An Examination of Reproduction and Development in Secondary School Biology Curricula: Türkiye and Germany

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Abstract: Biology, a living science, is known as a balance and complement among other branches of science. Just like the science of biology, biology as a course also plays a very important role among other courses at all school types and grades. It is thought that the adults of the future should not be deprived of knowledge in the field of biology and should use every correct information they have acquired in their daily life to overcome related problems they may encounter. For the change that occurs in the individual's life to be permanent, the way to effective education is through a curriculum developed with socio-cultural, scientific and technological developments, taking into account the conditions of the country. For example, comparing other countries' educational practices and curricula based on the results from international assessments such as PISA TIMSS. According to the PISA science scores (2018), Germany has performed above the average determined by the OECD. Therefore, current education programs in Munich are discussed as an example in this research. This study adopted document analysis, one of the qualitative research methods, as the methodology. The "2018 Secondary Education Biology (9, 10, 11 and 12th Grades) Curriculum" published by the Ministry of National Education in Türkiye and the "Biology Curriculum of Germany" published by Kultusministerkonferenz were examined. While examining the documents in the study, they were subjected to content analysis. According to the findings, as in Bavaria, instead of encouraging rote learning regarding these topics for the sole purpose of university entrance purposes, Türkiye should include in curricula or teach in seminars the social and ethical aspects of HIV/AIDS, sexual/reproductive health, adolescent development, transmission and prevention of diseases, reproductive drug diagnostics, biomedical processes, opportunities, and risks. As a result, there are some differences in terms of content in the curriculum of both countries.

Keywords: Reproduction, Development, Reproductive health, Biology curriculum, Comparative education.

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Introduction

Biology education, which is a part in human life, is a whole with transferring the knowledge regarding both biological and cultural issues happening from the birth to the death of human in line with the peculiar talents of an individual in such institutions as primary, secondary and higher education where students are given general information, with training them in a versatile way and making them attain a good character (Kiziroğlu, 1988). The fact that the change happening through education in individual's life become permanent and that they can keep up with the change in the world are the basic determinants of educational system. The skills attained through educational process will make a contribution both to the development of life quality of individual and to the welfare of the country, to the social and democratic development (Ministry of National Education, 2020). A great many countries in the world concentrate more particularly on the researches in applied sciences to be able to keep pace with the innovations accompanied by developments (Ekici and Heyedanlı, 2010). The countries which are aware of the fact that biology learning and teaching is a cultural and vital must for the modern world frequently revise the current biology curricula in order to increase the quality of biology education, indicate the necessary findings, carry out studies for the purpose of applying new curricula they develop in an effective way and to provide necessary opportunities at schools, so setting forth the efficiency of curricula (Avas, 1995; cited in Soysal, 2018).

It becomes a significant problem that the young people do not have adequate and true knowledge about reproduction health and learn inconsistent information by means of media (Giray and Kılıç, 2004). Giving importance to a healthy life and developing the health of young people come in the first place of the list of 21 health targets to reach 21st century determined by World Health Organisation (Öksüz and Malhan, 2005). The fact that young people do not have sufficient information about reproduction health means that they do not know how to benefit from health applications and as to the risks likely to occur because of sexual behaviours (Civil, 2010). Some studies carried out abroad point out that the courses of reproduction health taught at schools are not sufficient and that what they learn about reproduction health comes from their close vicinity, media and family (Rivera, Cabral de Mello, Johnson, Chandra Mouli, 2001; Bennet, 2001). In a few studies carried out in Türkiye particularly into sexual health or reproduction health of adolescents, mostly their knowledge about reproduction health was investigated. It was found at the end of the studies that the knowledge of adolescents regarding sexual health is low (Çok, 1998; Mağden et al., 2003; Giray and Kılıç, 2004). Ignoring an education in this issue could lead to some problems both in the current time and in the future. Since any investment to be made into the education of young people determine economic and social developments of societies, young people are the biggest group for whom some investments must be made in social and economic fields in a country (Özalp, 2005; cited in Karabulutlu and Kılıç, 2011).

