

## **Reform of the course, *Analysis of Disaster Accidents in Mines*, based on discussion teaching**

**Ye Qing, Zhenzhen Jia & Zhaojun Tian**

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

**ABSTRACT:** The *Analysis of Disaster Accidents in Mines* course is compulsory for the safety engineering specialty at the Hunan University of Science and Technology. It includes many concepts, theories and methods. Teaching is difficult using traditional teaching because this system ignores students' initiative and ability for individual thinking and learning. The research carried out for this study explored the features, significance, feasibility, principles, basic conditions, basic steps and key points of discussion teaching. The discussion teaching method was adopted in teaching the course and after the course; the teaching using this method was assessed by applying an anonymous questionnaire. The results show that the students' initiative was enhanced, and a good teaching outcome obtained. The students' abilities in reading, oral expression and reasoning were significantly improved. Consequently, the discussion teaching method has a role to play in improving teaching.

### INTRODUCTION

With the development of the knowledge economy in China, the requirements are much higher for teaching quality in regular institutions of higher education. In universities and colleges, research on teaching reform is carried out to study various teaching methods. Thus, many new teaching methods are explored to see if they lead to better teaching [1]. The new teaching methods include *case teaching*, the *research and exploration method* and *curriculum interest teaching*. These all take the form of classroom discussion, with a focus on questions related to the teaching content [2][3]. The classroom discussion method is also being widely applied in regular institutions of higher education in other countries; for example, in the United States and Japan, where classroom discussion is quite popular, especially, for courses that have much analysis and many discussion opportunities. Discussion in class increasingly is important in university teaching. The work reported in this article covers the use of discussion teaching for the course, *Analysis of Disaster Accidents in Mines*.

### ANALYSIS OF DISASTER ACCIDENTS IN MINES COURSE

Analysis of Disaster Accidents in Mines is a comprehensive professional course in China, which is compulsory for the safety engineering specialty related to mines. Its main content is disaster types and their occurrence in mines, accident analysis, response to accidents, disaster relief decision-making and accident prevention and treatment planning. This course enables students to understand the basic theory and knowledge of disasters and accidents in mines and to master the basic skills. They can use the knowledge and skills to solve practical problems. The course is a combination of theory with practice; consequently teachers should pay attention to cultivating students' dialectical, logical and independent thinking for accident analysis. The foundation courses include Coal Mining, Safety Management, Safety Economics and Safety Ergonomics. Moreover, it is matched with Mine Gas Prevention and Control, Mine Fire Prevention, Mine Dust Prevention, and other courses.

### SIGNIFICANCE AND FEASIBILITY OF DISCUSSION TEACHING

The discussion teaching method is a new type of interactive teaching designed to increase students' enthusiasm for acquiring knowledge [4]. The teacher assumes the leading role and the method is characterised by the use of reverse thinking and divergent thinking, with the aim of cultivating students of high quality [5]. Experience shows that discussion teaching can improve students' initiative, enhance the teaching, improve the capacity and quality of students' knowledge, as well as cultivating creativity and co-operation [6]. Therefore, it is appropriate to use discussion teaching in the Analysis of Disaster Accidents in Mines course. However, there are some preconditions and requirements for the implementation of discussion teaching, viz. the teaching content should be both procedural knowledge and non-declarative knowledge, and the discussion should increase and expand the teaching content [7].

The course aims to provide comprehensive solutions to complex practical problems. Typically, these problems do not have a single, fixed solution. Hence, students should have ability in dialectical, logical and independent thinking to solve problems. This makes the discussion teaching method suitable for this course. In recent years, with the rapid development of mining technology, there has been an increased emphasis on safety. Safety in the mines has become an important issue, attracting more attention and with more academic research being undertaken. The research carried out for this study feeds into the discussion teaching of the course. Consequently, the adoption of discussion teaching for the course is both meaningful and feasible.

#### FEATURES OF THE DISCUSSION TEACHING METHOD

In discussion teaching, the teacher guides and leads students in exploring topics [8]. The students are positively engaged by the activity, *problem-think-explore-answer* [9]. Because there are a number of students participating, concepts are explored from a variety of different points of view and aspects. A teacher, who develops a discussion around these different points of view and aspects, will stimulate interest in the students and produce a result in a learning environment that is, at the same time, autonomous, exploratory and collaborative [10]. This teaching method is *teacher-led, student-centred*. The information exchange in discussion teaching is shown in Figure 1.

