Developing A Learning Continuum of Biological Resources Management Aspect from Elementary School to Senior High School Based on The Experts' Opinions

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Abstract. This study aims to determine the experts' opinions and the design of the learning continuum on aspects of biological resource management reviewed at the level of competence and characteristics of specific pedagogical material from elementary to high school. The method used in this research was survey by giving questionnaire to the experts. The sample of this study is convenience sample, which is 85 lecturers. This research was conducted at several State and Private Universities in the Special Region of Yogyakarta, Central Java, East Java, West Java, Jakarta. Results of this study indicate that the experts believe that the aspect of biological resource management has been taught in the tenth grade of senior high school (SHS) with cognitive levels (CL) “understanding” (C2) and “applying” (C3), and in seventh grade junior high school (JHS) with C2 CL. The design of learning continuum aspects of the management of biological resources from the FGD results based on the opinions of experts is that most of the specific pedagogical materials have begun to be taught at the JHS level with C2 CL, then continued at the SHS level with C3 CL, and there are also some specific pedagogic materials that have begun to be taught at the SHS level with C3 CL.

1. Introduction
Curriculum is a set of plans and rules about the objectives, contents, and learning materials and the techniques that are used as the manual in the implementation of teaching and learning activities to achieve certain education objective. [1] In the curriculum substance there is inconsistence of the content aspect in the materials that becomes main problem since there were many basic competences in the materials that are overlap. [2] Therefore, the characteristics, broadness, and depth of the materials must be adapted with the learning continuum. If there is no attention from the development of curriculum about the importance of the continuity materials in each level, it will cause the learning process be ineffective. [3] The efficiency of a learning program can be seen from the program that is sustainability and continuity. The implementation process of learning must be able to support the achieved purposes in the education, for example its implementation in the elementary school (ES), junior high school (JHS), or senior high school (SHS) level. [4] The learning process in the level of education, however, can work well if it can be sustainable and appropriate with the students’ development. [5]

The ability in human being based on the Taxonomy Bloom is divided into three domains that are cognitive domain, affective domain, and psychomotor domain. One of the competencies that must be had by the students for learning science or especially biology is cognitive competency. [6] Piaget theory stated that child actively build an understanding about the world through four stages of
cognitive development. [7] The cognitive development is a learning process that follows on the thought and the way of working. [8] Biology/science learning places the students as subject of assessment where the assessment that focuses on cognitive level actually must consider about the achievement levels and stages. Based on Biological Science Curriculum Study (BSCS) biology has scientific scope that consists of biology objects, biology problems, and organizational level of life. [9] Essentially, biology has various aspects of life that are taught to the students in the middle school (MS) either in JHS or SHS from morphology aspects of living things, anatomy of living things, physiology of living things, diversity of living things, biological resources management, the classification of living things, ecology, genetic, evolution, and physic and chemistry aspects. [10] Biology is a science that has a very broad scope in studying the science of living things and their interactions with surrounding environment. [11] It can be said that aspects of management of biological resources are within the scope of learning biology/natural science subjects.

One of the basic in arranging the curriculum is considerations that are used to arrange the materials (content) so that they become the learning materials (content knowledge) in learning activities to support in achieving the competency targeted. The unification between content knowledge as the specific pedagogical materials and the competencies and the learning strategy will be able to determine the curriculum. This explanation cannot be found in curriculum development of biology in SHS whether in biology aspects in natural science at ES or JHS. It must be a presentation course that shows the gradation of complexity and abstract about the content knowledge from ES to SHS. Since there is no presentation about it, it need to arrange the learning continuum.

Learning continuum is learning where specific pedagogical material is arranged on a continuum from one level to another higher level that is adjusted to the development of students (metal and age). The basis for developing or developing a learning continuum is the preparation of specific pedagogic material from concrete to abstract, or easy to difficult, or simple to complex. With the learning continuum, learning will be more meaningful and effective. According to Subali, the students are expected to learn the material from basic level to complex level. To be able to guarantee the sustainability between levels, it is needed a concrete standard about the learning materials that will be taught to the students in each level or degree. This standard is started from basic education level to MS level. So that, it is also needed the references in arranging the grillwork such as learning continuum that shows the abstract continuum from all competencies that are targeted from simple level to the complex level. [3] The teachers’, principals’, and school supervisors’ views could be used for developing a learning continuum of “natural science”. [12]