The topics of reproduction, generation and development basically comprise information as to how generations

human being and other living creatures convey their genetic compounds to the coming generations for the continuation of their generations. Having such an intense place in life, the topics of reproduction, generation and development attach an importance on body and mental health and allow us to train individuals keeping any case affecting their health away (Zeren, 2005). In this sense, apart from being able to comprehend that individuals provide the biological continuation of other living creatures, giving important information that they should acquire in terms of community health under the heading of reproduction and development comes to the forefront.

For the change that occurs in the individual's life to be permanent, the way to effective education is through a curriculum developed with socio-cultural, scientific and technological developments, taking into account the conditions of the country. Many countries recognize the importance of biology education as a cultural and essential aspect of the modern world. To improve the quality of biology instruction, these nations regularly evaluate their current biology teaching programs, identify necessary changes, and consider the conditions required for the successful implementation of newly developed curricula (Soysal, 2018). In this context, the Ministry of National Education of Republic of Türkiye (2018) uses methods such as international comparisons and evaluation of different education systems to determine how to develop a correct education system and therefore an effective curriculum. For example, comparing the educational practices and curricula of other countries based on the results from international assessments such as PISA TIMSS. PISA examines to what extent students acquire information in the fields of reading, mathematics and applied sciences and what they can do with this information. At the same time, PISA provides the most comprehensive and neatest international evaluation regarding the learning outcomes students. The results obtained from PISA show the quality and equality of the learning outcomes obtained throughout the world. Besides them, it allows educators to learn about up-to-date applications in the field of educations in other countries. Comparison studies were also conducted prior to the development of the programs to investigate the similarities and differences between world standards and those adopted by Türkiye under certain conditions. Therefore, this research determined scores from PISA 2018 as the determinant factor to select countries to compare Türkiye's existing education system with the curriculum of the top-scored countries'. According to the PISA science scores (2018), Germany has performed above the average determined by the OECD (OECD, 2018). Therefore, current education program in Baden-Württemberg is discussed as an example in this research.

In the current study, it was aimed to investigate the place of reproduction, generation and development in the secondary curricula. In this sense, the topics of reproduction, generation and development were evaluated in terms of level of grade, content and outcomes in the secondary education, biology course curriculum.

Research Questions

1. What is the content and grade level of the learning outcomes of the units that include reproduction and development in the biology curriculum in Türkiye?
2. What is the content and grade level of the learning outcomes of the units that include reproduction and

development in the biology curriculum in Baden-Württemberg, Germany?
3. What are the similarities and differences between the biology curricula used in Baden-Württemberg and Türkiye regarding the place of reproduction and development?

Method

In the current study, document analysis method, one of the qualitative research methods, was used. Document analysis is a systematic process used to examine and evaluate both printed and electronic materials (Özkan, 2020). Document analysis in qualitative research could be a data collection method alone as well as being used together with other data collection methods. In the document analysis method, it is necessary to follow the stages of a casual examine of the document as the first step and then a detailed examination, determining the results, and follow up the steps of commenting (Bowen, 2009).

In order to enlarge and enrich the data obtained in the research, biology course curricula in Türkiye were investigated in comparison with the biology course curricula in the State of Baden-Württemberg, Germany. Comparative education could comprise the comparison of the education of countries together with their teaching programs or in terms of various factors (Balcı, 2007). In the comparative studies, Ültanır (2000) pointed out that there are two approaches as horizontal and vertical ones. In the vertical approach, the changes coming from the past are investigated while the variables of the same period are compared and the similarities and differences are determined in the horizontal approach (Türkoğlu, 1998). In this sense, horizontal approach was used in the current study and the data obtained was tried to be extended.

