Journal of Computer and Education Research
December 2019 Volume 7 Issue 14 (ISSN:2148-2896)
http://dergipark.org.tr/jcer

Research Article

Comparison of the Learning Outcomes in 12th Grade Biology Curriculum According to the Revised Bloom Taxonomy: 2013, 2017 and 2018 Curriculums

Hülya ASLAN EFE *[1], Rıfat EFE [2]

[1] Dicle University, Ziya Gokalp Faculty of Education, Diyarbakır, Turkey, hulyaefe@dicle.edu.tr

[2] Dicle University, Ziya Gokalp Faculty of Education, Diyarbakır, Turkey, rifatefe@dicle.edu.tr

* Corresponding Author: hulyaefe@dicle.edu.tr

Article Info

Received: *13 August 2019*
Accepted: *24 October 2019*

Keywords: Biology curriculum, objectives, revised bloom taxonomy

DOI: 10.18009/jcer.591450

Publication Language: English

Abstract

In this study, the learning outcomes of 2013, 2017 and 2018 secondary biology programs were examined according to the revised Bloom Taxonomy and the distribution of the outcomes to the corresponding level was expressed in figures and graphics. A qualitative approach was employed through document analysis. The outcomes were coded into dimensions based on descriptive analysis in the Revised Bloom Taxonomy. The study revealed that the outcomes framed for the 12th grade of 2013 biology curriculum were more diverse in comparison to the same grade of the 2017 and 2018 biology curriculums in terms of knowledge dimension. There were number of outcomes were higher in the analysis and evaluation of cognitive dimensions in the 2013 biology curriculum compared to the 2017 and 2018 biology curriculum. While the 2018 biology curriculum for the 12th grade have four outcomes for the creating level of the cognitive dimension, 2013 biology curriculum for the same grade did not include any outcome for the creating level of the cognitive dimension.

To cite this article: Aslan-Efe, H. & Efe, R. (2019). Comparison of the learning outcomes in 12th grade biology curriculum according to the revised bloom taxonomy: 2013,2017 and 2018 curriculums. *Journal of Computer and Education Research*, *7* (14), 464-479. DOI: 10.18009/jcer.591450

Introduction

Along with the developing and changing world, many changes and innovations have been made in education systems globally. With the emergence of constructivist theory, the concepts and processes of learning and teaching gained new meanings which was the adapted to education systems through the renewal of the curriculums. (Sadiç & Çam, 2015). The first studies in the field of biology teaching in Turkey were conducted in 2000 (Ministry of National Education [MoNE], 2000). The basis of the curriculum is the answers to the questions "what we teach? "and "how we teach?". The base of answers to these questions on the official taxonomy systems collected through studies ensures that the content of the curriculum is clearly and accurately demonstrated. Some taxonomies classify intellectual disciplines (Hirst, 1973), while others classify the nature and complexity of learning

outcomes for evaluation purposes (Bloom, 1956) and the learning capacity of the human mind (Gardner, 1993). When planning the course within the framework of the curriculum, instructional activities are designed for each outcome within the scope of the aim of the course. Thus, it is ensured that the subject is comprehended, understood or realized by the students. It is emphasized that the nature of knowing or doing depends on the nature of what needs to be known or done (Bloom, 1956). When leaning outcomes in different subject topics are framed, the use of Bloom's taxonomy as a guide leads to accurate planning of the type of knowledge and level of knowledge in acquisition. Using Bloom taxonomy to prepare learning outcomes within different types of knowledge requires different learning activities. Bloom Taxonomy is a useful tool for teachers to categorize different types of knowledge, to follow different ways of teaching each type of knowledge, and to be used as a guide for the existence of learning at different cognitive levels in learning areas. It also facilitates the classification and evaluation of the knowledge and cognition levels of the learning outcomes (Bloom, 1956). Original Bloom taxonomy was published in 1956 under the title of the taxonomy of educational objectives and the taxonomy consists of six cognitive categories: knowledge, comprehension, application, analysis, synthesis and evaluation. It is assumed that mastery in each simple category is a precondition for the mastery of the next more complex one (Krathwohl, 2002). Anderson et al. (2001) renewed the original Bloom Taxonomy. Anderson et al. (2001) attributed the need for renewal to two reasons. First, the need for educators to focus their attention again on the value of the Original Bloom Taxonomy. The second is the need to incorporate new knowledge and thinking into the framework. The growing knowledge of thinking, teaching and evaluation has brought with it the need for renewal of the original Bloom Taxonomy. The necessity of renewed taxonomy to incorporate these new learner-centred approaches emerged. Therefore, one of the changes is the transfer of taxonomy from one dimension to two dimensions. In the renewed taxonomy, the original knowledge category was transformed into two dimensions: knowledge dimension (noun) and cognitive process dimension (verb) (Anderson et al., 2001). Due to innovations in educational psychology the "knowledge" dimension in revised taxonomy includes four categories: factual, conceptual, procedural and metacognition (Pintrich, 2002). The number of categories in the previous taxonomy was maintained according to the cognitive process dimension. The three categories were renamed, the order of the two changed and the names of these categories were preserved by transforming them

