Analysis of Digital Map Application for Middle School Geography

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Abstract: This study investigates the application of digital mapping in middle school geography education, addressing the limitations of traditional map teaching methods and the potential of digital maps to enhance geographic learning. Traditional map teaching struggles with outdated data, information overload, and lack of engagement, hindering the development of students' geographic skills. In contrast, digital maps offer real-time updates, diverse presentations, and interactive capabilities, significantly improving the educational process. Through surveys of teachers and students, this paper explores the current use, benefits, and challenges of digital mapping in schools, highlighting the necessity for tailored educational materials, software enhancements, and teacher training. The research underscores the importance of aligning digital map design with educational standards, cognitive development, and student engagement to foster a comprehensive understanding of geography.

1. Introduction

The role of maps in geography education has evolved with technological advancements, transitioning from traditional paper maps to digital formats.[1] Traditional map teaching methods are often criticized for their static nature and inability to reflect the dynamic changes in geographical information. This paper delves into the application of digital maps in middle school geography, examining how they can overcome the shortcomings of conventional methods. Digital maps, characterized by their up-to-date content, interactive features, and multimedia integration, offer a more engaging and effective learning experience. However, the transition to digital mapping in education is not without challenges, including the need for adequate software, training, and materials that align with educational goals. This study aims to analyze the current state of digital map usage in schools, assess its impact on teaching and learning, and identify strategies to maximize its educational potential.[2] Through this research, we seek to contribute to the ongoing discourse on enhancing geographic literacy and skills in the digital age, providing insights for educators, policymakers, and software developers.

2. The Disadvantages of Traditional Map Teaching

2.1. Shortcomings in map production

Traditional paper map teaching materials are difficult to update in a timely manner, lagging behind the changes in geographic information, and have poor updating ability; The overload of map content information makes it difficult for students to understand and master it in a short period of time, which affects their interest in geographical knowledge; Flat maps lack interest and a single presentation format is difficult to stimulate learning motivation. These deficiencies have constrained the development of geography education, making it difficult to meet the requirements of the new curriculum reform and the new college entrance examination for improving students' geography abilities. It is urgent to explore new forms of map teaching.

2.2. Problems for Teachers in Traditional Map Teaching Process

Influenced by exam oriented education, teachers often use experiential teaching methods to guide students in observing and reading map information, and train their thinking abilities. Under this teaching mode, students can improve their short-term grades, but lack interactive fun, passively receive knowledge,

and it is difficult to truly understand complex geographical concepts. They cannot meet the requirements for solving geographical problems, which is not conducive to learning geographical knowledge in the long run. At the same time, students are prone to develop a sense of boredom, feeling physically and mentally exhausted from hard memory patterns, which affects their learning attitude.

3. The advantages and characteristics of digital map teaching

3.1. Concept and advantages of digital maps

Digital maps are the digital existence and representation of paper maps, which are discrete data sets of ground features and phenomena with determined coordinates and attributes within a certain coordinate system. They can be presented and operated on computers.[3]

Digital maps have the following advantages: firstly, they can be updated at any time to ensure consistency with the actual situation; Secondly, it can present various forms such as flat, three-dimensional, and satellite imagery to enrich the representation of geographic information; Thirdly, it can be combined with multimedia to expand the scientific nature of geography; Fourthly, it has interactivity, allowing users to intuitively experience changes in geographic information, which is its biggest feature.[4]

3.2. Educational functions of digital maps

Digital maps stimulate students' interest in learning in teaching, providing various visual effects and interactive experiences, such as satellite image maps and game like segments, allowing students to explore in depth in virtual geographic scenes. This multi angle presentation method enriches the learning experience and makes geographic knowledge lively and interesting. By integrating interdisciplinary resources such as geography, history, and culture, digital maps broaden students' knowledge and enable them to obtain diverse information while observing maps, thereby increasing opportunities for interdisciplinary learning. Digital maps also enhance students' geographical core literacy by visually displaying concepts such as terrain, climate, and population, promoting their spatial imagination and data analysis abilities. Meanwhile, by providing real-life geographical problem scenarios, digital maps help students understand various features and changes of the Earth, cultivating their geographical concepts and practical abilities. For teachers, digital maps provide a platform for information-based mapping, utilizing GIS software for spatial analysis and thematic map production, improving their mapping skills and data processing capabilities.[5] Through these tools, teachers can more effectively manage teaching resources, create meaningful learning experiences, while reducing the technical difficulty of drawing and improving teaching efficiency.

