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# DEVELOPING SPATIAL THINKING SKILLS IN TEACHING GEOGRAPHY FOR THE 12TH GRADE STUDENTS BY USING GEOGRAPHY ATLAS OF VIETNAM

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**Abstract.** Spatial thinking skills are the bridge between the knowledge and experience of students with a new understanding of the regions. Based on previous studies of spatial thinking skills, this article offers some skills that are relevant to the 12th grade geography curriculum and can be developed by using Geography Atlas of Vietnam. They are: Analyzing and synthesizing geographic features on the maps, establishing spatial relationships of geography objects, comparing geography objects, reasoning, and explaining the geospatial issues. Practice these spatial thinking skills helps students to get better aware of space and more proficient in using spatial tools. We also give some teaching techniques using the Atlas to develop them.

***Keywords:*** Spatial thinking, teaching geography, maps, Geography Atlas.

## 1. Introduction

Spatial thinking is a cognitive process that can be developed by practicing thinking skills. S. Bednarz (2004) argues that spatial thinking skills are the combinations of spatial relationships and the use of mental maps. He identified 13 spatial thinking tasks and 16 processes using maps and GIS to understand spatial interaction [1]. Without the emphasis on geospatial technology such as S. Bednarz, P. Gersmehl (2006) focuses on understanding and using spatial concepts [2]. In another article [3], P. Gersmehl (2008) describes eight modes of spatial thinking, which are the combinations of concepts and skills. Aura, Region, Hierarchy, Transition, Analogy, Pattern, Association. C. Jarvis (2011) and T. Ishikawa (2006) offer groups of skills, from simple to complex and from cognitive to analytical, insightful and applied to human life [4], [5]. One key publication is the report of National research council (NRC, 2006). It defines spatial thinking as "a collection of cognitive skills comprised of knowing concepts of space, using tools of representation and reasoning processes" [6]. The NRC study emphasizes the use of maps and other tools to develop spatial thinking skills. Geospatial technology exhibits clear advantages in the development of spatial thinking [7], [8]. GIS helps students develop basic understanding of spatial thinking by reflecting, observing, comparing, and practicing skills [9], [10]. The author synthetics these studies, analyzes the 12th grade curriculum, and offers four spatial thinking skills. In each skill, the author describes some teaching ideas based on exchanges with other teachers and follows the learning progress of students in teaching geography. The author also analyzes the contents of Atlas to point out the link between the development of spatial thinking skills and the use of Atlas.

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# 2. Content

## 2.1. Contents of The Geography Atlas of Vietnam

Geography Atlas of Vietnam [11] is both a source of knowledge and an important teaching aid for teachers in teaching Geography. It is also an important studying material for 12th grade students because it offers them knowledge, practice skills and develops spatial thinking. Therefore, if teachers use Atlas, create situations, practice the skills, they can develop spatial thinking for students.

The atlas published in 2018 by Vietnam education publisher, presents general geography of Vietnam as well as its natural, population-social, economic sector and economic zone aspects. The common legend explained the symbols for the whole of the Atlas, which helps students to understand the content easily

The first page shows the administrative units of Vietnam and the position of Vietnam in Southeast Asia

The natural part describes the shape of the territory, the elements of the nature of Vietnam: geology, minerals, climate, land, rivers, creatures, and natural regions.

The following part analyzes in detail the socio-population aspects, showing prominent features of Vietnam population: scale, ethnic composition, growth, distribution, and labor use.

The third part provides detailed information on the Vietnamese economy. Page 17 highlights some economic indicators: scale, growth, structure, and distribution. Pages 18-25 provide information on the development, structure, distribution of agriculture, industry, and services. This is a great resource for teachers to teach students how to develop spatial thinking with these various sources of information.

The last part is the economic zone content. Each page is divided into two parts: the natural and economic map. At this scale, the content is more specific, more detailed. Thus, students can observe easier.

The last page - the Focal economic zones of Vietnam is about their place in comparison with the country, scale, structure, and distribution of each region and economic centers.

The structure of the atlas is quite similar to the 12th grade geography curriculum with the concepts, and economic sectors, economic zones divided. Each page of the atlas combines with the main map and the supplement map, the chart, the picture, the data table, which are rich sources to help students to analyze the current partition, distribution, and the development of the geography objects.

## 2.2. Spatial thinking skills in using maps

Based on the review of previous studies and the analysis of the 12th grade geography curriculum, the author identifies the following general spatial thinking skills. These skills are aimed at better understanding of the regions and expected to solve spatial problems. These will be illustrated clearly in the atlas, too.

- Analyzing and synthesizing geographic features on the maps. In order to analyze, students describe the distribution in space and the relationship between the objects on the map. The information is exploited in many ways: on each page and on combined pages. The ability of students creates different analysis results.

- Establishing spatial relationships of geography objects: The complex geographic relationships in the atlas are clearly, so students need to learn how to analyze them. The following are some general spatial relationships that are illustrated in the atlas: location of one object on a map, between objects in a one page map and between objects in some map pages.

- Comparing geography objects. The geographic comparison process identifies the similarities and differences between other objects or regions and then shows the prominent features of them.