into verb forms appropriate to the forms in which they were used for educational purposes. Knowledge has been renamed as remembering, comprehension as understanding and synthesis as creating. The revised version of Bloom taxonomy for cognitive domain includes remembering, understanding, applying, analysing, evaluating and creating. The "knowledge" dimension in the revised taxonomy includes four categories: factual, conceptual, procedural and metacognition (Anderson et al., 2001). In all original subcategories, nouns were replaced with verbs and named as "cognitive process". In addition, the order of "Creation" and "Evaluation" categories has been changed (Amer, 2006). The transition from one dimension to two dimensions in the renewed taxonomy, the formation of a two-dimensional taxonomy table, caused another change in the structure of taxonomy. The taxonomy table reflects a dual perspective on cognition and learning. Having two dimensions in guiding the process of specifying plans and objectives enables the link between evaluation, teaching and objectives to be more effective, clear and powerful. Taxonomy table can, also, be used to help teachers not confuse objectives and activities in the analysis of the learning outcomes in the curriculum. Taxonomy table can be used as a model framework for teachers and prospective teachers to examine and analyse their teaching (Amer, 2006). Because of all these features, the renewed Bloom taxonomy is a very suitable tool for the classification of learning outcomes (Eke, 2015). Different studies investigated the renewed Bloom taxonomy. While some of the studies examined the appropriateness of the questions asked during the education process to Bloom Taxonomy (Tanık & Saraçoğlu, 2011), some of them examined the appropriateness of the learning outcomes in the curriculum to the taxonomy (Ayvacı & Şahin, 2009). In the literature reviewed, there were not any studies comparing the learning outcomes in the 12th grade secondary biology curriculum of 2013, 2017 and 2018 according to the renewed Bloom taxonomy. By analysing the appropriateness of the learning outcomes delineated in the 2013, 2017 and 2018 12th Grade biology curriculums to the renewed Bloom taxonomy this study will contribute to the related literature and to the improvement of the secondary education biology curriculum.

Method

Research Model

In this research, document analysis, one of the qualitative research methods, was used. Document analysis includes analysis of written materials containing information about

events (Yıldırım & Şimşek, 2010). The data of the study was analysed using descriptive analysis based on summarizing and interpreting according to pre-existing categories or dimensions.

Data Collection Instruments

In this study, 2013, 2017 and 2018 12th grade biology curriculums published by the Ministry of National Education (MEB) were analysed for the learning outcomes identified in these curriculums.

Analysis of the Data

In the 2013 curriculum, 29 learning outcomes of the 12th grade biology curriculum turned into 38 learning outcomes in the study. The reason for this situation was because 1., 2., 4., 5., 6., 8., 15., 18. and 19. outcomes were combination of two outcomes from different cognitive dimensions linked "and". Therefore, each of the learning outcomes from this group were into two codes. For example; the learning outcome "1. A student analyses the discovery process of nucleic acids and investigates the scientists who contributed to this process" turned into learning outcomes " 1.1. a student analysis the discovery of nucleic acids" and "1.2 a student investigates scientists who contribute to the discovery process of nucleic acids". This is not the case in the 12th grade secondary biology curriculum for 2017 and 2018.

