Application of VR Technology to Geography Teaching in Senior High School under the Guidance of Core Competence
—Taking the Course of “The Development of Regional Economy” as a Case

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Abstract—The education of geography core competence is an important course promoted by international education nowadays, how to cultivate the core competence of geography has become a hotspot in geography teaching. It is of great significance to bring the new technology into teaching and its superiority into full play, which is significant to the cultivation of geography core competence. The interaction, immersion and intuition of VR technology bring funny and vitality to geography teaching, enhance the teaching effect, provide a new idea for geography core competence education. By the means of cooperative and explorative study as well as the links of initial roam, retrospect roam, analysis roam and integrate roam, the course of “The Development of Regional Economy” was taken as a case to conduct the teaching design, VR technology was applied to the teaching, and geography knowledge was contained in the panoramic roam in this paper, in order to change classroom teaching methods, fill up the blank of the school books, cultivate cooperative inquiry capacity and geography core competence.

Keywords—VR technology; core competence; geography teaching

I. INTRODUCTION

Core competence education is an important course of geography education in recent years. The 2016 International Charter on Geographical Education put forward that the geography gives core competence of the 21st century to youth. International organizations such as UNESCO, EU, OECD in the world attach great importance to the study of “competence”, and take it as the core to promote curriculum construction [1]. In China Senior High School Geography Curriculum Standard (2017 Edition), cultivation of the necessary geography competence of future citizens was also regarded as a vital goal of geography teaching [2]. How to cultivate the core competence of geography has become a hotspot in geography teaching. Meanwhile, the boom of VR technology and Internet provides the technical support for the innovation of geography teaching mode [3]. It is of great significance to bring the new technology into teaching and its superiority into full play, which is significant to the cultivation of geography core competence [4-5]. It is an innovative issue that how to introduce VR technology into the classroom and make it run through geography knowledge so that we can implement geography competence. Taking the course of “The Development of Regional Economy” as a case, this paper explored the application of VR technology to teaching under the guidance of core competence.

II. THE SUMMARY OF RELATIVE THEORY

A. Overview of VR Technology

VR technology is the virtual reality technology, a kind of computer system which can create a virtual world user can experience [6]. Based on the computer to establish a vivid virtual environment very similar to the reality environment, VR technology makes people experience reality environment by the use of natural skills and captures a great deal of people’s interests. Compared with traditional technology, VR technology is more interactive, immersive and intuitive and has many advantages.

Interactivity means that participants send a signal or input a command to the computer software system in the virtual reality technology by an interactive window, then the computer software system in the virtual reality technology receives the command or signal, and intelligently replies according to computer programs or shifts to another virtual world, which is superior to the 3D screen and is not passive information receiving or like performance watching. The interactivity of VR technology is not available in other new technologies, the application of it to teaching will make up for the deficiency of traditional teaching technologies.

Immersion means that the users seem to be personally on the scene when they experience the virtual world created by VR technology. This is because the interaction of helmet-mounted displays, controllers and computer systems in VR devices creates a virtual environment relatively independent...
from the outside world. Here users can achieve the effect of unification of the sense organ and the environment, and virtual environment changes with movement of head, eye, ear and body, which make people immersed in the virtual environment. The immersion of VR technology will vastly attract students’ attention in class and improve their learning efficiency.

Intuition means that users have a strong sense of intuition in the immersive experience, resulting in intuitive perception of high concentration, of which the reason is that the virtual reality system has all-round simulative sensory assembly, multi-sensory sensors such as visual, listening, tactile, kinesthetic and reaction devices that work cooperatively, so that users can obtain a variety of perceived experiences in the virtual environment. Intuitive perception is the first step of human cognition, which is helpful for students to memory of knowledge in teaching activities.

In recent two years, people’s attention to the application of VR technology has been increasing, with which the degree of acceptance has also been increasing. Initially, driven by the interest lever, VR technology was mainly applied to entertainment. With the improvement of technology, the simplification of its fabrication and the decrease of its cost, more people gradually turn to user from original viewer. As a result, its application range has expanded, the gravity of its application in the field of education has increased gradually. In Liaoning province, China, VR technology has been extensively used in the popularization of science, and the combination of VR technology with the popularization of science of the museum makes it funnier. Meanwhile, some geography teachers have demonstrated the advantages and disadvantages of VR technology applied to the teaching, and analyzed the application mode and the existing problems of the VR technology in the geography teaching theoretically [6-7]. However, they have not combined it with specific teaching examples, and the role of VR technology in the education of geography competence has not been explored.

B. Overview of Geographical Core Competence

In essence, the term “core” in the educational competence refers to a set of learning outcomes (skills or abilities), each of them should be obtained or displayed at the end of the study. It is a syncretism of many related concepts including core skills, core competencies, general skills and qualification. All these concepts are different from others, but they are all related to study achievements that supports further learning, employment, personal development and socialization [8-10].

