

## **Dual-subject interactive teaching of the course, *Mining Pressure and Strata Control***

**Qing Ye & Weijun Wang**

Hunan University of Science and Technology  
Xiangtan, Hunan, People's Republic of China

**ABSTRACT:** Mining Pressure and Strata Control is one of the core courses for the mining engineering major and the safety engineering major, related to mining. The course has many concepts, complex mathematical formulae and theoretical deductions. In the research for this article, problems in the teaching of the course were analysed first. The traditional teaching mode was found wanting, because it does not take into account the students' individual learning abilities and subjective factors. Then, the teacher-student interactive relationship, which takes students and teachers as dual subjects, was constructed, i.e. the dual-subject interactive teaching mode was advanced. The connotation, essential factors, implementation requirements and principles of the teaching mode are discussed. Finally, this teaching mode was implemented for the Mining Pressure and Strata Control course and its teaching-learning effect evaluated, then compared with the traditional teaching mode. The results show that this teaching mode can greatly improve the teaching effect, as well as provide a reference for the teaching of other practical courses.

### **INTRODUCTION**

In recent years, the rapid development of China's mining industry has resulted in an increased demand for mining industry talent. The Chinese Government attaches great importance to the cultivation of talent in the coal industry, in order to address shortages in coal enterprises. The National Energy Administration of China issued the 12th Five Year Plan of Coal Industry Development in March, 2012, which specifies a requirement to strengthen the cultivation of technical talent in the coal industry.

Based on rock mechanics, the Mining Pressure and Strata Control course at Hunan University of Science and Technology in China, is closely related to mine exploitation and mining technology, which are very important in mining engineering [1]. In addition, it is an important specialised foundation course for the mining engineering major and the safety engineering major, related to mining. It not only connects with the frontiers of rock mechanics, but also has wide application in mining engineering. The technology of mine pressure and rock strata control is essential for the stable and healthy development of the mining industry. Therefore, the Mining Pressure and Strata Control course plays a very important role in training for the coal industry, and its content points to the necessary technical expertise required for mining and mining safety.

### **PROBLEMS IN TEACHING THE MINING PRESSURE AND STRATA CONTROL COURSE**

There are various views on teaching in China, such as the process-oriented and concept-oriented teaching modes [2–4]. These generally involve five basic implementation procedures: arousing learning motivation, reviewing prior knowledge, teaching new knowledge, consolidating and applying the knowledge, and evaluating the teaching-learning effect. These traditional teaching modes have the following advantages: first, they pay attention to systematic knowledge and the relationship between prior knowledge and new knowledge. Second, the teacher's performance is the primary focus of the teaching. Third, the students can acquire more knowledge and information from lessons.

Actually, using these traditional teaching modes reveal that they have the following disadvantages: the information exchange is one-way; the teacher monopolises the teaching process and controls the students' learning. These traditional teaching modes place the teacher and textbook at the centre of learning, and pay little attention to the students' or employers' demands.

The Mining Pressure and Strata Control course introduces rock stability in mines, and the prediction, prevention and control methods to avoid mine disasters [1]. The course is characterised by requiring advanced mechanics, being highly abstract and strongly practical. Thus, in the teaching, conflicts frequently occur in teaching and learning key points. The teaching of abstract mechanics is very difficult; and the students' learning is often confronted by masses of abstract

mechanical models and formulae. Especially in the chapters of the voussoir beam structure, plate fracture of the main roofs, key strata theory and the top coal broken mechanism, there are many formulae and deductions. Most students find these formulae and deductions difficult to understand; students with poor rock mechanics knowledge have even more difficulty. Students may not know what the teacher said in class for lack of theory and perceptual knowledge. Consequently, a direct and innovative teaching mode should be developed to help students enhance their perceptual knowledge and learning.

## DUAL-SUBJECT INTERACTIVE TEACHING MODE

How to understand the position and functions of teachers and students in the teaching process has been debated for a long time. At present, with the implementation of quality education, it is agreed that students must actively participate in teaching activities. However, this view can be extremely exaggerated, particularly for practice teaching. Here, the view of *putting students at the centre* is advocated, with the teacher occupying a subordinate position or the students are allowed to do what they want. Such an approach takes teaching from one extreme to another extreme. In fact, teaching is a bilateral activity that teachers and students participate in together. Only if the dual roles of teachers and students are fully expressed, can both groups participate fully in the teaching activities, through the interaction between teacher and student.