The learning outcomes of the 12th grade biology curriculums published by the Ministry of National Education in 2013, 2017 and 2018, were examined independently by each researcher and were coded based on the renewed Bloom taxonomy. After this stage, the researchers met to compare and discuss the coding, and reach a common conclusion. The majority of the activities independently classified by the researchers were consistent with each other. Miles and Huberman (1994) agreement percentage of the study was calculated as 83%. The other outcomes were discussed and agreed upon. The coded data was then arranged into tables. After the coding process, the frequency of the codes was calculated and interpreted with graphics.

Table 1. The number of learning outcomes based on the topics for 12th grade biology programs published in 2013, 2017 and 2018.

Year	Unit	Topic	Numbers of learning outcomes
2013	From gene to protein	Discovery and Importance of Nucleic Acids	3
		Genetic code and protein synthesis	4
	Plant biology	Structure, Growth and Movement of Plants	3
		Transport of Matter in Plants	4
		Sexual Reproduction in Plants	4
	Community and Population Ecology	Community Ecology	4
		Population Ecology	2
	The Beginning of Life and Evolution	The Beginning of Life	3
		Evolution	2
2017	From gene to protein	Discovery and Importance of Nucleic Acids	4
		Genetic code and protein synthesis	4
	Energy Transformations in Living Things	Life and Energy	1
		Photosynthesis	4
		Respiration	6
	Plant biology	Structure of plants	3
		Transport of Matter in Plants	4
		Sexual Reproduction in Plants	4
	Living things and Environment	Living things and Environment	2
2018	From gene to protein	Discovery and Importance of Nucleic Acids	4
		Genetic code and protein synthesis	4
	Energy Transformations in Living Things	Life and Energy	1
		Photosynthesis	3
		Chemosynthesis	1
		Cellular Respiration	3
	Plant biology	Structure of plants	3
		Transport of Matter in Plants	4
		Sexual Reproduction in Plants	4
	Living things and Environment	Living things and Environment	2

Findings

The learning outcomes for 12th grade biology curriculum published by the Ministry of National Education in 2013 are displayed in Table 2.

Table 2. Learning outcomes for 12th grade in biology 2013 curriculum

Unit	Topic	Learning outcome
From gene to protein	Discovery and Importance of Nucleic Acids	1. Analyses the discovery process of nucleic acids and investigates the scientists who contribute to this process. 2. Examines the types of nucleic acids and investigates their functions. 3. Comprehends DNA replication.

	Genetic code and protein synthesis	4. Recognizes the universality of genetic code and examines its importance. 5. Explains and evaluates the relationship between genetic code and protein synthesis. 6. Analyses the genetic engineering and biotechnology study areas and investigates their working methods. 7. Examines the contributions of genetic engineering and biotechnology applications to health and economy.
Plant biology	Structure, Growth and Movement of Plants	8. On a flowering plant shows the basic parts of the plant, specifies the structure and functions of these parts. 9. Compares monocotyledonous and dicotyledonous plants in terms of their root, stem and leaf. 10. Explains hormones that are effective in plant growth and movement types in plants with examples.
	Transport of Matter in Plants	11. Understands the absorption of water and minerals in the roots. 12. Investigates the structure and functions of transmission tissue elements in plants. 13. Explains the mechanism of water and mineral transport in plants. 14. Explains the transport mechanism of photosynthesis products in plants.
	Sexual Reproduction in Plants	15. Shows the parts of the flower, explains the functions of these parts. 16. Understands the relationship between pollination and fertilization. 17. Realizes the importance of seed and fruit in reproduction and propagation of plants. 18. Comprehends germination of a seed and analyses environmental factors affecting germination.
Community and Population Ecology	Community Ecology	19. Understands the structure of the community, analyses the factors that affect it. 20. Explains with examples intra-species and inter-species competition in the community. 21. Explains with examples symbiotic relations between species in the community. 22. Explains with examples primary and secondary succession in communities.
	Population Ecology	23. Analyses the factors affecting population dynamics. 24. Discusses the reasons of the endangering of some species.
The Beginning of Life and Evolution	The Beginning of Life	25. Summarizes the opinions about the emergence of life. 26. gives examples of the similarities and differences of living things and the contribution of fossils to understanding of life. 27. Analyses the changes and causes of living diversity throughout the history of life.
	Evolution	28. Summarizes the views on evolution. 29. Discusses how life can be affected over time based on climatic changes that may occur in nature.

