Sumatra Journal of Disaster, Geography and Geography Education, December, 2020, Vol. 4, No. 2, pp. 189-195
DISASTER, GEOGRAPHY, GEOGRAPHY EDUCATION http://sjdgge.ppj.unp.ac.id/index.php/Sjdgge
ISSN : 2580 - 4030 (Print) 2580 - 1775 (Online), Indonesia

EVALUATION OF THE QUESTIONS IN GEOGRAPHY TEXTBOOK TO PROMOTE HIGHER ORDER THINKING

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*Corresponding Author, Received: Aug 11. 2020, Revised: Sep 10, 2020, Accepted: Oct 12. 2020

ABSTRACT: Geography investigates issues and topics of the environment and people by using the spatial perspective. It requires the concept of space, using tools of representation and engaging a higher cognitive process. Therefore, it is necessary to evaluate the questions' cognitive level in geography textbooks, especially spatial thinking. Evaluation of spatial thinking does not sufficiently refer to Bloom's taxonomy because it does not identify the using tools of representation and various levels of spatial concepts as an important part of the reasoning. This research examines the distribution of questions in geography book for Senior High School in Indonesia by using Bloom's and spatial thinking taxonomy. It was found that the questions were mostly at the lower-order of thinking, which seems more intended just to recall and retrieval the information, and very few categorized as spatial thinking questions.

Keywords: Question, Bloom's Taxonomy, Spatial Thinking

1. INTRODUCTION

As often said in popular terms, the education curriculum needs to prepare students to face the era of the industrial revolution 4.0 of the 21st century. The Indonesian Ministry of Education had revised the elementary and secondary education curriculum in 2013. This latest curriculum stated explicitly requires students, such as: to be active in learning, to be able to learn independently, to bethink logically, to be critical, to be curious, creative, innovative, to able to collaborate, and to have the skills to solve problems. In short, the curriculum aspires to change the learning paradigm from result or product-oriented to action or process-oriented.

In Indonesia education, at the elementary and secondary levels, geography is a part of integrated social science and as a separate subject at the high school. Nevertheless, the concepts of geography as a part of social science in the curriculum 2013 has an important place because it became a study platform considering that all events and activities within the scope of social life are spatially interconnected. Hence geography concept functions as the framework for integrating the subjects of social science. At the next level in senior high school, it is expected that geography as a separate subject will be able to encourage students to learn at a higher level of thinking, especially to think spatially using spatial concepts and spatial representation tools.

After seven years since implemented, it is necessary to evaluate whether geography learning in high school has been able to encourage students to think on the higher-order level especially, to think spatially or at least have headed towards it. An important learning component to evaluate is the cognitive level of thinking questions in the textbook. Question is essential in guiding learning and enhancing the level of thinking [1]. In the learning process, the questions and exercises should invite students to review, think, use and apply knowledge and not only imparting information [2]. A good question is expected to invite students to think at a higher-order level and more deeply about a subject. A good question should prompt curiosity about the world, invite and challenge to think in a complex analysis process, involve big or essential ideas in a subject area [3]. Moreover, for the purpose of evaluating, as suggested by [4] the real content objectives can be revealed by the design of questions.

However, Wilen (1991) said that there is a gap between theory and practice of questioning. Theory suggests to ask higher-cognitive-level questions, but practice convincingly only demand lower-cognitive-level questions to recall

knowledge. Therefore it is necessary to evaluate the quality of the textbook's questions in encouraging students to think at a higher level, which also reflects the real content objectives of learning.

The object of study of this research is a textbook that is widely used by geography teachers in senior high schools.

The taxonomies used as the evaluation framework are Bloom's taxonomy in the cognitive domain (revised version) and the taxonomy of spatial thinking by Jo and Bednarz.

1.1 Bloom's taxonomy and its revision

The cognitive process framework commonly known and used as a reference in classifying and designing learning objectives is Bloom's taxonomy in its original version [5] [6].

This taxonomy represents a continuum of increasing cognitive complexity, and the knowledge dimension representing a range of knowledge from factual to more abstract. Bloom's cognitive process consists of six levels: knowledge, comprehension, application, analysis, synthesis and evaluation (see table 1). In the revised version, evaluation decrease one level and "synthesis" replaced by "create" (see table 2). There are also changes in the wording of the noun to the verb form. However, what the concept referred to has not changed significantly.