- Reasoning, and explaining the geospatial issues. One of the important skills in study geography is asking questions. Students examine the distribution on the map, ask "why?" question, and find an explanation. The answer may be based on information available on the map or by reasoning. Due to different background knowledge, students explain the problem in different ways and get different results.

## 2.3. Developing spatial thinking skills by using the atlas

### 2.3.1. Analyzing and synthesizing geographic features on the maps

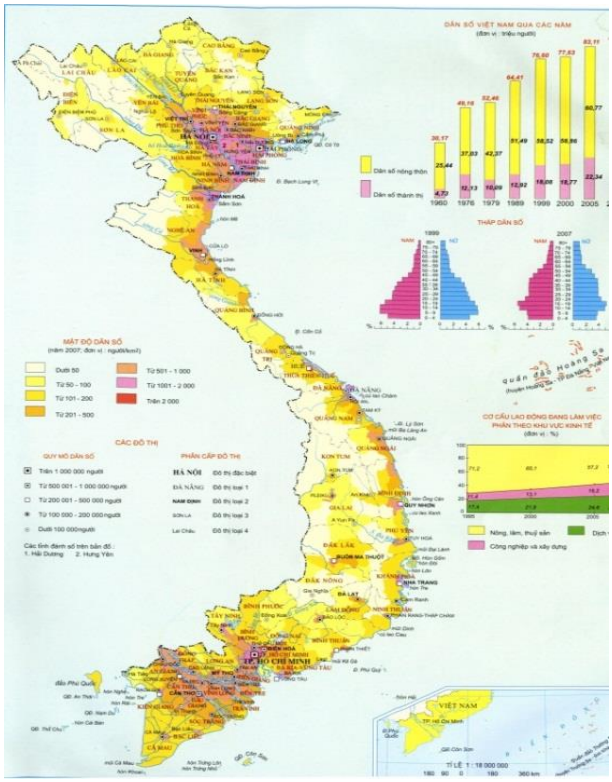


***Figure 1. Map of population of Vietnam, 2007***

The first task of understanding a particular map is analyzing visualize elements from the map to see whether any particular pattern will rapidly emerge or can be recognized. Considering the map Figure 1 taken from the atlas (P. 15).

Based on the ground color of the main map, students realize that the population is crowded in the delta areas and sparse in the mountain areas. Then, they read column charts to see the size and the growth of the population, read the age pyramid to see the population structure. After reading these simple elements, students should combine information from many maps to draw meaningful conclusions. For example: Combining the distribution of population and the distribution of resources, socio-economic development to find that the population distribution in Vietnam is not reasonable.

The different task of understanding maps is synthesizing the characteristics of geography elements and analyzing the relationships between them. Students focus on observing, analyzing

the geographic elements of a place and then, combine other elements or maps to find the relationship between them and conclude. Because of being a different task, exercise should be diversity, such as explaining, describing details, building relationship graph, and problem-solving.

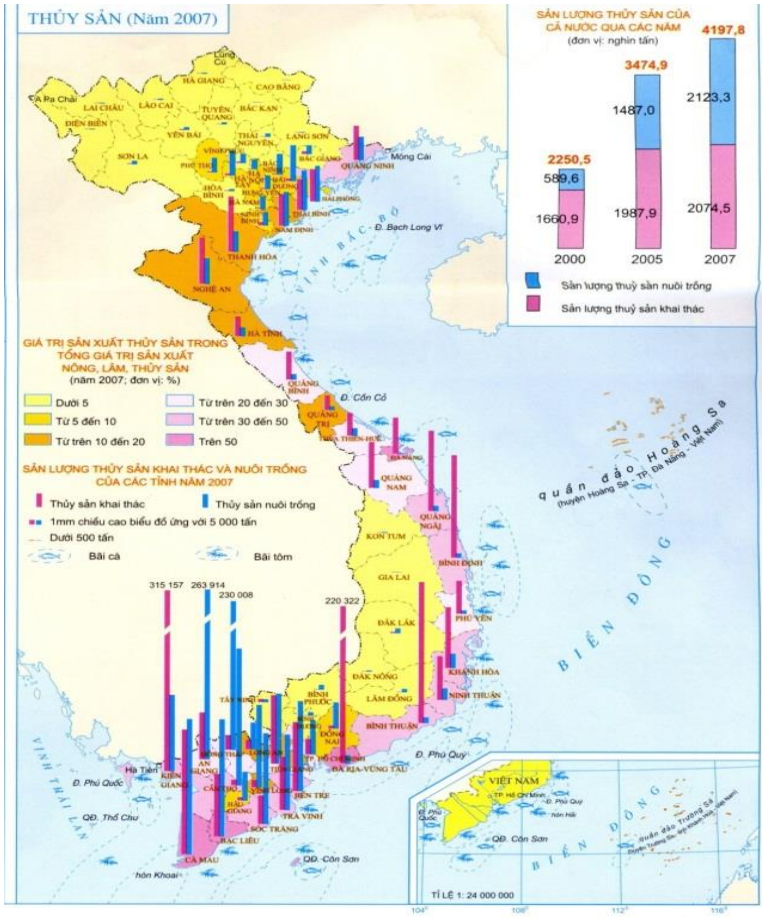


***Figure 2. Map of fishery of Vietnam, 2007***

Figure 2, a map, taken from page 20 of the atlas, shows the relationship in fishery between productivity and resource. If students read the legend carefully, they will get much information. It is easy to see that the fishery development locals are concentrated mainly in the South-Central Coast and the Mekong Delta. Combining the distribution of fishing grounds, fish-shrimp farms helps students to explain this. The fishery is concentrated in the coastal locals, in which, there are abundant aquatic resources and good fishing conditions. Thus, these areas are mainly exploiting seafood. Aquaculture is concentrated in areas, in which, there is large water surface of rivers and lakes mainly growing in freshwater and brackish water.

