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Learning Materials to Increase Spatial Ability of Senior High School Students

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Abstract. There are five terms which are currently being discussed a lot to formulate their definitions, they are spatial intelligence, spatial ability, geography skill, geoliteration and ecoliteration. These terms are spoken by many people, but rarely explained the differences consistently. This research tries to identify or to be more exact suggests element or component of each terms and measuring one of spatial ability in everyday life. Research method that used was descriptive. Collecting data technique was by literature study, test, readability test of learning materials. Sample technique that used is stratified random with the amount of sample 120 people. Based on research results, spatial ability and geography skill can be increased normatively. Although this research only use learning materials to be read, but it was already proven to be helpful, especially if it is delivered through face-to-face meeting in the class, being practiced, and trained to students, the results will be more significant. Finally the researchers recommend that spatial ability and geography skill to be develop in case of preparing a generation that more positive in assesing the excellence of geography.

1. Introduction

There are five terms which are currently being discussed a lot to formulate their definitions, they are spatial intelligence, spatial ability, geography skill, geo-literation and eco-literation. These terms are spoken by many people, but rarely explained the differences consistently. In this paper were tried to differentiate those terms, namely:

- a. Spatial intelligence were identic with intelligence of space and visual intelligence. This intelligence are innate (fluid intelligence)[1]. People who has spatial intelligence are understand and able to think in visual form and interpretate it. In addition, they will looked responsive and easily carry out various complicated activities such as compiling puzzles, compiling legos, etc.
- b. Spatial ability [2] in many references has similar meaning with spatial intelligence that is mental ability in perceiving, saving, remembering, creating, changing, and communicating geometry. But, researchers are more agree to differentiate it with spatial intelligence. The difference is, spatial ability has the element of experience as a learning result because it belongs to crystalized intelligence [1] that experiencing enhancement along with human psychological development.
- c. Geography skill is a skill that being learned to understand geographical condition of a region through observation, descriptive, classification, mapping, and rational analysis. Geography skill is tend to be interpreted as skill of epistemological geography that was a research process to obtain an understanding of geography. Geography skills consist of five stages: (1) Asking Geographic



- Questions, (2) Acquiring Geographic Information, (3) Organizing Geographic Information, (4) Analyzing Geographic Information, dan (5) Answering Geographic Questions [3]. In this definition, geography skills are more likely to be interpreted as geographic epistemology skills.
- d. Geoliteracy or geography literacy or literacy of geography is an ability of people to understand geographical aspects such as location, place, relation, movement, interaction, and region to solve problems and makes them to has sensitive attitude towards themselves and environment, and could make a decision in geography things. Geo-literacy enables people to steer away from choices that will be costly themselves and others. Geo-literacy elements has three aspect, that is interconnection, interaction, and implication. [4]
 - e. Ecoliteracy is an ability to understand human postion in web of life. Ecoliteracy is a condition of people who has understand the ecological principles and life that appropriate with ecological principles in arrange and building life with humankind in the world and to manifesting sustainable community [5].

In this study, space intelligence takes distance from visual intelligence [6] [7] such as interpreting images, being sensitive to color, balance, and so on. Space intelligence in this context puts more emphasis on geographical skills that can read natural signs and awareness of changes in environmental conditions due to the presence and absence of certain elements of the environment. However, space intelligence cannot escape the ability to capture details from a visual object to understand its settings, make patterns, and match these patterns into a context [8]. People who have spatial visual intelligence are characterized by several things, namely: (1) can observe images in detail; (2) being able to easily imagine the form in his mind; (3) can pay attention to existing images from various angles so that they can recognize a particular location and place; and (4) tend to be imaginative and creative. Visual thinking consists of what we see, imagine or picture [9]. The space intelligence referred to in the study is closer to the opinion of Van Schaik Leon [10] who explains that spatial intelligence is related to the way individuals value the environment. The concrete form is an awareness of what is happening around someone, such as one's ability to be able to estimate the right strength and angle when kicking a ball in a soccer game. In Aboriginal people in Australia, they have landscape paintings (landscapes) around their environment that have similarities with the real world. In the picture seen the flow of water, the grazing of animals, drawing edible plants depicting paths of hunting, observing animals, and even spearing game animals. All of that is considered a visual intelligence.

Based on the above explanation, there are many similarities in terms. The difference in understanding and or definition of a term causing confusion for academic community, especially students. The confusion lies on the scope of study of each terms, therefore this research tries to identify or to be more exact suggests element or component of each terms and measuring one of spatial ability in everyday life.

