Instability of rock slope with different joints and multimedia politics teaching in plain area

Jingjing Qin¹ · Ziyang Li²

Received: 2 June 2021 / Accepted: 2 August 2021 / Published online: 20 August 2021
© Saudi Society for Geosciences 2021

Abstract
Multimedia technology is widely used in various fields around the world. In recent years, it has also entered teaching classrooms, expounding theories and opinions with its powerful information and sensory stimulation, enriching learning resources, affecting old learning models, and bringing new ideas. Due to a strong sense of time, current affairs and policy courses require multimedia technology to simplify teaching. Current affairs and politics class is an important part of political education. It integrates important current affairs at home and abroad, such as politics, economy, and culture, into the ideological and political theory of textbooks, and teaches them in the form of classroom activities. Moreover, this way of teaching can also stimulate students’ interest in learning to a certain extent. Correctly assessing the impact of rock thickness on the instability mechanism of bedding cliffs is an urgent problem for the mining industry. This article is based on early research and follows the technical route of “researched geological exploration, theory, and numerical simulation”. Based on the proper division of bedrock slope types, this paper systematically studies the influence of rock thickness on bedrock slopes and systematically studied the instability mechanism, failure process, and stability grade of three types of rock slopes. By creating a mechanical calculation model to derive the formula for calculating the stability, the completion of this work has a certain reference value for solving the problem of rock slope expansion in mining construction.

Keywords Joint form · Rock slope instability · Plain area · Multimedia political teaching

Introduction
Politics and current education choose internal and external political, economic, and cultural information suitable for students and combine political theory to educate students, so that students can understand domestic and foreign situations and events in a timely and rational manner and can analyze objectively. Training on current issues has also solved the problems of textbook backlogs, boring content and unclear understanding, and low student enthusiasm for learning (Abrams et al. 1994). Introduce current affairs to students, organically combine theoretical knowledge and relevant information in the classroom to master the ability to objectively analyze problems, and further enhance the sense of responsibility and mission related to the country and society (Al-Taj 2000). Slope refers to all geological bodies on the earth’s surface that tend to extend into open space and is a landform that is widely distributed on the surface. Slopes include natural and artificial slopes. Natural long-term development is the formation of natural slopes, while artificial slopes are created by rebuilding the site during construction to meet the needs of life and production (Atallah and Al-Taj 2004). With the steady development of China’s economy, especially with the implementation of the Western Development Strategy, the number of infrastructure construction, energy development, and other projects has further increased, and there are more and more problems related to slope stability (Barberi et al. 1980). More importantly, landslides and landslides caused by slope instability are very serious geological natural disasters (Ben-Avraham et al. 1994). They often damage buildings, block traffic and rivers, damage the environment and mechanical engineering,
cause huge economic and human losses (Ben-Avraham et al. 2005).

Geographical environment and social culture of the plain area

It is located in the western part of the basin of a certain place. Broadly speaking, there are certain steps between A mountain, B mountain, and C mountain, from a bridge on mountain D in the south to land A, land B, land C, and land A in the north. In a narrow sense, plain A only refers to land D, land E, land F, land G, county H, and land I in Qiaoxia Mountain. Plain B is about 200 km long, 40 to 70 km wide, and covers an area of about 7340 km² (Bender 1974). It forms most of plain A. The research object of this article is mainly at a certain level in a strict sense. A certain plain has a relatively flat terrain, a loose surface, and a good agricultural structure. It is the most fertile soil in Sichuan. The basin has a subtropical monsoon climate with wet currents, four different seasons, no hot weather in summer, and no severe winter suitable for plant growth and human habitation (Diabat 2005). Since ancient times, it has been one of the birthplaces of early human civilization with a long history. A certain level of social culture is the result of the joint effect of social economy and regional culture and has its unique and remarkable characteristics (Fossen 2016).

Deeply influenced by Taoist culture, the world view of harmony between man and nature

Taoism promotes natural thinking, dialectics, and atheism, which leads to a certain degree of tacit understanding of inaction and the prevalence of resistance struggles (Galli 1999). It claims that Taoism is natural, omnipotent, inactive in nature, and living in harmony with nature. Therefore, Shushu did not take the problem strictly, did not boldly innovate, and did not do anything to connect with other things (Garfunkel 1981) (Hardy et al. 2010). This has an important impact on the life and perception of residents at a certain level and plays an important role in the concept of harmony between man and nature (Khalil 1997).

A simple farming culture where people and nature live in harmony

Around the end of the Neolithic age 4500 years ago, human settlements and agricultural civilizations based mainly on rice plants appeared to a certain extent. During the reign of King Qin Chaoxiang in 256 AD, Governor Shu Libing led the construction of a water conservancy project in a certain area (Klinger et al. 2000). The design of the water protection project took into account the local conditions and combined the natural topography. Instead, the traditional river blocking method was used to control the water source. Regardless of whether there is protection of water resources, a highly developed agricultural civilization has been created to a certain extent (Lefevre et al. 2018).

Inclusive immigration culture of multi-ethnic and multi-regional integration

Due to a certain number of immigrants and immigration activities at a certain level in different periods between the North and the South, the development process of the Shu culture is compatible with the characteristics of the North and South cultures and has a strong tolerance. In addition, there are many ethnic groups at a certain level, and the integration of minority culture and Shu culture makes Shu culture more unique and attractive. As the Shu people are geographically distant from politics and human society, Shu advocates the return of freedom and natural individuality (Maercklin et al. 2005). The residential buildings in a certain place are more exquisite than the official residences in the north. It is mainly practical, tightly integrated with the terrain, and does not follow the old methods. The architectural form is light and flexible, expressing the nature and tranquility of the lifestyle. In addition, the location of the water net and the cultivated land are designed according to the situation, not limited by the shape, thus creating a unique “field scattering” pattern on a given plain (Masri 1997).

The characteristics of multimedia teaching

Lively image of knowledge transfer

The teacher writing on the blackboard is an essential part of the learning process, and the students just stand in front of the blackboard. The multimedia course can present the abstract and boring content of the course with vivid pictures and text and stimulate students’ interest in learning (Masson et al. 2015). For the teacher, he can get twice the result with half the effort.

