ECEM YALIM

HIGH SCHOOL STUDENTS' LEVEL OF KNOWLEDGE AND ATTITUDES TOWARDS THE USE OF TECHNOLOGY IN BIOLOGY CLASSROOMS

A MASTER'S THESIS

BY

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THE PROGRAM OF CURRICULUM AND INSTRUCTION
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To my uncle, Erhan Çelikkaya

High School Students' Level of Knowledge and Attitudes Towards The Use of Technology In Biology Classrooms

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Ecem Yalım

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High School Students' Level of Knowledge and Attitudes Towards The Use of Technology In Biology Classrooms

Ecem Yalım

December 2020

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Curriculum and Instruction.

Asst. Prof. Dr. Armağan Ateşkan (Supervisor)

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Curriculum and Instruction.

Assoc. Prof. Dr. Erdat Çataloğlu (Examining Committee Member)

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ABSTRACT

HIGH SCHOOL STUDENTS' LEVEL OF KNOWLEDGE AND ATTITUDES TOWARDS THE USE OF TECHNOLOGY IN BIOLOGY CLASSROOMS

Ecem Yalım

M.A., Program of Curriculum and Instruction

Supervisor: Asst. Prof. Dr. Armağan Ateşkan

January 2021

Through the rapid development of technology of our age more technology tools are used in the field of education. In education, the use of technology and its tools affects students' attitudes towards lessons. Therefore, technology and its tools have been used in the education field to provide opportunities for students to have better educational environments and to improve their learning. This study aims to investigate high school students' (*N*= 612, 58% female and 42% male students) level of knowledge and attitudes towards the use of technology in biology classrooms. In this quantitative study, a questionnaire was used to collect data from four different high school in Ankara province. As a result of this study, the most used technology tools in biology classrooms are video, animation and interactive white board. In terms of gender difference, it was concluded that male students' knowledge level of technology and its tools used in biology classrooms are higher than female students. However, it was explored that female students' attitudes are more positive than male students' attitudes in biology classrooms. Finally, there is a weak correlation between students' technology knowledge and the program that they follow in schools. On the other hand, there is no relationship between students' attitudes towards technology and the program that they follow. Considering the results, the present study suggests that the technology and its tools used in high school biology classrooms will be useful in informing teachers and educational program developers about students' level of technology knowledge and attitudes towards technology.

Keywords: Secondary education, biology classroom, technology, knowledge, attitude

ÖZET

LİSE ÖĞRENCİLERİNİN BİYOLOJİ SINIFLARINDA KULLANILAN TEKNOLOJİ İLE İLGİLİ BİLGİLERİ VE TEKNOLOJİYE KARŞI TUTUMLARI

Ecem Yalım

Yüksek Lisans, Eğitim Programları ve Öğretim

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Çağımız teknolojisinin hızlı gelişimi sayesinde daha fazla teknoloji aracı eğitim alanında kullanılmaya başlanmıştır. Teknolojinin ve araçlarının eğitimde kullanımı, öğrencilerin derslere karşı olan tutumlarını etkilemektedir. Bu nedenle, teknoloji ve araçları öğrencilerin daha iyi eğitim ortamlarına sahip olmalarına ve öğrenimlerini geliştirmelerine olanak sağlamak için eğitim alanında da kullanılmaktadır. Bu çalışma, lise öğrencilerinin (*N*= 612, %58 kız ve %42 erkek öğrenci) biyoloji sınıflarında kullanılan teknoloji ve teknoloji araçlarını, teknoloji araçları ile ilgili bilgilerini ve teknoloji araçlarına karşı tutumlarını araştırmayı amaçlamıştır. Bu nicel tasarım yöntemi çalışmasında, Ankara ilindeki dört farklı liseden veri toplamak için anket kullanılmıştır. Anket verilerinin sonucunda, biyoloji sınıflarında en çok kullanılan teknoloji araçlarının video, animasyon ve interaktif beyaz tahta olduğu görülmüştür. Katılımcılardan erkek öğrencilerin, biyoloji sınıflarında kullanılan teknoloji ve teknoloji araçları hakkındaki bilgilerinin, kız öğrencilerin bilgilerine kıyasla daha fazla olduğu görülmüştür. Ancak, biyoloji sınıflarında kullanılan teknoloji ve teknoloji araçlarına karşı tutumları açısından kız öğrencilerin tutumlarının, erkek öğrencilerin tutumlarına göre daha olumlu olduğu görülmüştür. Son olarak, öğrencilerin teknoloji bilgisi ile takip ettikleri program arasında zayıf bir ilişki olduğu bulunmuştur. Öte yandan, öğrencilerin teknolojiye yönelik tutumları ile takip ettikleri program arasında bir ilişki görülmemiştir. Bu tezde lise düzeyindeki öğrencilerin biyoloji derslerinde kullandıkları teknoloji ve teknoloji araçlarına olan bilgisi ve teknolojiye yönelik yaklaşımları çalışılmıştır. Çalışma sonuçlarının hem öğretmenler hem de eğitim programlarını geliştiren çalışanlara yararlı olacağı düşünülmektedir.