Table 1. Bloom's Cognitive Process Dimension

Cognitive process	
Knowledge	Recall information about facts, terms, basic concepts, or answers
Comprehension	Demonstrate an understanding of fact and ideas
Application	Using acquired knowledge to interpret a situation, provide an example, or solving the problem.
Analysis	Analysis of elements, relationships, and organization of information
Synthesis	Act of putting parts of information together to form a whole, composing or creating something new with the information
Evaluation	Requires students to presenting and defending opinions by making judgments about information based on a set of criteria or predict outcomes based on values

Table 2 Bloom's Cognitive Process and its Revised Version

Original version [5]	Revised Version [6]
Knowledge	Remember
Comprehension	Understand
Application	Apply
Analysis	Analyze
Synthesis	Evaluate
Evaluation	Create

1.2 Taxonomy of Spatial Thinking

[7] defines spatial thinking as a cognitive skill to structure problems, find answers and express solutions using the properties of space. According to [8], spatial thinking is at the core of geographic knowledge and a way of thinking that can be used to solve complex human and environmental problems.

The spatial thinking taxonomy consists of three components, namely the dimensions of the spatial concept, the use of tools of representation, and the process of reasoning [9] [10] [11]. Spatial thinking skills are essential in the field of geography [12]. Spatial thinking is not sufficiently evaluated by referring to Bloom's taxonomy because it can not be identifying the spatial dimension of tools of representation and concept of space. The following section describes the components of spatial thinking.

a. The concept of space consists of spatial primitives, simple-spatial, and complex-spatial. Location, specific place identity, and magnitude are elements of simple-spatial concepts. Simple-spatial concepts are derived from simple-concept like distance, direction, relationship, connection, movement, transition, boundary, region, shape, arrangement, and closeness. Finally, a complex spatial concept combines previous concepts such as distribution, pattern, distribution, grouping, density, diffusion, dominance, hierarchy, network, and spatial associations.
b. Tools of Representation. Representation is used not only for displaying spatial information input but also as a tool for processing information, evaluating, designing, discovering, imagining, generalizing, modeling, and others engage in higher-order thinking. The taxonomic framework created by Jo and Bednarz is a three-dimensional table with 24 cells. [13] simplifies Jo and Bednarz's model into a two-dimensional relationship matrix between the dimensions of spatial concepts and the dimensions of the spatial reasoning process by only including subject subjects using spatial representation tools that are considered to be spatial thinking

c. Spatial cognitive processes consist of three categories: input, process and output. The first level is receiving information. The next level is the activity of processing the information received. The highest level of spatial reasoning uses the information from the lower level to evaluate, predict, predict, make hypotheses, speculate, plan, make, design, discover, imagine, generalize, model, or apply a principle. This highest level is called the output level of reasoning.

Jo and Bednarz's matrix seems to emphasize the concept of space than the process of reasoning in order to classify spatial thinking. We reversed it to emphasize that the process of reasoning is more appropriate as a representation of the level of thinking. Questions that involve more complex-spatial concepts address the higher level of thinking. Hence, it is logical to place the spatial concept as a column and process of reasoning as a row to show the image of a hierarchical level. Output level (cell 7,8,9) involves a higher order of thinking than processing level (cell 4,5,6) and so forth (see table 2).

The reason to reverse the placement of column and row is to adjust to Bloom's cognitive process where the input level is similar to the remember and understand level, processing information to apply and analyze levels, and the output level to evaluate and create level. Second, considering that there are tendencies in textbooks' question in Indonesia to use questions contain complex concepts but just for recall information about it. The Spatial concept tends to be just a name to know than an idea involves in the reasoning process.

Table 2. Classification Matrix of Spatial Thinking

Process of Reasoning	Spatial Concept		
	Spatial primitives	Simple Spatial	Complex Spatial
Input	1	2	3
Processing	4	5	6
Output	7	8	8

1.3 Higher Order Thinking

[14] summarize the difference between lower-order thinking (LOT) and higher-order thinking (HOT). The former's main feature is the repetition or routine application and the mechanical application of previously acquired information. Thus the result of the learning is reproductive. Meanwhile, the latter relates to reasoning and challenges students to interpret, analyze and manipulate information, making productive learning. However, they said that teaching needs to involves both LOT and HOT, which are interweaving.

Associated with Bloom's taxonomy, it has become common that the first three levels (remember, understand, and apply) are classified as lower-order thinking while the next three levels (analyze, evaluate, and create) are on the higher-order thinking.

2. RESEARCH METHODS

The questions to be evaluated are in geography textbooks for class X, XI, and XII at senior high school (SMA/MA) published by Erlangga Press. Overall, there are 1,054 questions in the textbook.

