Research on Curriculum System of General Geology Teaching Reform Based on Computer 3D Modelling

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Abstract. Geology is a relatively new branch of geology. It is mainly used to study various ecological functions of the lithosphere, the laws of origin, and the relationship between time and space under the influence of natural environment and human activities. The content is very consistent with the current "Industry needs in the context of "big geology". Combining the engineering geology course teaching and scientific research practice, this paper firstly puts forward the theoretical connotation and practical extension of the engineering geology course teaching objectives; secondly, it systematically discusses the theoretical connotation, that is, the progressive relationship of the theoretical knowledge system of the engineering geology course. The main content, based on this, expounds the main guiding principles that should be followed and the corresponding key skills that should be mastered to realize its practical extension. Its open design facilitates the follow-up maintenance of high-quality courses; the visual expression interface designed with multimedia screen elements allows experts to immediately enter the review and observation points; teachers can prepare lessons online and learn about students' learning status through online tests; students It can rely on course resources such as multimedia courseware to conduct independent learning and communicate with teachers in various ways. The practice shows that the national excellent course geology designed with this framework is very successful.

Keywords: Computer · 3D modelling · geology teaching · teaching system

1 Introduction

With the rapid development of the globalized economy, Chinese goal of cultivating undergraduates is getting higher and higher, and the educational policy integrating teaching, production and scientific research and the theoretical model of general education have been put forward. Obviously, the original talent training mode, teaching content and teaching methods can no longer meet the society's requirements for high-level talents. Geology is a science that studies the structure, material composition, development and changes of the crust, and the formation and distribution of minerals [1]. It is a basic course for geological engineering and mining engineering majors. Starting from the

P. Qi and Z. Chen (Eds.): ICBDIE 2023, AISR 178, pp. 548–555, 2024.
https://doi.org/10.2991/978-94-6463-238-5_76

needs of the course blended teaching reform, this paper proposes the design concept and requirements of the online and offline blended teaching mode of the "Geology" course based on the teaching status and existing problems of the "Geology" course. On this basis, based on the course teaching resources and SPOC teaching platform, the design of the "Geology" course blended teaching mode was carried out, which realized the deep integration of online teaching and offline classroom teaching, and significantly improved the teaching quality.

2 Course Introduction

Geology is an important professional course that must be taken by undergraduates majoring in geology in our school. It belongs to a relatively new horizontal and marginal basic subject. This course is not identical to the study content of "Genecology", which includes the former. Geology was first proposed in 1994 and is mainly devoted to exploring the ecological functions of the lithosphere, with the biological groups (including humans and societies) that directly act on certain lithospheres or their surfaces in the ecosystem as the main research objects. The main line of the theoretical method is based on the ideological viewpoints of ecology, and the rock, soil, water, biological community and its generation under the modern geological action (including natural and human factors) are studied under the overall framework of earth system science. Ecological geological problems and effects [2]. The course content mainly includes the research methods of geology, the relationship between the geological environment of animals and plants (including poultry, livestock and crops) and the ecological role of the lithosphere, the relationship between trace elements and human health, etc. The key to understanding the ecological role of the lithosphere under different conditions, the law of formation and the relationship between time-space transformation under the influence of natural environment and human activities, focusing on the geological environment problems affecting the ecological role of plants and animals, mainly emphasizing the responsibilities and Task. The purpose and task of the course is to enable students to master its basic principles and basic research methods, understand its research progress and development trends, focus on understanding the application of its results, initially establish geological thinking, and cultivate the comprehensive ability to analyse and solve practical problems using geological knowledge will lay a good foundation for in-depth study and application of related courses in the future.

3 Architecture Design of the Geology Website

3.1 System Architecture

Taking into account the needs of teacher-student interaction and the convenience of subsequent maintenance of the course website, the website system of the geological excellent course we designed adopts the browser/server three-tier architecture model [3]. Windows 2015 Server+IIS5.0+ASP framework, SQL 2015 Server and ACCESS 2015 are used in the background database, ASP is used for the remote teaching system, and the Remoting Server client technology of FLASHMX is used, which is convenient for students to use mobile phones to send short messages to the website to consult related learning problems. The structure of the system is shown in Fig. 1.

