

Application of Beidou Navigation System in Middle School Geography Education

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ABSTRACT. *Beidou Navigation System is a satellite navigation and positioning system developed by China. However, the current education of middle school geography has not involved the Beidou Navigation System in China. This paper analyzes the feasibility of introducing the Beidou Navigation System into middle school geography education from the perspectives of teachers, students, technology and policy. By analyzing the advantages of Beidou in middle school geography education, this paper puts forward four practical teaching methods, including classroom teaching, field visit, experiment teaching, and scenario simulation. It provides new learning ideas to middle school students in learning geographic information technology courses and new teaching reference for geography teachers.*

KEYWORDS: *Beidou Navigation Satellite System, Middle school geography, Geographic information technology*

1. Introduction

China built the Beidou Navigation System, which is one of the four major navigation satellite systems in the world. It can achieve high-precision and high-reliable positioning of all-weather and all-day time and provide navigation, timing and short message communication functions [1].

In the middle school geography education in China, Geographic information technology is one of the knowledge modules that students need to master. However, in the current geography textbooks, the navigation and positioning system refers to the global positioning system of the United States (GPS). Compared with that of GPS, the education of middle school geography has not widely used the Beidou

Navigation System. With the development of the global navigation satellite system technology, the Beidou Navigation System has been gradually improved and used in the fields of transportation, marine fishery, disaster prevention and reduction, weather forecast, correspondence, and so on. By 2020, it will complete global networking to provide services to worldwide users [2]. The completion of the Beidou Navigation System marks the passing of the era of GPS dominance. Although some researchers believe that exploring the application of the Beidou Navigation System in middle school geography teaching can promote the integration of geographic information technology and daily geography teaching better [3], there is a lack of practical guidance for classroom teaching. This paper analyzes the feasibility and advantages of introducing the Beidou Navigation System into middle school geography education and put forward corresponding practical teaching methods. As a teaching aid, adding the knowledge of the Beidou Navigation System into the geography education of the middle school can make the students master the more knowledge of geography, and improve the science and technology quality and practical ability of middle school students in an information-based classroom.

2. Analysis of the feasibility of the Beidou Navigation System to assist middle school geography teaching

Beidou Navigation System is an independent intellectual property technology owned by China, and its improvement also marks that China is moving towards self-reliance in the navigation field. Therefore, it is necessary to introduce Beidou into the geography teaching of the middle school in China. This paper analyzes the feasibility of adding the Beidou Navigation System into geography teaching in middle schools from four aspects:

2.1 Students' levels

In the early 1990s, the curriculum of primary and secondary schools in China had gradually incorporated computer teaching. Because of the development of computer courses, each student has some basic computer knowledge and skills, and this also provides a good premise for the application of the Beidou Navigation System in the teaching of geography courses in middle schools [4]. Geography is not a favourite subject among all the students. With the improvement of social and economic conditions and the change in people's concept of career choice, more and more college students choose to be a teacher. Therefore, the teachers' age structure is younger. Compared with the older generation of teachers, young teachers are more receptive to new knowledge, new concepts, and new skills. They have no fixed teaching models and strong plasticity, and can better adapt to the new mode of modern teaching, which provides an essential objective condition for the better popularization of the Beidou Navigation System in the geography education of middle school.

According to the ministry of education in 2008 revised "Professional ethics for primary and secondary school teachers", lifelong learning is a fundamental quality

that primary and secondary school teachers must possess [5]. For middle school teachers in the new era, they should advocate the scientific spirit, establish the concept of lifelong learning, enrich their knowledge reserve and update their knowledge structure. Therefore, the teachers' explanation of geographic information technology only stays in the current theoretical explanation, the content of the textbook is scripted and copied mechanically, and this not only leads to students' inability to understand geographic information technology such as satellite navigation and positioning, but also fails to stimulate students' interest in learning geographic information technology.