Dual-subject interactive teaching is a new mode, which deals with the teacher-student interaction relationship by *taking students and teachers as the subjects* in class, hence *dual-subject* [5]. In fact, this teaching mode can be explicated from two aspects of teaching and learning. The dual-subject interaction can enrich and deepen the understanding of teachers and students. In addition, in the teaching, the relationship between teachers and students is dynamic and varies with the teaching content, taught subjects, teaching forms and educational factors. Its concrete manifestation is the different roles of teachers and students in different stages of the teaching. For example, in the process of teaching and commenting, the teacher is the subject of the teaching activity and plays a central role; however, in the process of role simulation, questioning, exercises and discussion, the students are the subject of the teaching activity and play a central role [6].

Based on the teaching syllabus of the Mining Pressure and Strata Control course, the teaching content, objectives, key teaching points and difficult points were analysed. The key knowledge in the course is taught through practical cases. When the teacher is taken to be the subject, the teacher should create a real case scenario with the help of multimedia, e.g. playing videos of numerical simulation and similarity simulation experiments or displaying a teaching model.

The teacher should then lead the students to put forward a series of difficult questions and, then, provide the corresponding answers. Subsequently, the students become the subject. The students are divided into several groups and a case (model) simulation based on the students' knowledge is organised by the group leader. Finally, both the students and the teacher participate in discussions of these cases (models), express their views and propose solutions. This is how the exchange of the subject position between the teacher and the students is realised.

## ESSENTIAL FACTORS FOR DUAL-SUBJECT INTERACTIVE TEACHING

According to the connotations and characteristics of the dual-subject interactive teaching mode, the essential factors include the teaching objectives, the teaching content, student characteristics, the teaching environment, teaching-learning activities and the teaching assessment.

- The teaching objectives:

The teaching objectives are the basis of the design of teaching content; and the content and process of the course are determined by the learning objectives. According to the characteristics and requirements of the Mining Pressure and Strata Control course, the teaching objectives include the overall objectives and the unit objectives, which are specifically described in the course syllabus.

- The teaching content:

In the selection and organisation of teaching content, a modular organisation was adopted based on teaching units. Each unit is composed of several sections and each section is divided into knowledge points. The teaching content in each unit contains the learning content, the learning objectives, the key teaching points of the chapter, typical cases, capacity requirements, classes and time arrangements, and a summary. This facilitates students' independent study.

- Student characteristics:

Students are the cognitive subjects in teaching and the teaching is greatly influenced by the characteristics of the students. The class with a good atmosphere has a considerable positive influence on the psychology and behaviour of individuals. When students take the course, Mining Pressure and Strata Control, they already have taken so many courses, such as Mining Science, Surveying and Theoretical Mechanics, that they possess the theoretical

basis for studying this course. The course aims to enable students to flexibly use strata control theory in mining roof management, the design of roadway supports and the optimisation of mining methods.

In dual-subject interactive teaching, the teacher should construct a good classroom atmosphere, which can have a positive influence on students and so improve the teaching [7]. The development of the students also has an influence on the teacher. The teacher should adjust teaching methods and teaching strategy, according to the development of the students. Hence, the teacher and students develop together.

- The teaching environment:

The teaching environment is the integration of teaching resources, teaching tools and teaching strategies [8]. First, the teaching resources should be designed, which are composed of the teaching content and the related learning resources.

In the Mining Pressure and Strata Control course, the cases, animations, videos, journals and Web sites are provided as teaching resources. Information technology should be fully exploited, to produce rich information resources, broaden the teaching space, and create a new platform for teacher-student interaction, to promote students' autonomous learning and research.

Second, the teaching tools should be designed. In the teaching of Mining Pressure and Strata Control, masses of numerical simulation videos, similar simulation experiments and experimental models are provided to help students build new knowledge, deepen their understanding and improve understanding of applications. In addition, due to the advantages of information exchange and feedback, network technology should be used to provide an exchange platform for student activities, such as dialogue, consultation and discussion. This enhances teacher-student interaction, cultivates the exploration of the subject and, hence, improves the teaching.

Third, the teaching strategies should be designed. Dual-subject interactive teaching is based on integrated classroom teaching, co-operative learning, explorative learning and discussion. According to the practices and characteristics of the Mining Pressure and Strata Control course, the dual-subject interactive teaching mode should be adopted for this course.

- Teaching-learning activities:

Learning is the process to actively explore, find problems and construct understanding. In the teaching-learning activities of the Mining Pressure and Strata Control course, a problem is first presented; then, research questions and topics are put forward and, finally, various forms of exploration activity, such as case analysis, discussion and interaction, are carried out by the students. These activities enable students to acquire knowledge and skills. Moreover, in the process of discussion, communication and co-operation, students face not just declarative knowledge, but cases that will raise some new problems.

