



BIOLOGY SUBJECTS WHICH THE TEACHER CANDIDATES HAVE DIFFICULTIES IN LEARNING AND LEADING REASONSⁱ

M. Said Dođruⁱⁱⁱ,

Lale Cerrah Özsevgeç²

¹Kastamonu University, Turkey

²Trabzon University, Turkey

Abstract:

The objective of this study is to make a research on the challenges faced in learning the concepts of biology and the reasons for not learning them based on the opinions of teacher candidates. The study group comprises of teacher candidates studying in a state university in Turkey. The challenges faced by teacher candidates in understanding are gathered under three groups (I can't understand, I have difficulty in understanding, I understand) with the help of statistics program, after being compiled with a questionnaire form. After the respective analyses, it was understood that the reasons that make it challenging for biology subjects to be learned are as follows: not correlating the studied concepts with other concepts; learning by memorizing; not commenting on the result; not attributing the correct meaning to the concepts; not using tangible data on learning the concepts; misunderstanding of concepts due to lack of knowledge; not using the technology on a satisfactory level within the scope of the learning methods. Additionally, the biology subjects, which teacher candidates have difficulty in understanding, can be found on the findings section.

Keywords: biology education, science teacher candidates, learning difficulties, pre-service classroom teachers

1. Introduction

The swift progression of the scientific and technological developments in our era is now felt in our Daily lives. The scientific and technological developments have a critical role in the designation of development level of countries, as well, which, naturally, leads countries to place emphasis on science learning. Today, new science programs are being developed, while (Han, Yalvac, Capraro and Capraro, 2015; Karaman and Karaman,

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ⁱⁱ Correspondence: email msaid.dogru@yahoo.com

2016; Timur and İmer Çetin, 2017; Erden, 1998). In today's world, with a new information input on daily basis, teaching the basic concepts comes to forefront instead of teaching everything (Çömek, Akınođlu, Elmacı and Gündođdu, 2016; Ültay, Ültay and Dönmez Usta, 2018).

In addition to scientificness, as one of the critical parts of science, its social aspects are of vital importance within the scope of many professions in biology, including the decisions we make in our daily lives, as well as protecting our health. Therefore, it can be clearly said that biology education has a critical role in creating developed and informed societies (Üstün and Demirci, 2016; Kara, 2016). Thus, the subjects are to be thought without being memorized, but in accordance with the cognitive structures of the respective concepts, in order to provide a high-quality biology education. In addition to this, it is essential for the methods of accessing other concepts to be students, as may be deemed required. This led the researchers and teachers to seek solutions within this matter (Mazlum and Yiđit, 2017).

The subjects that the students make conceptual mistakes and have difficulty in learning in biology are as follows: classification (Connor and Lawrence, 2017), cell divisions (Alkan, Akkaya and Köksal, 2016), cell structure and function (Maraş and Akman, 2009), photosynthesis (Güneş and Taştan Akdađ, 2016), diffusion and osmosis (Artun and Coştu, 2013; Harman, 2014), systems of our body (Ahi and Balcı, 2017), genetics (Yates and Marek 2014; Etobro and Banjoko, 2017).

It is known fact that the prior knowledge and experience of the students are critical for construing the challenges faced. Since each student has a unique learning method, the conceptual faults vary based on their knowledge and experiences (Abdul Raheem, Bello and Odutayo, 2018). It is suggested to develop a subject and person-based program within this context (Kontaş and Yađcı, 2016).

After recognizing that the conceptual mistakes of students that do not correspond with the scientific information, lead to problems in science teaching, a deep research was initiated in each and every science branch on what these mistakes are, the root causes and what to do for eliminating these problems (Elangovan, 2017; Kalimuthu, 2017). Under the light of all this information, it can be clearly seen that the detection of conceptual mistakes, including their prior knowledge are of importance not only for planning the lectures effectively, but also for preventing the mistakes (Mahdi, 2014; Yavuz Mumcu and Yıldız, 2015). Students not having the ability correlate the subjects with their daily lives, the Latin and foreign terms used in the general content of biology subjects for primary and secondary level students, including the complicated relations between these subjects, lead these subjects not being learned properly (Toyoma, 2000; Kwen and Lawson, 2000; Orcajo and Aznar, 2005; Fonseca and Cunha, 2011; Fujita, 2012; Özkan and Bal, 2018).

