Analysis of earth and space science curriculum at senior high school

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Abstract. This study aims to describe the curriculum of earth and space science at junior and senior high schools. The approach of the research is qualitative with literature review methods. The source of data used in this study is regulation minister of national education number 22 of 2006, regulation minister of education and culture number 69 of 2013 and regulation minister of education and culture number 24 of 2016. The results of the analysis obtained the provision material of earth and space science of education unit level curriculum at senior high school for physics by 2.63% and geography by 19.23%. Furthermore, the 2013 curriculum for Physics by 6.45% and geography by 26.30% and 2013 curriculum of revised edition for Physics is 5.88% and geography is 27.78%. Based on the results of the analysis, there are changes in the structure of curriculum content for senior high school such as in education unit level curriculum, material of global warming is not given. While after the curriculum existence changes into the 2013 curriculum and 2013 curriculum of revised edition, the material of global warming is given in class XI of physics.

1. Introduction

In the last decade, environmental issues have received widespread public attention. The trigger is global warming. Global warming is one of the most important environmental problems facing the world today [1]. Global warming has caused climate change [2-4]. In Indonesia, the period of 2004 to 2013 has increased by an average surface temperature of 1° Celsius and followed by an increase in air humidity of 5% [5]. The impact of climate change is a big threat when it is associated with Indonesia's geographical conditions, namely sea level rise and threats to the sinking of islands and coastal areas. In addition, the effects of global warming have been very visible, such as the increase in the intensity and frequency of natural disasters (floods, tsunamis, earthquakes), sea water rise, biodiversity damage, decreasing sources of clean water and longer dry seasons [6]

The overall world climate is experiencing damage as a consequence of human activities. Many people realize that to stop global warming. However, there are still many people who do not know what actions to take to stop global warming. This shows that the community does not understand a variety of knowledge about natural phenomena. Public knowledge about natural phenomena, whether they are earth and space...
science phenomena, should have been obtained when they were in school. In this case earth and space science is the scope of the study of earth and space phenomena, but the problem is whether the study of the material is contained in the earth and space science curriculum?

Earth and space science continuous to grow. Changes in curriculum structure for earth and space are one of the concerns in curriculum development. According to the National Conference on Revolution on Earth and Space Science, all schools must review earth and space science curricula, to ensure that the contents and pedagogy of earth and space science curriculum are in accordance with national standards [7]. Therefore, researchers are interested in analyzing the development of earth and space science curriculum in high schools.

2. Methods
The approach used in this research is a qualitative research with literature review methods. The source of data used in this research is regulation minister of national education number 22 of 2006, regulation minister of education and culture number 69 of 2013 and regulation minister of education and culture number 24 of 2016. This research uses descriptive analysis. The analyzed data are basic competencies that contain integrated material of earth and space science in physics and geography for senior high school.

3. Results and Discussion
Based on the results of the literature review, material of earth and space science for various curriculum were given in different portions at senior high school level both in the education unit level curriculum, 2013 curriculum and the 2013 curriculum of revised edition.

3.1. Education Unit Level Curriculum
Material of earth and space science for senior high school in physics by 2.63% and geography by 19.23%. The proportion of material of earth and space science on education unit level curriculum is presented on Table 1:

| Class          | Basic Competencies                                                                 |
|----------------|-------------------------------------------------------------------------------------|
| X (Physics)    | 1.2 Analyze the regularity of planetary motion in the solar system based on Newton's laws |
| X (Geography)  | 2.1 Describe the universe and the solar system                                        |
|                | 2.2 Explain the history of earth formation                                             |
|                | 3.1 Analyze the dynamics and trends of changes in the lithosphere and pedosphere and their impact on life on earth |
|                | 3.2 Analyze the atmosphere and its impact on life on earth                             |
|                | 3.3 Analyze hydrosphere and its impact on life on earth                                |

3.2. 2013 Curriculum
Material of earth and space science for senior high school in physics by 6.45% and geography 26.30% of. The proportion of material of earth and space science in the 2013 curriculum is presented on Table 2:
Table 2. Giving material of earth and space science in the 2013 curriculum.