The evaluation uses Bloom's taxonomy for all questions, and Jo and Bednarz's spatial thinking taxonomy for those that qualify to be considered spatial thinking questions.

There are two steps to identify spatial thinking questions. First, identify questions that have spatial concepts and set aside those that are not spatial concepts. Second, check whether the questions require the use of the spatial tools of representation. After that, questions that fulfill both requirements are placed in the right cell in the matrix to know its reasoning level (see figure 1).

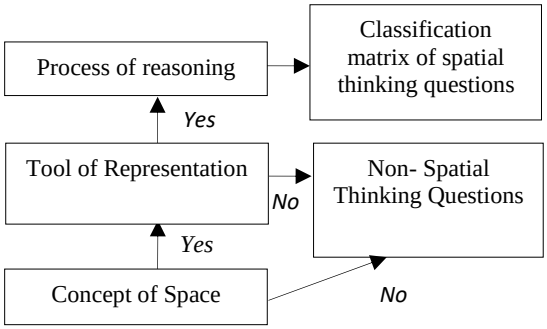

Fig.1. The process to identify and classify spatial thinking questions.

3. RESULTS AND DISCUSSION

3.1. Evaluate the level of thinking according to Bloom's taxonomy

More than three-quarters of questions (79%) in Bloom's category falls in the cognitive dimensions of remember and understand. Students are asked to recall and know various terminology, concepts, and information of the discipline. Questions at a more higher level, the apply level, are only 6%, While questions at higher-order thinking level (at the analysis, synthesis, and evaluation level) are only 16% (see figure 2 and table 3).

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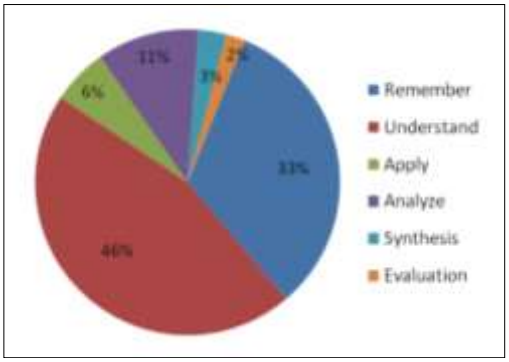

Fig. 2. Share of Question in Bloom's category (in percent).

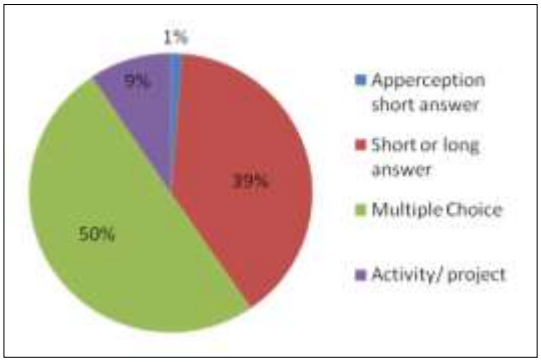

Fig. 3. Type of Question in Bloom's category (in percent).

It looks like the questions in the textbook is not sufficient to encourage students to think on higher levels. However, it needs to be considered cautiously. Questions referred to the level of the cognitive process are arranged naturally like a pyramid shape where those on the higher level are fewer in number. The question should be arranged sequentially, starting from simple to complex concepts and promoting LOT first and gradually increase to HOT level. This study did not analyze the questions' content and limited only to examine the distribution of questions between classes and then make interpretations.

It is expected that the higher the grades, the higher the proportion of the HOT questions. A concept or issue that integrates the other or previous one should provide more HOT questions because it generates more complex concepts and issues. However, it can be seen that the distribution of HOT questions in all textbook grade is almost the same, around 14-15 percent (see Table 3). Although the data are not shown here, the distribution of cognitive levels of questions in each book chapter's for every grade is also found almost alike.

[15] categorizes four approaches commonly used in organizing curriculum, namely: the chronological approach, thematic approach, part-to-whole approach, and the whole-to-part approach. Geography curriculum 2013 for senior high school level seems to fall into the type of thematic approach**.** The geography learning content is structured more as detached sections where one chapter is not so much connected to the other or built on what preceded. This type of geography curriculum arrangement may be the reason to explain why there is no accumulative increase in the number of higher-order levels of questions in geography textbook.

Table 4 shows the distribution of question types by location (during, before, and after instruction) in the textbook. A noticeable number of questions in the textbook are that most of the questions are multiple-choice types located both at the end of sections and the end of chapters.