However, most of the opinions of teachers (science teachers in junior high school and Biology teachers in senior high school) regarding the continuity of learning aspects of biology based on the level of student competence and specific pedagogical material still refer to the current syllabus and curriculum. Therefore, the teachers do not have personal opinions about the continuum of learning specific pedagogical material that must be taught at school at each level. [13] [14] [15] [16] [17] Based on these ideas, the researcher is interested in conducting a research to formulate a learning continuum on aspects of biological resource management that are taught from elementary to high schools based on the opinion of experts in Biology Education. The basis for the preparation of a learning continuum is the abstractness of concepts (from the concrete to the abstract), the ease of the concept (from the very easy to the most difficult), and the complexity of the concept (from the simplest to the most complex). By this research, it is expected that the specific pedagogical material and competency levels targeted at elementary to high school students will be organized according to class levels and students’ cognitive development. It is hoped that from the development of learning continuum which makes specific pedagogical material no longer overlaps. The difference between this study and other studies is that the development of learning continuum in this study is based on the opinions of experts so that the design of the pedagogical learning continuum produced specific aspects of the management of biological resources.
2. Methods
This research is descriptive research by using survey method to gather the data of experts’ opinions about the competency level and specific pedagogical materials toward the aspects of biological resources management. This research is a follow-up study conducted by Bambang Subali about the learning continuum aspects of biology in 2016 (at ES) and 2017 (at JHS and SHS). The basis of the preparation of learning continuum aspects of natural resource management in terms of competency levels and specific pedagogical material characteristics are concrete to abstract, easy to difficult, and simple to complex.

This research is the descriptive research by using survey method to gather the data of the experts. Gathering the experts’ opinion was already done in the previous research by Bambang Subali in 2016 and 2017. This research is done in the private and state university in Yogyakarta province, Central Java, East Java, West Java, and Jakarta. Gathering the population and sample follows Daniel terminology. In this case, the hypothetic of the population is the biology education lecturers that teach in the private and state university in Indonesia. The sample is convenience sample that consists of 85 respondents of the biology education lecturers from 9 state university and 9 private university. The collecting data technique in this research uses instrument of questionnaire that is given to the respondent (expert). The collecting data is done by using questionnaire instrument of learning continuum-based confirmatory assessment model about the aspects of biological resources management. The validity of the questionnaire is done through Focus Group Discussion (FGD) that is done by Bambang Subali in 2016. The discussion consists of 3 lecturers of Biology Education at Yogyakarta State University and 5 lecturers of Biology Education at UNS.

The data of experts’ opinions collected through questionnaires were analyzed by searching for a mode, where the mode illustrates the agreement between respondents. For example, from the overall opinion of the experts, the highest category is 55% of respondents who think that the material is taught in class X with the cognitive domain of “applying” (C3). This opinion can be used as a mode of describing the agreement of opinion between respondents. Data from the analysis of the questionnaire were then discussed through the FGD by lecturers with Biology Education expertise or their allies (experts) at Yogyakarta State University to compile a learning continuum on specific pedagogic material for the management of biological resources. This FGD determines the logical or illogical opinion of experts. The logical or illogical determination of experts’ opinion depends on the level of mental development of students with specific pedagogical material aspects of the management of biological natural resources.

3. Results and Discussion
The percentage data of the experts’ opinions (the lecturers of biology education) about the learning of the aspects of biological resources management that must be taught in the school is gathered from 85 respondents that spread out from 18 colleges in Yogyakarta, Central Java, East Java, West Java, and Jakarta. The data will be shown as follows. The result of data analysis that is done shows the experts’ opinions about the teaching of the aspects of biological resources management in the school are various that contain from the class level to the competency level (cognitive scope) that are targeted to the students in ES level to SHS level.
Table 1. The percentage percentage of expert opinion data and results of FGD study about the learning of the aspects of biological resources management that must be taught in the school

