Construction of safety training course system under crisis theory

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Abstract. Based on the statistical analysis of coal mine accidents in 2018, it is found that there are some problems in coal mine, such as the poor effect of safety training, the poor initiative of employees in learning, and the loopholes in assessment, which are the main reasons for the illegal operation of employees. In view of the above problems, by introducing the concept of crisis education, a set of crisis education curriculum system is developed for the safety training of on-site operators in coal mining enterprises. Taking WeChat mini program as the carrier, a comprehensive safety training function module is designed, and three ports of teachers, trainees and managers are configured at the same time to meet the needs of different users. And through JS, Hbuilder and other technologies to achieve the development of WeChat mini program. This course system has certain guiding significance to optimize the training course, improve the training effect, enhance the learning enthusiasm of employees, and reduce the three violations.

1. Introduction

In coal mines and other high-risk industries, the actual working environment is complex, the safety awareness of employees is low, resulting in serious casualties. The research shows that human factors, especially the illegal operation of front-line operators, are often the direct and key causes of production safety accidents [1]-[3]. The research on coal mine safety training in China is to analyze, summarize and reflect on the existing safety education and training courses [4]-[5], and to establish a new safety mode and system by analyzing the shortcomings and problems in the current training mode and effect [6]-[7].

As one of the important ideas of crisis prevention, crisis education is not integrated into the training course as the main design concept in the current situation, and the corresponding assessment system is not strict, and the curriculum content design is unreasonable. In view of the high proportion of human caused accidents and the lack of training effect, and in combination with the blank of crisis education in occupational safety training, this paper attempts to implement the concept of crisis education into the personnel production safety training, and combine with the post operation norms of employees, to carry out the pioneering research and development of systematic crisis education courses, so as to achieve more effective reduction of personnel violations and reduce incidents Purpose of occurrence rate.

2. Analysis on the causes of accidents in coal industry

2.1 Statistics and cause analysis of coal mine accidents in 2018
With the high attention and active governance of the state, the situation of coal mine safety production in China has been generally improved (Table 1-1). However, the mining conditions are becoming more and more complex. In addition, the safety quality of coal mine employees is low, and the safety skills are insufficient. Coal mine accidents happen frequently, and the situation of safety production in China is still grim [7].

Table 1-1 statistics of coal mine accidents in recent years

| Particular year | Number of accidents | death toll (person) | Death Rate per Million-ton |
|-----------------|---------------------|---------------------|---------------------------|
| 2014            | 508                 | 931                 | 0.257                     |
| 2015            | 350                 | 588                 | 0.159                     |
| 2016            | 249                 | 528                 | 0.156                     |
| 2017            | 217                 | 375                 | 0.106                     |
| 2018            | 224                 | 333                 | 0.093                     |

According to the statistics[8][9], 224 accidents with 333 deaths occurred in coal mines nationwide in 2018, down 0.9% and 13.1% respectively. Among them, there were 17 bigger accidents with 69 deaths, down 34.6% and 33.7% respectively; there were 2 major accidents with 34 deaths, down 66.7% and 50.7% respectively; the death rate of one million tons of coal mine was 0.093, down 12.3% year on year.

As shown in Figure 1.1, Through analysis of 189 coal mine accidents collected, it is found that the majority of accidents are caused by illegal operation of employees, the proportion of human caused accidents is very high, including gas accidents 81.3%, roof accidents 78.6%, transportation accidents 93.8%, mechanical and electrical accidents 75%, As shown in Figure 1.2 (a) - (e). Although the existing coal mining enterprises have attached great importance to safety training, the proportion of human caused accidents is still high. It is imperative for the coal industry to reduce the incidence of accidents to standardize the operating habits of the staff, improve the awareness of crisis, strictly eliminate violations, and strengthen safety education and training.

2.2 Analysis of violations

In the process of work, the workers violate the rules and regulations, such as the non explosion-proof mobile phones carried by the coal miners or the illegal use of coal powder instead of water cannon mud to block the blasthole, etc., which are not in line with the safety production regulations, are regarded as violations[10]. If the illegal act directly or indirectly causes the accident, it is called the illegal act.
It is assumed that the number of violations is $n$ and the probability of violation is $p$. Then: illegal behaviors $= n \times p$; that is to say, the more illegal behaviors, the higher the accident risk rate.