| Class            | Basic Competencies                                                                 |
|------------------|--------------------------------------------------------------------------------------|
| X (Physics)      | 3.2 Evaluating his thoughts on the regularity of planetary motion in the solar system based on Newton's laws |
| XI (Physics)     | 3.9 Analyze the symptoms of global warming and their impact on life and the environment |
| X (Geography)    | 3.3 Analyzing the dynamics of planet earth as a space of life.                       |
|                  | 3.4 Analyzing the relationship between humans and the environment as a result of the dynamics of the lithosphere. |
|                  | 3.5 Analyzing the relationship between humans and the environment as a result of atmospheric dynamics. |
|                  | 3.6 Analyzing the relationship between humans and the environment as a result of the dynamics of hydrosphere. |
|                  | 3.7 Analyze mitigation and adaptation of natural disasters with geographic studies. |

3.3. 2013 Curriculum of Revised Edition

Material earth and space science for senior high school level in physics get 5.88% and geography by 27.78%. Proportion of earth and space science material in the 2013 curriculum of revised edition is presented on Table 3:

Table 3. Giving material of earth and space science in the 2013 curriculum of revised edition.

| Class            | Basic competencies                                                                 |
|------------------|--------------------------------------------------------------------------------------|
| X (Physics)      | 3.8 Analyze the regularity of planetary and satellite motion in the solar system based on Newton's laws |
| XI (Physics)     | 3.12 Analyzing the symptoms of global warming and their impact on life and the environment |
| X (Geography)    | 3.4 Analyzing the dynamics of planet earth as a space of life.                       |
|                  | 3.5 Analyze the dynamics of the lithosphere and its impact on life.                  |
|                  | 3.6 Analyze atmospheric dynamics and their impact on life.                          |
|                  | 3.7 Analyze the dynamics of hydrosphere and its impact on life.                     |
| XI (Geography)   | 3.7 Analyze the types and management of natural disasters through education, local wisdom and utilization of modern technology. |

Proportion material of earth and space science for each curriculum is presented by diagram below.
Figure 1. Giving material of earth and space science curriculum at senior high schools

Based on the diagram above, the largest proportion for science and space matter in geography. At every change of curriculum, the portion is always increasing. In education unit level curriculum, the portion was 19.23%, 2013 curriculum by 26.3% and 2013 curriculum of revised edition by 27.78%. As for the integrated earth and space science in Physics subjects, the portion of earth and space science increased when the change from education unit level curriculum by 2.63% to 2013 curriculum by 6.45%. But in the 2013 curriculum of revised edition, the portion was reduced to 5.88%.

Based on the explanation above, there is a change in curriculum accompanied by changes in the portion of earth and space science material. In addition, both in terms of content and structure of the curriculum also experienced changes. Based on the results of the analysis, there are changes in the structure of curriculum content for senior high school such as in education unit level curriculum, material of global warming is not given. While after the curriculum existence changes into the 2013 curriculum, the material on the symptoms of global warming is given in class XI (Physics). Like in the 2013 edition of the revised curriculum, material for global warming remains.

Based on the findings above, there were changes of the earth and space science curriculum in the provision material of global warming at the high school level. The of this material in the curriculum structure indicates the importance of knowledge about global warming to be adapted to the younger generation. This is because global warming is becoming one of the most important environmental problems facing the world today. Therefore, it requires the maturity and awareness of individuals in overcoming this global warming. The basic way to deal with global warming and other environmental problems requires organized environmental education. Environmental education can be explained by the acquisition of knowledge, skills and individual behaviour in accordance with the people around, educating people who have responsibility and active involvement in problem solving [8]. Thus, it becomes very important to provide material of global warming in the structure of the applied curriculum because it provides an opportunity for students to obtain this knowledge in school as a provision in dealing with environmental conditions.

