm for learning, with a gradual increase in difficulty or expansion of knowledge after comprehensive practical training. This includes experiments and practical exercises.

For these classes, after basic concepts are explained through examples, exercises are used to consolidate knowledge. Knowledge points are broken down into more detailed, manageable segments. This is followed by practical training and other practical teaching methods to enhance specialized skills. At the end of practical teaching, two rounds of stage examinations or tests are conducted after comprehensive training and expansion exercises. Comprehensive training includes indoor test operations, pit support, slope protection, mine geological environmental protection, land reclamation, and slope stability analysis and calculation in open pit mines. Expansion and upgrading primarily involve reviewing information, group program design, and solving engineering problems posed by engineers. The design programs are then evaluated by engineers for safety, stability, and applicability.

5. Teaching methods applicable to applied undergraduate colleges and universities

The key to the construction of applied undergraduate colleges and universities is for teachers to change their teaching methods and teaching concepts, cultivate high-quality applied talents, implement the OBE teaching concept in the teaching of geological engineering, pilot blended learning, take the actual engineering problems as the basis, take the cultivation of students' ability as the ultimate goal, and establish the whole process of nurturing the whole process of progressive dynamic evaluation system [12]. The enhancement of dual-teacher faculty, involving production unit engineers in the entire spectrum of basic professional courses, specialized courses, and the integration of theory and practical teaching, is crucial. This approach includes increasing the proportion of enterprise engineers in student performance evaluations. In collaboration with industry trends, the development of basic skills that college students should possess is emphasized. This development spans various internship stages: observational internships, filling internships, production internships, engineering survey internships, and graduation internships. At each stage, learning objectives are reviewed and audited by engineers.

The shift from traditional teacher and student assessment of teaching to evaluations by third-party agencies marks a significant change in the assessment process. This change is aimed at stepwise enhancement of teaching quality and promotion of employment opportunities. Additionally, through the integration of industry and education, negotiations with businesses are conducted on a small scale to "custom-tailor" the cultivation of students. This approach ensures that graduates can quickly adapt to their work roles. The practice of teaching links allows employers to select students, fostering a competitive environment. This model of collaboration and division of labor between

schools and enterprises focuses on strengthening key aspects of professional training, thereby effectively enhancing students' practical abilities.

The systematic training approach aims to equip students with the capacity to identify, analyze, and solve engineering problems, instilling in them robust engineering thinking and skills. This method not only prepares students for the immediate demands of their professional roles but also contributes to their long-term development as competent engineers, capable of adapting to and meeting the evolving needs of the industry.

Improve the seamless connection between theory and practice in the cultivation of high-quality applied talents. Experiment and theory is a dialectical unity of relationship, mutual promotion of the teaching system, geological engineering belongs to the application of engineering technology, and field practice is closely related to the graduates are required to have a strong practical ability, so the practical teaching link is the key to determine the quality of the students of this profession [13]. Practical teaching is in urgent need of "systematic training as the basis, higher-order problem solving as the goal" reform. Through the process of practical teaching from basic to professional, from simple to complex, from sensibility to rationality, systematic training of basic skills, professional courses to solve high-level, comprehensive, complex engineering geological problems as the goal, to achieve the purpose of strengthening the theoretical foundation, practical skills and the cultivation of innovation ability.

The practical teaching process includes course design, practical training, internship, practical training in off-campus internship bases and practical training. Through practical training, students can deepen their understanding and application of the basic theoretical knowledge of geology, enhance their sense of space and practical awareness for adapting to geological work, improve their logical reasoning and comprehensive judgement, enhance their ability to analyse and solve problems, and gradually transition to engineering problems and engineering construction, so as to lay a solid foundation for serving the society in the future.

6. Conclusions

Teaching process of self-study, chapter self-tests, group discussion, group reporting, peer learning, group display and other ways to improve learning efficiency, enhance learning initiative, classroom discussion after in-depth study of some issues, students access to information after class, to be the next offline class with the teacher in-depth discussion, while exercising the student's ability to self-study as well as the discovery of the problem → access to information → peer discussion → information mutual feedback → preliminary formation of the programme of the problem The problem-solving mode, in order to find problems and solve problems in subsequent courses or work, guides and cultivates students' diversified resource acquisition, digestion and absorption, and knowledge transfer and application ability. Transform the learning style, students take the initiative to consult the information to complete the design task of orientated and driven learning. Formation of the old, middle-aged and young teaching team, "passing on" mentor-apprentice mode is more conducive to the cultivation of engineering professionals, knowledge transfer and skills enhancement. Engineers evaluate the teaching effect, the real problems, and further enhance the students' professional quality of rigour, scientific prudence and carefulness.

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