For minimizing these mistakes of students and to accomplish the respective objective in teaching, it is essential for the teachers to pick the materials tailored for the respective subjects, to use them correctly and to have a satisfactory level of knowledge on the respective subjects. Therefore, they must receive a first-class education during undergraduate study period, as well as having good knowledge and skills on the

respective areas. It was stated that the teachers that are not well-informed in the respective area, providing inconsistent information, cannot properly relay information to the students, thus leading the students to be negatively affected (Valanides, 2000; Sewell-Smith, 2004; Halim and Meerah, 2002; Mahdi, 2014). As a matter of fact, Alkan et al. (2016) and Özdemir, Şimşek and Ecevit (2017) pointed out that the majority of teachers fall into conceptual errors in biology. In another study carried out on active teachers and teacher candidates, it was confirmed that the teachers did not control the information on the textbooks while teaching, and led the students to face with learning problems while simplifying the subjects without even realizing it (Sewell-Smith, 2004). Considering all these matters, it can be seen that the domain knowledge of the teacher candidates and actively working teachers are to be reviewed and researched with regards to the subjects that the students have difficulty in understanding.

Therefore, it was determined to carry out a study that set forth the reasons for being unable to learn the biology subjects and concepts.

2. Material and Methods

The study is a descriptive research in terms of its survey model. The sampling of this study comprises of 354 sophomore teacher candidates, studying on the Science and School Teaching Programs in the Faculty of Education of a state university (see: Table 1). The reason for choosing these candidates is to reveal their opinions with regards to the difficulty level of the subjects, where all the subjects are completed in the General Biology class (Memnun, 2008). The distribution of teacher candidates by gender can be seen on the following table, within the study with purposive sample:

Table 1: Distribution of the Candidates by Gender and the Frequency Values

Gender	Classroom Teaching		Science Teaching	
	f	%	f	%
Female	107	59,4	92	52,9
Male	73	40,6	82	47,1
Total	180	100	174	100

First of all, the biology subjects that cannot be well-understood or conceptually misunderstood were specified and gathered under 17 topics, by analyzing the written resources that are used by the teacher candidates, in addition to the national and foreign studies related to this matter. Two questionnaires were conducted on the teacher candidates, one of which is as per their comprehension level on these subjects under “I understand, I have difficulty in understanding and I don’t understand”, while the other one is oriented at the reasons for not understanding (see: Table 1-2). The teacher candidates were requested to state the reasons for not understanding as being unable to correlate, inconclusive teaching, conceptual mistakes, abstract concepts, negative approaches, material deficiency.

3. Findings

According to the questionnaire results, as the first phase of the research, the teachers stated that they have difficulty in understanding the following subjects, in order: tissues, regulatory and controller systems, activities of living organisms and genetics (see: Table 2). A considerable part of the same group stated the following as the subjects, which they cannot understand anything, at all: cell divisions, microorganisms, genetics and biotechnology, endocrine system and controller & regulatory systems. Cell divisions and microorganisms are some of the essential subjects, among those that cannot be well-understood (see: Table 2).

The reasons for not understanding the respective subjects were detected to be as follows: being unable to correlate with daily life, conceptual mistakes, lack of knowledge, not using visual materials, not utilizing proper teaching strategies and the subject to be abstract (see: Table 3).

On the second phase of the research, the following were determined to be as the subjects that the teacher candidates have difficulty in understanding, according to the questionnaire results: diversity of living creatures, animals, plants, microorganisms, monocellulars, structures of living creatures, cells, general information on genetics, tissues, photosynthesis, organs and organ systems, human body and activities of living creatures (see: Table 2).