The existence of new material in the applied curriculum structure is a challenge especially for teachers in implementing it in the learning system. This is because the success of learning one of them is influenced by teacher competence [9]. Competent teachers will be better able to create an effective, enjoyable learning environment and will be able to manage the class, so that the learning of students is at an optimal level [10].
In the process of preparing learning, the teacher must of course review basic competencies so that the learning process can be in accordance with the demands of the curriculum. Based on the basic competencies of global warming material shows that physics learning must emphasize how students can understand concepts to solve problems in everyday life. Understanding concepts becomes the basis of someone in making problem solving [11]. Therefore, to develop the concept, harmony between the facts and the basic concepts that students have is needed so that the concept can be built systematically and intact. But the harmony between the basic concepts possessed by students is often influenced by the initial understanding that students get before entering classroom learning. This is because students coming to class have built their own knowledge based on prior experience [12-13].

To facilitate students reorganizing their knowledge requires a constructivist approach in which students can play an active role in reorganizing their knowledge [14]. Effective learning that can build understanding and empower students' thinking skills is learning that emphasizes the importance of learning as an individual process in which each student builds personal knowledge and experience [15-16]. One learning strategy that involves students actively in knowledge reorganization is cognitive conflict learning strategies [17].

Cognitive conflict strategies as a means to help students construct knowledge [18]. Cognitive conflict strategies emphasize the destabilization of students' beliefs in existing conceptions through contradictory experiences and then allow students to replace their inaccurate conceptions with scientifically accepted conceptions [19]. Stimulation of cognitive conflict in learning helps the assimilation process become more effective and meaningful in the formation of student intellectual [20]. In addition, cognitive conflict strategies are learning strategies that accommodate differences, be open and provide more effective stimuli in helping students improve their understanding of concepts [21] In accommodating these differences, the learning process needs to pay attention to the learning styles of each student. According to Gardner student learning styles are reflected in the tendency of intelligence possessed by these students [22]. The intelligence possessed by students is very diverse. Therefore, so that all intelligence possessed by students can be accommodated, the learning process needs to be carried out by integrating a multiple intelligence approach [23].

The multiple intelligence approach presents lessons using a variety of instructional techniques to meet a variety of student learning styles [24]. So that the learning process can involve active participation of students [23]. Besides that, learning by using a multiple intelligence approach is useful in deepening the concepts that students have [25].

4. Conclusion
Based on the results of the data, the material of earth science and examinations for high school level is given to the subjects of physics and geography. Then in the 2013 curriculum both before and after there is new material, namely global warming which does not exist in the Education unit level curriculum. The existence of global warming material shows the importance of knowledge of global warming for the younger generation in the process of climate change adaptation due to global warming which is the current issue of the world. Thus, learning physics must emphasize how students can understand concepts to solve problems in everyday life. The learning solution that can build student knowledge is by applying cognitive conflict learning strategies. In addition, it is also necessary to integrate a multiple intelligence approach in it to facilitate various student learning styles. Thus, it is expected that through the learning process, students can develop concepts correctly to be used in solving problems in everyday life.

5. References
[1] Aydin F 2010 Secondary school students’ perceptions towards global warming: A phenomenographic analysis Scientific Research and Essays 5 12 1566-1570
[2] Aizebeokhai A P 2009 Global warming and climate change: Realities, uncertainties and measures
International Journal of Physical Sciences 4 13 868-879

[3] Barstow D, Geary and Yazijian H 2007 Revolution in Earth and Space Science Education National Conference on Revolution in Earth and Space Science Education

[4] Febrianti, Nur 2009 Hubungan Pemanasan Global Dengan Kondisi Suhu Udara Dan Curah Hujan Di Indonesia Research Gate MT 299-305

[5] Indriatmoko and Purwanta 2017 Perubahan Lingkungan dan Strategi Adaptasi Dampak Perubahan iklim di Bandar Udara Hasanuddin, Makassar Jurnal Teknologi Lingkungan 18 1 80-87