Active classroom atmosphere

This is the biggest function of using multimedia learning-establishing situational learning, creating a relaxed and active learning environment, reducing the pressure on students in the classroom and improving teacher-student interaction (Niemi et al. 2001).

Outstanding teaching content, broaden students’ horizons

Compared with traditional teaching, multimedia teaching has a large amount of teaching content, and the main difficulties of teaching are not easy to highlight. According to the class time,
teachers can add new knowledge and broaden students’ horizons (Nuriel et al. 2017).

**Principles of multimedia teaching**

The principle of subsidiarity

Regardless of the degree of development of modern multimedia technology, they can not only replace the dominant position of teachers in the education process, but only be used as a teaching aid. The visual and intuitive characteristics of multimedia learning can not only help learners understand and remember knowledge, but also achieve unexpected results in the integration of key and complex knowledge (Ortner et al. 2002).

Principle of applicability

The content of multimedia courses in modern subjects is rich and diverse, which not only saves the time for teachers to prepare lessons, but also enriches the teaching content of teachers. However, the course content can only choose one form, and the learning level of students varies greatly (Powell 1988). Some teachers directly use unmodified course software without considering students’ enrollment, which makes it difficult to obtain good classroom teaching effects. As the course materials are separate, they cannot be tailored to each student’s situation. Therefore, when choosing textbooks, teachers should choose textbooks that suit their teaching content. It is important for students to participate in the classroom, but we need to ensure the consistency of knowledge and the applicability of multimedia software content.

Interactivity principle

The principle of interactivity is the embodiment of the essence of multimedia learning. Students must actively participate in multimedia courses, fully demonstrate their main body status, and achieve the perfect combination of man-machine dialog. “Teachers can analyze various specific situations and specific problems to find the most effective way of teacher-student interaction. Many teachers ignore this in teaching and blindly use multimedia software to exchange knowledge and interact with students. As a result, the effect of learning in a multimedia classroom is completely lost, so one-way teaching is no different from the traditional “cracking duck” learning model (Sharon et al. 2020). Therefore, in order to reflect the interactive nature of multimedia teaching, teachers must properly raise some problems when preparing multimedia courses. Before reviewing the answers, students should be given the opportunity to reflect and discuss. At the same time, the course content can guide students through customizing multiple step-by-step prompts, helping students answer questions and improve their active learning skills (Stern and Johnson 2010).

Benefit principle

Compared with traditional teaching, multimedia teaching can maximize learning efficiency. In real teaching, teachers cannot specifically follow the modernization of teaching methods. When using multimedia courses, it is very important to observe the principle of efficiency. The use of course materials must comply with the teaching rules, and the correct use of multimedia learning can achieve the expected learning goals, improve learning efficiency, and achieve the best learning results.

Materials and methods

Model introduction and parameter selection

The mechanical response of this micro-contact model is divided into three parts: normal direction, tangent direction, and anti-rotation direction, as shown in Fig. 1.

Through simulating internal experiments, the relationship between the microscopic parameters and the macroscopic mechanical parameters is obtained. The uniaxial compression and Brazilian delamination test are simulated under the microscope to determine the bond strength parameters, and the elastic modulus of the bond is changed to simulate and maintain bond strength. In order to determine the elastic modulus of carbonizing, a biaxial compression test is simulated to find out the relationship between the internal friction angle and the friction coefficient of the particles, the anti-rotation coefficient and the elastic modulus of carbonizing, and obtain the corresponding microscopic parameters. The final determination of the microscopic parameters of the model is shown in Table 1, and the corresponding macroscopic and mechanical parameters of limestone are shown in Table 2, and the absolute value of the relative error is controlled within 10%.

Geological geometry model and corresponding stability calculation formula

Currently, rock and soil mechanics slope models mainly include single sliding surface models and polyline sliding surface models with vertical cracks. Based on the combination of double-joint spaces, the rock-soil mechanical slope models with two sets of stepped structural planes are divided into three types. The horizontal projection ratio $Q = 1$ is used as the differential point, where $Q = A/B$, please refer to Fig. 2.

The formula for calculating the safety factor using the transfer factor method is as Formula 1–7:
When the safety factor must be calculated for each model, insert the corresponding reinforced weight formula into the transfer factor method to obtain safety. In Formula 1–7, \( F \) is the safety factor, \( \alpha \) and \( \beta \) are the inclination angles of the slightly inclined and steep surface of the structure, \( c_1 \) and \( c_2 \) are the adhesion of the slightly inclined and steep surface of the structure, and \( \phi_1 \) and \( \phi_2 \) are inclined relative to the friction angle of the structure surface. \( L_1 \) and \( L_2 \) are the length of the flat or inclined surface of the structure, \( \psi_1 \) is the transmittance, \( h_1 \) and \( h_2 \) are the height of the flat surface of the structure, \( \gamma \) is the weight of the rock, and \( \theta \) is slope.

### Numerical calculation model of slope

Use DEM software PFC2D5.0 to create a slope calculation model, as follows:

1. **Preparation of rock samples.** Select as few particles as possible under boundary conditions, use the layered vacuum method to generate a homogeneous rock sample with 300,000 particles and a target porosity of 0.2, and apply a cementing model.

2. **Miter.** Remove particles to create models with inclined angles of 75°, 60°, and 45°.