**2.3.2. Establishing spatial relationships of geography objects**

Being a specific skill of geography, the spatial relationship can be established by the process of analyzing, generalizing, and comparing territorial features.

To determine spatial relationship in one map, students can look for the links between different symbols, ground color and symbol, and ground color and cartodiagram. They ask themselves "where", "why", and "how" questions to determine the distribution and the links between objects.

To analyze spatial relationships thoroughly, students need to place objects in relation with natural and socio - economic elements. Thus, it is necessary to combine different maps. This skill, difficult to implement, requires students to have the ability to visualize mind patterns and knowledge of geography interrelationships, causality. Students need to understand the basic connections between geographic elements, such as topography with climate, river with climate, factor influence of economic sectors, etc.

By analyzing the relationship between geography objects, the students recognize the characteristics of regions. This is the first step for students to look for relationships between regions. They check the possibilities of natural or economic activity contact, by asking questions about the characteristics, strengths of the region, and the ability to contact within one region and between other regions.

**2.3.3. Comparing the geography objects.**

Comparing skill, popular in teaching Geography, requires students to master other skills, such as analyzing and reasoning.

Students analyze the characteristics of the objects or the regions to be able to seek comparison criteria. It is difficult for students to determine criteria. Because comparison process is not only the statistics of discrete features but also the synthesis of the characteristics of the object or the territory. For example, the criteria for comparing four mountainous areas of Vietnam are boundary, direction, altitude, specific characteristics, and some major mountains. This is also the content when analyzing the characteristics of any mountainous area.

The important task in comparison is to find out the characteristics of one object and distinguish it from other objects. From there, students will see the meaning of this region in comparison with other regions or the direction of exploitation and development of the region. For example, after comparing victuals production between the Red River Delta and the Mekong Delta, students conclude that the Mekong Delta is the first focal victuals zone of Vietnam with the specialization in rice and fruit, poultry, porks, and seafood.

**2.3.4. Reasoning, explaining the geospatial issues.**

The inference is a complex spatial thinking technique, involving geographic relationships. Students know how to synthesize knowledge and experience to find new issues or solve problems. The reasoning process is often associated with inferential questions. Some types of questions, included “how”, “how to”, “what… if”, are inferred from the information on the map. Teachers can ask more questions to test the students thinking such as: “What makes you think so?”, “How did you think?”, “What information do you rely on to answer?”. Such thinking questions will lead to many further discussions, stimulate students to think positively that the teacher can generate. Students will also be trained to look for geographic causes to solve the problems of the territory.

Figure 3, from page 27, shows two maps of natural and economic of North Central of Vietnam. Legend of the map is on page 3, for the whole the Atlas. Giving overview symbols can make many spatial questions.

- What are coastal economic zones? Border economic zones? These concepts, contained characteristics of location, cooperation, competition, and commercial activities, are the basis for inferring geospatial issues.

- What conditions to build these economic zones? Students analyze simultaneously factors about natural, historical, and the level of socio-economic development of the surrounding area to infer why these zones are located there.


***Figure 3. Maps of Nature and Economy of the North Central Coast of Vietnam, 2007***

- What will happen to the economy of North Central and Vietnam if these zones develop? What makes you so predictable?

Beyond reasoning and explaining based on direct analysis on the map, students need to be formed geospatial mental pattern.

- How are these new economic zones linked to industrial centers? Students create images in the minds of industrial centers, coastal and border economic zones and visualize the arrows that connect them. The length and the size of the arrows depend on the distance and connectivity. They can draw out their mental models on the paper and explain them.

- How should the North Central Coast develop infrastructure? Students continue to visualize the natural, socio-economic conditions of the North Central Coast and predict that routes should be built to connect these economic zones.

## 3. Conclusions

According to Bloom's taxonomy, the spatial thinking skills, presented in this article, are high order thinking. They suit with the goals of the geography 12 curriculum and can be developed by using the atlas.

Some notes when developing spatial thinking for students by using the Atlas are:

- It is necessary to carry out parallel training of knowledge and practice of thinking skills. Because knowledge is the foundation of thinking.

- The data and information in Atlas are old, but still significant for students to practice space thinking skills. Teachers should update new data to attract more students, inferences, analysis, and explanation closer to the current reality.

- These skills are not sequential but they depend on the content of each lesson. To maximize performance, in each lesson, the teacher should only select the most appropriate skill to train their students.

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