Anahtar kelimeler: Orta öğretim, biyoloji sınıfı, teknoloji, bilgi, tutum

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CHAPTER 1: INTRODUCTION

Introduction

Technology and its tools have been used in the education field to provide opportunities for students to have better educational environments and to improve their learning. In recent years, researchers have examined the reform of instructional methods, its effects on curriculum content and students' attitudes towards technology (Daugherty & Carter, 2019). With the continued growth, spread and much use of technology, students frequently interact with technology in various areas of their lives. This has resulted in sourced technology communication and skill gaps, which have disadvantages in terms of how instructors connect with their students (Prensky, 2001).

According to Prensky's study, technology and its tools are rapidly replacing traditional teaching techniques. The aim of using technology in the education field is to increase students' self-esteem by developing their understanding of the different assembling forms and the utilization of different materials in the craft (Autio, Soobik, Thorsteinsson, & Olafsson, 2015). Moreover, students' gender, the applied curricula, regional differences influence students' knowledge levels and attitudes towards technology and its tools.

This study explores four different high schools in Ankara to gain insight into high school students' knowledge levels and their attitudes towards technology and its tools in biology classrooms.

In this chapter, the researcher will state the necessary background information for this study, its problem statement, purpose, research questions, signicance and definition of key terms respectively.

Background

Over the past several decades, technology has been used in classrooms in various ways like overhead projectors, tablets, interactive white boards, laptops. Thus, the use of relevant educational technologies recommended together with their use in classrooms. Introducing and using technology in learning environments make learning more student-centered, encourage students' interaction with the teacher and facilitate cooperative learning (Sivin-Kachala & Bialo, 2000). In an increasingly technological environment, students need twenty-first century skills which include the ability to increase creativity, critical thinking, communication, and collaboration (Bialik & Fadel, 2015). These skills require, mastery of technology, inspiration of thoughts, improvement and progress in subject areas like biology. Biology allows students to be aware of the existence and the influence of nature in their daily lives and to see themselves empowered to take duty for the attention and conservation of the environment (Garraway-Lashley, 2014). In order to achieve teaching and learning outcomes in biology lessons, meaningful learning methods can be employed together with technology to support students' performance.

The proposal made UNESCO to improve biology teaching strategies encouraged the diversification of lesson content, methods and knowledge sharing with technology in biology courses (Anderson, van Weert, & Duchateau, 2002). Accordingly, these diversifications can be used as teaching methods that incorporates technology in

biology courses. Thus, students will have to improve their thinking and learning skills as well as information and communication technology literacy so as to comply with these teaching methods.

As for the effects of technology on students, it has both advantages and disadvantages in terms of students' knowledge and attitudes (Incantalupo, Treagust, & Koul, 2014). One of the advantages of using technology is improving students' higher level thinking skills in addition to their inquiry abilities. (Costley, 2014). Nonetheless, researchers state that students become inactive in class participation and their behavior is affected negatively (Al-Fahad, 2009). Considering both approaches, many researchers argue that technology should be left to evolve on its own.