Data Collecting Tools and Data Analysis

In the research, "2018 Secondary Education Biology Curricula for the 9th, 10th, 11th and 12th grades" published by the Ministry of National Education (MoNE) in Türkiye and "Germany (Baden-Württemberg) Biology Curriculum" published by Kultusministerkonferenz (2020) were investigated as a document.
During the investigation of the documents obtained in the study, they were applied content analysis. The content analysis was carried out within the framework of investigating the class level, course hour, content and learning outcomes for the topics of reproduction, generation, development given in the secondary education biology curriculum. The main purpose of the content analysis is to reveal the data obtained in a framework and reach the concepts and the relation between the concepts (Yıldırım and Şimşek, 2018).

Findings

Secondary School Biology Curriculum in Türkiye

Upon the review of secondary education biology course curriculum, it was found that the topics of reproduction, generation and development were given directly or indirectly in the units of "Life Science Biology" in 9th grade, "Cellular Divisions" in 10th grade, "Human Physiology" in 11th grade and "Plant Biology" in the 12th grade.

9.1. Life Science Biology

9.1.1 Biology and Common Features of Living Creatures

9.1.1.1 Comments the common features of living creatures.

b. The features of living creatures such as cellular structure, nutrition, respiration, excretion, movement, reaction to stimuli, metabolism, homeostasis, adaptation, organisation, reproduction, growing and development are emphasized (MoNE, 2018).

10.1 Cellular Divisions

10.1.1. Mitosis and Agamogenesis

10.1.1.1. Explains the necessity of cellular division.

a. Cellular division is related to reproduction and development in living creatures and explained.

b. Cellular reasons of division is mentioned.

10. 1.1.2 Explains mitosis.

a. Interphase is studied at basic level.

b. The phases of mitosis are studied at basic level. In the process of explaining the phases, visual elements (photographs, pictures, drawings, caricatures etc.) and graphical arrangements (concept maps, mental maps, and schemes etc.) e-learning objects and applications (animation, video, simulation, infographic, augmented and virtual reality applications etc.) are benefitted.

c. The control of cellular division and its importance for living creatures is explained. The names of the molecules controlling cellular division are not given.

d. The relation of cellular division with cancer is made.

e. Students are encouraged to prepare a product or an electronic presentation (animation, video etc.) explaining mitosis and share this presentation.

10.1.1.3. Explains agamogenesis with examples.

a. In the context of agamogenesis, the examples of schizogenesis, gemmation, reproduction through spores, regeneration parthenogenesis and vegetative reproduction are given. The examples are given only at reproduction through spores and metagenesis is not mentioned.

b. The applications of agamogenesis techniques in gardening and agriculture sector (the ways of reproduction through grafts and onions) are exemplified.

10.1.2 Meiosis and Amphigenesis

10.1.2 Explains meiosis and amphigenesis.

a. Meiosis stages are explained at basic level. While explaining the stages, visual elements, graphic arrangements, e-learning object and applications are benefitted.

b. Students are encouraged to prepare a product or an electronic presentation (animation, video etc.) explaining meiosis and share this presentation.

10.1.2.2. Explains amphigenesis with examples.

a. External and internal fertilization are not given.

b. It is explained that the basis of amphigenesis is meiosis and fertilization (MoNE, 2018).

11.1. Human Physiology

11.1.7 Reproductive system and Embryonic Development

11.1.7.1 Explains the structure, task and process of reproductive system.

a. In the study of the structure of male and female reproductive system, visual elements, graphic arrangements, e-learning and applications are benefitted.

b. Graphics regarding the hormones arranging menstrual cycle are given.

c. The methods of in vitro fertilization are shortly explained.

11.1.7.2 Inferences regarding the things to be done to protect the healthy structure of reproductive system are made.

11.1.7.3 Explains the embryonic development process.

a. The organs made up of embryonic layers are not given.

b. The factors having a negative effect on the development of baby in pregnancy (using medicine including antibiotics in early pregnancy period, extreme stress, lack of folic acid, X-ray exposition) are explained.

c. The importance of following pregnancy in terms of baby's and mother's health is emphasized (MoNE 2018).

