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Application of GIS Risk Assessment and Disaster Prevention Planning in Education

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Abstract: Geological disaster, as a common natural disaster, pose a serious threat to human society and natural environment. The paper aims to explore the application of geographic information system (GIS) technology in geological disaster risk assessment and disaster prevention planning, and further analyze its application value in the field of education. By systematically combing the key links of GIS technology in geological disaster risk assessment, including data collection, processing, analysis and visual display, this paper shows how GIS technology can improve the accuracy and efficiency of geological disaster risk assessment. Meanwhile, the paper also explores the role of GIS technology in formulating disaster prevention planning, especially in disaster early warning, emergency response and post-disaster recovery. On this basis, this paper focuses on the analysis of GIS technology application potential in education, put forward the GIS technology into geology, environmental science and disaster management related course teaching strategy, and through the actual case teaching, laboratory simulation and extracurricular practice, improve the students practical ability and comprehensive quality. Finally, this paper summarizes the importance of GIS technology in the study of geological disaster risk assessment and disaster prevention planning, and prospects its broad application prospects in education.

Keywords: geographic information system; geological disaster; risk assessment; disaster prevention planning and educational application

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1. Introduction

1.1. Research Background and Significance

Geological disasters, such as earthquakes, landslides and debris flows, occur frequently around the world, bringing great challenges to the safety of human life and property and social stability. With the acceleration of urbanization and the intensification of climate change, the risk of geological disasters is increasing. Therefore, it is of great practical significance to carry out geological disaster risk assessment and disaster prevention planning research. As a powerful spatial data analysis tool, geographic information system (GIS) is playing an increasingly important role in geological disaster risk assessment and disaster prevention planning. Through GIS technology, the efficient collection, processing, analysis and visual display of geological disaster-related data can be realized, so as to improve the accuracy of risk assessment and the scientific nature of disaster prevention planning. At the same time, the introduction of GIS technology into the field of education is helpful to cultivate students spatial thinking ability, data processing ability and practical problem solving ability, which is of great significance to cultivating high-quality geology, environmental science and disaster management talents.

1.2. Foreign Research Status

At present, foreign scholars have made a series of research achievements in the application of GIS in geological disaster risk assessment and disaster prevention planning. American scholars began to use GIS technology to conduct geological disaster risk assessment and mapping work earlier, and developed a variety of geological disaster assessment models and decision support systems. For example, American scholars have used GIS technology to assess the earthquake risk in California and formulated corresponding disaster prevention planning schemes. In addition, some European countries have also actively carried out the application research of GIS in geological disaster risk assessment and disaster prevention planning, and have achieved remarkable results.

1.3. Domestic Research Status

Domestic scholars also actively carry out relevant research, combining with the characteristics and actual situation of geological disasters in China, to explore the risk assessment methods and technical processes of GIS geological disasters in China. For example, Chinese scholars have applied GIS technology in earthquake-affected regions to assess geological disaster risks, providing scientific support for post-disaster reconstruction. At the same time, domestic scholars have also developed some GIS software platforms with independent intellectual property rights, such as SuperMap, GeoStar, etc., which have made important contributions to promoting the development and application of GIS technology in China. However, most of the existing research focuses on the technical level and the application level, and there is relatively little research and practical exploration on the application of GIS technology in education. Therefore, this paper aims to fill this gap and explore the application value and implementation strategies of GIS technology in geological disaster risk assessment and disaster prevention planning education.

2. GIS Technical Foundation

2.1. Overview of the GIS Technology

Geographic information system (GIS) is a comprehensive system that integrates the theories and technologies of computer science, geography, surveying and mapping, and management science. It has powerful data collection, storage, management, analysis and visualization functions, can process a large number of spatial and non-spatial data, and through the map, charts and other forms of intuitive display results. The development of GIS technology provides a new perspective and method for geological disaster risk assessment and disaster prevention planning [1].

2.2. Application of GIS in Geological Disaster Risk Assessment

GIS technology plays a vital role in the risk assessment of geological disasters. Firstly, GIS can integrate multi-source data, including remote sensing images, topographic and landform data, meteorological data, historical disaster data, etc., to provide comprehensive data support for risk assessment. Secondly, GIS can identify geological disaster prone areas, danger area and potential impact range through spatial analysis function, providing scientific basis for risk assessment. In addition, GIS can also predict the occurrence probability and development trend of geological disasters through modeling and simulation technology, so as to provide decision support for disaster prevention planning.

2.3. Application of GIS in Disaster Prevention Planning

GIS technology also plays an important role in disaster prevention planning. GIS can help develop scientific and reasonable disaster prevention planning programs, including the establishment of disaster warning system, the site selection of emergency shelters, the planning of rescue channels and other related aspects. At the same time, GIS can also

evaluate the implementation effect of disaster prevention planning scheme through dynamic simulation and visual display, to provide a basis for the optimization scheme. In addition, GIS can also play an important role in the post-disaster recovery stage, providing strong support for the post-disaster recovery work by quickly obtaining the damage situation in the disaster areas and assessing the demand for post-disaster reconstruction [2].