3. **Strengthen by gravity.** Using the principle of centrifugal testing, the incision is fixed at 200 g (\( g = 9.8 \text{ m/s}^2 \)), and the incline is increased by 200 times, which corresponds

### Table 1: Microscopic parameter model

| Composition       | Parameter                          | Numerical value |
|-------------------|------------------------------------|-----------------|
| Granular part     | Particle density \( \rho / (\text{kg m}^{-3}) \) | 2700            |
|                   | Particle normal stiffness \( k_b / \text{N m}^{-1} \) | \( 9.0 \times 10^8 \) |
|                   | Particle tangential stiffness \( k_s / \text{N m}^{-1} \) | \( 3.6 \times 10^8 \) |
|                   | Particle friction coefficient \( \mu \) | 0.7             |
|                   | Particle anti-rotation coefficient \( \beta \) | 0.6             |
| Cemented part     | Maximum bonding thickness \( h_{\text{max}} / \text{m} \) | \( 1.3 \times 10^{-4} \) |
|                   | Bond tensile strength \( \sigma_t / \text{Pa} \) | \( 2.3 \times 10^8 \) |
|                   | Cementation compressive strength \( \sigma_c / \text{Pa} \) | \( 2.18 \times 10^7 \) |
|                   | Cementation elastic modulus \( E_p / \text{Pa} \) | \( 1.1 \times 10^7 \) |
|                   | Cement elongation \( sp \) | 0.15            |
to the inclination of the prototype. Figure 3 shows the 74-m high slope and a slope of 75°.

(4) Create joints. The actual joint distribution of rock slopes is difficult. In this paper, their distribution is simplified to parallel and uniform joints, and the joint parameters are listed in Table 3. The internal friction angle of the joint is similar to the friction angle and toughness of the rock, and the adhesion force is negligible. Therefore, when a joint is formed, the mud reduction process can be used to zero the consolidation strength parameters of the particles in the joint area, and other parameters will match the rock mass parameters. The final rock slope model is shown in Fig. 3.

(5) A bedding rock slope $b$ anti-dipping rock slope

Results

Simulation results and analysis of discrete element method

The failure process of slope instability

According to the shape of the slope and the motion state of the sliding body, it can be divided into three levels: initial level, destruction level, and gradual stability level. In the modeling process, a rigid wall was built at the bottom of the slope to expand the space for particle movement, and the complete slope failure process was simulated with calculation efficiency in mind. The slope particle map reflects the overall shape of

| Sample     | $\sigma_c$/MPa | $\sigma_t$/MPa | $E$/GPa | $c$/MPa | $\phi$/° |
|-----------|---------------|---------------|--------|--------|--------|
| Limestone | 2.15          | 0.34          | 0.29   | 0.60   | 29.0   |
| DEM       | 2.04          | 0.33          | 0.30   | 0.65   | 30.1   |
| Relative error absolute value/% | 5.4 | 4.6 | 1.7 | 7.1 | 3.7 |
the slope at each stage, and the damage distribution map reflects the location of the slope collapse.

During the simulation, the measuring circle was placed at various positions on the slope to record the speed and position of each area.

Simulation results and analysis

When using the discrete element method to model the slope instability process, the strength reduction method or the gravity increase method is usually used. Existing research shows that using these two methods to study the process of slope instability can get similar results. This paper uses the gravity enhancement method to simulate and analyze the failure of the slope. The main idea of the gravity enhancement method is to continuously increase the gravity of the slope, so that the failure of the slope cementing will produce micro-cracks. When the gravity is low, the slope is consolidated the number of failed attempts remained stable, and the cracks remained stable. After rework, the slope is in a stable state. When the gravity field increases to a certain value, the failure times during the slope consolidation process continue, and it can be considered that the gravity field damages the slope.

Numerical simulation of slope instability mechanism under the combination of mechanical parameters

The vertical height of 1 h can also be automatically determined. Therefore, in these two cases, the numerical simulation should not artificially consider the change of 1 h. The corresponding combinations of the two cases are shown in Tables 4 and 5. The main design models and geometric parameters of the slope are shown in Table 6. The physical and mechanical parameters of rock mass and structural planes are similarly selected and corrected by Dong Yuanbin’s results, shown in Tables 7 and 8, respectively.

In Table 7, $D_{\alpha}$ and $D_{\beta}$ are the distances between slightly inclined and steep structural planes, $\theta$ is the angle of inclination, $K$ is the elastic modulus of the rock mass, $G$ is the shear modulus of the rock mass, and $t_0$ is the tensile strength of the rock mass. $c_0$ is the adhesion of the rock mass, $\phi_0$ is the friction angle in the rock mass, $k_n$ and $k_s$ are the normal or tangential stiffness of the structure plane, and $\sigma_{ij}$ is the tensile strength of the structure plane. Among the slope geometric parameters of various spatial combinations, special attention should be paid to the values of the inclination angles $\alpha$ and $\beta$ of the slightly inclined and steep structural planes and the values of $c$ and $\phi$ in mechanical structure on the plane. The parameters are 0.3 MPa and 33°, respectively.

In the sliding surface distribution diagram, the red part represents the open sliding surface, and the blue part represents the shear sliding part. The horizontal offset measurement

| Joint form          | Joint inclination /° | Connectivity | Joint width /m | Joint spacing /m |
|---------------------|----------------------|--------------|----------------|------------------|
| Bedding joints      | 45                   | 0.8          | 0.003          | 0.045            |
| Anti-dumping joint  | 120                  | 0.8          | 0.003          | 0.045            |
lines are located at the top, middle, and bottom of the slope, numbered 1, 2, and 3, as shown in Fig. 5b. From the displacement vector cloud diagram and the slip surface distribution diagram, it can be seen that the slope composed of $\alpha = 18^\circ$ and $\beta = 48^\circ$ represents the instability of a slip surface, and the slip surface is a structural surface with low slope. The inclination angle $\beta = 48^\circ$. The displacement detection line at the upper, middle, and lower part of the slope changes suddenly at $\beta = 48^\circ$ at the lowest structural plane, and the displacement is significantly reduced. According to the sudden change of displacement, it can be determined that the surface of the lowermost part of the structure is a sliding surface extending at an inclination angle $\beta = 48^\circ$. From the normal stress distribution diagram and shear stress distribution diagram of the sliding surface, it can be seen that the sliding surface is mainly affected by pressure and shear force. The normal stress of the sliding surface on only a small part of the top of the slope is tensile stress. It can be considered that the way to destroy the instability of the slope at this time is to destroy the shear force in the compressed state.