[6] Tarno and Martani 2014 Peningkatan Sikap Peduli Lingkungan Anak Prasekolah Melalui Bermain Peran “Aku Sayang Bumiku Humanitas 11 1 41-55

[7] Rohmah S Z and Jatmiko B 2015 Penerapan Pembelajaran dengan Model Diskusi Kelas Tipe Beach Ball untuk Meningkatkan Hasil Belajar Siswa pada Materi Pemanasan Global Kelas XI SMA Berbasis Kurikulum 2013 Jurnal Inovasi Pendidikan Fisika 4 3 101-106

[8] Kilinc, Stanisstreet M and Boyes E 2008 Turkish students’ ideas about global warming International Journal Environmental and Science. Education 3 2 89-98

[9] Widyastuti N, Widyaningrum P and Lisdiana 2017 Analisis Kompetensi Guru Biologi Berdasarkan Persepsi Siswa SMA di Kota Semarang Journal of Innovative Science Education 6 2 212-226

[10] Hamalik O 2002 Proses Belajar Mengajar (Jakarta: Bumi Aksara)

[11] Trianggono and Maulana M 2017 Analisis Kausalitas Pemahaman Konsep Dengan Kemampuan Berpikir Kreatif Siswa Pada Pemecahan Masalah Jurnal Pendidikan Fisika dan Keilmuan 3 1 1-12

[12] Docktor J L and Mestre J P 2014 Synthesis of Discipline-Based Education Research Physics Education Research 10 2 1-58

[13] Turgut U 2011 An Investigation Tenth Grade Student’s Misconception about Electric Current Procedia Social and Behavioral Sciences 15 1965-1971

[14] Kalpana T 2014 A Constructivist Perspective on Teaching and Learning: A Conceptual Framework International Research Journal of Social Sciences 3 1 27-29

[15] Kao H L 2007 A study of aboriginal and urban junior high school students’ alternative conceptions on the definition of respiration International Journal of Science Education 29 5 517-533

[16] Alwan A. 2011 Misconception of Heat and Temperature Among Physic Student Procedia Social and Behavior Sciences 12 600-614

[17] Baser M 2006 Fostering conceptual change by cognitive conflict based instruction on students’ understanding of heat and temperature concepts Eurasia Journal of Mathematics, Science and Technology Education 2 2 96-144

[18] Sela H and Zaslavsky O 2007 resolving cognitive conflict with peers – is there a difference between two and four, In Woo, J. H., Lew, H. C., Park, K. S. & Seo, D. Y. (Eds.) Proceedings of the 31st Conference of the International Group for the Psychology of Mathematics Education 4 169-176

[19] Kang H, Scharmann L. C, Kang S and Noh T 2010 Cognitive conflict and situational interest as factors influencing conceptual change International Journal of Environmental and Science Education 5 4 383-405

[20] Akham A, Anshari R, Amir H, Jalinus N and Amran A 2018 Influence of Learning Strategy of Cognitive Conflict on Student Misconception in Computational Physics Course IOP Conf. Series: Konsepals Science and Engineering 335

[21] Sukariastih L 2016 The Use of Cognitive Conflict Strategy to Reduce Student Misconceptions On The Subject Matter of Rectilinear Motion International Journal Of Education And Research 4 7 483-492

[22] Chati M 2012 Sekolahnya Manusia: Sekolah Berbasis Multiple Intelligences di Indonesia. (Bandung: Kaifa)
[23] Kumalasari L, Hilmi Y and Priyandoko D 2017 The application of multiple intelligence approach to the learning of human circulatory system *IOP Conf. Series: Journal of Physics: Conf. Series* **909** 1-9

[24] Nwanneka J. O and Obianuju S. O 2014 Effect of Multiple Intelligence- Based Instructional Approach on Secondary School Students’ Achievement in the Learning of Difficult Biology Concepts *International Journal of Scientific & Engineering Research* **5** 4 118-127

[25] Sugiharti P 2005 Penerapan Teori Multiple Intelligence dalam Pembelajaran Fisika *Jurnal Pendidikan Penabur* **5** 4 29-42