| The aspects of biological resources management | The experts’ opinions of biology lecturers (N=85) | Results of the FGD Study |
|-----------------------------------------------|-----------------------------------------------|--------------------------|
| Sub-aspects 1 The benefit of biological resources | Modus | Cls/CL |
| Sub-aspects 2 The kinds of biological resources | 26 % | X/C2 | Illogical, replaced VII/C2 |
| Sub-aspects 3 The balance of nature | 27 % | X/C2 | Illogical, replaced VII/C2 |
| a. The harmony of nature | 25 % | X/C3 | Logical |
| b. The conservation and preservation | 26 % | X/C3 | Logical |
| Sub-aspects 4 The conservation | 24 % | X/C3 | Logical |
| a. The conservation with general purposes | 24 % | X/C3 | Logical |
| 1) The tight conservation | 24 % | X/C3 | Logical |
| 2) The guided conservation | 24 % | X/C3 | Logical |
| b. The conservation with certain purposes | 43 % | X/C2 | Illogical, replaced VII/C2 |
| 1) Geological protection | 44 % | X/C2 | Illogical, replaced VII/C2 |
| 2) Botany conservation | 41 % | X/C2 | Illogical, replaced VII/C2 |
| 3) Zoology conservation | 40 % | X/C2 | Illogical, replaced VII/C2 |
| Sub-aspects 5 Conservation efforts of biological resources | 27 % | X/C2 | Illogical, replaced VII/C2 |
| a. Conservation efforts of biological resources artificially | 26 % | X/C2 | Illogical, replaced VII/C2 |
| b. Conservation efforts of biological resources naturally | 24 % | VII/C2 | Logical |
| c. In-situ maintenance | 24 % | VII/C2 | Logical |
| d. Ex-situ maintenance | 24 % | VII/C2 | Logical |
| Sub-aspects 6 Forms of nature conservation | 26 % | X/C2 | Illogical, replaced VII/C2 |
| a. National park | 26 % | X/C2 | Illogical, replaced VII/C2 |
| b. Sea park | 26 % | X/C2 | Illogical, replaced VII/C2 |
| c. Nature preserve | 26 % | X/C2 | Illogical, replaced VII/C2 |
| d. Wildlife sanctuary | 26 % | X/C2 | Illogical, replaced VII/C2 |
| e. Botanical garden | 25 % | X/C2 | Illogical, replaced VII/C2 |

Finding out the agreement of the experts in this research, it needs to look for the highest opinions. The modus is the experts’ opinions that grouped together with the highest number, so the modus can draw the agreement of the experts’ opinions. These opinions relate to the sub-aspects 1 and sub-aspects 2 that are taught in the tenth grade with “understand” (C2) cognitive level. Based on the FGD activity, they are illogical since these aspects must be taught in the seventh grade with C2 cognitive level. In the sub-aspects 3 that is taught in the tenth grade with “apply” (C3) cognitive level, the experts stated that it is logic whereas they also stated that sub-aspects 4 about the strict conservation...
and long guided protection is logically taught in the tenth grade with C3 cognitive level. Thus, the sub-aspects 4 about the geology, botany, zoology, and anthropology conservation are illogically taught in the tenth grade with C2 cognitive level based on the FGD results since they have to be taught in the seventh grade with C2 cognitive level. Moreover, the sub-aspects 5 about the conservation efforts of biological resources artificially and naturally are illogical if they are taught in the tenth grade with C2 cognitive level based on the FGD results since they have to be taught in the seventh grade with C2 cognitive level. Thus, the sub-aspects 5 about in-situ and ex-situ maintenance are logically taught in the seventh grade with C2 level based on the FGD results. Finally, the sub-aspects 6 are illogically taught in the tenth grade with C2 cognitive level based on the FGD results since they have to be taught in the seventh grade with C2 cognitive level.

The deciding of logical or illogical statement of the experts follows the students’ mental development level with the specific pedagogic materials of biological resources management. The basis of the preparation of learning continuum aspects of natural resource management in terms of competency levels and specific pedagogical material characteristics are concrete to abstract, easy to difficult, and simple to complex. Based on Subali and Suyata, “the students’ competency level in the elementary level is “remember” (C1) and “understand” (C2), for the students of JHS placed in “understand” (C2), “apply” (C3), and “analyze” (C4), and the students of SHS placed in “apply” (C3), “analyze” (C4), “evaluate” (C5), and “create” (C6). According to the FGD activity, the opinion that is illogical caused by the sub-aspects that are easy to be learned, so they can be taught in the beginning level.” [18] On the other hand, according to Santrock explains that, based on the theory of cognitive development by Piaget, the students in the ES level from the 7 to 11 ages are in the stage of concrete operational development, so they must be able to think logically and be able to implement their reasoning and cognitive skill to the concrete examples specifically in the cognitive scope of C1 and C2. [19] Anderson and Krathwohl stated that the students can reach the C2 level when they are able to build the meaning from instructional message (oral communication, written, and graphics). The cognitive processes in the C2 level are interpreting, summarizing, giving example, classifying, explaining, comparing, and concluding. This cognitive level of C2 is in the lower order thinking skills. [6] Moreover, according to Subali and Suyata in their research stated that almost all sub-aspects of biology are taught in the competency level of remembering and understanding. These competencies are easier and simpler than other skills such as applying, analyzing, evaluating, and creating. On the JHS and SHS level, the students with 12 to 17 ages are in the formal development stage. In this stage, the students are already able to do reasoning in the way that is more abstract, idealism, and logic. Thus, the students in the JHS level are in the thinking skill level of C2, C3, and C4. In the SHS level, the students are expected to think in the high order thinking skill that is C3, C4, C5, and C6. [18] Determining the level of the cognitive scope is important in teaching biology since it can help the students to understand the materials. It is also stated by Powell and Kalina that the cognitive development of the students is needed to be the consideration to arrange he pedagogic materials and its level of competencies that refers to the cognitive development theory by Piaget. [20]