China General Senior High School Geography Curriculum Standard (2017 Edition) took “cultivating the necessary geographical competence of future citizens” as the basic concept of geography curriculum [2]. The geography core competence is a general and professional expression of the value of geography education. It is the unity and refinement of the three-dimensional goal of knowledge and skill, process and method, emotional attitude and value. It is necessary character and key ability formed in or after the study of this course and expressed in solving the problems of real situation [11-12].

Geography is a study on the natural environment, physical environment and human environment of the earth [13]. Geography makes it possible to study human activities and their relationship from a local scale to a global scale. Although geography often serves as a bridge in the middle of the natural and social sciences, it is the only science concerned for spatial differentiation, such as the change of phenomena, events and processes in different places [14]. Therefore, it is an important part of the education of all the citizens of the whole society.

Geography core competence consists of human-land coordination value, comprehensive thoughts, region cognition and ability of geography practice [2]. Among them, region cognition is the basis of learning geography, because geography is a subject based on location and regional knowledge. Our appreciation of unique environment and conditions in the interconnected world can deepen our understanding of human diversity [10]. Geography focuses on the interaction between people and nature in specific places and locations, and on issues with strong geography thoughts, such as natural disasters, climate change, energy supply, population migration, land use, urbanization, poverty and identity, etc. It can be seen that the gradual cultivation of region cognition is helpful to the formation of comprehensive thoughts, comprehensive thoughts are dominant in geography learning, and dialectical and comprehensive comprehension will promote the establishment of human-land coordination value, a core value. Meanwhile, the use of comprehensive thoughts and region cognition is also a necessary way to understand the relationship between human and land in the practice of geography.

Region cognition is the foundation of geography teaching, of which necessity is determined by the spatiality and comprehensiveness of geography. In the past, the teachers used pictures, videos and Hands-on Inquiry Based Learning [11], a new teaching form that emerged in recent years, in training of region cognition and comprehensive thoughts. With the boom of “The Internet+”, the new technologies of teaching are providing a new thought for the cultivation of geography core competence [15-16]. The Interactivity, immersion and intuition of VR technology can enhance the teaching effect, so that the core competence can be implemented better. Thus, in this article, a panoramic roaming was made and introduced into geography class to put forward a new scheme that explore the geography core competence education.

III. CLASSROOM TEACHING DESIGN BASED ON VR TECHNOLOGY

The authors choose the chapter four, “The development of Regional economy”, in compulsory three of the China’s senior high school geography textbook, the northeast in China was selected in section one of this chapter to explore the region agricultural development, the section two selected the Pearl River delta to explore the industrialization and urbanization development. By studying these two cases, students can preliminarily understand the importance of geography conditions to development of regional economy and can put forward some measures for sustainable development of regional economy according to geography conditions. But this cases in this chapter do not expound the development of regional economy from the point of tertiary industry. In other words, the effects of geography conditions to development of
tertiary industry and the effects of tertiary industry to comprehensive development in the whole region are not involved. From the view of implementing the core competence, it is not conductive to the cultivation of students’ comprehensive thoughts. Therefore, authors selected the case “Comprehensive Development of Changbai Mountain area” as a supplement and applied the panoramic roaming, a new teaching technology, to enhance the effect of teaching. The specific teaching design is shown in Table I:

| Teaching Process | Teacher-student Activity | Design Intention |
|------------------|--------------------------|------------------|
| Lead-in (2 minutes) | In the section “Regional Agricultural Development—taking the Northeast in China as an example”, we can understand that agricultural area of the Northeast can be divided into three production areas: farming agricultural area, forestry area, specialty and animal husbandry area. In the northeast, where are forestry and special production area located in? (Great Khingan Mountains, Lesser Khingan Mountains and Changbai Mountain area) Next, we will use the panoramic roaming to explore the economy development of Changbai Mountain area. | As a result of the student’s thinking, it is connected with the knowledge gained from previous section to make a foundation for learning this section [17-18]. |
| Initial roaming (5 minutes) | The students take the VR glasses to watch the panoramic roaming of the Changbai Mountain showed by the Teacher | The panoramic roam consists of ten scenes, click the hotspots button to convert to the next scene, along with a voice explanation that can deepen understanding. The aims of ten scenes: 1) To make students experience the natural environment of the virgin forest in Changbai Mountain Nature Reserve and cultivate the ability of regional cognition. 2) To make students understand the transformation of management mode, the development of economy activities in Changbai Mountain Forest Farm, and understand the relationship between natural resources and economic development, and the relationship between ecotourism and human-land coordination [19-20]. 3) By realizing the transformation of Hongshi Forest Farm management, to understand the sustainable development of economy that respect nature, and the human-land coordination view, so that the comprehensive thoughts of geography could be cultivated. |

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Fig. 3. The stack channel of Hongshi Forest Farm scenic spot. (in development)

Fig. 4. Observation platform of Guangming Forest Farm

Fig. 5. Weird stone in the peak. (in development)
At the end of the roaming, please take off your VR glasses, recall what you saw, and talk about your feelings.

To realize the students’ response to the introduction of VR technology into the classroom [21].