12.3 Plant Biology

12.3.3 Amphigenesis in Plants

12.3.3.1 Explains the parts of a flower and the task of these parts.

12.3.3.2 Explains fertilization, seed and fruit formation in plants.

a. Depending on a flowering plant, amphigenesis in plants is studied by benefiting from visual elements, graphic arrangements, e-learning and applications.

b. The role of seed and fruit in reproduction and spread of plants are given through examples.

12.3.3.3 Designs an experiment where they can observe seed germination. They are encouraged to determine the factors affecting germination.

12.3.3.4 Makes a relation between dormancy and germination (MoNE, 2018).

Biology Curriculum in Baden-Württemberg, Germany

Every state in Germany has the administrative authority in all cultural issues including teaching programs. In this sense, the curricula practiced in Baden – Württemberg, the third biggest state in terms of population, located in the southwest of the country were taken as a reference. Upon the review of the curricula practiced in Baden-Württemberg State, it was found that high school grades are between the grades of 5 and 12 and that biology subjects are different in each grade. It was also found that there are two different curricula in practice in the state (2004 and 2016 educational plans) by KMK. According to KMK (2020), 2004 educational plan is valid for all the students starting 6th grade before the educational year of 2016-2017. Besides that, 2004 educational plan is valid for Abitur for the last time in the educational year of 2021-2020, which means students starting 1st grade in the educational year 2020-2021 will take their education based on 2004 curriculum in their two-year period.It was determined that the topics of reproduction, generation and development were given under the heading of "Reproduction and Development" unit in 8th grade and under the heading of "Reproduction Biology" unit in 12th grade.

3.2 7/8th Grades

3.2.1 Cell and Metabolism

Student can define cells, organs, and organisms as a system. He can name the structural and functional similarities and differences between animal and plant cells. He can explain the relation between structure and functions of organs and systems in the transformation of materials and energy, and the importance of cellular division.

- *Defines cellular division as the basis of the growth of organisms.*

  P Knowledge Acquisition (Erkenntnisgewinnung) 1, 7, 11

  P Communication (Kommunikation) 3, 4

  F PH 3.2.2 Optic and Acoustic (10), (11) (Ministerium für Kultus, Jugend und Sport Baden-Württemberg, 2016).

3.2.2. Human Biology

3.2.2.3 Reproduction and Biology

Student tells the growth of baby in the womb up to birth and comprehends the special importance of care for prenatal development; compares and evaluates different birth control methods; defines different sexual orientations and forms of sexual identities independently from values.

- *Explains the formation of an embryo out of an egg cell fertilized through cellular division and cellular differentiation.*
- *Explains the most important development stages of pregnancy (implantation, embryo, foetus, birth) and the results of external effects.*
-

  P Knowledge Acquisition (Erkenntnisgewinnung) 11

  P Communication (Kommunikation) 4

  P Evaluation (Bewertung) 1,14

  I 3.2.1 Cell and Metabolism

  F BNT Human Development

  L PG Body and Hygiene
- *Compares and evaluates different birth control methods.*
- *Explains the importance of the way to apply to protect from sexually transmitted infectious diseases (HIV).*

  P Communication (Kommunikation) 1, 10

  P Evaluation (Bewertung) 1,3

  I 3.2.2.5 Immunobiology

  F BNT Human Development

  L PG Body and Hygiene
- *Defines sexual orientation and sexual identity forms without judging them.*
- *Explains the importance of sexuality for partnership.*

  P Communication (Kommunikation) 5,9

F ETH 3.1.1.1 Identity, individuality and role

F ETH 3.1.1.2 Freedom and Responsibility

F RRK 3.2.1 Human Being

L BTV Personal and social variety; self-discovery and accepting other life styles

L VB Personal needs and wishes (Ministerium für Kultus, Jugend und Sport Baden-Württemberg, 2016).

3.3.9/10th Grades

3.3.2 Genetics

Student can use a simple model to explain the features of DNA. In addition, he can define and compare the transformation of genetic information in mitosis and meiosis division. Also, he can explain what kind of a change amphigenesis creates. He can evaluate the opportunities and risks of genetic engineering.