Table 2: Comprehension Levels of Biology Subjects By Percentage

Subjects	I understand		I have difficulty in understanding		I don't understand	
	CT	ST	CT	ST	CT	ST
Regulatory and controller systems	43	40	32	27	25	37
Activities of living creatures	48	59	31	22	21	18
ATP energy	63	72	24	16	13	12
Genetics	43	52	37	32	20	16
Cell divisions	38	45	43	34	29	21
Microorganisms	44	52	31	25	25	23
Tissues (Plants and Animals)	59	63	23	20	18	17
Cellular respiration and fermentation	73	79	15	10	12	11
Sensorial mechanisms	82	89	13	8	5	3
Endocrine system	35	48	44	38	21	14
Cardiac, vascular and blood structures	64	71	29	23	7	6
Genetics and biotechnology	29	41	44	36	23	23
Diversity and classification of living creatures	73	81	14	11	13	7
Aerobic and anaerobic respiration	65	75	17	13	18	12
Bodily systems	62	73	23	19	15	8
Cell and its structure	68	77	14	13	16	10
Sexual and asexual reproduction	66	70	22	24	12	6

Note: CT = Classroom Teaching, ST = Science Teaching

Table 3: Percentages for the Reasons of Not Understanding the Biology Subjects

Subjects	Non-correlation		Poor teaching		Conceptual mistake		Abstract concepts		Negative approaches		Material deficiency	
	CT	ST	CT	ST	CT	ST	CT	ST	CT	ST	CT	ST
Regulatory and controller systems	17	20	16	9	20	18	30	24	15	10	23	19
Activities of living creatures	9	16	27	18	20	25	25	14	2	5	17	22
ATP energy	12	14	24	28	18	20	13	17	8	3	25	18
Genetics	8	5	13	18	21	27	29	32	3	1	28	17
Cell divisions	21	14	6	6	18	12	26	30	5	8	28	30
Microorganisms	9	7	14	19	10	8	21	28	7	4	33	35
Tissues (Plants and Animals)	38	36	4	6	12	8	24	18	0	3	25	16
Cellular respiration and fermentation	9	4	12	17	14	18	26	22	5	7	33	32
Sensorial mechanisms	10	8	8	12	18	14	13	19	18	21	11	14
Endocrine system	20	22	16	19	23	26	17	16	5	2	19	15
Cardiac, vascular and blood structures	14	16	14	20	7	10	39	32	4	3	22	19
Genetics and biotechnology	19	15	10	3	16	22	18	18	21	24	9	18
Diversity and classification of living creatures	4	8	11	17	5	4	24	29	11	7	17	20
Aerobic and anaerobic respiration	10	15	5	27	23	26	28	23	10	12	6	15
Bodily systems	14	13	3	8	16	22	18	10	32	24	17	23
Cell and its structure	6	3	16	18	20	15	27	33	13	12	18	19
Sexual and asexual reproduction	8	12	0	1	18	12	29	25	2	1	19	22

The classroom teacher candidates answered the questions for the reasons of not understanding or having difficulty in understanding, similarly to the science teacher candidates, as follows: lack of experiments, memorization based teaching, conceptual mistakes, abstract concepts and not using proper teaching strategies. The subjects that they have difficulty in understanding or they never understand were detected to be as the activities of living creatures, genetics, organs and organ systems, in which they find the teaching methods as incompetent (see: Table 3).

Not using visual materials and proper teaching strategies in both groups is of vital importance among the reasons for having difficulty in understanding or not understanding the subjects (see: Table 3).

4. Discussion and Conclusion

In this study, the research subject is the level of understanding and the challenges faced in understanding within biology subjects for teacher candidates studying in the science

and classroom teaching departments, within the scope of higher-education curriculum. Examining the research results, it can be seen that the teacher candidates have difficulty in understanding or do not understand the main subjects of biology (see: Table 2). For example, the following subjects were detected to be the ones that the students have difficulty in understand or do not understand, at all: organs and organ systems, genetics, animal tissues, cell division and activities of living creatures (see: Table 2). Additionally, classroom teacher candidates to state that they do not have difficulty in understanding certain subjects that are new to them, and science teacher candidates to have difficulty in understanding certain subjects, which they previously did not have any difficulty in understanding, indicates that there are some alternative concepts in the respective subjects.