A set of staggered structures work together to offset the instability of the slope. According to the distribution of normal stress and shear stress on the sliding surface, most of the sliding surface is subjected to compressive stress and shear force and when sliding along the sliding surface when the movement mode is mainly sliding. The tensile stress at the top of the steeply inclined structure has a wide distribution area, the depth from the top of the slope is about 30 m, and according to the sliding surface distribution map, the sliding surface in this area is open, as shown in Fig. 6. At the pivot point of the sliding surface, the concentration of shear stress and compressive stress was observed, and part of the tensile stress distribution range appeared on the lower part of the steeply inclined structural surface near the pivot point. In addition, according to the distribution of the sliding surface, the lower part of the steeply inclined structural surface is open near the pivot point.

### Table 4 Various space combinations

| $B \alpha$ | $18^\circ$ | $30^\circ$ | $42^\circ$ |
|------------|-----------|-----------|-----------|
| $45^\circ$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ |
| $36^\circ$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ |
| $27^\circ$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ |

This is due to the deviation of the tensile stress and the displacement direction in the region at the inflection point, and the inconsistent distribution of the displacement value, which results in the steeply inclined surface of the lower part of the structure. Therefore, the instability mode is compression shear fracture, in which the fractured part has a steeply inclined structural surface, which is the apex slope and the non-slip surface transition respectively.

According to the cloud map of the displacement vector and the distribution map of the sliding surface, under the combination of $c = 0.25 \text{ MPa}$ and $\phi = 27^\circ$, the sliding surface type of the slope is a double sliding surface, as shown in Fig. 7. According to the stress distribution on the sliding surface, the failure mode of slope instability is still compression shear failure. The tensile stress is distributed on the steeply inclined surface of the structure, which is located at the top of the slope and the bottom of the pivot near the sliding surface. The pivot point of the sliding surface is located at the bottom of the slope and is 35 m higher than the slope (if the vertical height of the steep structure surface is 115 m), the depth of the sliding surface extending inside the slope is less than $c = 0.25 \text{ MPa}$ and $\phi = 27^\circ$. The thickness of the sliding body is 50 m.

According to the cloud map of the displacement vector and the distribution map of the sliding surface, under the combination of $c = 0.25 \text{ MPa}$ and $\phi = 45^\circ$, the type of sliding surface of the slope is a double sliding surface, as shown in Fig. 8. According to the stress distribution on the sliding surface, the failure mode caused by slope instability is still compression shear failure. The tensile stress is distributed on the steeply inclined surface of the structure, which is located at the top of the inclined surface and the bottom of the pivot near the sliding surface. The depth of the open part of the steeply inclined surface of the structure is 15 m, and the range of the part close to the pivot point of the sliding surface is also close to 10 m. Compressive stress and shear stress are concentrated at the sliding pivot point. The pivot point of the sliding surface moves 30 m from the top of the slope to the bottom of the slope. When the vertical height of the steeply inclined surface

### Table 5 Combinations of various mechanical parameters

| $c(\text{MPa})$ | $0.25 \text{ MPa}$ | $0.35 \text{ MPa}$ | $0.45 \text{ MPa}$ |
|---------------|----------------|----------------|----------------|
| $27^\circ$     | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ |
| $36^\circ$     | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ |
| $45^\circ$     | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ | $0.25 \text{ MPa}$, $0.35 \text{ MPa}$, $0.45 \text{ MPa}$ |

### Table 6 Slope geometric parameters

| $H(\text{m})$ | $D_a(\text{m})$ | $D_b(\text{m})$ | $\theta(\text{°})$ | $\alpha(\text{°})$ | $\beta(\text{°})$ |
|--------------|----------------|----------------|----------------|----------------|----------------|
| 150          | 10             | 10             | 72             | To be determined | To be determined |

### Table 7 Physical and mechanical parameters of slope rock mass

| $G(\text{GPa})$ | $K(\text{GPa})$ | $\sigma_1(\text{MPa})$ | $\gamma(\text{KN/m}^3)$ | $c_0(\text{MPa})$ | $\phi(\text{°})$ |
|----------------|----------------|--------------------------|--------------------------|----------------|----------------|
| 4.29           | 7.90           | 1.8                      | 27                       | 1.0            | 43.2           |
of the structure is 120 m, and the depth of the sliding surface passing through the interior is further reduced, the thickness of the sliding body is 40 m.

According to the cloud image and the sliding surface distribution diagram of the displacement vector, under the combination of $c = 0.35$ MPa and $\phi = 27^\circ$, the sliding surface type of the slope is a double sliding surface, as shown in Fig. 9. According to the stress distribution on the sliding surface, the oblique failure modes are compression failure and shear failure. The tensile stress is distributed on the steeply inclined surface of the structure, which is at the top of the slope. The top of the steeply inclined structure is about 30 m deep, and stress concentration occurs at the pivot point of the sliding surface. The pivot point of the sliding surface is located at the middle and lower part of the slope, that is, the slope distance. The height from the toe of the slope is 50 m. If the vertical height of the steep structure surface is 100 m, and the sliding surface goes deep into the slope, the thickness of the sliding body is 70 m.

According to the cloud diagram of the displacement vector and the distribution map of the sliding surface, under the combination of $c = 0.45$ MPa and $\phi = 27^\circ$, the sliding surface type of the slope is a double sliding surface, as shown in Fig. 10. According to the stress distribution on the sliding surface, the failure mode of the slope is still compression and shear failure. The tensile stress is distributed on the steeply inclined surface of the structure, which is located at the top of the slope and the bottom of the pivot point of the non-slip surface. The tensile stress and compressive stress of the lower surface near the bending point are alternately distributed, and the depth of the upper part of the steeply inclined structure is 30 m. The pivot point of the sliding surface moves to the bottom of the slope, 45 m away from the top of the slope. If the vertical height of the inclined and steep structure is 105 m, the depth of the sliding surface extending to the slope is less than the combination of $c = 0.45$ MPa and $\phi = 36^\circ$. It is 60 m.