- Strengthen students’ grasp of the basic knowledge of regional geography in Changbai Mountain area.
- Watching roaming again, students could change from novelty to understand, study and master the geography contained in the panoramic roaming by teachers [22].

| Review roaming (3 minutes) | At the end of the roaming, please take off your VR glasses, recall what you saw, and talk about your feelings. | To realize the students’ response to the introduction of VR technology into the classroom [21]. |
|---------------------------|----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| A group discussion based on the roaming analysis (5 minutes) | Watching the roaming carefully, groups discuss and complete the blanks below, last the representatives of each group show the results. 1. In a broad sense, Changbai Mountain involves ______, while, the narrow Changbai Mountain includes ______, which is the boundary of China and ______. 2. Changbai Mountain is the headstream of the ______, and Tumen River. 3. Changbai Mountain is an ______ volcano, is a giant compound volcano, the broad circular crater on top of the mountain had become a lake with water flowing into, that is ______. 4. The landform of Changbai Mountains is typical ______. It consists of basalt platform, basalt plateau and volcanic cone with the altitude rising. 5. The climate type of the main peak of Changbai Mountain is ______, in addition to the common characteristics of the mountain climate, there are obvious vertical variations. in general, the winter is long and cold, and the summer is cool and short. 6. ______ is the highest and largest volcanic lake in China and the deepest inland lake in the world. 7. The main characteristics of tourism resources of Changbai Mountain are: ______. 8. Changbai Mountain forest farm management has been successfully transformed, the traditional cutting of tree has converted to ______. Hongshi Forest Farm mainly has some economic activities, include ______. 9. With the development of tourism in Changbai Mountain, Erdaobaie Town has had many changes, include ______. | - In order to fill up the blank of the overall tourism development and traffic situation in panoramic roaming.  
- By analyzing these change features of the number of tourists, income of tourism and the traffic situation, students can understand the factors affecting the development of tourism.  
- Thus, students’ cooperative inquiry capacity and comprehensive thoughts can be cultivated [24-27]. |
| Cooperative inquiry based on roaming analysis (12 minutes) | Watching the roaming freely, reading the supplementary materials and completing the inquiry questions. Fig. 7. Statistical Chart on the number of tourists of Erdaobaie Town from 2006 to 2016 [23]. 1. Analyzing the features and reasons of tourist quantity change in Erdaobaie town. | - In order to fill up the blank of the overall tourism development and traffic situation in panoramic roaming.  
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**Fig. 6. Sample plot of Chinese Academy of Sciences.**
Analyzing the change features of tourism income in Erdanbaihe town, and evaluate the development of local tourism resources in combination with panoramic roaming.

Analyzing the current situation of traffic in Changbai Mountain protection and development Zone and the influence of traffic on local economic development.

Roaming Integration (15 minutes)
Each group draws the mind map of this lesson, taking the Changbai mountain area economy comprehensive development as the center. Mind map can train the continuity of thinking, help students to establish knowledge network and train comprehensive thoughts of geography [28-29]. At the same time, by the design of thinking map, students' innovation ability can be improved [30].

Assignment (2 minutes)
Looking for information and designing a tourism development project for Changbai Mountain area in combined with the tourism development in panoramic roaming.

To cultivate students' ability to study and deal with information by looking up data. The design of tourism project can help students to understand the development of tourism and region comprehensively. Learning this geography knowledge to apply it [31], and combine it with practice, so that students can improve their ability of geography practice.

IV. TEACHING REFLECTION
This course design applied VR technology to geography teaching creatively, and made it run through the whole lesson. It integrated geography knowledge of regional development into panoramic, and combined geography knowledge with social economic activities by roaming. According to the difficulty of the problem, groups discussion and cooperative inquiry was used respectively, so that students participated in the class activities more actively, then actively found problems and solved that. The design of each teaching link intended to cultivate the core competence of geography, and watching panoramic roaming in Changbai Mountain deepens students’ understanding to the area. Analyzing roaming by those links such as cooperative inquiry, comprehensive thinking, the concept of human-land coordination of students were trained. Geography education aims at cultivating geography competence of modern citizens, and learning geography well could solve the problems of modern life better. Therefore, this paper designed the homework of planning tourism project, intending to return the geography competence to human society and strive to complete the fundamental task: establishing virtue and building people, put forward by the curriculum reform.

V. CONCLUSION
To sum up, it is a basic idea to cultivate the necessary geography competence of future citizens, and the implementation of geography core competence is a vital goal of geography teaching today. How to implement geography core competence effectively is a question every geography educator is thinking about. VR technology is applied to
geography teaching, because it’s interactivity, immersion and intuition, broadens the knowledge field of students, enhances the teaching effect, brings funny and vitality to geography teaching, provides a new thought for geography core competence education, and promotes the implementation of geography competence.

VI. PERSPECTIVE

It is the responsibility of every geography educator to cultivate geography core competence of students. It is the direction of the geography workers to strengthen the professional ability, grasp the pulse of the development of science and technology, enrich the classroom teaching, and innovate the teaching method of geography competence. However, competence education still needs countless educators to make unremitting efforts and has a long way to go. It is hoped that competence education can be realized as soon as possible by the hard work of educators all over the world.

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