- *Explains how baby cells having the same set of chromosomes appear in the cellular cycle by means of mitosis and cellular division.*
- *Defines the process and meaning of meiosis and compares it with mitosis.*
- *Explains how sex is determined by sex chromosomes at human.*

P Knowledge Acquisition (Erkenntnisgewinnung) 11, 14

P Communication (Kommunikation) 3

I 3.2.1 Cell and Metabolism

I 3.2.2.3 Reproduction and development

F NWT 3.2.4.3 Information processing (1) (Ministerium für Kultus, Jugend und Sport Baden-Württemberg, 2016).

3.4 11/12th Grades (Two-Hour Course)

3.4.5 Reproduction Biology

Student can compare amphigenesis and agamogenesis; can define modern reproduction biology methods and evaluates the opportunities and risks of various prenatal diagnosis methods.

- *Compares amphigenesis and agamogenesis.*
- *Knows the processes of reproduction biology (germ line treatment, cloning, in vitro fertilisation).*
- *Defines and evaluates prenatal diagnosis methods.*

P Communication (Kommunikation) 1, 10

P Evaluation (Bewertung) 4, 7, 9, 11

I 3.2.2.3 Reproduction and development

F ETH 3.3.4.1 Responsibility ethics (5)

F REV 3.5.2 World and responsibility

F RRK 3.4.2 World and responsibility

F RRK 3.5.2 World and responsibility

L BTV Value Oriented Action (Ministerium für Kultus, Jugend und Sport Baden-Württemberg, 2016).

3.5.2 Biomolecules and Molecular Genetics (Four-Hour Course)

3.5.2.1 Biomolecules

Student can explain the importance of macromolecules in life. At the same time, he uses suitable models to be able explain the relation between the structure and functions of both proteins and nucleic acids.

- *Explains the structural features of proteins (primary, secondary, tertiary, quaternary structure).*

  P Knowledge Acquisition (Erkenntnisgewinnung) 11

  P Communication (Kommunikation) 7

  I 3.2.2.1 Diet and digestion

  I 3.2.2.3 Reproduction and development

  I 3.3.2 Genetic

  F CH 3.2.1.3 Attachment and interaction models

  F CH 3.3.2 Natural materials

  F CH 3.4.4 Natural materials

- *Explains the structural features of DNA on a model (complementarity, anti-parallelism, double stranded).*

  P Knowledge Acquisition (Erkenntnisgewinnung) 9, 11, 14

  I 3.2.2.3 Reproduction and development

  I 3.3.2 Genetics (Ministerium für Kultus, Jugend und Sport Baden-Württemberg, 2016).

3.5.2.3 DNA and Gen Activity

Student comprehends the importance of replication and can explain how genetic information leads to the expression of features. He can compare transcription and translation and explain how antibiotics work by means of their differences. He can also explain the importance of arranging a gen activity for metabolism.

- *Explains DNA replication and its importance for cellular division.*

  P Knowledge Acquisition (Erkenntnisgewinnung) 5, 11, 14

  P Communication (Kommunikation) 4, 7

  I 3.2.1 Cell and Metabolism

  I 3.2.2.3 Reproduction and development (Ministerium für Kultus, Jugend und Sport Baden-Württemberg, 2016).

3.5.4 Intercellular Communication

3.5.4.2 Endocrine System

Student can explain the importance of hormonal system in the arrangement by metabolism and hormones and define different effect mechanisms of hormones on target cells.

- *He can explain the arrangement of metabolic processes by hormones (eg. Thyroxine , insulin, gender hormones) with an example.*

  P Knowledge Acquisition (Erkenntnisgewinnung) 12, 14

  P Communication (Kommunikation) 4, 7

  I 3.2.2.3 Reproduction and Development

  I 3.2.2.4 Information System

  L PG Sense and Sensation (Ministerium für Kultus, Jugend und Sport Baden-Württemberg, 2016).