### Comparison of discrete element method and limit equilibrium method

When the acceleration due to gravity increases from 200 to 240 g, the cementation in the bedrock slope is destroyed, and as the number of calculation steps increases, the number of errors also increases. As the number of calculation steps increases, the number gradually remains stable, and the internal cracks of the slope stop developing, and there will be no instability and damage under this gravitational acceleration. Under the acceleration of gravity of 250 and 260 g, the number of connection errors occurring on the slope has the same changing law. Finally, in the case of a free fall acceleration of

![Fig. 4](image-url)
270 g, the number of connection errors increases sharply as the number of calculation steps increases, cracks on the slope develop rapidly, and the slope becomes unstable and damaged, that is, the acceleration due to gravity is 270 g. Similarly, the acceleration of the critical weight of the slope against diving is 360 g. According to the slope safety factor

Fig. 5 Combination of $c = 0.25$ MPa, $\phi = 27^\circ$ (safety factor 0.96)

Fig. 6 $c = 0.25$ MPa, $\phi = 36^\circ$ combination (safety factor 1.26)
formula, if the top of the slope is 75°, the safety factors for cushioning and preventing immersion on the rock slope are 1.35 and 1.80. According to the above steps, continue to simulate the discrete elements of littering and underground slope

\[ c = 0.25 \text{ MPa}, \, \phi = 45° \] combination (safety factor 1.59)

\[ c = 0.35 \text{ MPa}, \, \phi = 27° \]

Fig. 7  \[ c = 0.25 \text{ MPa}, \, \phi = 45° \] combination (safety factor 1.59)

Fig. 8  \[ c = 0.35 \text{ MPa}, \, \phi = 27° \]
destruction, with peak slopes of 60° and 45° and corresponding slopes respectively. In addition, the safety factor of the slope of the submerged rock is greater than the safety factor of the slope of the bedrock, that is, the protection of the slope. The slope is more stable than the slope of the bedrock, which corresponds to the actual understanding of the project. The

![Displacement vector cloud diagram](image)

![Slip surface distribution](image)

![Normal stress of sliding surface](image)

![Tangential stress on sliding surface](image)

Fig. 9  \( c = 0.35 \text{ MPa}, \phi = 36° \)

![Displacement vector cloud diagram](image)

![Slip surface distribution](image)

![Normal stress of sliding surface](image)

![Tangential stress on sliding surface](image)

Fig. 10  \( c = 0.45 \text{ MPa}, \phi = 27° \) combination (safety factor 1.32)
The safety factor obtained by the discrete element method is similar to the limit equilibrium method, and the safety factor decreases with the increase of the tilt angle. That is, the discrete element method and the gravity enhancement method can be combined to evaluate the safety of the slope.

The test results of the basic tilt with 75° tilt angle and 45° joint tilt angle under dynamic action are also discussed. If the slope is not passed, the butt surface at the bottom will become a slip surface, and the upper rock will become a slip surface. The mass slides along the sliding surface. The boundary conditions of the 75° bedrock slope are similar in this paper. The results show that the upper stratum blocks are overloaded under the action of gravity. The hinged rock surface appears along the weak surface of the joint. When it slides down, the collapsed body maintains a certain shape and actually exhibits shear failure. The simulation results of the discrete element of the anti-flooding slope show that the slope is formed by joint cutting to form a relatively independent slope. The boulders are rotated by gravity, dumped objects and rollers at the bottom, forming a random accumulation structure, which is a typical collapse failure mode. The results of the model test are similar, and both appear in the form of falling deformation and fracture due to deformation. Use Slide5.0 to create a 75° slope model and determine the most dangerous sliding surface on the slope. The dashed line is the sliding surface of the limit equilibrium method, and the solid line is the second stage of Jiang Mingjing et al. Discrete element analysis of the development of slope instability. The discrete element analysis of the slope instability development of rocks with different joint shapes is based on the slope sliding surface obtained by the discrete element modeling, the number of which is the safety margin of the slope. When using 60° and 45° inclination angles, modeling the sliding surface on discrete elements can draw the same conclusions as when using the limit equilibrium method.

Discussion

The role of multimedia teaching in ideological and political courses

In order to further explore multimedia education in ideological and political courses, we first compare traditional ideological and political education with ideological and political multimedia education according to the new curriculum standards, as shown in Table 9.

It can be seen from Table 9 that compared with traditional teaching, multimedia as a new teaching resource not only changes teaching methods and methods, but also significantly improves teaching effects. Taking students as the center, using modern information technology to realize the diversification of courses and the interaction between teachers and students
have played a very active role in modern ideological and political courses.

**Problems in using multimedia teaching in ideological and political classrooms**

The use of multimedia in teaching may have changed the traditional classroom, but nothing is perfect. Although multimedia education plays an indispensable role in ideological and political courses, its weaknesses have also been revealed. According to the results of questionnaire surveys and interviews, the common problems of multimedia teaching in ideological and political courses are mainly reflected in the following aspects.

**Misuse of multimedia, ignoring the novelty of the subject content**

First of all, the information capacity is too large, and important and complex knowledge is easily diluted. Teachers use multimedia functions with images and text to make it easier for students to absorb abstract theoretical knowledge and obtain the best learning experience. However, many teachers do not understand this "degree" when using multimedia teaching, and blindly use multimedia teaching programs, as a result, students become indifferent to knowledge. Especially for ideological and political courses, although the use of multimedia increases the content of most courses in a limited time, the subject itself has less time and more content. However, if you do not understand this, it is easy for students to become tense and stressed in class, leading to visual fatigue. Some students even broadcast the course content like a movie, so they lose the importance of multimedia courses. In addition, the information capacity of multimedia course materials is too large, key knowledge and complex knowledge has not played a role, and the expected learning goals have not been achieved.

The second is to copy textbooks without innovative educational content. At present, most of the teaching aids selected by teachers are equipped with electronic textbooks, which greatly simplifies the teachers' lesson preparation process and forms a "use theory". Teachers do not need to spend time to develop course content or simply copy textbook content and add some images, so there is no need to use multimedia for teaching. Everything is like this, the teacher's laziness will increase, and his personal intentions and innovative ideas cannot be revealed. It is easy for students to lose interest in learning, especially on ideological and political issues that combine theory with practice.