3. Geological Disaster Risk Assessment and Disaster Prevention Planning Research

3.1. Geological Hazard Risk Assessment Process

Geological disaster risk assessment is a complex and systematic process, which mainly includes the following steps: Firstly, define the assessment target and scope, and determine the assessment objects and indicators; secondly, collect relevant data, including historical disaster data, landform data and meteorological data; then use GIS technology for data processing and analysis, extract key information; then, construct risk assessment model, calculate geological disaster risk index; finally, divide risk levels according to risk assessment results, and propose corresponding disaster prevention suggestions and measures [3].

3.2. Principles and Methods of Disaster Prevention Planning

The formulation of disaster prevention planning should follow the principles of scientificity, rationality and feasibility. Firstly, the characteristics and laws of geological disasters should be fully considered to ensure that the planning scheme is in line with the actual situation; secondly, we should emphasize the policy of prevention first and prevention and control, and strengthen the construction of disaster warning and monitoring system; in addition, the construction of emergency rescue team and material reserve should be strengthened to improve the ability to respond to emergencies. In specific methods, GIS technology can be used for spatial analysis and simulation to provide scientific basis for disaster prevention planning, and advanced experience and successful cases to improve and optimize the planning scheme.

4. Application and Exploration of GIS Technology in Education

4.1. Strategies of Integrating GIS Technology into Classroom Teaching

Integrating GIS technology into classroom teaching is one of the important ways to improve the teaching quality and effect. Teachers can guide students to use GIS technology to solve practical problems by designing relevant teaching cases and experimental projects, and they can also use GIS software for interactive teaching and demonstration operations to enhance students participation and interest. In addition, teachers can also encourage students to participate in scientific research projects and social practice activities, and apply what they have learned to practical work.

4.2. Practical Teaching of Geological Disaster Risk Assessment and Disaster Prevention Planning with the Assistance of GIS Technology

Practical teaching is one of the important links to cultivate students practical ability and innovation ability. By organizing students to participate in practical projects or simulation exercises of geological disaster risk assessment and disaster prevention planning, students can experience the effects and advantages of GIS technology in practical application. Meanwhile, it can also cultivate students teamwork ability and problem solving ability. In practical teaching, teachers should pay attention to guiding students to think independently and explore independently, and encourage them to put forward innovative ideas and solutions.

4.3. The Role of GIS Technology in Cultivating Students Comprehensive Quality

GIS technology not only has strong data processing and analysis ability, but also can cultivate students spatial thinking ability, data processing ability and the ability to solve practical problems. By learning and mastering GIS technology, students can have a deeper understanding of the principles and methods of geological disaster risk assessment and disaster prevention planning; at the same time, they can broaden their knowledge vision and thinking mode, and improve their comprehensive quality and competitiveness. Therefore, it is of great significance and value to introduce GIS technology in the educational field.

5. Case Analysis and Discussion

5.1. Case 1: Research on the Risk Assessment and Disaster Prevention Planning of Geological Disaster in a Certain Area

Take a region as an example, introduce the type, distribution characteristics and hazard degree of geological disasters in detail; then explain the process and method of geological disaster risk assessment using GIS technology; and finally show the specific content and implementation effect of disaster prevention planning scheme. Through the analysis and discussion of this case, the application value and advantages of GIS technology in geological disaster risk assessment and disaster prevention planning can be deeply understood.

5.1.1. Overview of the Study Area

A typical mountainous area in southwest China was selected as the study area. This area is located in the eastern edge of the Qinghai-Tibet Plateau, with complex geological structure and changeable climate conditions, and belongs to the area with high incidence of geological disasters. The main types of geological disasters in the region include landslide, debris flow and collapse. These disasters not only threaten the life and property safety of local residents, but also have a serious impact on the regional ecological environment and economic development.

5.1.2. Data Collection and Processing

In this study, we used multi-source data for a comprehensive analysis. Firstly, the topographic data of the region was obtained through remote sensing technology, including digital elevation model (DEM), slope map and land use map. Secondly, the regional historical disaster data were collected, including the time, place and scale of landslides and debris flows that occurred in the past. In addition, meteorological data, hydrological data and other auxiliary data were also collected. All the data are pre-processed and imported into the GIS system for unified management and analysis [4].

5.1.3. Spatial Analysis and Modeling

Using the spatial analysis function of GIS, we performed a detailed geological hazard risk assessment of the study area. Firstly, the geological disaster prone and high risk areas were determined by superposition analysis. Then, the network analysis function of GIS was used to optimize the layout of rescue channels and shelters. Finally, the modeling and simulation techniques predicted the possible geological disasters under different rainfall conditions.