The teacher candidates to not clearly comprehend the respective subjects lead the students to have deficiency in knowledge and to face with conceptual mistakes, while these teachers perform their duties. Güneş and Güneş (2005) stated in their studies that there is a possibility for the students to bring their conceptual mistakes to the next level. In various studies within the literature, it is argued that it is still recognized as a problem for the high school and university students to face with subjects that they have difficulty in understand or cannot understand, at all. Şen and Özdemir (2016) stated that there are alternative concepts within the scope of gene and chromosome concepts, which are used by the students. As can be understood from this perspective, it was suggested that teaching of the aforementioned subjects is still a problem and that not comprehending these subjects, as the main subjects of biology, on a satisfactory level makes other subjects more challenging to be learned, where the same topics were suggested as the subjects that the students have difficulty in understanding or cannot understand (see: Table 2). Similarly, Yakısan (2016) and Altunođlu and Şeker (2015), in their studies, suggested that students have difficulty in understanding the subjects mitotic and meiosis divisions, chromosomes, gene and bodily systems. In this study, similar findings were obtained, which shows that the same problems are still being faced in higher-education. The majority of studies that were carried out with regards to the challenges in understanding the biology subjects, it was argued that the subjects “cell division” and “genetics are difficulty to be comprehended”, while suggesting that the genetics, in particular, is recognized as a subject, which is not only difficult to be taught, but also challenging to be learned (Ahmed, Opatola and Yahaya, 2018; Lee and Kim, 2015; Şen, Öztekin and Demirdöğen, 2018). According to the obtained results, it can be seen that the teacher candidates will have difficulty in teaching the main subjects, particularly the cell division, genetics and tissues, in their professional lives.

Examining the reasons for the teacher candidates not understanding the biology subjects, such matters as material deficiency, conceptual mistakes and poor teaching come to the forefront (see: Table 3). In previous studies carried out on the students, it was argued that the biology lesson was taught just with textbooks and power-point presentations, out of practicality and visibility, with direct instruction method (Sıcaker and Öz Aydın, 2015), while making the subjects to be difficulty for being understood due to not being presented with computer based images, not being correlated with

daily life, thus being hard to attract the attention of students (Şen and Özdemir, 2016; McLaren, Adams, Mayer and Forlizzi, 2017). Having similar results in this study, it can be said that the respective subjects cannot be properly comprehended due to not being correlated with daily life, as well as not using the required materials, thus not accomplishing the expected objectives.

The teacher candidates stated that motivation and usage of visual materials are of great importance in learning. Materialization of subjects that are particularly difficulty to be understood, as well as correlating with daily life is suggested for empowering the teaching strategies. The studies carried out with regards to the challenges faced in understanding biology are of characteristic that support the findings of this study (Scott, 2016; Şen and Özdemir, 2016; Özyay Köse and Gül, 2016). According to these researchers, it makes it difficult for abstract concepts to be materialized during teaching, where the direct instruction and question & answer methods are utilized, without establishing correlation with daily life. Goff, Reindl, Johnson, McClean, Offerdahl, Schroeder and White (2017) argued that the subject “cell division” can be understood better where it is supported with experimental methods and virtual learning module. In other related studies, it was suggested that the students obtain more materialistic facts with visual materials; that they configure the knowledge by contributing to their prior knowledge in line with the philosophy of doing & living; that they are motivated when they believe in themselves for solving problems in their lives, where the learning process is satisfactory; and that they try harder for understanding the subjects related to genetics better (Güneş, 2005; Şen and Özdemir, 2016; Kavak and Coşkun, 2017; Saydam and Çangal, 2018). It was emphasized by the researchers in the studies, where these techniques (visual materials) were used, that the learning process became more convenient (Keser and Özdemir, 2018; Nagro, de Bettencourt, Rosenberg, Carran and Weiss, 2017; Soykan and Özdamli, 2016).

In conclusion, it was seen that it is a critical problem for certain biology subjects like cell division, controller and regulatory systems, chromosomes and genes, etc. as some of the main subjects of biology and which are in the higher education curriculums, and that it becomes more difficulty for these candidates in their professional lives to teach these subjects to the students. Therefore, while teaching the biology subjects in higher-education, they should be correlated with daily life, while being taught in a manner that is interesting to the students, as well as being supported with visual materials. Additionally, it is thought that certain subjects like tissues, diversity of living creatures, bodily systems and reproduction can be more interesting and easier to be learned, where they are taught by using visual materials and physical examples.

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