2. Methods

The research method used was descriptive, which describes the concepts related to the object of research. The technique used is literature study, test, readability test of learningg materials. Literature study are used to describe differences in terms of intelligence, ability, and literacy. Tests are used to determine the effectiveness of learning materials about spatial ability, and readability tests are used to determine the feasibility of the developed learning materials.

Subjects of this research were Senior High School students who studied geography both in group of Social class and crossed specialization of Social Studies from Science Class. The sample technique used is stratified random with 120 people (see table 1). Data then being analyzed, specifically the test results will be analyzed with *Different Paired Test*. Analysis results will be conclude appropriate with the aims of research.

Table 1. Numbers of Research Subject for Feasibility Test of Learning Materials

No	School	Male	Female	Numbers
1	SMAN 1 Bandung	12	12	24
2	SMAN 2 Bandung	12	12	24
3	SMAN 4 Bandung	6	18	24
4	SMAN 20 Bandung	14	10	24
5	SMAN Cisarua	10	14	24

3. Results and Discussion

There were two research results that will be discussed, that is identification results of competence or scope of spatial intelligence, spatial ability, geography skill, geoliteracy, and ecoliteracy. Other results are result of effectivity test of learning materials the enhancement of geography ability and geography skill.

3.1. Competence of Intelligence and Ability of Geography and Environment

As its already explained that there are five terms which often confusing. To differentiate and formulate the definition, the most “wise” step is make the details in form of competence scope. This is the results of identification:

- a. Competence of spatial intellegence
 - Find the equivalent relation between images
 - Find the next image series
 - Find the images that was not a group
 - Find the shadow of mirror
 - Choose the appropriate image pieces
 - Find the objects after rotated
 - Find the objects from different perspective
- b. Spatial ability
 - Realize the place and time
 - Read symbol of maps
 - Choose a comfortable place for living
 - Prediction of social process occurrence
 - Skilled in the trip
 - Understand the fact of artifacts
 - Aware to the threat of disasters
- c. Geography skill
 - Observation
 - Describe descriptively
 - Classification
 - Mapping
 - Analysis
- d. Geography literacy
 - Understand the concepts of geography (location, place, distance, relation, movement, interaction, region, etc.)
 - Understand the objects of geography study (physical aspects and human aspects)
 - Understand the principles of geography (interconnection, interaction, dan implication)

- Skilled in using technology for geography analysis
 - Can utilize the science of geography in life
- e. Ecoliteracy
- Understand the environment components
 - Understand the principles of ecology
 - Understand the movement of energy and materials and the causative factors
 - Understand of population or species changes in different times and the factors that causing it
 - Understand the interaction between species of living things and interaction between living things and their environment
 - Understand the position as human in the web of life and environment
 - Care and could take care their environment

3.2. Test of Spatial Ability Learning Materials

One of the ways to increase spatial ability and geography skill of student needs learning materials. Learning materials that has been succesfully developed is spatial ability learning materials with the details of:

- | | |
|---|------------------|
| a. Realize the place and time | (7 competences) |
| b. Read the symbol of maps | (15 competences) |
| c. Choose a comfortable place for living | (12 competences) |
| d. Prediction of social process occurrences | (9 competences) |
| e. Skilled in the trips | (12 competences) |
| f. Understand the facts of artifact | (4 competences) |
| g. Aware to the threat of disasters | (13 competences) |

To identify the effectivity and readability, it has been conducted the tests in form of assesment instrument with respondents of Senior High School students.

3.2.1 Learning materials effectivity

Effectivity of learning materials and its excellences to increase the spatial ability. The method is by testing, that compare the results of pre-test with post-test with t-test. The results is quite significant that This results show that learning materials are feasible to use to add the knowledge and increase spatial ability of students, especially in Senior High School.

3.2.2. Readability test of learning materials

Data of readability test are obtained from research subjects that fill the research instrument. The results is descibed in table 2.

Table 2. Feasibility Test of Learning Materials

No	Statement	Scale			
		1	2	3	4
1	Linguistic aspects	22	135	252	71
2	Content aspects	5	96	272	227
3	Graphic aspects	5	63	174	118
4	Presentation of learning material aspects	3	53	213	91

4. Conclusions

Based on this research, spatial ability and geography skill normatively can be increased. The researchers assume that geo-literacy and eco-literacy also can be increased the ability step by step that appropriate with the age development. Although this research is only utilized learning materials as facility to increase the spatial ability and geography skill, but it has been proven that it was helpful, moreover if it delivered through the face-to-face meeting in class, being practiced, and being trained to the students then the results would be more significant. Finally from this research, researchers are recommend that spatial ability and geography skill have to develop continuously to prepare the better generation.

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