2.2 Technology levels

In 2000, China built the Beidou Navigation Test System, making China the third country in the world with autonomous satellite navigation system after the United States and Russia [6]. After 14 years of rough exploration, the Beidou Navigation System was officially incorporated into the global radio navigation system by the United Nations in 2014, and this is a symbol of Beidou's acceptance worldwide. Beidou Navigation System will provide navigation, positioning and timing services for Asia and the world in the future. Meanwhile, Beidou's unique services such as short message and inter-satellite communication will also bring new application opportunities [7]. So, as the technology has matured and perfected, China's Beidou Navigation System is going to be an integral part of the middle of a high school geography education.

2.3 Policy levels

In 2013, General Secretary Xi Jinping put forward the "One Belt And One Road" strategic concept of building the "new silk road economic belt" and the "21st century maritime silk road" respectively, the Beidou Navigation System has brought a lot of convenience to people in countries along the "One Belt And One Road" [8]. From the perspective of the land, many countries along the "One Belt And One Road" route are not able to build their satellite navigation and positioning systems due to the limitations of national strength. Currently, the BDS has begun to provide navigation services for these countries. From the sea, the "One Belt And One Road" strategy radiates to the western Pacific, South Pacific, northern Indian Ocean, the Mediterranean Sea, and the eastern Atlantic Ocean, etc. According to different needs, the Beidou Navigation System can provide customized services, such as marine vessels, cross-border transport, fishery management, port clearance, and so on, to serve the economic development of all countries in the world. The BDS now covers nearly 30 "One Belt And One Road" countries and has a population of nearly 2.7 billion. The construction of the BDS and the promotion of the "One Belt And One Road" strategy are mutually beneficial and win-win, the Beidou Navigation System provides navigation services for countries along the "One Belt And One Road" route, "One Belt And One Road" added ground monitoring stations to the BDS to improve the accuracy of the BDS navigation system. Therefore, China has included "Steadily

promoting BDS to go global" in the "One Belt And One Road" strategic plan, which provides unprecedented development opportunities and a broad platform for the international development of BDS.

3. Analysis of the advantages of the Beidou Navigation System in assisting middle school geography education

GPS is a navigation and positioning system developed by the U.S. government in the 1970s. Since its advent, GPS has been the first in the civilian areas [9]. As a dark horse, China's Beidou Navigation System started late. At present, the Beidou system has occupied a considerable market share [10]. Beidou Navigation System has the following advantages in assisting secondary school geography education.

3.1 Independent research and development, rapid positioning

Beidou Navigation System is that it is independently constructed and operated by China. It provides users in the service area with all-weather and real-time positioning services, and its positioning accuracy is equivalent to GPS. Although GPS is free for both civilian and commercial use, the GPS does not have an open code on the military side. Information warfare is the dominant form of the 21st-century war, over-reliance on GPS will make satellite communications a great deal, so, in defence of foreign enemies and defence security, China also has to actively deploy its satellite navigation system, and only in this way can we ensure homeland security and people's happiness. Popularizing the study and application of the Beidou Navigation System is more conducive to Chinese students' acceptance of navigation knowledge and can stimulate students' desire to explore by mobilizing their emotional factors.

3.2 Short message communication services

A Special short message service provided by the Beidou Navigation System not only solves the problem of whether China has a satellite navigation system, but also combines short message and navigation. These Beidou's characteristics are not just a unique invention in the research field of Chinese navigation and positioning technology but also a significant advantage. The Beidou navigation system can not only locate, but also send location information to the outside world, and provide information to other people who want to inform. It solves the problems of "who", "what" and "where", and has critical civil and military value and broad application prospects. "Short message" is equivalent to the commonly used "short message". Even in the sea, desert and the wild where there is no communication network, users can use BDS terminals to locate themselves and send text messages to the outside world. Therefore, the use of the Beidou Navigation System will involve the fields of oceans, lakes, mountains and rivers, natural disasters and environmental protection in secondary geography education.

3.3 Compatibility and cost

The civil coding design of Beidou is consistent with GPS and compatible with GPS. It increases the number of satellites searched by users and improves positioning accuracy. Besides, concerning cost, although GPS is free for individuals in civil and commercial areas, the use of satellite signals is not free, and these costs are borne by enterprises. Beidou system also uses enterprise fees, but the price is the lowest, which significantly reduces the burden of using navigation services.