According to Sivin-Kachala and Bialo (2000), "[p]ositive changes in the learning environment brought about by technology are more evolutionary" (p. 9). Thus, the relevant technology should not be accelerated and revolutionized by human beings; it should be accelerated and evolved by itself in the field. As both teachers and students already use technology and its tools, studies address issues regarding the knowledge and attitudes of students towards technology and its tools in biology classrooms.

Although the results of most studies show positive impact of technology on students' knowledge and attitude, when it comes to biology gender differences create an important difference. As a result, researchers found that there is a significant difference between male students and female ones in terms of their attitudes towards technology. Females students tend to use technology via social influence rather than making their own decisions. However, male students are more inclined towards

making their own decisions while using technology (Mazman & Usluel, 2010). According to Incantalupo, Treagust & Koul (2014)'s study; perception, interest, and gender differences can affect students' behavior and attitudes towards technology. There is a slight difference in perception regarding gender, while female students consider computer as a technological tool, males consider it as a game. Mammes (2004) indicate that females have difficulty connecting with technology; therefore, they are more reluctant towards using technology or joining technological activites considering their limited experience. The previous studies on the use of technology in classroom in order to affect student learning positively explore if technology "is well-received by both genders" (Incantalupo, Treagust, & Koul, 2014, p. 101). For, technology and its tools will take place more in both female and male students' future jobs. Therefore, the students will have to increase their use of technology that will help them to work in a technological society. Information and communication technologies (ICTs), that should be used by students, include technological tools that are used from past to present such as overhead projector, radio, television, computers and the Internet. These are powerful tools for educational change and reform in teaching and learning environments.

ICT has the capacity to implement and promote teaching methods that should be adapted to the previous data and society (Dede, 2000). However, some studies have shown that ICT within curricula is a complex process. According to Olaore (2014),

> If the teacher does not adapt their methods in order to make the best use of ICT, then the purpose of using ICT becomes defeated, also the attitude of the educational establishment seems to have a greater effect when the people running them do not have the knowledge and experience. (p. 156)

Thus, there should be more studies focusing on the use of ICT in order to improve both students' learning and teaching methods while focusing on various subject areas including biology. The studies on using technology in different curricula such as International Baccalaureate Diploma Program (IBDP) and Ministry of National Education (MoNE) program are insufficient. Within the IBDP program, technology and its tools play a significant role because the IB's learner profile attributes such as inquirers, communicators and knowledgeable may become more effective with the use of ICT. International Baccalaureate Organization (2020) stated that, "IB uses an integrated approach, encouraging students to make informed judgements and decisions about the role of information and communication technologies in contemporary society".

Consequently, using ICT is an important and effective method for students in the IB education program. Moreover, expanding access to technology and its tools will support IB students' development to be more internationally minded in addition to improving their comprehension of design and technological world (IBO, 2020).

As for the Turkish Ministry of National Education, the ministry carries out most of the technology and its use of tools in the education system. Previous research studies have also focused on the impact of using educational technology tools in order to improve students' abilities and learning in classrooms, by considering various learning strategies and individual learning differences (Simsek et al., 2009). According to the Turkish Ministry of National Education, educational technologies should support learner-centered and constructivist instruction, expressing that instructional technologies are useful at having the option to help students' abilities

related to accessing, processing and introducing data, solving problems and communication (MoNE, 2020). Nowadays, the biology curriculum of the Turkish Ministry of National Education standardizes that ICT needs to be incorporated with education and learning systems in and out of classrooms. Further use of ICT in the education field would be a reform for Turkish education system because it aims at leading towards a more knowledgeable society in terms of technology literacy.

In the IB Biology guide, there is a section that discusses the word "technology" in relation to science. IB emphasizes the practical use of technology and its importance regarding sustainability (IBO, 2016, p. 6). Additionally, there is a mention of creative thinking, which is a 21st century skill, "comparing science and the use of technology" in it (p. 12). Within the aims of the biology course, IB highlights the importance of technology use by experiments, various skills such as "communication and scientific thinking" (p. 18). Furthermore, IB clearly states that "ICT is encouraged throughout all aspects of the course in relation to both the practical programme and day-to-day classroom activities. Teachers should make use of the ICT pages of the teacher support materials" (p. 23).