**Over-reliance on multimedia, neglecting the integration with traditional teaching**

The essence of the classroom teaching process is the interaction between teachers and students. When using multimedia programs in the classroom, the teacher will become a player, and the classroom will become a computer presentation room. The space for teacher-student interaction is very small, which is inconsistent with the requirements of the new curriculum reform. The ideological and political class is mainly to promote the development of students' cognitive ability and the formation of students' values and moral concepts. Some students do not like to watch the multimedia courses of the course too much. They prefer to listen to the teacher's explanation, especially when it comes to acquiring complex knowledge. I prefer to explain the teacher's blackboard, which reflects the personal charm of political scientists. In many traditional teaching, the role of multimedia in ideological and political courses is essential, but it cannot be said that they can replace all teaching methods. If the projection screen completely replaces the whiteboard, the content plays too fast. This not only affects the fact that students can take notes, but it is also difficult to ask questions
about knowledge, and in the long run, teachers cannot change the screen according to the problems that affect the effect of the class.

The courseware design is unreasonable and neglects the cultivation of students’ ability

In order to increase interest in multimedia classrooms and attract students’ attention, some teachers excessively use artistic multimedia effects in their courses. For example, trivial small animations, excessive graphics, sound effects, etc., rarely show sentences with key knowledge. These types of courses are usually distracting, and some students even consider them “visual noise”. The survey also showed that when designing course materials, teachers usually do not care about background colors and slide content. Such colors may make it difficult for students to see the layout, which directly affects students’ acceptance of knowledge. In addition, the new curriculum reform places special emphasis on transforming students’ teaching methods from perceptual to exploratory. In modern classrooms, teachers often prepare a large number of ready-made multimedia courses to show students, and the entire structure of the course is based on the ready-made teacher model. This not only reduces the students’ ability to discover, analyze, and solve problems, but also affects the improvement of students’ thinking and imagination.

The teacher’s dominant position is lacking and the communication between teachers and students neglected

The new curriculum reform emphasizes the principle of teacher-led and student-based, and requires teachers to fully mobilize and display the enthusiasm, initiative, and creativity of students in the learning process so that students truly become the core of the curriculum. In the practice of ideological and political teaching in multimedia teaching, some teachers overemphasize the role of multimedia teaching, thinking that multimedia technology can solve or even solve the main problems of classroom learning. Using teaching aids to organize classroom courses, the understanding will inevitably weaken the teacher’s teaching function in the classroom and affect the quality of teaching.

Optimizing countermeasures for multimedia teaching in ideological and political courses

Learning in a multimedia classroom is a direct manifestation of information technology and curriculum integration. Optimizing multimedia learning is the key to making full use of the advantages of educational informatization and improving the quality of teaching and talent training. In order to solve the abovementioned problems in multimedia teaching of ideological and political courses, in order to make full use of multimedia teaching and stimulate students’ thinking ability, it is necessary to combine it with traditional teaching methods to improve the comprehensive level of teacher teaching and optimize it.

The combination of multimedia courses and traditional teaching methods

If the relationship between multimedia learning and traditional learning is properly managed, and multimedia learning is used, then traditional one-to-one learning will not be able to get rid of. Traditional courses and multimedia courses are complementary to each other, making full use of the advantages of traditional learning, learning from each other, and making up for the disadvantages of multimedia learning. In the actual education process, the blackboard is still an indispensable auxiliary tool in modern teaching. The subsequent writing on the blackboard makes students have plenty of time to reflect, establish a clear logical foundation for the knowledge system, and enhance students’ memory of important and complex knowledge after class. In addition, some political teachers were suddenly inspired by multimedia courses and had to write on the blackboard to prove this. Therefore, it is necessary to write on the blackboard to fill the gaps in the multimedia course materials. For example, in the course of “Business Value”, the handwriting of the student’s speech in the blackboard discussion works well, making the students feel respected.

Improve the multimedia teaching level of ideological and political teachers

Modern education technology optimizes classroom learning, not only improves the comprehensive quality of students, but also puts forward higher requirements for the quality of modern teachers. Every teacher must stand at the forefront of the times, actively study, research and boldly try new teaching methods, constantly adapt and update their own teaching methods, and cultivate high-quality talents. First of all, we need political science teachers. Do not forget to collect as many training materials as possible. In addition to newspapers and magazines, slides, audio, video, and computer courses and other audio-visual materials have also been added to the strategy database. At the same time, for today’s teachers, continuing learning is a prerequisite in order to be able to better create and use multimedia course materials. This requires attention to improve teachers’ ability to use multimedia. In their free time, for example, during winter and summer vacations, teachers can receive intensive training. According to the basic principles of teachers, we should pay attention to teaching from the smallest to the deepest and combine theory with practice. Second, change the way teachers are taught and
continuously improve their innovative spirit and practical ability. Every teacher should use modern teaching ideas in classroom teaching. Through learning new theories and new technologies, teachers can master new educational technology methods and flexibly use existing resources for teaching. We can choose teaching software and create teaching aids according to different teaching contents to continuously improve the production and art training level of teachers.

**Optimize the multimedia teaching elements of ideological and political courses**

With the deepening of China’s new curriculum reform, we have selected the most appropriate educational content, methods and channels in the education reform, and strive to improve the quality of education. The use of new teaching methods to optimize the learning process to achieve learning goals has become a new topic for today’s educators. In ideological and political classes, it is necessary to optimize learning based on the three elements of curriculum content, curriculum structure, and teaching methods, combined with multimedia teaching methods process, thereby enhancing the influence of ideological and political courses.

**Optimize the content of multimedia courses**

Optimizing classroom content requires teachers to process the materials collected in the classroom carefully and realistically and to accurately perceive the materials in the classroom. In this case, the form of expression must conform to the students’ cognitive laws. In order to enrich the course content, teachers have collected a large amount of materials through various channels or media to create courses, such as graphics, materials selected from CDs, video tapes, other materials downloaded from the internet, self-created text, animation materials, content, and time to enrich classroom learning content. When political teachers use multimedia in the classroom, they can provide necessary materials and environments for learners of different levels, so that all learners have different learning states throughout the teaching period.