The presentation data of learning continuum framework toward the aspects of biological resources management is gotten from the FGD activity based on the experts’ opinions, and it is considered from competency level and the characteristics of specific pedagogical materials from ES to SHS. The FGD activity actually focuses to justify and analyze the experts’ opinions that are discussed or be an analysis substance. Thus, the data of learning continuum framework toward the aspects of biological resources management based on the experts’ opinions that is considered from competency level and the characteristics of specific pedagogical materials from ES to SHS will be shown further.
Table 2. Learning continuum framework toward the aspects of biological resources management based on the experts’ opinions

| The aspects of biological resources management | The experts’ opinions of biology lecturers |
|-----------------------------------------------|------------------------------------------|
|                                               | ES<sup>a</sup>  | JHS<sup>b</sup> | SHS<sup>c</sup> |
|                                               | Cls<sup>d</sup> | Cls<sup>e</sup> | Cls  | Cls  | Cls  | Cls  |
| 1. The benefit of biological resources         | -                | -                | VII  | C2<sup>f</sup> | X    | C3<sup>g</sup> |
| 2. The kinds of biological resources           | -                | -                | VII  | C2  | X    | C3  |
| 3. The balance of nature                       | a. The harmony of nature | - | - | - | - | X | C3 |
|                                               | b. The conservation and preservation | - | - | - | - | X | C3 |
| 4. The conservation                           | a. The conservation with general purposes | - | - | VII | C2 | X | C3 |
|                                               | b. The conservation with certain purposes | 1) | The tight conservation | - | - | - | - | X | C3 |
|                                               | 2) | The guided conservation | - | - | - | - | X | C3 |
|                                               | 1) | Geological protection | - | - | VII | C2 | X | C3 |
|                                               | 2) | Botany conservation | - | - | VII | C2 | X | C3 |
|                                               | 3) | Zoology conservation | - | - | VII | C2 | X | C3 |
|                                               | 4) | Anthropology protection | - | - | VII | C2 | X | C3 |
| 5. Conservation efforts of biological resources| a. Conservation efforts of biological resources artificially | - | - | VII | C2 | X | C3 |
|                                               | b. Conservation efforts of biological resources naturally | - | - | VII | C2 | X | C3 |
|                                               | c. In-situ maintenance | - | - | VII | C2 | X | C3 |
|                                               | d. Ex-situ maintenance | - | - | VII | C2 | X | C3 |
| 6. Forms of nature conservation                | a) National park | - | - | VII | C2 | X | C3 |
|                                               | b) Sea park | - | - | VII | C2 | X | C3 |
|                                               | c) Nature preserve | - | - | VII | C2 | X | C3 |
|                                               | d) Wildlife sanctuary | - | - | VII | C2 | X | C3 |
|                                               | e) Botanical garden | - | - | VII | C2 | X | C3 |

<sup>a</sup> elementary school  
<sup>b</sup> junior high school  
<sup>c</sup> senior high school  
<sup>d</sup> class  
<sup>e</sup> competency level (cognitive scope)  
<sup>f</sup> understand  
<sup>g</sup> apply

Table 2 is a learning continuum framework toward the aspects of biological resources management based on the experts’ opinions that is considered from competency level and the characteristics of specific pedagogical materials from ES to SHS. The research result of learning continuum framework toward the aspects of biological resources management from FGD activity based on the experts’ opinions that is considered from competency level and the characteristics of specific pedagogical materials from ES to SHS shows that almost all sub-aspects and specific pedagogical materials of the aspects of biological resources management are started to be taught in the JHS level with the cognitive scope of “understand” (C2). Thus, it is continued in the SHS level with the cognitive scope of “apply” (C3). Moreover, there are several sub-aspects and specific pedagogical materials of the aspects of biological resources management that is started to be taught in the SHS level with the cognitive
scope of C3. In the sub-aspects of the benefit of biological resources, sub-aspects of the kinds of biological resources, sub-aspects of the forms of conservation, and the specific pedagogical materials of conservation with certain purposes (geological conservation, botany conservation, zoology conservation, and anthropology conservation) are started to be taught in the JHS level at the seventh grade with the cognitive level of C2, then, they are continued to be taught in the tenth grade of SHS with the cognitive scope of C3. Afterward, on the sub-aspects of the balance of the nature and the specific pedagogical materials of conservation with general purposes (the tight conservation and the guided conservation) are started to be taught in the tenth grade of SHS with the cognitive scope of C3.