4. Application of Beidou Satellite Navigation System in the practical teaching of geography education at the middle school in China

4.1 Classroom teaching

4.1.1 Lecture on Beidou Navigation System

In order to let students fully understand the current situation and development of the Beidou Navigation System, the arrangements, such as the early satellite positioning technology, American GPS, Russia's GLONASS system, European Galileo system, China's BDS system (Fig. 1), and the comparison between the satellite navigation systems (Table 1), can be made when teaching.

The above arrangement explains the development process of navigation and positioning system and the background and development status of China's Beidou Navigation System. When teaching GPS, GLONASS and Galileo, the current state, advantages, and disadvantages of the system will be mainly discussed. When interpreting the Beidou System, the teacher should combine the policy of implementing Beidou System strategy, and explain that satellite navigation and positioning has been listed as a national strategic emerging industry.

At the same time, the teacher can introduce the latest developments of Beidou system satellite launching, the current operational status and the content of global service expected to be realized in 2020, so that middle school students can get the latest development information. The above lecture on the most recent development status of the Beidou Navigation System and the trend of integrated development, it enables students to have a comprehensive understanding of the technical application and dynamics of the Beidou Navigation System, and stimulates the interest of middle school students in the knowledge learning of the Beidou Navigation System [11].

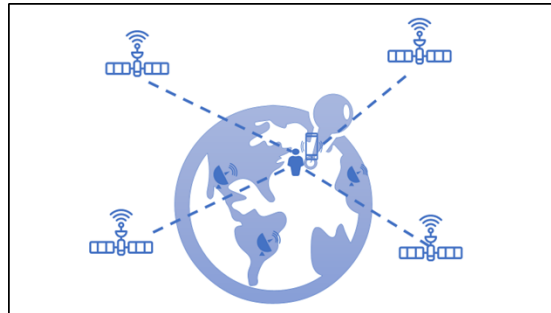


Figure. 1 Schematic diagram of the BD-2 planet orientation system

4.1.2 A lecture on the application of the Beidou Navigation System

Under the circumstances of national policy leading, sustained efforts of departments and active local policies, the Beidou Navigation System is emerging in China. Teachers can introduce the application knowledge of Beidou Navigation System, such as the traffic field, city gas, water supply and drainage, heat, electricity and other aspects into teaching so that students can have a deep understanding of the broad application market and development prospects of Beidou Navigation System [13].

4.2 Field visiting

Schools can organize students to visit the scientific research institutes to understand the construction of the Beidou Navigation System after class and invite scientific experts to popularize the Beidou's working principles for middle school students. Students can have a deeper understanding of the Beidou Navigation System, deepen their knowledge of the system, and feel the honest, rigorous and pragmatic working attitude. It also extends their horizon of geography, and cultivate the spirit of exploration and innovation while experiencing the progress of science and technology.

4.3 Experiment teachings

To enable middle school students to understand the working principle and the application of the Beidou Navigation System in a short time, geography teachers can use the mobile terminals (e.g., Beidou mobile phone, Beidou watch, and tablet), the school's teaching computer room, and other hardware facilities to arrange one class hour for the experiment teaching of the Beidou Navigation System. Before the experiment class, teachers can pre-send the user's instructions including Beidou Chip's Mobile Terminal, Beidou Satellite Information Platform operation instructions and operation demonstration videos to students for a preview, which lays a good foundation for practical operation. During class, the teacher first shows

students the Beidou Navigation System schematic diagram (Fig. 2). Taking four people as a unit, three members with mobile terminals arbitrarily select five points (five points should be more than 10 meters apart) and send location information to the receiver. The remaining member records the location information of the three people on the Beidou receiving platform. After the experiment, a group discussion is conducted. Teachers can ask each group of students to describe the working principle of the Beidou system and let students analyze the practical application of the Beidou system in life. Students can understand the Beidou system more intuitively through experiment teaching method, which not only cultivates students' learning interest but also opens up students' creative thinking.