Similarly, in Ministry of National Education (MoNE) program, there are mentions of the use of technology in biology classes. MoNE suggests that students' needs evolved in the 21st century because of the rapid changes in science and technology (MoNE, 2018, p. 4). Therefore, the use of technology in biology classrooms is further encouraged by increasing students' knowledge and abilities of using it (p. 7). MoNE provides reasons for this such as many innovations in biology especially in the field of genetic engineering and biotechnology. That's why, biology has become

a significant part of individuals which has increased the use of technology in biology classes. MoNE biology curriculum is updated regarding changes and innovations to include the use of ICTs via research and questioning (p. 11).

Problem

In recent years, technology has developed rapidly in Turkey with positive and negative effects in education field. Education with modern technology and its tools have started to replace traditional classroom and its tools. As Yapıcı and Karakoyun (2016) stated, unlike traditional classrooms, nowadays "white boards and smart boards are in use" (p. 459). The use of technology in modern classrooms has influenced students' learning both positively and negatively, which were addressed by many researchers.

For instance, when technology was implemented in classrooms, Schroeder et al. (2007) observed positive effects of technology on students' achievement in their test scores. Also, according to Cramer et al. (2007), the ideas of using all the technological materials are supporting to learn with accessible components on the web, and information that learnt with technology, can affect students' success positevly. Likewise, the use of technology and its tools in the classrooms increased students' positive attitudes towards technology and enhanced their skills in writing and problem solving (Ross, Morrison, & Lowther, 2010). Another example is that students are engaged in meaningful learning by getting involved in dynamic, intended, reliable, constructive and conjunctive learning through the use of technology in lessons (Hung, Jonassen, & Liu, 2008). As for integrating technology in biology lessons, a picture, video, simulation, field trip or case study, which can be

directly connected with technology, may reinforce students' learning and thinking abilities. Correspondingly, Garraway-Lashley (2014) noted that "Integrating computer technology into the teaching of biology can enhance students' academic performance in the subject" (p. 13).

On the other hand, regarding the negative effects of using technology in classrooms, those depend more on the teachers. Teachers' anxiety of using technology and its tools, mainly caused by their incompetency of implementing technology, may decrease students' understanding and abilities in the classroom. However, this anxiety in teachers can be reduced by getting them to be more involved with technological tools via various experiences. Therefore, it can be said that "[t]he ability to reduce anxiety may also depend on the type of computer experience to which the teachers are exposed" (McInernet, McInerney, & Sinclair, 1994 as cited in Christensen, 2002, p. 412). Furthermore, Eristi, Kurt and Dindar (2012) stated that "constant and good-quality support supposed to be provided for teachers is quite important for technology use in educational environments".

As for the importance of gender while analyzing the effect of using technology in classrooms, there are various approaches. For example, Incantalupo, Treagust and Koul's (2014) results indicate that "the technology and its tools used in classrooms increased students' attendance and success levels from both genders" (p. 104). However, in a 2013 study done in the United States, a survey was conducted to assess the level of technology and technology knowledge for 700 high school students, the interest and attitudes of technology use in education. This research also examined whether there is a particular difference between male and female students

in the level of knowledge, interest and attitudes of the technology and its tools used. According to the research findings male students have more knowledge level, interest and attitudes of technology and its tools compared to female students. Thus, it can be concluded that the results differ depending on the analysis of the research study.