3.3. Application of Digital Map Teaching

Digital geographic map teaching relies on advanced hardware and software resources to promote innovation in teaching methods and improve learning outcomes.[6]

Interactive electronic whiteboard, as the hardware foundation of digital map teaching, integrates electronic induction whiteboard and operating system, replacing traditional blackboard, providing teachers and students with a clear and intuitive viewing and interactive platform. This technology not only improves the visual effects of teaching, but also promotes the development of interactive and diverse teaching through tools such as electronic induction pens.

In terms of software, ArcGIS, as a professional geographic information system software, provides rich map making, geographic data management, and analysis functions.[7] It can handle multiple data types and support the creation of complex geographic models and thematic maps, making teaching more vivid and practical. Through these functions, teachers and students can deeply explore geographical phenomena, analyze data, establish models, and deepen their understanding of geographical laws.

Tiantu, as a national level geographic information public service platform, provides comprehensive basic geographic data and map services.[8] It provides rich resources for teaching, such as administrative divisions, landforms, transportation and other data, supports interactive queries and explorations, and helps students more accurately understand and process geographic information. At the same time, its open data interface also provides possibilities for teaching innovation and curriculum development of digital maps.

With the development of mobile technology, mobile digital map software has become an important

component of digital map applications. This type of software is not only convenient to use, but also integrates rich multimedia information, such as real-life images, videos, etc., providing students with real-time geographic information and a scenario based learning experience. Through these tools, students can engage in in-depth geographical exploration, such as terrain analysis and visualization of geographic data, enhancing the interactivity and practicality of learning.

4. Survey on the Application Status of Three Digital Maps in Middle School Geography Teaching

4.1. Questionnaire design

To gain a deeper understanding of the application and needs of digital maps in middle school geography teaching, this study designed two sets of questionnaires for teachers and students. The investigation is scheduled for five days from March 1st to March 5th, 2024. The student questionnaire was distributed to a total of 200 first and second year high school students in Cangnan Middle School, and the teacher questionnaire was distributed to a total of 18 geography teachers in the school.

4.2. Analysis of Teacher Survey Results

The purpose of the teacher survey questionnaire is to understand the frequency, reasons, effects, difficulties and opinions of teachers using digital maps in geography teaching. The questionnaire was designed to be anonymous, with a total of 18 responses collected and 16 responses effectively collected. The teacher's understanding, usage, application methods, and expectations of digital maps are presented in the form of charts.

4.2.1. Understanding and Use of Digital Maps by Middle School Geography Teachers

The research results indicate that with the popularization of Internet information, teachers in central and western China have a certain understanding of digital map teaching methods. Most teachers actively try to use digital maps, but most of them obtain resources in the form of copying digital maps on the Internet, with few self mapping analysis; A small number of teachers are more conservative in using digital maps, and they may not be familiar with digital map technology and lack a certain hardware infrastructure foundation. Overall, most teachers lack training on digital maps.

4.2.2. The application methods of digital maps by middle school geography teachers

From the results, it can be seen that 65% of teachers use digital maps to understand the latest map, population and other data; 35% of teachers conduct applications such as establishing relevant geographic models and designing geographic virtual scenes. At the same time, 55% of geography teachers affirm the teaching effectiveness of digital maps, and 37% of teachers hope that digital maps can improve students' spatial thinking ability, enhance their geographical core literacy, and promote the long-term development of their geographical abilities.