Table 3. Analysis of 2013 grade 12 biology curriculum learning outcomes according to renewed bloom taxonomy

Knowledge dimension	Cognitive dimension					
	Remembering	Understanding	Applying	Analysing	Evaluating	Creating
Factual	2^1, 8^2, 15^2, 18^1, 19^1	1^2, 12,		1^1,		
Conceptual	13,14	2^2, 3, 4^1, 4^2,5^1, 5^2, 6^2, 9, 10, 11, 16, 17, 20, 21, 22, 25, 26, 28		6^1, 19^2, 24,	27, 29	
Procedural			8^1, 15^1	18^2,23		
Metacognition		7				

In Table 3 the learning outcomes in the 12th grade Biology Curriculum in 2013 are analysed according to the renewed Bloom taxonomy. Seven of the learning outcomes were at remembering level of the cognitive dimension. Five of these outcomes were factual and two were conceptual. Twenty-one learning outcomes in the same curriculum were grouped under the understanding level of the cognitive dimension based on the renewed Bloom taxonomy. Two of these outcomes were factual, eight conceptual and one was metacognitive. There were two learning outcomes can be considered at the application level of the cognitive dimension. Both of these outcomes were procedural in terms of knowledge dimension. Six learning outcomes were classified under the analysis level. One of these outcomes was factual, three conceptual and two were procedural. Two of learning outcomes in the curriculum were identified to be at the evaluation level. Both of the outcomes were conceptual. None of the learning outcomes in the 2013 biology curriculum for 12th grade was identified as creating.

Table 4 shows the 12th grade learning outcomes in the Biology Teaching Program of Secondary Education published by the Ministry of National Education in 2017.

Table 4. Learning outcomes in 2017 curriculum for 12th grade biology.

Unit	Topic	Learning outcome
From gene to protein	Discovery and Importance of Nucleic Acids	1. Summarizes the discovery process of nucleic acids. 2. Explains the types and functions of nucleic acids. 3. Establishes the relation between the whole and the parts in the organization of the genetic material in the cell. 4. Explains duplication of DNA.
	Genetic code and protein synthesis	5. Explains the mechanism of protein synthesis.

		6. Explains the concepts of genetic engineering and biotechnology. 7. Explains genetic engineering and biotechnology applications. 8. Evaluates the effects of genetic engineering and biotechnology applications on human life.
Energy Transformations in Living Things	Life and Energy	9. Explains the necessity of energy for the survival of life.
	Photosynthesis	10. Questions the importance of photosynthesis for living things. 11. Explains the process of photosynthesis on a diagram. 12. Evaluates the factors affecting the photosynthesis rate. 13. Designs experiments related to the factors affecting the rate of photosynthesis.
	Respiration	14. Explain the importance of cellular respiration for living organisms. 15.Explains the glycolysis phase of cellular respiration. 16.Explains fermentation with examples from daily life. 17.Explains aerobic respiration on a diagram. 18.Designs experiments for reactants and products in aerobic respiration. 19. Make inferences about the relationship between photosynthesis and respiration.
Plant biology	Structure of plants	20. Explains the structure and functions of the basic parts of a flowering plant. 21. Explains, with examples, the effect of hormones on plant growth. 22. Designs experiments to observe plant movements.

	Transport of Matter in Plants	23. Explains the absorption of water and minerals in the roots. 24. Explains the mechanism of water and mineral transport in plants. 25. Explains the transport mechanism of photosynthesis products in plants. 26. Designs experiments about water and matter transport in plants.
	Sexual Reproduction in Plants	27. Explains the parts of the flower and the tasks of these parts. 28. Explains fertilization, seed and fruit formation in flowering plants. 29. Designs experiments to observe seed germination. 30. Establishes the relationship between dormancy and germination.
Living things and Environment	Living things and Environment	31. Explains the effect of environmental conditions on the continuity of genetic changes. 32. Gives examples of artificial selection practices in agriculture and animal husbandry.