The use of technology in classrooms detects the motivation of students, the interest of the course, and the better understanding of the lesson (Onder & Aydın, 2016). In Turkey, the number of studies (Altun, 2006; Uslu & Bümen 2012) for researching technology and technology knowledge in education of high school students is limited. According to Altun (2006), MoNE is the organization who needs to make sure that schools use technology efficiently (p. 184). The results show that the issues regarding the use of technology are related to software programs at schools which are not compatible with students' needs (p. 185). Altun clarifies that even though there are many studies on the use of technology in biology classes (i.e., Aduwa-Ogiegbaen & Iyamu, 2005; Hakkarainen et al., 2000; Pelgrum, 2001; Warschauer, 2003), further studies might be helpful to provide solutions for the issues in this technological reform (p. 186). Likewise, Uslu and Bümen (2012) analyzes the use of technology in classrooms considering the recent investments made and states that MoNE teachers should be able to use technology efficiently (p. 115). However, technology is used in biology lessons to raise awareness of high school students' use of technology. This improves the efficiency of using biology classrooms as a learning and teaching space. Prior to the preparation of these programs, students should be aware of current used in the field of education, especially in biology classes, and their interest and attitudes towards technology. Therefore, this study is a resource to fill the gaps in literature which are related to students' knowledge and attitudes towards technology in high school biology classrooms.

Purpose

The study's main purpose is to offer insight into high school students' knowledge levels of and attitudes towards technology and its tools used in biology classes. In addition, the study compares knowledge and attitudes of different genders and curricula. Data analysis and results provide recommendations for learning more about technology and its tools used in high school biology classes and improving the use of technology in biology classrooms.

Research questions

The research questions listed below are investigated in this research:

1. Which technology tools are used in high school biology classrooms?
2. What are high school students' level of knowledge and attitudes towards the use of technology in biology classrooms?
    a. Is there a significant difference between female and male students in terms of their level of knowledge and attitudes towards technology in the biology classrooms?
    b. Is there a significant difference between the students who follow the Turkey's Ministry of National Education (MoNE) and the International Baccalaureate Diploma program (IBDP) together, and the students who follow only the Ministry of National Education (MoNE) program in terms of their level of technology knowledge?
    c. Is there a relationship between the students who follow the Turkey's Ministry of National Education (MoNE) and the International Baccalaureate Diploma program (IBDP) together, and the students who follow only the Ministry of National education

(MoNE) program in terms of their level of knowledge and attitudes towards technology?

Significance

Technology has become more efficient in every field. Due to technological developments, in classrooms, moreover in biology classrooms, technology has become more effective on teaching and learning in the world. However, in Turkey there is limited research, and the researcher hopes to contribute the current literature by the study's findings that presents high school students' attitudes and knowledge towards the technology and its tools in biology classrooms. Another significant aspect of the study is to improve curricula and fortunately increase the understanding of the use of technology and its tools in biology classrooms. People who work at education sector such as curriculum developments specialists, school administrators and teachers use this study by understanding the effects of technology and its tools on students' level of knowledge, attitudes and usage in biology classrooms.

Definition of key terms

Attitude: "A disposition to respond favourably or unfavourably to an object, person, institution, or event" (Ajzen, 2005).

Information and Communication Technology (ICT): "Abbreviation for information and communication technology: a school subject in which students learn to use computers and other electronic equipment to store and send information" (Cambridge's online dictionary, n.d.).

Knowledge: "The state of knowing about or being familiar with something" (Cambridge's online dictionary, n.d.).

Technology: “New machines, equipment, and ways of doing things that are based on modern knowledge about science and computers” (Longman dictionary of contemporary English, 2005).

The International Baccalaureate Diploma Programme (IBDP): “A two-year educational programme for students aged at sixteen to eighteen” (https://www.ibo.org, 2020).

Ministry of National Education (MoNE): “The ministry where education and training services are carried out by the state” (http://www.meb.gov.tr/en/).

CHAPTER 2: REVIEW OF RELATED LITERATURE

Introduction

Results of recent research and investigation show that technology has become an integral part of human life paving the way for many innovations. These innovations and developments in technology, in turn, have also led to the introduction of new terms into our lives. By this way, ideas have been introduced about the use of technology in different areas like education. Recently, technology has been more used in education system. For twenty-first century skills require mastery of subject areas with technology to improve learning and thinking skills. Technology improves the effectiveness of educational methods by expanding the rate, profundity, accuracy and estimation of realizing, which exist in education (Nicolle, 2008). Currently, it is hard to find researches about students' attitudes, knowledge level of technology and its tools in biology classrooms. Thus, the researcher intention to explore high school biology students' level of knowledge and attitudes towards technology and its tools. The study is worth investigating because technology and its tools are becoming more globally widespread within educational systems.