The questions before instruction are used to evoke and focus students on learning. They mostly visualize the fact or information in the form of a photo. Students are asked to identify topics and issues related to it. A large number of questions are at the LOT level, as is expected.

Students are asked to answer short or long-type questions during the learning process, mostly in the form of short-type questions based on the previously provided material. Sixty-nine percent of this question is at the LOT level that asking students to recognize and recalling information.

There are questions with various types, namely multiple-choice, short or long answer, group and individual activity/project, at the end of sections and chapters. Almost all of the multiple-choice questions only asked the students to recognize and recall information, and a small part asked them to apply formula and procedures mechanically.

Similarly, for the type of short/long answer question. Four-fifths of questions at the end of each section and three-quarter at the end of the chapter only asked students to think at the LOT level.

The question in the type of activity/project is expected to be able to invite students to explore and integrate information. However, it is found that less than half of the total 99 questions addressed this aim.

Multiple-choice questions a bit redundant because both are found at the end of the section and the chapter. Along with that, the majority of those questions ask about facts or information located in the text. This suggests that the purpose of textbooks seems to be about knowledge acquisition. Similarly, we expected open-ended questions considering its structure would be more able to encourage thinking at a higher cognitive level. Nevertheless, the data shows the majority of question is on lower-order thinking as presented in table 4. There is more than 70 percent of the questions of this type. It seems targeted to retrieve or to understand information that is already given in the text.

Table 3 shows no significant change in the distribution of questions at a higher cognitive level

across chapters and classes. The percentage of HOT question at 10th, 11th, and 12th grade are 14%, 16%, and 15%, respectively. This indicates that the textbook's learning topics are not likely arranged sequentially but more treated as a separate material. Considering that the curriculum should be arranged sequentially, the following chapters should be structured by presuming knowledge of the previous chapter and contains more complex questions that require a higher reasoning process.

Table 3. Level of Cognitive Process of Questions in Geography Textbooks

Level		Grade						Total	%
		10th	%	11th	%	12th	%		
Lower-Order Thinking (LOT)	Remember (C1)	151	46%	125	37%	77	20%	353	33%
	Understand (C2)	127	38%	126	38%	232	59%	485	46%
	Apply (C3)	7	2%	27	8%	24	6%	58	6%
Higher-Order Thinking (HOT)	Analyze (C4)	33	10%	40	12%	39	10%	112	11%
	Synthesis (C5)	7	2%	11	3%	11	3%	29	3%
	Evaluation (C6)	5	2%	5	1%	7	2%	17	2%
	Total	330	100%	334	100%	390	100%	1,054	100%

Table 4 Details of Geography Textbooks Questions and Its Level of Cognitive Process

Location in textbook instruction	Question types	C1	C2	Total (C1+C2)	C3	C4	C5	C6	Total (C4+C5+ C6)	Total
Before	Apperception short answer	4	3	7 (50%)	3 (21%)	3	2	0	5 (36%)	14 (100%)
During	Short or long answer	18	89	107 (64%)	9 (5%)	40	6	7	53 (32%)	168 (100%)
After	Multiple Choice (at the end of each chapter's section)	189	145	334 (93%)	17 (5%)	6	2	0	8 (2%)	359 (100%)
	Short or long answer (at the end of each chapter's section)	36	106	142 (79%)	4 (2%)	34	1	0	35 (19%)	181 (100%)
	Group activity/ project	19	5	24 (56%)	7 (16%)	7	2	3	12 (28%)	43 (100%)
	Individual activity/ project	9	8	17 (31%)	10 (16%)	12	10	7	29 (53%)	56 (100%)
	Multiple Choice (at the end of chapter)	66	101	167 (98%)	3 (2%)	0	0	0	0 (0%)	170 (100%)
	Short or long answer (at the end of a chapter)	12	28	40 (67%)	5 (8%)	10	6	0	16 (27%)	61 (100%)
	Total	353	485	838 (79%)	58 (6%)	112	29	17	158 (15%)	1,054 (100%)

3.2. Evaluate the level of thinking according to Spatial Thinking taxonomy

Table 5 shows that questions contain the concept of space are found in only 309 (29%) of 1,054, and the rest (71%) are categorized as non-spatial. Looking at the distribution across the grade, we expected that the higher the grade, the more the number of spatial thinking questions. However, the reverse is true. Less than others, on the highest 12th grade, only 22 percent of questions contain the concept of space.