- The teaching assessment:

Teaching assessment is the most important part of the course implementation, with student performance evaluated according to a specific standard. The traditional assessment method for the Mining Pressure and Strata Control course consists of two parts; a general assessment and a final assessment. The general assessment includes a mid-term examination, attendance and homework.

The mid-term examination accounts for 20% of the total score, attendance and homework accounts for 5% each. Hence, the general assessment accounts for 30% of the total score. The final assessment is a theory examination, which accounts for 70% of the total score. The assessment scheme is shown in Table 1.

Table 1: Mining Pressure and Strata Control course teaching assessment.

Teaching mode	General assessment					Final assessment	Total score
	Mid-term examination	Class discussion	Case preparation	Attendance	Homework	Theory examination	
Traditional teaching mode	20	0	0	5	5	70	100
Dual-subject interactive teaching mode	0	10	20	5	5	60	100

With dual-subject interactive teaching, the teaching assessment method was adjusted to adapt to the characteristics of this teaching mode. First, the students participate in setting the final examination paper, which stimulates the

students' interest, and cultivates their ability to find and solve problems. Each student marks the key and difficult points at the end of each chapter. Students list examination questions based on their own key and difficult points. The teacher reviews the questions and about 30% are selected to be part of the examination paper. The final examination accounts for 60% of the total score. The mid-term examination has been dropped.

The general assessment for dual-subject interactive teaching has risen to 40%, from 30%. The general assessment includes class discussion, case preparation, attendance and homework, which account for 10%, 20%, 5%, and 5% of the total score respectively, as shown in Table 1.

#### Requirements of Dual-subject Interactive Teaching

Teachers should pay close attention to complicated problems in the production of coal in coal mines. These include rock bursts, roof support, accident management and the collection of relevant information. In addition, the teacher should select typical cases, which can improve students' experience and require theoretical exploration.

Teachers should prepare lesson plans in advance and provide them to the students. The teacher should ask students to preview the plans and encourage them to think about the subject matter. This helps students to master the material. At the end of a lesson, the teacher should tell students the content and cases for the next lesson.

The dual-subject interactive teaching mode is implemented by the following steps:

- Students are divided into several groups. The number in a group must be appropriate, so that group members can have the opportunity to communicate with each other. Therefore, students in the same dormitory generally are taken as a group. The number in a group is limited to about six.
- There should be a preliminary analysis of cases. Relevant issues should be put forward by the teacher and by the students. This can enhance the students' subject awareness, cultivate the students' initiative and improve their knowledge.
- Discussion is undertaken and the summary produced. The teacher and students discuss and think about the practical problems in the specific production environment, propose solutions, compare them with real cases, sum up experience and draw lessons from failures. This can lay a solid foundation for work in the future.
- The students' subject role should be tracked and evaluated. The different assessment standards of different processes should be determined. The student assigns himself/herself a score; then, other students assign him or her a score, the teacher comments and also assigns a score. Finally, a comprehensive score is obtained based on these scores. This enhances the fairness and transparency of the assessment.

#### PRINCIPLES OF THE DUAL-SUBJECT INTERACTIVE TEACHING MODE

In dual-subject interactive teaching, the requirements listed in the previous section should be met. But in addition, three principles also should be obeyed:

- The principle of democracy:

Dual-subject interactive teaching should strive to establish a new type of teacher-student relationship based on a modern view of students. First, the teacher and student relationship is democratic and equal. Second, students should respect their teachers, respectfully listen to the teachers and accept guidance from them. Third, the teacher should care for students and be energetic in teaching them.

- The principle of activity:

The teacher should stimulate the students' learning interest, create the opportunities and conditions for active participation and co-operative learning, encourage the students to freely speak and question, guide them to listen to and evaluate other views, and respect different opinions. In addition, the students' development should be broadened, their creativity should be developed, and their practical and innovative abilities should be cultivated.

- The principle of fairness:

The teacher should treat fairly each student, provide them with the same opportunities for development and participation, encourage excellent students to progress quickly, and allow less capable students to still progress, albeit more slowly. Through co-operative learning and individual guidance, the university should treat students in accordance with their aptitude, so as to ultimately achieve their overall improvement.

Consequently, the keys to construct and implement the dual-subject interactive teaching mode are correct educational concepts coupled with the high teaching quality of the teachers. In this way, the dual-subject roles and the student-teacher interaction in class can be realised.