This chapter offers an extended explanation of the following; technology, educational technology and its history, tools, advantages, and obstacles, technology in biology classrooms, and students' attitudes, knowledge level of technology in classrooms by considering other studies.

Technology

"Technology […] seeks to find practical ways to use scientific discoveries profitably, ways of turning scientific knowledge into utilitarian process and devices" (McNeil, 2003, p. 1). The development of technology was explained with two contradictory ideas; the East and the West. In the West, the history of technology began with Aristotle and still continues to develop. However, there was no scientific information or knowledge related to technology in that period. On the contrary, the first technology was developed in the East with scientific information. Later on, the historical development of technology accelerated, and its definition altered in the 18th century with the start of Industrial Revolution. Through the knowledge gained with the Industrial Revolution, people were able to create technologies and tools which assist humans (Schatzberg, 2018).

Throughout the history of humanity, technology has changed continuously, and accordingly various definitions have been made from past to present. However, despite the different definitions, technology is often associated with machine or mechanical equipment but also to talent, science and art. Technology can be defined a complex structure in which people and machines are integrated together (Hoban, 1965, p. 242).

There have been scholarly attempts to understand and define technology within the last century to explain technological ideas that become widespread. However, although it is hard to define technology, people can actually understand it, including the difference between what is "natural" and what is "human-made" (Brey, 2009). This difference is important as it explains the association of knowledge of

technology with regards to its definition. In order to comprehend this difference, we should focus on the following distinctions (Carroll, 2017):

1. One is able to comprehend the difference between what is “natural” (not technology) and what is “human-made” (technology with the knowledge of technology or
2. One is able to comprehend the difference between what is “natural” (natural technology) and what is “human-made” (technology created by man) with the knowledge of technology.

Technology’s definitions and features include following:

- As the word “logos” implies the “principle of ordering”, it suggests the principle of creation through the meaning of “techne” (Skribina, 2015, p. 119).
- The word “techne” is extensively assumed to mean “skill” and “art”. In it, technology is explained as “a system created by humans that uses knowledge and organization to supply objects and methods for the reach of specific goals” (Volti, 2009, p. 6).

Just as these definitions suggest, technology, which is used to facilitate learning, is part of the instructional process. And so, one may regard educational pedagogy as a feature of technology because it refers to a system that “purposefully changes students or provide the possibility to change themselves” (Rudy, 2016). Hence, it should be explained further because technology has a great potential to be used in educational pedagogy.

Technology, joined with an understudy that is focused on constructivist methodology, can possibly give students a more significant level of psychological and relational abilities (Saba, 2009).

Although technology is seen as an innovation in education, it is actually a part of the modern world. That is because every passing year, innovations in our lives is becoming increasingly common to improve learning.

Educational technology

Before looking at the history of it, knowing the role and influence of technology on teaching better is important to understand educational technology because like technology, educational technology is more than merely computers. According to Spector (2016):

> Education can be extensively characterized as including exercise focused on the improvement of beneficial, insightful and dependable people, which obviously includes learning. Technology can be extensively characterized as the methodical uses of information to accomplish a reason esteemed by people or groups. (p. 354)

Among those engaged in the education profession, the term “educational technology” is widely used. As a result, it is thought that the term should not be introduced into a definition pattern. For, as time goes on, it is observed that a lot of definitions which were defined earlier, were refuted by the increase of information and innovations. In outline, educational technology is the successful utilization of technology, apparatuses, systems, assets, and procedures to help learning, execution, and guidance (Huang, Spector, & Yang, 2019).

Nowadays, educational technology is a significant part of the world and it is evolving in many ways to make teaching ang learning easier and wide. The definition of educational technology has also developed over the years as a deviation of ways in relation to learning procedures, a theoretical framework, techniques and practice, and the early research and practices of engaging with technological procedures and resources. “Educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using and guiding relevant technological processes and resources” (AECT Definition and Terminology Committee, 2008).