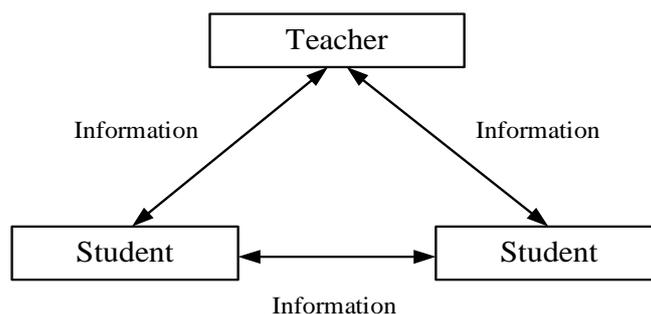


Figure 1: Information exchange in discussion teaching.

Discussion teaching has the following characteristics:

- Teachers and students immediately obtain feedback during the discussion;
- Students are enthused by the interactivity of the process;
- Oral communication and thinking of students is improved;
- Analysis and problem-solving of students is improved;
- Teachers better grasp the knowledge and capabilities of the students and so are able to adjust the teaching to improve the effectiveness of the teaching;
- Students can compare their abilities with other students, providing valuable feedback on their progress.

Consequently, the discussion teaching method is favoured in establishing a new teacher-student relationship and a new relationship between students.

#### PRINCIPLES AND BASIC CONDITIONS FOR DISCUSSION TEACHING

Based on previous experience, to achieve success using the discussion teaching method for the Analysis of Disaster Accidents in Mines course, five principles and three basic conditions must be met [11]. The five principles are:

- Student development is the goal of discussion teaching. To carry out the discussion, students must master the causes, processes, influencing factors, disaster mechanisms, prevention technology, rescue principles, and relevant laws of disasters and accidents in mines.
- Adherence to the principle of *teacher-led, student-centred*.
- Adherence to the principle of interaction.
- Adherence to the principle of discussion.
- Adherence to the principle of appropriate, moderate difficulty.

The three basic conditions include teaching materials, students and teachers [4][12]:

- The discussion teaching method and nature of the teaching material is unlikely to be suitable for all courses. Generally, the discussion teaching method can be used where the teaching content is procedural and suitable for discussion. The content is an extension of existing knowledge from previous courses. Thus, this method usually is used for practical courses. Accordingly, discussion teaching is suitable for the Analysis of Disaster Accidents in Mines course. Its contents, including the mechanism of mine disasters, the principles and procedures of accident investigations and handling, can be discussed.

- Students must break with the habit of teacher-talking and student-listening, and develop the habit of active learning and positive thinking. Students must have the courage to express their opinions and participate in discussion. They must listen to others' opinions and engage in a debate about them. Students should be articulate and able to think independently.
- Teachers must build a harmonious teacher-student relationship and create a harmonious discussion atmosphere. Teachers must rigorously prepare for a lesson and carefully plan the discussion questions. The lesson must be well organised. The teacher must understand the level of student knowledge. The teacher must be able to sum-up the discussion and deal with various problems that arise during the discussion. The teacher must be able to control the discussion tempo and direction.

## STEPS IN DISCUSSION TEACHING

Good results in discussion teaching require the following [11][13]:

- Comprehensive preparation:

Before the class, teachers should carefully design the discussion topics, based on the teaching content and informed by the teaching targets, as well as the interest and knowledge of the students. There are four aspects to consider when developing a discussion topic. First, the topic should be specific and its target clear; second, the topic should be procedural; third, the extent and difficulty of the topic should be appropriate given the knowledge and abilities of the students; fourth, the solution to the problem should enable students to acquire new skills. For example, for a discussion topic on a gas outburst disaster accident, the teacher should lead the students on discussing the accident's occurrence, development, disaster damage, prevention and control, as well as accident rescue and disposal.

- Class discussion:

Generally, discussion in class can be divided into group discussion, class discussion, and their combination. In group discussion, two- to-four adjacent students form a group to discuss a certain topic. In class discussion, all students in the class participate, guided by the teacher. In the combination of group discussion and class discussion, the group discussion is carried out first and then, as organised by the teacher, common questions and different opinions are discussed by all the students, to form a common view.