Table 5. Analysis of 2017 grade 12 biology curriculum learning outcomes according to renewed bloom taxonomy

Knowledge dimension	Cognitive dimension					
	Remembering	Understanding	Applying	Analysing	Evaluating	Creating
Factual	2,4,5,6,15,20,23, 24,25,27,28	1				
Conceptual		7,9,10,12,14,16,21,32		3,19,30,31	8	
Procedural			11,17			13,18,22,26,29
Metacognition						

Table 5 shows the analysis of the learning outcomes in the 12th grade biology curriculum in 2017 based on the renewed Bloom taxonomy. The table reveals that eleven outcomes were at the remembering level of the cognitive dimension. All of the learning outcomes at this level were at the factual level of the knowledge dimension. Nine outcomes in the 12th grade biology curriculum in 2017 were found to be in understanding level

according to the renewed Bloom taxonomy (Table 5.). It was determined that one learning outcome at the understanding level was factual and eight outcomes were at conceptual knowledge level. The table displays two outcomes at the application level and these outcomes at the procedural level of the knowledge dimension. It was determined that four of the learning outcomes in the 12th grade biology curriculum in 2017 were at the level of analysis according to the renewed Bloom taxonomy. All of the four outcomes at the analysis level were at the conceptual level of knowledge dimension. The table also shows that there was one learning outcome at evaluation level in 2017 biology curriculum and this outcome was at the conceptual level of the knowledge dimension. Also, there were five outcomes at the creation level and these outcomes were at the procedural level of the knowledge dimension.

Table 6 shows the 12th grade learning outcomes in the biology curriculum published by the Ministry of National Education in 2018.

Table 6. Learning outcomes in 2018 curriculum for 12th grade biology.

Unit	Topic	Learning outcome
From gene to protein	Discovery and Importance of Nucleic Acids	1. Summarizes the discovery process of nucleic acids. 2. Explains the types and functions of nucleic acids. 3. Establishes the relation between the whole and the parts in the organization of the genetic material in the cell. 4. Explains duplication of DNA.
	Genetic code and protein synthesis	5. Explains the mechanism of protein synthesis. 6. Explains the concepts of genetic engineering and biotechnology. 7. Explains genetic engineering and biotechnology applications. 8. Evaluates the effects of genetic engineering and biotechnology applications on human life.
Energy Transformations in Living Things	Life and Energy	9. Explains the necessity of energy for the survival of life.
	Photosynthesis	10. Questions the importance of photosynthesis for living things. 11. Explains the process of

		photosynthesis on a diagram. 12. Evaluate the factors affecting the photosynthesis rate.
	Chemosynthesis	13. Explain the phenomenon of chemosynthesis.
	Respiration	14. Explains cellular respiration. 15. Designs experiments for reactants and products in aerobic respiration.. 16. Make inferences about the relationship between photosynthesis and respiration.
Plant biology	Structure of plants	17. Explains the structure and functions of the basic parts of a flowering plant. 18. Explains the effect of hormones on plant growth with examples. 19. Makes controlled experiment to observe plant movements.
	Transport of Matter in Plants	20. Explains the absorption of water and minerals in the roots. 21. Explains the mechanism of water and mineral transport in plants. 22. Explains the transport mechanism of photosynthesis products in plants. 23. Designs experiments about water and matter transport in plants.
	Sexual Reproduction in Plants	24. Explains the parts of the flower and the tasks of these parts. 25. Explains fertilization, seed and fruit formation in flowering plants. 26. Design experiments to observe seed germination. 27. Establishes the relationship between dormancy and germination.
Living things and Environment	Living things and Environment	28. Explain the effect of environmental conditions on the continuity of genetic changes. 29. Gives examples of artificial selection practices in