**Optimize the structure of multimedia courses**

In order to optimize the structure of multimedia learning, it is necessary to consider the systematic nature of the curriculum design and the internal logic of the knowledge structure so that students have a deep understanding of the internal relationships between different knowledge points. Independence, collaboration, research teaching methods and “student development orientation” are the main concepts of the new curriculum in the design of teaching structure. This requires policy educators to engage as many students as possible in classroom activities that reflect the reality of the course content when using multimedia software to develop students’ potential. At the same time, students should be given enough time to reflect, appreciate the value of knowledge and develop their ability to explore themselves. Politics teachers should also fully consider the development of different teaching materials and action methods for students with different learning abilities. Although the implementation conditions are limited, we must pay attention to this issue and try to optimize the training structure. In addition, when designing the curriculum structure, the formation of students’ attitudes, emotions, and values should be strengthened so that students can learn behaviors while absorbing knowledge.

**Optimize multimedia teaching methods**

Teaching method is an effective combination of teacher’s teaching method and student’s teaching method. In order to achieve learning goals and complete general learning tasks, it is necessary to adopt the method of participating in activities. Modern ideological and political education has gradually shifted from traditional teaching to meaningful teaching methods.

**Optimize the multimedia teaching process of ideological and political courses**

Optimize the import process of multimedia teaching The introduction of new courses is the first part of teacher training and an important part of the introduction of new courses. As the saying goes, a good start is half the battle. The course introduction can best reflect the personality and teaching characteristics of an excellent teacher. The combination of multimedia teaching mode and traditional teaching provides a new atmosphere for course introduction. An effective introduction to ideological and political education requires teachers to carefully create introductory references and choose different introductory methods according to the content of the course. In line with the requirements of the new curriculum standards, the effective introductory skills in the political classroom are very useful to increase students’ interest in learning, stimulate thinking and pave the way for new curriculum development. In modern classrooms, teachers mainly use the method of introducing theories and the method of introducing specific images. The theory introduction method is more common in traditional classrooms. The method of starting a new course is mainly to review the old knowledge before acquiring new knowledge. The method of introducing specific images can attract students’ attention more in modern teaching and specific abstract theoretical knowledge. It is especially suitable for ideological and political classes in the classroom and is easy for students to understand and accept. There is no doubt that multimedia teaching methods can implement the image introduction of knowledge before class. In terms of entry...
skills, teachers can use different entry methods for different subject materials according to the curiosity of students. There are many import methods of this type, including the most commonly used methods: problem method settings, graph query methods, previous inspections, learning new methods, and media import methods.

**Optimized courseware design for multimedia teaching** The correct use of multimedia software in the classroom is very important for creating a classroom atmosphere, stimulating students’ interest, overcoming classroom challenges, and encouraging students to innovate. Excellent study materials should be expressive and attractive so that students can develop their emotions while studying. In the process of ideological and political education, teachers mainly use the form of slide show. When making slides, teachers should pay attention to the characteristics of students’ own development and explain the learning goals. This should not only conform to the teaching rules, but also reflect the teacher’s thinking and personal charm. The production of multimedia courses must adapt to the students’ psychological characteristics, cognitive characteristics, cognitive level, situation, and environment. To create high-quality multimedia teaching materials, we must pay attention to the following points: First, the teaching content should be reflected. Not all course content is suitable or needs to be converted into teaching materials. Therefore, choosing a good topic is a prerequisite for creating multimedia course materials. This requires teachers to carefully study textbooks when choosing subjects, explain what their learning goals are, what learning problems need to be solved, which teaching methods to use, what learning goals they pursue, etc., and carefully draft a series of courses. The course plan corresponding to the course content makes full use of the graphic function of the multimedia course to overcome learning difficulties. When preparing the course, the teacher is relatively abstract in the content of the course, and it is difficult to describe it in words. They make full use of images, text, audio, and video course materials and display them on slides to obtain a double effective learning experience.

**Optimize classroom interaction of multimedia courses** In the implementation of the new curriculum, teachers act as instructors, participants, and facilitators of students; students build knowledge; and students use their own knowledge development exercise to develop their potential, emotions, and will. Especially in modern multimedia classrooms, all classroom activities are a one-way path between teachers and students. Here, teachers blindly rely on multimedia technology and neglect the emotional interaction with students, thus completely losing the importance of multimedia learning. Therefore, when using multimedia teaching, policy educators cannot allow students to accept the information provided by the course, especially in the course of course development, to arouse students’ curiosity as much as possible. At the same time, teachers cannot simply use computers to explain instead of communicating with students, because students lack a sense of reality in classroom content displayed through multimedia. The language of teachers and students must be organized in order to exchange ideas and emotions and interact.

**Conclusion**

In this paper, discrete element numerical method is used to simulate the damage of two different rock masses along the bedding and anti-soaking protection, and the safety factor and slip surface are simulated and determined according to the shape of the slope, the distribution of cemented cracks and the movement of the slip body. Compare two values. The various forms of slope collapse development are compared and analyzed, and the following conclusions are drawn. Discrete elements are combined with gravity methods to simulate rock slopes, and the stability of the slope can be evaluated based on safety factors. Compared with the limit equilibrium method, the discrete element method does not require the assumption of simultaneous compliance of all parts of the sliding surface, can more accurately reflect the interaction between the rock masses, and can reflect the gradual failure process of the slope, such as the velocity field and path displacement. Multimedia teaching is very common in political classrooms today. Students like teachers and are willing to use them. This is a harmless situation. The benefits of multimedia learning itself prove that student acceptance is the first step to the success of multimedia learning. This is in line with the current basic education and training needs to update teaching methods. Multimedia is a modern teaching method that can meet the needs of time and classroom learning. The use of multimedia in political education is a general trend and demand for courses. Because political education is different from other courses, students can acquire a lot of scientific knowledge without learning, but can improve personality and citizenship in many aspects, such as ideology and morality, life orientation, political awareness, and political education. Patriotism is part of the growth process of youth, and the importance of creating a curriculum about prospects, worldviews, and values is obvious. As far as the content of the political class is concerned, many principles of knowledge originate from life and are higher than life. His views and theories are a perfection and generalization of common things. To some extent, students have a certain distance in understanding the content, and I think the content is unrealistic. In fact, the prototype of this knowledge comes from real life. Although this universal language is esoteric and difficult to read, it does not mean that the political class is a lobbying class without reality, but that it is talking about it and students can understand it, which is like holding up banners and shouting
slogans on the street. The emergence of multimedia learning has changed this situation to some extent. Multimedia learning resources can demonstrate these incomprehensible “great principles” through practical examples. The advent of multimedia teaching has changed the nature of teaching and promoted the transformation of teachers’ educational concepts. By using multimedia courses wisely, pleasant learning effects can be achieved.