2.3 How to reduce employee violations
Employees' illegal operations, includes subjective intentional and unintentional behaviors\textsuperscript{[11]}. Intentional and conscious violation of rules and regulations is caused by the actor's efforts to maximize his own interests. The main motivation is to reduce working time, work intensity and work procedures. The actor adopts more convenient and easy operation to replace the operation required by the original rules and regulations. If this behavior is not stopped in time, it will continue to drive and increase the fluke psychology of violators, induce more and more violations, and improve the risk rate. The unintentional and unconsciousness violations are generally caused by the disobeyer's ignorance and unskilled of the operating procedures. If the behavior is not improved and trained in time, the violator will mistakenly think that the behavior is a compliant operation and continue to occur.

Reasons for intentional and conscious violations:
- Reduce work procedures > Violation consequences (Accident risk);
- Training input > Violation consequences (Accident risk);

Through the analysis of the result theory, most of the current coal mine accidents are caused by the three violations of personnel operation, which reflects the problems existing in the process of safety training, insufficient learning level of coal mine staff, training course design and actual operation, loopholes in the assessment system, poor training effect and so on.

In order to solve these problems, this paper refers to 4R crisis theory, integrates crisis education into safety training courses, so as to optimize the training courses. For the problem of violation of rules and regulations, the best way to reduce the crisis is to strictly eliminate / minimize violations in the production process of high-risk industries, and do a good job in personnel safety training management. Safety education and training is an important guarantee to improve the quality of employees. Scientific and effective training mode and appropriate training content can improve the training effect and enhance the safety awareness of employees, so as to reduce the three violations.

3. Design of crisis education curriculum system

3.1 Curriculum design principles of crisis education
This paper introduces crisis education for curriculum design, which mainly follows the following key design principles:

1. The principle of mutual confirmation of crisis and Practice
   In terms of course content design, it is necessary to focus on the actual work process and the characteristics of accidents and disasters, it is required to design the training course according to the actual operation process and rules and regulations by comparing the course with the actual working process, adopting the mine clearance learning method and taking the operation process as the outline, focusing on the operation prone to illegal behaviors in the operation process, and "mine clearance" one by one.

2. Principle of understanding priority
   In the design of courses and key knowledge points, the difficulty degree of trainees' understanding is taken as the design principle. Through basic operation explanation, consequences of misoperation and accident record, in combination with various forms of text and video, the comprehensiveness of courses is enhanced so that trainees can participate in the course learning.

3.2 Outline of safety training course system for coal mine crisis education
Based on the underground production and operation training of coal mining, the form of shaft as the basis, and the comprehensive development mode as an example, the training course outline is designed,
mainly including the preparation, mining process and assessment content design. The specific design is shown in Figure 2.1.

![Figure 2.1 curriculum outline of underground coal mining combined with crisis education](image)

3.3 Assessment standard design
Assessment standard is an important basis to determine the training effect. This course design combines post skill training with safety training, combines safety knowledge training with practical training, verifies each other and deepens understanding. As shown in Table 2-1.

| Qualification requirements | Examination contents | Assessment method |
|---------------------------|----------------------|------------------|
| Part I: Risk behaviors due to violation of regulations | 1. Risk behaviors due to violation of regulations in the operation of the post over the years; 2. Judge the correctness of behavior and supplement correct operation. | A: Short Answer Questions |
| accuracy 100% | | |
| Part II: Violation behavior | 1. Consequences of dangerous acts; 2. Choose the consequences of the risk causing act. | B: Choice question |
| accuracy 80% | | |
| Part III: Basic regulations and post knowledge | 1. Violation behaviors easy to occur in this post; 2. Judge the correctness and consequences of the case behavior. | Choice question: Judgement question |
| accuracy 80% | | |
| | Basic laws and regulations and post knowledge | Choice question: fill-in-the-blanks exercise |

4. Crisis education curriculum system carrier
This course adopts the operation mode of wechat mini program (Internet tools) as the main part and traditional classroom as the auxiliary (books, multimedia).