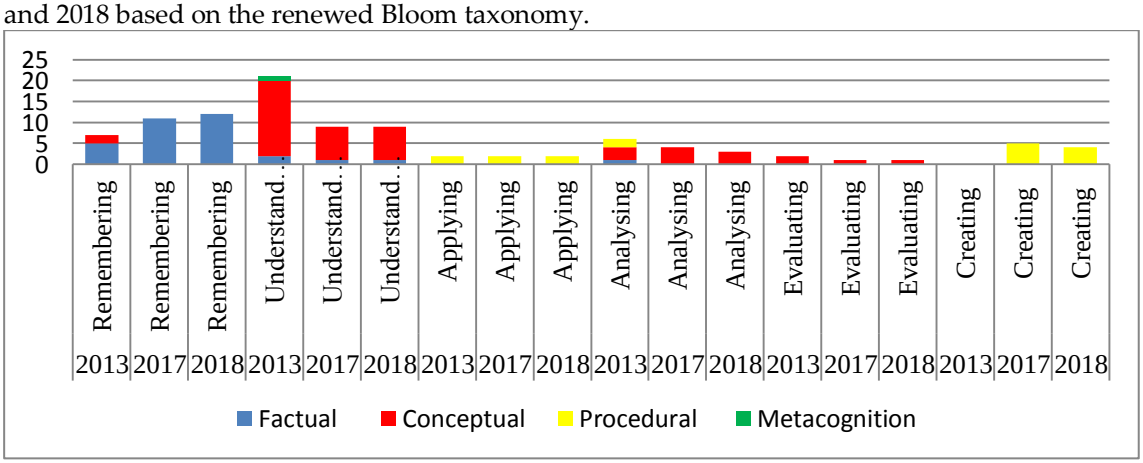
					agriculture and animal husbandry.	

Table 7. Analysis of 2018 grade 12 biology curriculum learning outcomes according to renewed bloom taxonomy

Knowledge dimension	Cognitive dimension					
	Remembering	Understanding	Applying	Analysing	Evaluating	Creating
Factual	2,4,5,6,13,14,17,20,21,22,24,25,	1				
Conceptual		3,7,9,10,12,16,18,29		3,27,28	8	
Procedural			11,15			13,19,23,26
Metacognition						

Table 7 shows the 12th grade biology curriculum of 2018 is analysed according to the renewed Bloom taxonomy. The Table displays that twelve outcomes are at the remembering level of the cognitive dimension. All of the outcomes at this level of the cognitive dimension are identified as factual knowledge. Also, it is evident from the table that ten of the learning outcomes in the current biology curriculum are at the understanding, two at the application, three at the analysis, one at the evaluation and five at the creating level of the cognitive dimension. One the outcomes at the understanding level are factual knowledge, while the remaining nine outcomes considered as conceptual knowledge. Both of the outcomes at the application level are identified as procedural knowledge. All three of outcomes identified as analysis are seen as conceptual knowledge. Similarly, the outcome identified to be at the evaluation level is at the conceptual level. Lastly, all five learning outcomes considered to be at the creating level are identified as procedural knowledge.

Figure 1. The comparison of the learning outcomes in the 12th grade biology curriculum of 2013, 2017 and 2018 based on the renewed Bloom taxonomy.



In Figure 1 the comparison of the learning outcomes in the 12th grade biology curriculum of 2013, 2017 and 2018 based on the renewed Bloom taxonomy is displayed. At the remembering level, there were seven learning outcomes in 2013, eleven learning outcomes in 2017 and twelve outcomes in in 2018 curriculums. While all of the outcomes at the remembering level were at the factual knowledge level in 2017 and 2018 curriculums, five outcomes were factual and two outcomes were conceptual in 2013 curriculum (figure 1.). Based on the revised Bloom taxonomy, there were twenty-one learning outcomes at the understanding level in the 2013 program and 9 outcomes in the 2017 and 2018 programs. While the outcomes in the 2013 program were factual, conceptual and metacognitive, none of the outcomes in 2017 and 2018 curriculums are metacognitive. The number of learning outcomes at the application level in cognitive dimension and their knowledge dimensions in the biology programs of 2013, 2017 and 2018 were similar. While the analysis dimension was represented by six outcomes in the 2013 program, the number of outcomes in the analysis cognitive dimension decreased in the programs of 2017 and 2018. In the analysis level of cognitive dimension, in 2013 program, one factual knowledge, three conceptual knowledge and two operational knowledge were identified, while all of the outcomes in 2017 and 2018 programs were in the conceptual knowledge dimension.