Further observation shows that of those 309 questions, only 60 questions require representation tools such as maps, images, and graphics to process information to answer it (Table 6). In other words, the questions that may engage students to think spatially (integrate the concept of space, the use of tools of representation, and the process of reasoning) are a very small number (5% of the total question). In 12th grade, there are only 12 spatial thinking questions, which is less than half of the grade below. This indicates that the learning of spatial concepts is not set gradually, starting to promote primitive concepts and then progressing to more complex concepts.

Of total 60 questions, more than half (34 questions) are at the input level, then approximately one third (22 questions) is at the process level, while at the output level, there are only four questions (see Table 7). The number suggests that spatial questions in textbooks are mostly at the lower order thinking level.

Many spatial questions at the input level only ask to identify information located in the text. Questions at the process level generally begin with the word explain. Example of among the few questions at the output level, such as:

"make your argument, why are countries in Europe and North America developed than regions in other continents?". This question has many point of view and facts to shows (such as location, natural resource, history, or culture) and encourages students to discuss, and more importantly, the answer cannot be taken simply from the text.

Table 5. Questions With Spatial Concepts Content

Grade	Total number of questions	Questions contain concept of space	%
10th	330	102	31
11th	341	123	36
12th	383	84	22
Total	1,054	309	29

Table 6. Spatial Thinking Questions in Textbook

Grade	Total question	Non-spatial thinking	Questions contain concept of space but not required tools of representation	Questions contain concept of space and required tools of representation
10th	330	228	76	26
11th	341	218	101	22
12th	383	299	72	12
Total	1,054	745	249	60
% of total		(71%)	(24%)	(5 %)

Table 7 Distribution of Questions in Taxonomy of Spatial Thinking

Cognitive process	Concept of Space			Total
	Spatial Primitive	Simple Spatial	Complex Spatial	
Output	1 (2%)	1 (2%)	2 (3%)	4 (7%)
Proses	5 (8%)	7 (12%)	10 (17%)	22 (37%)
Input	21 (35%)	8 (13%)	5 (8%)	34 (56%)
Total	27 (45%)	16 (27%)	17 (28%)	60 (100%)

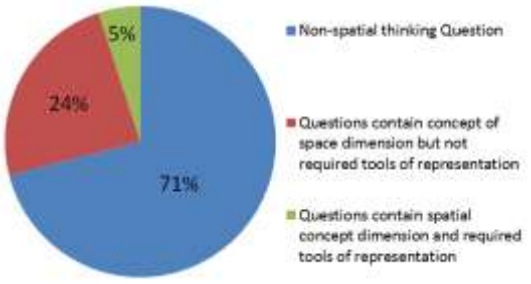

Fig. 4. Distribution of Text Book's question categories based on Spatial Thinking Taxonomy

4. CONCLUSION

The level of questions in high school geography textbooks analyze by Bloom's cognitive level is less convincing to promote higher-order thinking. There is a large majority of LOT questions and not so much effort to gradually increase students' level of thinking as indicated by the distribution of cognitive levels of questions that do not differ across grades.

Analysis using the taxonomy of spatial thinking shows that questions categorized as contain the concept of space are only 309 of 1,054 questions (29.3%). Of that number, only 60 questions require to use of spatial representation tools. So we can say that, in fact, the truly spatial question only 5 percent from the overall question. It could be said that there are very few questions to be able to promote spatial thinking in the textbook.

Geography curriculum 2013 explicitly emphasizes competency-based in learning output, which requires students to do scientific learning by observing, questioning, experimenting, associating, and communicating. In summary, the curriculum encourages the application of inquiry learning. According to Tofade (2013), this learning approach encourages students to get a deep understanding and build a personal perspective about phenomena or issues through analysis and information exploration. However, the textbook's question suggests that there is still a wide gap in the textbook to be able to promote students to think on a higher cognitive level as required by scientific learning. The condition is not different from what

was said by [15-19] that there is still a gap between theory and practice. This is also similar to what Mishra (2015) found in India's geography textbook that there are many encyclopedic questions that only facilitated recall and retrieval of information, which is the kind of question that can not generate discussion and thinking.

This study is limited to a quantitative analysis of the distribution of questions. Further studies need to be done to determine the quality of the questions through content analysis to get a more comprehensive and detailed interpretation.

5. ACKNOWLEDGEMENTS

This research can be carried out smoothly because of the help and cooperation of various parties. Therefore, the author would like to thank the Rector of Padang State University, who has provided the opportunity to do this research.

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