The learning continuum design shows that the aspects of managing biological resources have been begun to be taught in the seventh grade and then later on in the tenth grade. According to Subali, it is more difficult to teach several aspects of the scientific method (both basic and process skills) to students in grades 4 to grade 6 in elementary school. [21]

Determining the cognitive scopes (competency level) that are adapted with the education level is in line with Subali and Suyata statement where the competency levels for the ES students are “remember” (C1) and “understand” (C2), for JHS students are “understand” (C2); “apply” (C3); and “analysis” (C4) whereas for SHS students are “apply” (C3), “analysis” (C4), “evaluate” (C5), and “create” (C6). [18] Moreover, theory of the cognitive development based on Piaget (Piaget theory) can show the students’ development based on their age and mental. [7] The teacher roles, here, are very important. According to Feiman-Nemser to correlate the students and the materials that are suitable with their age and with the correct ways then the teachers must develop the pedagogical attitude that is formed from the knowledge about the progress and learning of the children. [22] Learning continuum can affect the way of the teacher in teaching to be more innovative in teaching the materials through the concepts that are already analyzed. [23] So that, the arrangement of learning continuum in the aspects of biological resources management is important to support the learning that is done by the teachers to give the learning outcome that is suitable with the learning objectives.

Learning continuum takes place as an abstract continuum of measurement that contains of competency aspects of the lessons that are related each other, and it is a basic of developing the learning assessment instrument of the lessons. [24] The learning process in the education level will work well if it can be continuity and suitable with the students’ progress. [5] The development of learning continuum must first pay attention to the aspects of targeted cognitive abilities starting from the simplest/easiest abilities to the most difficult aspects. If referring to the level/level of the cognitive domain, the ability to remember will be easier/simpler than the ability to understand, and the ability to understand will be easier than the ability to apply. The second thing to note is the complexity of teaching material (subject matter specific pedagogic). It depends on the breadth and depth of a piece of science that is used as material and as a tool to master the targeted competencies. [25] The presence of curriculum and basic competence in the materials of learning continuum will give many benefits. The learning continuum-based in the teaching and learning process has several benefits, such as: 1) the learning based on learning continuum where the teachers can find out the materials that are suitable with the students. Because the students have to get the materials that are appropriate with their needs, the teachers must be able to develop the students’ competency level in the classroom by selecting the materials; 2) the learning strategies that are used will be different when the demand of competency in the learning process increases; 3) the planning for learning curriculum based on learning continuum can be the affordable resources during the development of curriculum or the revising program of curriculum; 4) the control toward knowledge had by the students through learning continuum can be a big potency to increase the students’ quality of knowledge in cognitive, affective and psychomotor scope. Because the students’ knowledge relatively depends on the learning continuum presentation that is ongoing in education, it will be better to revise the school planning; 5) the continuity of education planning for the individual learning can focus on the students. [26]

The development of curriculum must show the relation between the subject matters that are needed in the further learning process for the higher level of education, and these matters actually must be taught in the previous level / stage or below it. Moreover, the learning materials that are taught in the
lower education level must not be taught again in the next level, so it can avoid the overlapping of the materials’ setting in teaching and learning process. Besides, it is also needed the standard or curriculum that pays attention to the essence of learning continuum and in developing it. [27] [28]

4. Conclusion
Based on the analysis data result of this research, it can be concluded in several ways, as follows: (i) Results of this study indicate that the experts believe that the aspect of biological resource management has been taught in the tenth grade of senior high school with cognitive levels “understanding” (C2) and “applying” (C3), and in seventh grade junior high school with cognitive level C2. (ii) The design of learning continuum aspects of the management of biological resources from the FGD results based on the opinions of experts is that most of the specific pedagogical materials have begun to be taught at the JHS level with cognitive domain C2, then continued at the SHS level with C3 cognitive domain, and there are also some specific pedagogic materials that have begun to be taught at the SHS level with cognitive domain C3.

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