In the research on the application of digital map teaching, in response to the views and needs of teachers on the use of digital maps, the results show that teachers face various challenges in the application and lesson preparation process of digital maps. Language barriers, copyright fees, and lack of appropriate training and technical support are the main problems that teachers encounter in digital map teaching. These issues limit the effective use of digital maps in teaching.

However, the popularization of electronic whiteboards and other technological devices has provided infrastructure support for the use of digital maps, demonstrating the potential and development prospects of digital map teaching. Therefore, researching and developing digital map resources that meet the needs of middle school geography teaching, as well as providing necessary training and technical support for teachers, are of great significance for enhancing the application value of digital maps in education. Solving the above problems can not only improve the teaching efficiency and quality of teachers, but also promote students' deep understanding and interest in geographical knowledge.

4.3. Analysis of Student Survey Results

The purpose of a questionnaire survey for students is to understand their exposure to digital maps in geography learning, their feelings and understanding after using digital maps, and their expectations and existing problems for future digital map teaching. A total of 100 questionnaires were distributed, 90 were collected, and 80 were valid. The survey results are as follows:

4.3.1. High school students' exposure to digital maps

Over 60% of students have some exposure to digital maps, which is also due to the development of information technology. Digital map software such as Google Maps has been introduced by schools, and the application of digital maps mainly focuses on the natural geographical parts that can be visually displayed, which helps to enhance students' spatial imagination and geographical thinking

4.3.2. The Learning Effectiveness of Digital Maps

Digital maps are not only applied in classroom teaching, but also in student homework. The data resources of digital maps have been further applied. From Figures 8 and 9, 80% of students believe that digital maps help them understand obscure geographical concepts and memorize geographical knowledge. Therefore, further exploring the teaching role of digital maps is of great significance.

4.4. Main Existing Problems

(1) The problem of map materials not matching the learning situation

The materials of digital maps may not be suitable for students' ability levels, leading to high or low difficulty and affecting learning outcomes. The solution includes teachers selecting appropriate maps based on the level of students, ensuring that the clarity and information content of the materials meet teaching needs. Software developers should provide rich auxiliary information and interactive features, such as mouse hover prompts and click pop-up instructions, to enhance the educational value of maps.

(2) The problem of inconsistency between map materials and teaching content

Map materials sometimes fail to cover teaching priorities or lack specific information, which affects teaching effectiveness. Teachers should create or screen map materials that match the teaching content, use map editing software or GIS platforms to customize maps, and ensure the relevance and applicability of the content. In addition, collaborating with geographic information professionals to customize teaching maps can better meet teaching needs.

(3) The problem of lack of sinicization and usage instructions in digital map software

Many digital map software lack sinicization and have unfriendly operating interfaces, which brings difficulties to teaching. Schools and teachers should seek software localization solutions, such as collaborating with developers or using third-party localization tools.At the same time, schools should provide software training and operational guidance to teachers and students in advance to ensure the effective use of digital map tools in the teaching process.

5. Design of Digital Maps in Middle School Geography Teaching

5.1. Design principles

The application of digital maps aims to stimulate students' interest in learning, enhance their spatial imagination and ability to solve practical problems. The following principles should be followed during design:

(1) The principle of student subjectivity

Value the active participation of students and respect their opinions and choices. Teachers should design interactive digital map learning activities that allow students to explore independently and choose different types of maps based on their learning style. In the classroom, teachers should encourage students to actively ask questions and provide feedback, establish an interactive learning environment, and promote students' learning enthusiasm and sense of responsibility.

(2) Adhere to curriculum standards and teaching objectives

The teaching design should comply with the high school geography curriculum standards, ensure that the digital map content matches the textbook information, and maintain the coherence and accuracy of knowledge. The use of digital maps should be in line with the teaching outline, unfolded in chapter and logical order to ensure the organization and effectiveness of teaching.

(3) Conforming to the laws of student cognitive development

Classroom design should be based on students' cognitive level and learning needs, and adopt a

teaching strategy from shallow to deep. When selecting or creating digital maps, teachers should consider their difficulty, information content, and presentation style to adapt to the cognitive development level of students. Diversified teaching resources, such as charts, images, and videos, should be integrated into teaching to meet the diverse learning styles and cognitive needs of students.