Figure 1 shows that there were two learning outcomes in the evaluation level in the 2013 curriculum and one at the same level in 2017 and 2018 curriculums. All of the outcomes in the evaluation level of the cognitive dimension in 2013, 2017 and 2018 curriculums were conceptual knowledge. The figure also displays that there are not any learning outcomes the creation level of the cognitive dimension in the 2013 biology curriculum. In contrast, At the level of creation, there are five outcomes in 2017 biology curriculum and four outcomes in 2018 biology curriculum. All the learning outcomes in the creation level of 2017 and 2018 were identified as procedural knowledge.

Discussion and Conclusions

When the results of the study are examined, it is seen that according to the renewed Bloom taxonomy, in terms of the remembering level, the highest number of the learning outcomes are represented in the 2018 curriculum. The analysis revealed that in 2017 and 2018 programs, all of the learning outcomes in cognitive level of remembering were in

factual knowledge level, while in 2013 program five learning outcomes were in factual knowledge and two outcomes were in conceptual knowledge level. Learning outcomes in remembering level are increased by the years type of knowledge is leaning toward the factual dimension. The learning outcomes in the remembering level increase over the years and the type of knowledge is concentrated on the factual dimension. When the revised Bloom Taxonomy is taken as reference points, understanding level of cognitive dimension was more representative in 2013 program, while the number of the learning outcomes in the understanding level of cognitive dimension decreased in 2017 and 2018 programs. While the knowledge types of the learning outcomes in the understanding level in the 2013 program were factual, conceptual and metacognitive, it is noteworthy that there is not any metacognitive the learning outcomes in the understanding level in the 2017 and 2018 curriculums. Metacognitive knowledge is based on an individual's understanding of how his or her learning accomplishes. That is why Flavel (1979) defines metacognitive knowledge as the knowledge of the individual about his / her cognitive skills. Secondary school students' knowledge of their own learning styles and monitoring of the results of learning processes will enable more informed learning to take place. Therefore, it is necessary to increase students' metacognitive knowledge and make it the focal point of teachers working at all levels (Corlis, 2005). In order for teachers to realize their metacognitive knowledge and practices, it is important to integrate the learning outcomes at the metacognitive knowledge level with the curriculum (Thamraksa, 2005).

Two learning outcomes at the application level were identified in all three curriculums investigated in this study and these outcomes were the procedural level. In other words, there has not been any improvement in the number of outcomes at the application level since the 2013 curriculum published. It is remarkable to witness that a field like biology with so much practical work can be with such a few learning outcomes in this level. Considering that the best way of learning is learning by doing and experiencing, it is emphasized that the learning outcomes in the procedural level are an integral part of biology teaching (Ayas, 2006). It is thought that it is important to integrate applications that develop research skills and scientific process skills into biology curriculum. It has been concluded that the number of learning outcomes in analysis and evaluation levels, in the 12th grade 2018 biology curriculum, decreased. In addition, it is noteworthy that in the 2018 curriculum, the diversity of the knowledge dimension of the analysis level outcomes, also, decreased. It is

seen that there is not any learning outcome at the level of creating in the 2013 biology curriculum. The cognitive level of analysing and evaluating is very important for students to be able to develop high level scientific process skills such as research, inference, comparison, analysis of the whole piece relation and decision making according to criteria. Analysis and evaluation at the cognitive level play a key role in order to make the curriculums richer in terms of high-level learning outcomes. On the other hand, it is worth to state that the learning outcomes at the level of creating were added to the biology curriculum of 2017 and 2018. All the outcomes in the creating level of 2017 and 2018 are at the level of procedural knowledge dimension. In order to educate productive individuals with analytical and critical thinking, creativity, innovation, entrepreneurship, and having 21st century qualifications, learning outcomes at the creating level are indispensable elements of the curriculum (MoNE, 2013).

In the light of the findings; learning outcomes at applying, analysing, evaluating and creating level of cognitive dimension should be added to the 12th grade 2018 secondary biology curriculum. In addition, it is recommended that the learning outcomes at the level of procedural and metacognitive knowledge be added to the current biology curriculum.

References

Amer, A. (2006). Reflections on Bloom's revised taxonomy. *Electronic Journal of Research in Educational Psychology*, *4* (1), 213-230.