## EVALUATION OF THE TEACHING

In 2014 and 2015, the dual-subject interactive teaching mode was implemented for the Mining Pressure and Strata Control course for the safety engineering major related to mining, while the traditional teaching mode was used for the same course delivered to the mining engineering major. Both courses were conducted at Hunan University of Science and Technology. The average general, final and total scores were used to compare the teaching, as shown in Figure 1.

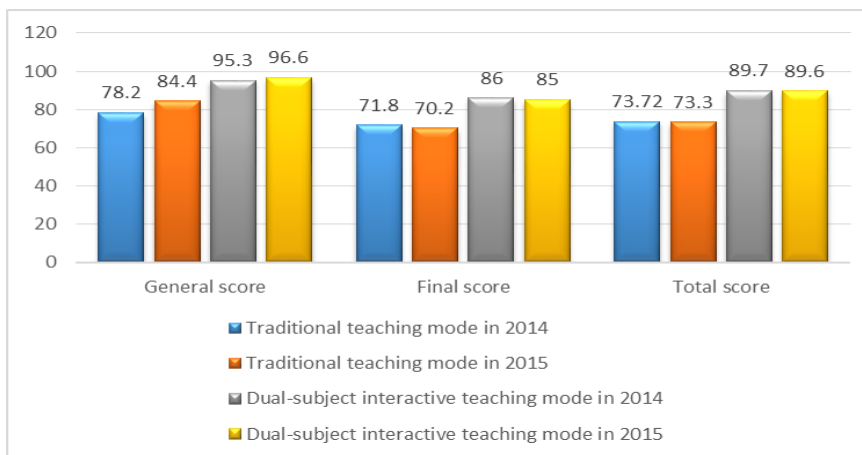


Figure 1: Comparison of scores for traditional teaching and dual-subject interactive teaching in 2014 and 2015.

Figure 1 shows that the course taught using the dual-subject interactive teaching mode achieved higher scores. Students generally believe that this teaching mode can heighten their learning interest, enhance the teacher-student interaction, improve the students' thinking ability and widen their knowledge.

## CONCLUSIONS

The dual-subject interactive teaching mode is beneficial to carrying out teaching reform. Its core is to construct the teacher-student interaction relationship, and take students and teachers as dual subjects. This enriches the education, provides a broad development of the students, and is a better basis for the professional development of the teachers.

In dual-subject interactive teaching, when the teacher is the subject, they teach the key points of a course through practical cases; when the students are the subject, they seek cases and, then, the teacher and students discuss and think about the cases and propose solutions. This teaching mode pays more attention to the students' attitude to learning and provides more opportunity for independent exploration. The teacher and students together solve the problems, so the teacher becomes the guide, who co-operates and promotes the students' learning.

The dual-subject interactive teaching includes the design of teaching objectives, the determination of teaching content, the analysis of student characteristics, the design of the teaching environment, the design of teaching-learning activities and the design of the teaching assessment.

In the Mining Pressure and Strata Control course, the dual-subject interactive teaching mode was implemented and the teaching assessment was adjusted. The results for the dual-subject interactive teaching were better than those for the traditional teaching of the same course.

## ACKNOWLEDGMENTS

This research was supported by the Construction points of Higher Education Department of Education (TS11624).

## REFERENCES

1. Qian, M.G. and Shi, P.W., *Mine Pressure and Strata Control*. Beijing: China University of Mining and Technology Press, 20-66 (2010).
2. Ye, Q., Jia, Z.Z. and Zhou, L.H., Case teaching method and its application in *Safety Management* course. *Coal Mine Safety*, **11**, 116-119 (2008).
3. Ye, Q.Y. and Qian, D.Z., Thinking and practice on the cultivation of innovative talents. *Teaching in Chinese Universities*, **2**, 12-15 (2002).
4. Gao, F. and Wu, P., Using the feedback teaching method to improve the quality of class teaching. *World Trans. on Engng. and Technol. Educ.*, **12**, **4**, 667-670 (2014).
5. Sui, Y.W., Song, J. and Sun, Z., Teaching based on the *double main bodies and interaction* and its practice. *Science and Technol. Infor.*, **1**, 201-202 (2011).

6. Zhang, J. and Chen, D.F., The relationship of *two subjects* and the learning-guidance interaction in teaching activities. *China Educ. Innov. Herald*, **4**, 129-130 (2009).
7. Deng, W.H. and Jiang, Y., The application of double subject interactive teaching method in the teaching of *Database* course. *Modern Agricultural Science and Technol.*, **24**, 337-339 (2009).
8. Lu, C.X. and Zhang, Y.H., The teaching design of *double main lines* serving the classroom teaching of *two subjects*. *Contemporary Educ. Science*, **16**, 20-26 (2010).