(4) Concise and clear

Digital maps should avoid information overload, and images, symbols, and text explanations should be concise and clear. Teachers should screen or design clear and understandable map materials to reduce students' cognitive burden, avoid unnecessary confusion or misunderstanding, and help students focus on the core content of learning

5.2. Teaching process design

5.2.1. Teaching Method Process

The geography teaching assisted by digital maps follows the following process: using maps for entry, thinking about reading maps, analyzing maps for exploration, and using maps for transfer. This process aims to gradually guide students from basic map understanding to in-depth geographic analysis and application, in order to better utilize digital maps to support teaching.

5.2.2. Teaching Method Analysis

(1) In order to enter the country

Classroom begins, introducing new topics through vivid digital maps in the form of videos or animations. Teachers can choose engaging content, such as popular tourist destinations or urban landscapes, and set exploration tasks based on teaching objectives to stimulate students' interest and enable them to quickly integrate into the learning environment. At the same time, by combining real-life geographical problems and cases, students can establish a connection between practice and theory, deepening their understanding of geographical concepts.

(2) Reading pictures and thinking

Next, let students deepen their understanding by reading digital maps related to the textbook. Teachers should ask questions based on students' cognitive level, guide them to organize information, and establish spatial thinking. By utilizing the visualization function of digital maps, abstract geographical phenomena can be transformed into intuitive images or videos, helping students reduce the difficulty of understanding and laying a foundation for further learning.

(3) Analysis and Exploration of Graphs

At this stage, students apply the knowledge they have learned to conduct in-depth exploration. Teachers ask questions, while students analyze different layers of digital maps, compare relevant geographic information, and identify trends and patterns. This method promotes collaborative learning among students and enhances their ability to analyze data and solve problems.

(4) Use graph migration

Finally, according to the New Geography Curriculum Standards, students need to use geographic information technology to observe and describe geographical phenomena, and collect and analyze information. At this stage, teachers provide practical geographical problem scenarios, and students use digital map tools to conduct comprehensive analysis and summarization. This not only enhances students' ability to apply geographic information technology, but also deepens their understanding of geographic issues.

Through this series of processes, the application of digital maps in middle school geography teaching can effectively enhance students' learning motivation, analytical ability, and practical application ability, laying a solid foundation for their geography learning and future geography practice.

6. Conclusion

Through analyzing literature and questionnaire survey results, we have learned that with the widespread use of electronic whiteboards and the improvement of geographic information technology capabilities among normal university students, the application of digital maps in China is constantly expanding. The widespread application of digital maps heralds a change in teaching methods and design

patterns. It is changing the way teachers and students receive geographic information, which is of great significance for improving students' geographic literacy and teachers' computer skills.

This study reveals the advantages of digital maps in middle school geography teaching by analyzing the limitations of traditional map teaching, including real-time, visualization, diversity, and interactivity. These characteristics make digital maps outstanding in presenting geospatial information, displaying multiple map types, and expanding subject knowledge. They can significantly stimulate students' interest in learning, broaden their knowledge horizons, and enhance their core geographic literacy. Therefore, the research on digital maps in middle school geography teaching has important value.

The survey results indicate that traditional paper maps are no longer sufficient to meet the learning needs of current students and cannot achieve the goal of comprehensive development of students. Although teachers and students have expectations for digital maps to play a greater role in future teaching, problems such as incomplete development of digital map software, lack of timely supporting measures, mismatch between teaching materials and actual teaching needs, and insufficient computer skills training for teachers are still challenges that need to be addressed in the application of digital maps.

When designing digital maps for middle school geography teaching, the following principles should be followed: Teachers should fully respect the subjectivity of students, encourage them to actively participate in the learning process, strictly adhere to teaching curriculum standards and goals, and choose textbooks that match the cognitive development of students. Moreover, teachers can utilize the various functions of digital maps, such as videos and dynamic images, to effectively assist teaching and make geographic knowledge more vivid and understandable.

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