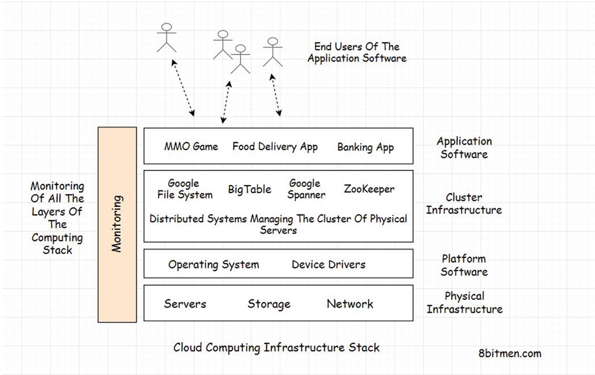

Fig. 1. System architecture diagram of the geological excellent course website

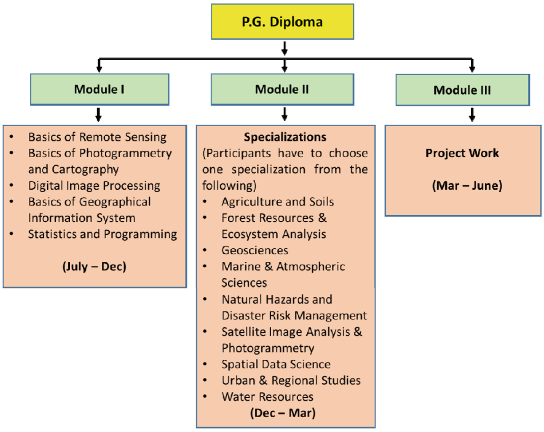

Fig. 2. Geology Quality Course Website Module

3.2 Content Structure Design

The content structure design of the website mainly determines the link structure of the website according to the requirements of the Ministry of Education's quality courses, and divides the different functions and modules of the website into different levels, taking into account not only expert review, but also the convenience of teachers. Student-oriented design, so that the three user groups have a clear concept of the function and structure of the website, thereby enhancing the usability of the website [4]. According to the teaching requirements, we have designed the structure of the geology teaching website. The specific structure is shown in Fig. 2.

3.3 Database Design

The textbook mentions the borehole histogram in the chapter of the original geological catalogue: the borehole histogram is a map that records the geological phenomena

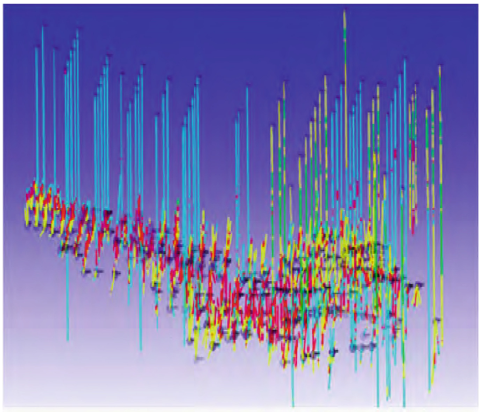

Fig. 3. Geodatabase spatial trajectory

revealed by the borehole. The sequence uses various symbols to draw different lithology or ore bodies into a histogram at a certain scale. In Dimine, by importing the original recorded opening table, inclination table, lithology table, and sample table, the drilling database can be formed (Fig. 3), and the style of the drilling database is displayed to form a column chart of the drilling holes. The borehole space trajectory in Fig. 3 describes the arrangement of boreholes in space. Different colours and patterns represent different lithologies, and the sample length and grade can also be shown in the figure [5]. After the operation of Dimine software, there is no need to manually draw tedious drill hole histograms. At the same time, students have a deeper understanding of drilling engineering, drilling trajectory, rock sample length, lithology and grade, not just Stay at the concept stage.

4 Simulation Design of Geology Teaching Example

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4.1 The Convective Diffusion Equation for Mean Kinetic Energy

We place a wind turbine in a rectangular computational domain as a simplification, ignoring the tower and considering only the rotor part [6]. Assume that the average kinetic energy in the area before and after placing the wind turbine is K and K′, respectively, which satisfy the equations

$$\rho u_j \frac{\partial K}{\partial x_j} = -u_j \frac{\partial p}{\partial x_j} + \mu_t \frac{\partial^2 K}{\partial x_j \partial x_j} - \mu_t \frac{\partial u_i}{\partial x_j} \frac{\partial u_i}{\partial x_j} \tag{1}$$

Among them, $K = u_i u_i/2$, $K' = u_i' u_i'/2$, the physical quantity with ' is the physical quantity after placing the wind turbine.

$$u_j \frac{\partial \rho_k}{\partial x_j} = \nu_t \frac{\partial^2 \rho_k}{\partial x_j \partial x_j} + \Phi \tag{2}$$

$$\begin{aligned} \Phi = & \frac{\rho\left(u_j - u_j'\right)}{c^2}\frac{\partial K'}{\partial x_j} + \frac{1}{c^2}\left(u_j \frac{\partial p}{\partial x_j} - u_j' \frac{\partial p'}{\partial x_j}\right) + \frac{\left(\mu_t' - \mu_t\right)}{c^2}\frac{\partial^2 K'}{\partial x_j \partial x_j} \\ & + \left(\frac{\mu_t}{c^2}\frac{\partial u_i}{\partial x_j}\frac{\partial u_i}{\partial x_j} - \frac{\mu_t'}{c^2}\frac{\partial u_i'}{\partial x_j}\frac{\partial u_i'}{\partial x_j}\right) \end{aligned} \tag{3}$$

where c is the speed of light in vacuum, and Φ is the equivalent source term of the convection-diffusion Eq. (3). Here, ρk is called the energy-mass density, which is the equivalent mass corresponding to the kinetic energy (K′ − K). Equation (3) is a convective-diffusion equation satisfied by the energy-mass density, which is the same in form as the convective-diffusion equation of matter. We approximate the equivalent of the source term (3) into the equation diffusion coefficient to obtain the equation:

$$u_j \frac{\partial \rho_k}{\partial x_j} = (\nu_t + \nu_\Phi) \frac{\partial^2 \rho_k}{\partial x_j \partial x_j} \tag{4}$$

The error due to equivalence is adjusted by the diffusion coefficient and attenuation coefficient in the particle simulation.