5.1.4. Preparation of Disaster Prevention Planning Plan

Based on the risk assessment results, we have developed a detailed disaster prevention plan. The plan includes the establishment of a sound disaster early warning system, strengthening the construction of geological disaster monitoring and early warning capacity, and improving the emergency rescue system. Specific measures include setting up

monitoring stations, installing early warning equipment, formulating emergency plans and carrying out emergency drills. In addition, suggestions are put forward to strengthen community publicity and education and raise public awareness of disaster prevention.

5.1.5. Implementation Effect Evaluation

To verify the effectiveness of the disaster prevention planning program, we follow up and evaluate the situation after implementation. The results show that through the implementation of disaster prevention planning scheme, the occurrence frequency of geological disasters in the study area was significantly reduced, and the disaster loss was significantly reduced. At the same time, the community residents awareness of disaster prevention and self-rescue and mutual rescue ability have been significantly improved. This shows that the application of GIS technology in geological disaster risk assessment and disaster prevention planning has a significant effect.

5.2. Case 2: GIS Application Examples in University Geology Major Courses

Take geology course in a university as an example, introduce how to integrate GIS technology into course teaching; share students performance in the learning process and feedback on GIS technology; summarize the successful experience and practice through case teaching for other universities. Through the analysis of this case, some successful experiences and practices can be summarized for reference by other universities [5].

5.2.1. Curriculum Design and Teaching Content

In the course of geology major in a university, we integrate GIS technology into multiple teaching modules. The course includes basic map making, spatial data analysis, three-dimensional geological modeling, etc. Through practical case teaching, students can master the basic operation and application methods of GIS technology. In addition, we have invited industry experts to give lectures and exchanges to help students keep abreast of the latest industry trends and technology trends.

5.2.2. Students Performance and Feedback

In the course of course learning, students show strong interest and enthusiasm. They actively participated in class discussions and experimental operations, and actively consulted relevant materials and literature. Through the final assessment, it is found that the students high grades generally indicate that they have a good grasp of the knowledge they have learned and can flexibly apply it to solve related problems in practice. In addition, the students also said that they have not only learned how to use GIS software through the course. Moreover, more importantly, they have developed their spatial thinking ability and problem-solving ability, which will have a positive impact on their future study and work.

5.2.3. Successful Experience and Enlightenment

Through this case teaching, we have obtained the following successful experiences: Firstly, to combine theoretical knowledge with practical operation to enable students to learn and master knowledge in practice; secondly, to cultivate students innovative thinking and problem-solving ability to encourage them to propose their own opinions and solutions; thirdly, to strengthen the cooperation with enterprises and society to provide students with more practical opportunities and employment channels. These experiences have important reference significance for our future teaching reform.

6. Conclusions and Prospects

6.1. Study Conclusion

This study discusses the application of GIS geological disaster risk assessment and prevention planning in education with the following conclusions: Firstly, GIS technology can improve the accuracy and efficiency of geological disaster risk assessment and prevention planning; secondly, integrating GIS technology into classroom teaching can stimulate students learning interest and enthusiasm to improve their practical ability and innovation ability; finally, GIS technology plays an important role in cultivating tudents comprehensive quality to broaden their knowledge vision and thinking mode to improve their comprehensive quality and competitiveness. Therefore, we should strengthen the research and application of GIS technology to promote its wide application and development in the field of education.

6.2. Research Deficiency and Prospects

Although this study has achieved some achievements, there are still some shortcomings to be further improved and improved. Firstly, due to time and resource constraints, we need to further improve the accuracy and quality of data collection and processing to ensure the accuracy and reliability of the evaluation results; secondly, we need to further strengthen the cooperation with enterprises and society to provide students with more practical opportunities and employment channels; finally, we need to constantly update and improve the content and methods of teaching to meet the rapidly developing technological needs and social changes. In the future, with the continuous development and improvement of GIS technology, it is believed that its application in geological disaster risk assessment and disaster prevention planning education will achieve more remarkable results and make greater contributions to the safety and development of human society.

In summary, GIS technology plays a crucial role in geological hazard risk assessment and prevention planning. Through spatial analysis and data management, GIS not only improves the accuracy and efficiency of assessments but also provides a scientific basis for formulating effective disaster prevention and mitigation strategies. The field of education should emphasize the integration and application of GIS technology by incorporating it into curricula, offering practical training, and organizing extracurricular activities to cultivate students' spatial thinking and data processing skills. This will prepare professionals for future fields such as geology, environmental science, and disaster management. Future research needs to further explore new applications of GIS technology and optimize its implementation strategies in education to fully realize its potential in disaster risk management.

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