3.5.6 Opportunities and Risks of Biomedical Processes

Student can define and compare natural reproduction in different living creatures. He can define the reproduction biology methods in human being and evaluates the opportunities and risks of various prenatal diagnosis methods.

- *Explains and evaluates the prenatal diagnosis methods and diagnosis method for preimplantation.*

  P Knowledge Acquisition (Erkenntnisgewinnung) 12, 14

  P Communication (Kommunikation) 4, 7

  I 3.2.2.3 Reproduction and Development

  F ETH 3.4.4.2 Applied ethics (4)

  F REV 3.4.2 World and Responsibility

  F RRK 3.5.2 World and Responsibility

  L BTV Value Oriented Action (Ministerium für Kultus, Jugend und Sport Baden-Württemberg, 2016).

Table 1. Symbols and Explanations for Skill Areas with a Reference to Learning Outcomes Regarding the Process Taking Place in the Secondary Education (Gymnasium) Biology Curriculum in the State of Baden-Württemberg, Germany (Ministerium für Kultus, Jugend und Sport Baden-Württemberg, 2016).

Symbol	Explanation
P	Reference to learning outcomes regarding the process
I	Reference to other standards for the learning outcomes of the same technical plan regarding the content
F	Reference to other topic units
L	Reference guiding for perspectives

Conclusion

It is likely to see that both curricula include the topics of reproduction, generation and development almost at every grade. When it comes to biology course curriculum in Türkiye, there are a total 13 learning outcomes regarding the topics of reproduction, generation and development while there are 19 outcomes in the state of Baden-Württemberg.

The findings show that while the topics of growing and developing are given in the first stage with the unit of common features of living creatures in Türkiye, the topic is dealt directly with the unit of reproduction and development in Baden-Württemberg. At the same time, such topics as biodiversity and evaluation with genetic recombination, biomedical processes and prenatal diagnosis methods are given in detail as differently from what is in Türkiye. As for Türkiye, it is likely to see that such topics as amphigenesis in plants, agriculture and gardening are given a place. Contrary to the one in Türkiye, such action expressions as “is not given” or “… topic is not taught” are not encountered in the outcomes in the curricula. As a result, besides some similarities between the two countries in terms of contents, there are some significant differences in the biology topics

taught. In their studies, Karabulutlu and Kılıç (2011), it pointed out that the information levels of the students studying at a health college about sexual health/reproduction health, but that majority of them have not been given services in this regard. For that reason, it is essential that the topics similar to the learning outcomes regarding reproduction, generation and development should be given by means of direct teaching methods in combination with daily life cases as much as possible in biology course curricula in Türkiye.

The recommendations depending on the results obtained in the current study are as follows:

- The number of learning outcomes should be increased in a way to support with more content regarding the topics of reproduction, generation and development in the biology course curricula in Türkiye.
- In order that future mothers and fathers become conscious parents, learning outcomes regarding prenatal diagnosis methods to decrease the prejudice in this issue could be given a place in the curricula in Türkiye as in Germany, so that students could reach as much information as possible in the course of biology by taking the conditions in Türkiye into consideration in terms of sexual health concerning reproduction and development topics.
- Given that secondary education students' receiving more information in terms of the topics of reproduction and development is of great social benefit, some in-service trainings should be held for teachers to increase their knowledge regarding the related field and teaching methods.

References

Balcı, A. (2007). Karşılaştırmalı eğitim sistemleri. Ankara: Pegem.

Bennett L. R. (2001). Single women's experiences of premarital pregnancy and induced abortionin Lambok, Eastern Indonesia. Reproductive Health Matters 9(17), 37-43.

Bowen, G. A. (2009). Document analysis as a qualitative research method. Qualitative research journal.

Civil B, Yıldız H. (2010). Erkek öğrencilerin cinsel deneyimleri ve toplumdaki cinsel tabulara yönelik görüşleri. Dokuz Eylül Hemşirelik Yüksekokulu Elektronik Journal 3(2), 58-64.