Table 1 Comparison of the four major global satellite navigation systems [12]

Designation	Nation	Number of satellites	Feature	Application
GPS	USA	24	Orbital altitudes: 20200 km Orbit inclination: 55° Location accuracy: about 10m Constitution: Space part, ground Control system, user equipment part	Dual-use
GLONASS	Russia	24	Orbital altitudes: 19100 km Orbit inclination: 64.8° Location accuracy: Up to 1 m, with a Speed error of only 15 cm/s	Dual-use
GALILEO	EU	24	Orbital altitude: 23616 km Orbit inclination: 56° Location accuracy: The ground Positioning error is less than 1 m	More developed civil areas (e.g., free public services, commercial services, life insurance services, transportation, search and rescue services)
BDS	China	5 Geostationary Satellites & 30 Non-geostationary Satellites	Location accuracy: 10 m Speed accuracy: 0.2 m/s Timing accuracy: 20 ns	Dual-use, short message communication

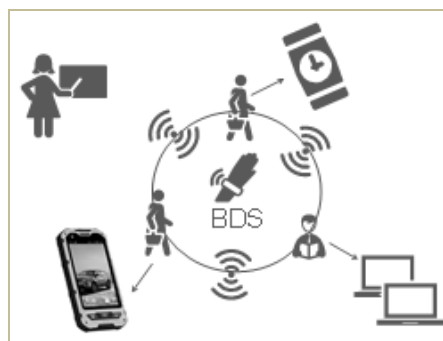


Figure. 2 Schematic diagrams of Beidou Navigation System experiment teaching method [14]

4.4 Scenario simulation

Middle school geography teachers can use the Beidou Navigation System to assist the field practice teaching of geography. Through designing the target route, teacher's point-by-point explanation, demonstration operation, and other forms, students can conduct field observation and investigation at once by utilizing the intelligent mobile terminals with the Beidou Navigation System [14]. For example, when teaching the section "Transportation Industry", the geography teacher can divide the class into groups. Each group should discuss and select the site on campus, and use the mobile phone equipped with the Beidou Navigation System to locate their selected point, then draw a simple map. After the field simulation, students are required to have a group discussion and summary, and familiar with the principle and method of Beidou Satellite Navigation and Positioning System. Then, teachers can guide students to apply this technology to the knowledge point of the transportation industry to understand the advantages and disadvantages of different modes of transportation. Students can reasonably choose different ways of traffic based on their different travel needs and positioning with Beidou (Fig. 3). The application knowledge of Beidou can effectively improve students' geographical level. Also, geography teachers can also apply the Beidou navigation technology to the teaching of aerospace, ocean, climate, map, agriculture, smart city, and other aspects.

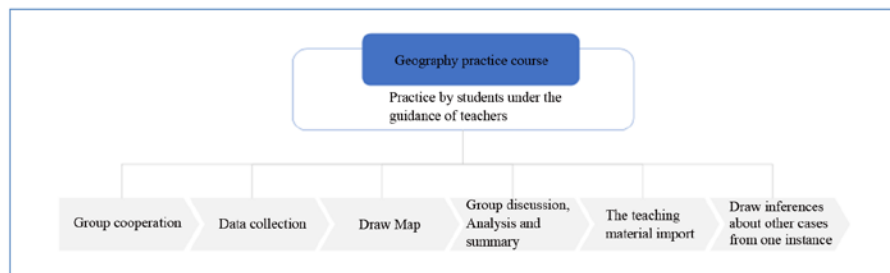


Figure. 3 Flow chart of situational teaching

5. Conclusion

To sum up, introducing the Beidou Navigation System into the geography education in middle schools not only has the corresponding foundation regarding technology and teachers and students but also conforms to the background of the "One Belt And One Road" policy vigorously promoted in China. Compared with the use of GPS technology, Beidou has the characteristics of independent research and development, featured SMS notification, compatibility and so on. Therefore, introducing the Beidou to replace the GPS in China's geography education is more conducive to the study of geographic information technology knowledge of Chinese students and stimulate their interest in learning geography science. The practical

exploration of classroom teaching, field visits, actual education, and scenario simulation also prove the feasibility and maneuverability of the Beidou Navigation System in middle school geography teaching. However, if the Beidou Navigation System is to assist middle school geography education to achieve the optimal effect, we also need to integrate teaching, practice and various learning activities into it, so that students can study something in the learning process.

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