The effect of the discussion in class depends on the discussion topics and the students' involvement. The discussion topics must be appropriate and reasonable. Thus, the topics should focus on the teaching goals and be relevant to the teaching material, reflect the link between different parts of the course, accord with the thinking of the students, be inspired and interesting, and be typical and pertinent to the teaching content. The difficulty of the topics should be suitable, given the knowledge and ability of the students. The topics should be specific and enable key points to be grasped when applying knowledge.

In addition, to improve students' participation in the discussion, the teacher must observe the following precepts. First, the teacher should play a leading role and carefully design the discussion topic, as well as the steps in the discussion. Second, when a student is wrong in the discussion, the teacher should not immediately correct the student, but rather should lead other students to participate in the debate to uncover the error. Third, the teacher should adjust the timing and progress of the discussion, according to the feedback as to how the discussion is going. When the main problems have been solved, the teacher should summarise the discussion. Fourth, good students should not be allowed to monopolise the discussion, which may demoralise the other students.

- The finishing process:

When the discussion is finished, the teacher should lead the students to summarising the discussion. The summary review should be linked systematically to the related knowledge. The finishing process has the aim of deepening and strengthening the students' understanding, improving and perfecting opinions formed during the discussion and to forming a consensus. Consequently, the finishing process has a decisive role in improving the cognition and learning of the students. The finishing process has two requirements. First, the language used in the summary should be specific, refined, accurate and understandable. Second, the views should be distinct and the structure of ideas should be clear. The teacher should pay attention to the object, conditions and limitations of the discussion, so as to avoid *sloppy* thinking.

- Consolidation:

- In the consolidation process, the students analyse and solve exercises set by the teacher, so as to consolidate knowledge. The exercises can take various forms, including questions and answers, blackboard chalk-and-talk and written exercises. During this phase, the teacher will comment on and highlight common problems.

- Strengthening

The strengthening process is the process of deepening and applying the knowledge of the course, so as to cultivate the student's ability to explore and solve problems.

## DISCUSSION TEACHING METHOD IN PRACTICE

### Preparation of Discussion Topics and Questions

To introduce teaching content and stimulate students' interest, at the beginning of a lesson, two or three questions should be put forward related to the topic's most important issues. For example, an accident has happened in an enterprise and the initial reasons for the accident had been identified through investigation. The teacher could ask the students what corrective measures, training measures, management measures and penalties should be adopted from the viewpoint of safety engineering.

After a simple introduction, the students discuss the accident's causes, unsafe behaviour, unsafe equipment or environment, problems in management, industry characteristics, and so on. Because the discussion time is limited, a student's contribution should be constrained and the students guided by the teacher to think about the accident's causes, the accident's process and the accident's consequences. But, clear answers to these questions should not be provided. If there is enough time, the teacher can introduce the teaching questions for the next discussion session and allow the students to preview these questions.

### Designing Discussion Lessons

Several topics in the Analysis of Disaster Accidents in Mines course are suitable for discussion teaching. Its use should conform to the principle of being student-oriented, with freedom to participate. Based on the discussion topics set by the teacher, the students are divided into several groups, where they investigate the questions and create a PowerPoint presentation.

In the discussion lesson, a representative of each group delivers a mini-lecture for five- to-ten minutes using the PowerPoint presentation. After this, the teacher and students have an active discussion on the opinions in the mini-lecture. The total time spent by each group is about 15 minutes, so that about three groups can present in a lesson.

### The Selection of Discussion Topics

Much material related to the Analysis of Disaster Accidents in Mines course is suitable for discussion. However, taking into account the undergraduate teaching syllabus and characteristic specialty construction at Hunan University of Science and Technology, the selected discussion topics must be related to the teaching content of the course and highlight the characteristics of mining.

Usually, the teacher provides about five discussion topics, from which the students can select, although the discussion content in the final examination will be larger than a student's selection. To facilitate students' preparation for the discussion and examination, the discussion topics must be determined and announced within two weeks of the start of the semester, and cannot be modified arbitrarily.

### Evaluation of the Course

To provide direction to the students and to ensure fairness and transparency, the grade evaluation criteria for the discussion lessons is announced before the start of the course. This includes evaluation of the verbal contributions in discussion lessons. A student's ongoing score is provided before each discussion lesson. At the end of the semester, students are required to write a research report or an academic paper of more than 5,000 words in a specific format. A poor score in the discussion lessons can be made up for by the score on the research report or the academic paper, to ensure the evaluation is fair.