Çok, F. (1998). Ergenler ve AIDS eğitimi. Eğitim ve Bilim, 22(107).

Ekici, G. & Hevedanlı, M. (2010). Lise öğrencilerinin biyoloji dersine yönelik tutumlarının farklı değişkenler açısından incelenmesi, Journal of Türk Fen Eğitimi, 7(4), 97-109.

Giray, H., & Kılıç, B. (2004). Bekar kadınlar ve üreme sağlığı. Sted, 13(8), 286- 289.

Karabulutlu, Ö., & Kılıç, M. (2011). Üniversite Öğrencilerinin Cinsel Sağlık ve Üreme Sağlığı Hakkındaki Bilgi Düzeylerinin Belirlenmesi. Journal of Anadolu Hemşirelik ve Sağlık Bilimleri, 14(2), 39-45.

Kiziroğlu, İ. (1988). Günümüzde biyoloji dersi ve amaçları. Hacettepe University, Journal of Eğitim Fakültesi, 3, 243-250.

Kultusminister Konferenz (KMK) (2020). Lehrplan-Datenbank. Accessed in the address of https://www.kmk.org/dokumentation-statistik/rechtsvorschriftenlehrplaene.html.

Mağden, D., Şahin, S., Metin, F. & Akkaya, F. (2003). Lise son sınıfa devam eden öğrencilerin AIDS hakkındaki bilgi düzeylerinin incelenmesi. Eğitim ve Bilim, 28(127), 31-36.

Ministerium für Kultus, Jugend und Sport Baden-Württemberg (2016). Bildungsplan des Gymnasiums. Accessed in the address of http://www.bildungsplaenebw.de/,Lde/LS/BP2016BW/ALLG

Ministry of National Education (MoNE) (2018). For parents. Retrieved from http://mufredat.meb.gov.tr/Veliler.aspx.

Ministry of National Education (MoNE) (2018a). Secondary school 9th, 10th, 11th and 12th grades biology curricula. Retrieved from http://mufredat.meb.gov.tr/Programlar.aspx.

Ministry of National Education (MoNE) (2019). PISA 2018 Türkiye Pre-Report. Retrieved from http://www.meb.gov.tr/meb_iys_dosyalar/2019_12/03105347_PISA_2018_ Turkiye_On_Raporu.pdf.

Ministry of Education (MoNE) (2020). Curriculum and Activity Examples for Critical Topics and Acquisitions of Courses for the Second Term of the 2019-2020 Academic Year. Retrieved from http://mufredat.meb.gov.tr/201920ikincidonem.html.

OECD (2018). PISA 2018 results. Accessed in the address of https://www.oecd.org/pisa/publications/pisa2018-results.htm

Öksüz, E., & Malhan, S. (2005). Sağlığa bağlı yaşam kalitesi kalitemetri. Başkent University, Ankara.

Özkan, N. (2011). Günümüz Biyoloji Eğitiminin Önemi. Trakya University, Journal of Social Sciences, 13(1), 234-243.

Soysal, S. (2018). 2018 Biyoloji Öğretim Programına Yönelik Biyoloji Öğretmenlerinin Görüşleri (Master thesis). Gazi University Institute of Educational Sciences, Ankara.

Türkoğlu, A. (2020). Karşılaştırmalı Eğitim: Dünya Ülkelerinden Örneklerle. (2nd Edition). Ankara: Anı Publishing.

Ültanır, G. (2000). Karşılaştırmalı Eğitim Yönetimi. Ankara: Eylül Book and Printing House

Yıldırım, A. & Şimşek, H. (2018). Sosyal bilimlerde nitel araştırma yöntemleri. (11th Edition). Ankara: Seçkin.

Zeren, D. (2005). İlköğretim Fen Bilgisindeki Üreme ve Gelişme Konusunun Düzenlenmesi ve Öğretimine Yönelik Program Geliştirme Üzerine Bir Çalışma (Master thesis). Uludağ University, Institute of Social Sciences, Bursa.