Anderson,L., Krathwohl, R., Airisian, P., Cruikshank, K. Mayer, R., Pintrich, P.,Raths, J.& Wittrock,M. (Ed.) (2001). *Taxonomy for learning, teaching and assessing: A Revision of Bloom's Taxonomy*, NY:Longman, Newyork, USA.

Ayas, A. (2006). Fen bilgisi öğretiminde laboratuvar kullanımı [The use of laboratory in science teaching] Anadolu Üniversitesi Yayınları retrieved from http://kisi.deu.edu.tr/bulent.cavas/ders/rapor2.pdf on 03.04.2018.

Ayvacı, H. Ş., & Şahin, Ç. (2009). Fen bilgisi öğretmenlerinin ders sürecinde ve yazılı sınavlarda sordukları soruların bilişsel seviyelerinin karşılaştırılması. [Comparison of Cognitive Levels of Science Teachers' Questions During the Course and Written Examinations]. *Uludağ Üniversitesi Eğitim Fakültesi Dergisi*, *22*(2), 441-455.

Bloom, B. (Ed.). (1956). *Taxonomy of educational objectives: The classification of educational goals*. New York: David McKay Co.

Corlis, S.B. (2005). The effects of reflective prompts and collaborative learning in hypermedia problem-based learning environments on problem solving and metacognitive skills (Unpublished Doctoral Thesis, The University of Texas, Austin).

Eke, C. (2015). Dalgalar ünitesindeki kazanımların yenilenmiş bloom taksonomisine göre incelenmesi [Determination of objectives of waves topics according to the revised bloom's taxonomy], *Eğitim ve Öğretim Çalışmaları Dergisi*, 4(2), 346-353.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist*, 34 (10), 906-911

Gardner, H. (1993). *Multiple intelligences: The theory in practice*. New York: Basic Books.

Hirst, P. (1973). Liberal education and the nature of knowledge. In R.S. Pete (Ed..), *The philosophy of education* (pp. 87-111). Oxford: Oxford University Press.

Krathwohl, D. R. (2002). A revision of bloom's taxonomy: An overview, *Theory into Practice, 41*(4), 212-264.

Ministry of National Education [MoNE]. (2000). *Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı Ortaöğretim Biyoloji Dersi Programı* [Ministry of National Education Board of Education and Training Secondary biology curriculum] Ankara.

Ministry of National Education [MoNE]. (2013). *Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı Ortaöğretim Biyoloji Dersi Programı* [Ministry of National Education Board of Education and Training Secondary biology curriculum], Ankara

Ministry of National Education [MoNE] (2017). *Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı Ortaöğretim Biyoloji Dersi Programı* [Ministry of National Education Board of Education and Training Secondary biology curriculum], Ankara

Ministry of National Education [MoNE]. (2018). *Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı Ortaöğretim Biyoloji Dersi Programı* [Ministry of National Education Board of Education and Training Secondary biology curriculum], Ankara

Miles, M. B. & Huberman, A.M. (1994). *Qualitative data analysis: an expanded sourcebook*. (2nd Edition). Calif: SAGE Publications.

Pintrich, P. (2002). The role of metacognitive knowledge in learning, teaching, and assessing, *Theory into Practice*, 41, 4, 119-225.

Sadiç, A & Çam, A. (2015). 8.sınıf öğrencilerinin epistemolojik inançlari ile pisa başarıları ve fen ve teknoloji okuryazarlığı [Eight grade students' epistemological beliefs with pisa success and their scientific literacy]. *Journal of Computer and Education Research*, 3 (5), 18-49.

Tanık, N. & Saraçoğlu, S. (2011). Fen ve teknoloji dersi yazılı sorularının yenilenmiş bloom taksonomisi'ne göre incelenmesi [An investigation of the social sciences courses exam questions according to revised bloom's taxonomy]. *TÜBAV Bilim Dergisi*, 4(4), 235-246.

Thamraksa, C. (2005). Metacognition: a key to success for EFL learners. *Bangkok University Academic Review, 4* (1), 95-99.

Yıldırım, A. & Şimşek, H. (2005). *Sosyal bilimlerde nitel araştırma yöntemleri* [Qualitative research methods in social sciences]. Ankara: Seçkin Yayıncılık.