4.1 Status and advantages of WeChat Mini Program
In 2017, wechat mini program was officially launched. Based on wechat's huge number of users, wide application scope and software stability, wechat mini program are rapidly applied in various industries with its unique advantages. In terms of education and learning, wechat mini program bring convenience to learning due to their convenience, easy sharing, cross platform, support of various formats of data and other characteristics, but also strengthen the communication between teachers and students, students, and obtain good learning effect[12]. Therefore, it has been paid attention to and popularized in the field of adult education, such as vocational education and skill training, and has obtained a good evaluation in the market of adult education, vocational education and skill training[13].
4.2 Analysis of the advantages of WeChat Mini Program Model to Vocational Education

In the field of vocational training and skill training, people who participate in learning are usually adults who enter into social work. They generally have problems such as low learning efficiency, memory decline, more trivia, lack of energy, poor self driving force, and low acceptance of conceptual content.

Compared with the traditional teacher classroom teaching mode, the course system with wechat mini program as the carrier, on the basis of the original face-to-face teaching, added wechat mini program as the auxiliary software, comprehensively combing the knowledge system, learning materials, preview, learning progress, testing and knowledge review of the training course. From the perspective of students, it provides a better learning platform, a comprehensive multi-level knowledge system and a variety of learning modes (pictures, videos, animations, scene restoration, etc.), which can not only make use of fragmented learning time, but also facilitate the acquisition and self-examination of learning materials; From the perspective of teachers, it can make teachers more aware of the learning progress, learning efficiency and effect of participants, facilitate problem feedback, key problem record, course resource sharing, etc; From the perspective of the manager, it is easier to monitor the learning status and effect of the trainees, as well as supervise, optimize and feedback the overall training courses [14].

4.3 Design of safety production information training system for coal mine enterprises

From the perspective of users, according to the principle of role demand analysis, wechat mini program design is divided into three ports: teacher end, student end and manager end, which are connected with each other. As shown in Figure 3.1(a), the course training system is mainly divided into four modules: course resources, Thematic training, massive item bank and my settings.

The course resource module includes the detailed introduction of knowledge content, practical operation standard video and summary of accident consequences caused by three violations. The module mainly provides systematic and comprehensive learning resources for employees, especially for new employees who lack knowledge.

The Thematic training module is to assist the training process according to the actual training needs of the unit. It can supervise the learning status and follow up the learning progress. It can also guide the students to take the initiative to learn through the incentive model. Through the function of the module, it can promote learning and improve the effect.

The massive item bank module is mainly to test and review the training results and test the self-learning effect. The trainees can carry out exercises and simulation tests according to their own needs, or classify and sort out the hesitant or wrong questions through my collection and wrong questions module, so as to facilitate the key memory and learning.

My settings are mainly to provide personal information filling and modification, record the training, receive information from teachers and administrators, etc.

![Diagram](image)

Figure 3.1

(a) Information training system of safety production in Coal Mine Enterprises  
(b) Wechat mini program code

The training course carrier, wechat mini program, is a front-end application framework uni app developed based on vue.js. It is developed in the hbuilder development tool, compiled into wechat...
mini program language by running, and released by wechat developer tool. The two-dimensional code of wechat mini program is shown in Figure 3.1(b), and the interface effect of wechat mini program after completion is shown in Figure 3.2.

![Figure 3.2](image)

Considering that there are more migrant workers and basic operators in high-risk industries with lower education level, because these personnel are not proficient in the use of Internet tools and have low learning initiative, traditional classroom is used to ensure the effectiveness and acceptability of training. Due to the correspondence between illegal behaviors and accidents, it needs more convenient means. Therefore, wechat mini program preferred as the carrier of course materials. Trainees can link the risks, penalties, hidden dangers and other problems caused by illegal behaviors in the operation specifications through hyperlink in the applet, which is helpful to deepen memory, including online video training for lecturers Training, training effect online assessment, greatly improve the efficiency of training, reduce training costs.

5. Conclusion

(1) By analyzing the causes of some coal mine accidents in 2018, it is concluded that at present, the human factor accident rate of coal mines in China is high, and the three violations frequently occur. Inadequate safety training and supervision will not only lead to unsafe behaviors of employees, but also lead to inadequate understanding of the consequences of violations, resulting in accident risks.

(2) Aiming at the problem of insufficient training effect, combined with the blank of crisis education in Vocational safety training, this paper puts crisis education into personnel production safety training, and develops a set of crisis education curriculum system combined with cases.

(3) Taking wechat mini program as the carrier, a comprehensive functional module of coal mine safety training course system is designed, and three ports of teachers, trainees and administrators are developed to meet the needs of enterprise training, and through JS, hbuilder and other small programs to achieve the development of wechat mini program.

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