Acknowledgements Heliongjiang Province art science planning project: Research on the influence of VR on film and television creation and industry under the background of 5G, no. 2020B041.

Declarations

Conflict of interest The authors declare no competing interests.

Open access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article’s Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article’s Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit http://creativecommons.org/licenses/by/4.0/.

References

Abrams DC, Facer P, Bishop AE, Polak JM (1994) A computer-assisted stereological quantification program: Openstereo. Microsce Res Tech 29(3):240–247. https://doi.org/10.1002/jemt.1070290310
Al-Taj M (2000) Active faulting along the Jordan Valley segment of the Jordan-Dead Sea Transform, Dissertation, The University of Jordan
Atallah M, Al-Taj M (2004) Active surface ruptures of the Dead Sea Zone. Atti Accad Naz Lincei 47:667–683
Barberi F, Capaldi G, Gasperini E, Martinelli G, Santacroce R, Scandone R, Treuil M, Varet J (1980) Recent basaltic volcanism of Jordan and its implications for the geodynamic history of the Dead Sea Shear Zone. Atti Accad Naz Lincei 47:667–683
Ben-Avraham Z, Lazar M, Labbattner U, Marco S (2005) The Dead Sea Fault and its effect on civilization. In Wenzel F (eds) Perspectives in modern tectonology. Springer - Verlag, Heidelberg, pp 145–163
Ben-Avraham Z, Lazar M, Garfunkel Z, Reshef M, Ginzbarg A, Rotstein Y (2012) Structural styles along the Dead Sea Fault. In: Roberts DG, Balley AW (eds) Phanerozoic regional geology of the world, 1st edn. Elsevier, Amsterdam, pp 612–633
Bender F (1974) Geology of Jordan. Brontrager, Berlin
Diabat A (2005) Sinkholes related to tectonic factor at Ghor Al Haditha Area, Dead Sea/Jordan. Hydrogeologie und Umwelt 33(11):1–17
Fossen H (2016) Structural geology. Cambridge Univ. Press, Cambridge
Galli P (1999) Active tectonics along the Wadi Araba-Jordan Valley transform fault. J Geophys Res Solid Earth 104(B2):2777–2796. https://doi.org/10.1029/1998JB000113
Garfunkel Z (1981) Internal structure of the Dead Sea leaky transform (rift) in relation to plate kinematics. Tectonophysics 80(1–4):81–108. https://doi.org/10.1016/0040-1951(81)90143-8
Hardy C, Homberg C, Eyal Y, Barrier É, Müller C (2000) Tectonic evolution of the southern Levant margin since the Cenozoic. Tectonophysics 349(3–4):211–225. https://doi.org/10.1016/S0040-1951.2010.09.007
Khalil B (1992) The geology of Ar Rabbah area, study no. 50,000, sheet no. 3152–I. Natural Resources Authority, Amman
Klinger Y, Avouac JP, Dorbath L, Karaki M, Tisserat S (2000) Seismic behaviour of the Dead Sea Fault along Araba valley, Jordan. Geophys J Int 142(3):769–782. https://doi.org/10.1046/j.1365-246x.2000.01666.x
Lefèvre M, Klinger Y, Al-Obeid M, Jornon ML, Moumouni K (2018) Slip deficit and temporal clustering along the Dead Sea Fault from paleoseismological investigations. Sci Rep 8:4511. https://doi.org/10.1038/s41598-018-22627-9
Maercklin N, Bensassan A, Haberland C, Ritter O, Ryberg T, Weber M, Weckmann U (2005) Characterizing a large shear-zone with seismic and magnetotelluric methods: the case of the Dead Sea Transform. Geophys Res Lett 32(15). https://doi.org/10.1029/2005GL022724
Masri I A (1997) The tectonic evolution of Ed Dhira monocline-east of Jordan-Dead Sea Transform, Jordan. J Seismol 5:449–470. https://doi.org/10.1023/A:1011487912054
Niemi TM, Zhang H, Atallah M, Harrison JBJ (2001) Late Pleistocene and Holocene slip rate of the northern Wadi Araba fault, Dead Sea Transform, Jordan. J Seismol 5:449–474. https://doi.org/10.1023/A:1011487912054
Nuriel P, Weinberger R, Kylander-Clark ARC, Hacker BR, Craddock JP (2017) The onset of the Dead Sea transform based on calcite age-strain analyses. Geology 45(7):587–590. https://doi.org/10.1130/G38903.1
Ortner H, Reiter F, Acs P (2002) Easy handling of tectonic data: the case of the Dead Sea Transform. Geophys J Int 142(3):769–782. https://doi.org/10.1046/j.1365-246x.2000.01666.x
Powell JH (1988) The geology of the Karak area, scale 1:50,000, sheet no. 3152–III. Natural Resources Authority, Amman
Sharon M, Sagi A, Kurzon I, Marco S, Rosenaft M (2020) Assessment of seismic sources and capable faults through hierarchic tectonic criteria: implications for seismic hazard in the Levant. Nat Hazards Earth Syst Sci 20(1):125–148. https://doi.org/10.5194/nhess-20-125-2020
Stern RJ, Johnson P (2010) Continental lithosphere of the Arabian Plate; a geologic, petrologic, and geophysical synthesis. Earth-Sci Rev 101(1–2):29–67. https://doi.org/10.1016/j.earscirev.2010.01.002