4.2 Boundary Conditions

For the Jensen linear model, the velocity at the onset of the wake is:

$$u'\big|_\Gamma = u_0(1 - 2a) \tag{5}$$

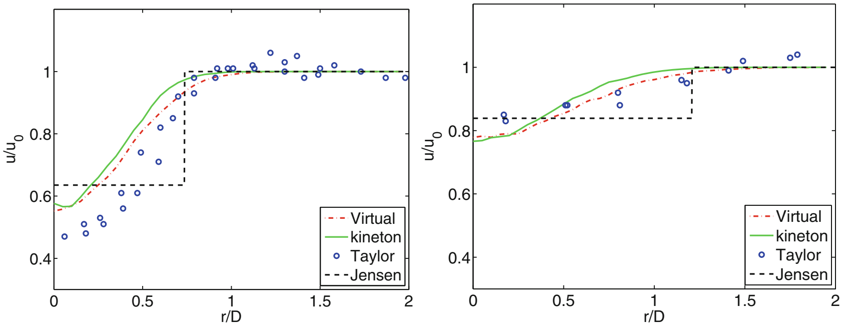
where Γ is the surface of the wind rotor, a is the axial flow induction factor, CT is the thrust coefficient of the wind turbine, and u and u' are the speeds before and after the wind rotor, respectively. The boundary conditions for converting the boundary conditions into energy-mass are

$$\rho_k|_\Gamma = \frac{\rho C_\mathrm{T}}{2}\frac{u_0^2}{c^2} \tag{6}$$

The terrain information is reflected into the solution through the boundary conditions of the equation, so the resulting wake velocity will vary with the terrain. Therefore, the model in this paper is suitable for wind turbine wake calculation in complex terrain.

5 System Teaching Simulation Design

Figure 4 shows the calculated results of dimensionless velocities for different sections downstream from the wind turbine. Compared with the virtual particle model, the velocity in the wake region of the energy-mass model is slightly larger, but the variation law is similar. Since the diffusion coefficient σ of the energy-mass wake model is small (σ = 0.23 in the virtual particle model), the particle diffusion effect is weak, so the wake radius of the energy-mass model is small. Table 1 shows the energy-mass diffusion wake model Properties comparison with the virtual particle wake model [7]. From the transformation relationship between velocity and concentration, the virtual particle model is linear, the energy-mass diffusion model is nonlinear, and the wake velocity obtained by the energy-mass model is slightly larger. From the perspective of the calculated physical quantities, the virtual particle model calculates the velocity attenuation ratio, and the convection-diffusion equation it satisfies is obtained by analogy, and the model error is difficult to determine; the energy-mass diffusion model calculates the energy-mass density (kinetic energy attenuation), which satisfies the convection-diffusion equation of is obtained by derivation. At the same time, the model error term is obtained.



(1) U_{in}=8.5m/s, x=2.5D (2) U_{in}=8.5m/s, x=7.5D

Fig. 4. Comparison of different wake models with experimental data

Table 1. Comparison of energy-mass dispersion wake model and virtual particle wake model

	Energy-Mass Diffusion Wake Model	**Virtual Particle Wake Model**
Calculated physical quantity	Energy-Mass Density (Kinetic Energy Attenuation)	Speed decay ratio
Equation satisfied	Convective Diffusion Equation	Convective Diffusion Equation
Linearization Error of Equation	Convection term, pressure term, kinetic energy decay term	unknown
The relationship between wake velocity and concentration	Nonlinear	linear
Wake region velocity	Smaller	larger
Wake radius	Smaller	larger

6 Conclusion

It is a long-term and arduous task to perfect the geological teaching system and the curriculum construction. This paper attempts to introduce and systematically summarize the background, course introduction, teaching content, teaching methods, teaching staff and assessment methods of geology courses for undergraduate geology, and put forward a preliminary conception of course teaching and assessment mode. In this paper, the concept of energy and mass is introduced from the mean kinetic energy of turbulent flow. We propose an energy-mass diffusion wake model. The convection-diffusion equation satisfied by energy-mass density and the transformation formula of wake velocity-energy-mass density are deduced.

Acknowledgment. This work was financially supported by the Demonstration course of Education Department of Anhui Province (2020SJJXSFK2442) & Offline programs of Education Department of Anhui Province (2020kfkc561) & College Excellent Talents Support Program of Education Department of Anhui Province (2021 gxyq2021243) & Major Teaching Research of Anhui Provincial Department of Education (2020jyxm2068).

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