## ASSESSMENT AND ANALYSIS OF DISCUSSION TEACHING

The discussion teaching method was implemented in 2014 in the Analysis of Disaster Accidents in Mines course at the safety engineering specialty at Hunan University of Science and Technology. Since then, attendance has increased greatly and the teaching has been improved. Most students prepare well for the discussions, actively participating in the discussion in class, and conscientiously writing the related research report or academic paper. As a result, the students' abilities in communication, co-operation, oral expression and writing were greatly improved. Some good, innovative ideas appeared in the research reports or the academic papers, the quality of which generally was high.

After the course was over, an assessment was conducted using an anonymous questionnaire. The results show that 95% of the students approve of, or like, the discussion teaching method, 90% of the students think their abilities in scientific

research, expression and computer applications have improved and 92% of the students hope that the discussion teaching method can be used in other courses. The results are shown in Figure 2. In conclusion, the application of the discussion teaching method for the Analysis on Disaster Accidents in Mines course has achieved satisfying results.

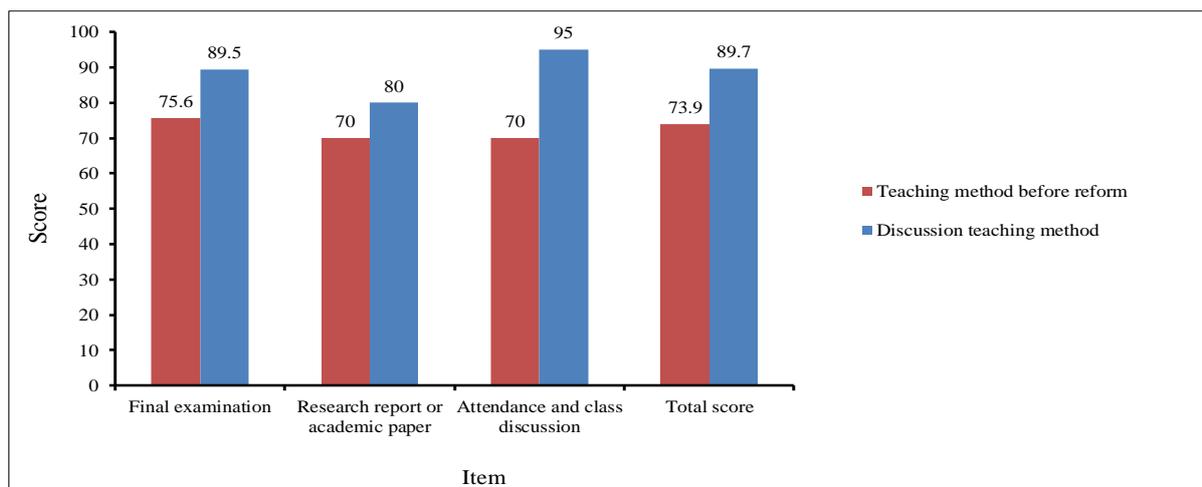


Figure 2: Comparison of results before and after the discussion teaching reform.

However, interviews in class and the investigation show that some problems still exist in the application of the discussion teaching method for the course. For example:

- The discussion lessons are so few that the issues raised by students cannot be fully discussed.
- This course takes place in the first semester of the senior year, when students have little knowledge of disaster accidents, production systems and ventilation systems in mines.
- Due to a limited number of reference topics, two or more students may choose the same topic. This is unhelpful for students' greatest increase in information and knowledge.

To solve these problems, the discussion lessons, the reference topics and discussion topics are all planned to increase.

In summary, discussion teaching can improve the students' ability to analyse and solve problems, can strengthen the interaction between teaching and learning, and can make students fully engage with the learning. Satisfying teaching results will be obtained so long as there is adequate preparation, reasonable student groupings, appropriate incentives, effective organisation and fair evaluation.

It is important to note that the total score is composed of the final examination (70% of total), the research report or academic paper (10%), and the attendance and class discussion (20%).

## CONCLUSIONS

It is feasible to use discussion teaching in the course, Analysis of Disaster Accidents in Mines. However, to improve the teaching and train professionals for mining enterprises, a definite evaluation method should be developed, reasonable discussion topics and questions designed, and the discussion lessons should be well organised. In addition, careful attention should be paid to the selection of discussion topics and the evaluation of course grades.

## ACKNOWLEDGMENTS

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

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