The definitions and features of educational technology include the following:

- “A methodical approach of designing, employing, and evaluating the overall method of learning and teaching in terms of particular aims, and using a fusion of human and nonhuman resources to create simpler directions” (Commission on Instructional Technology, 1970, p. 19).
- “An advanced, incorporated method involving individuals, techniques, ideas, contrivances, and organizations to examine the issues, and to realize, evaluate, and execute solutions for those issues concerning perspectives of individual learning” (AECT, 1977, p. 1).
- “Enhancing the effectiveness and potency of learning in educational contexts, notwithstanding the essence or content of that learning” (Cassidy, 1982, p. 1).
- “The implementation of our knowledge base concerning human learning to the sensible tasks of teaching learning” (Heinich et al., 1993, p. 16).

- "The hypothesis and procedure of design, enhancement, exploitation, management, and estimation of procedures and resources for understanding" (Seels & Richey, 1994, p. 9).
- The disciplined implementation of information with the aim of improving learning, instruction and/or performance (Spector, 2015).
- Educational technology refers to the utilization of devices, advancements, forms, procedures, assets and procedure to improve learning encounters in an assortment of setting such as; formal learning, causal learning, non-formal learning, long lasting picking up, learning on request, work environment learning, and without a moment to spare learning (Huang, Spector, & Yang, 2019).

The studies state on educational technology altered it focused from research that tries to "prove" technological tools as affected ones and research analyzing the methods of using technology and its tool. Educational technology revolves around both the specialized and academic available resources to support and guide students to improve learning (Huang, Spector, & Yang, 2019). According to Cuban (1986), educational technology, formerly called instructional technology is "any gadget to instructors for use in training understudies in a product effective and invigorating way than the sole utilization of the educator's voice" (p. 4). Nowadays, our view and use of educational technologies is far beyond digital tools. "The theoretical understanding of, as well as the practice of educational technology, requires continual knowledge construction and refinement through research and reflective practice" (Educational Technology: A definition with commentary, 2004). With regards to this, Bozkaya, Aydın and Kumtepe's (2012) study found the following:

> The studies on educational technology used to focus on educational instruments till 1960s. However, after that, educational research has started to focus more on the process, by studying the effects of the use of technology on learning and teaching. (p. 264)

Thus, there is a perpetual development and alterations in technology, and therefore in education. With respect to this, studies on educational technology evolves accordingly.

Moreover, the implementation and clarification of the content to be applied in educational technology take up a very wide place in our lives. Therefore, support for resources, performance and teaching in the use of educational technologies has to be facilitated and improved.

History of educational technology

Since the first appearance, nearly 6,000 years ago, educational technology has brought forth a portion of humanity's best development. In ancient times, humans formulated cognitive rules that refer to the process of applied knowledge systematically, analyzed subject matters, designed educational technologies and devised effective educational materials. The invention of pictographs, the use of sign writing to communicate and the organization of information by tribal leaders were the first examples of the use of educational technology (Saettler, 1990). Different tools and methods have been used to help teaching and learning all through the ages, so one can likewise conclude that educational technology has a long history (Spector & Ren, 2015).

In early human history, almost certainly, real objects like abacus were used to help learning. Since the introduction of technology into our lives, we have seen technological improvements like the integration of distance learning into education system. The use of technology in education aims to develop in accordance with many educational programs. For example, a particular technological tool might be used in classrooms to conduct scientific investigations, to communicate with each other, and to emphasize the individual or small group learning collaboration. Even more, "low-tech" activities such as reading, debating, designing and origami might be integrated into classrooms in accordance with the curriculum. Those activities help the way students work together, in addition to improving and supporting their learning (Kozma, 2000, p. 3).

Most researchers have different perspectives (Bauersfeld, 1980; Kilic Cakmak et al., 2016; Simsek et al., 2009; Thompson, 2005) about the historical development of educational technologies; however, the main points that are discussed in most of them are the teaching approaches, teaching methods and teaching practices for the usage of technological tools. As the perspectives, and so the teaching methodologies, have changed through time, the technological tools used have also altered accordingly.

When we look back to history of the educational technology, many technological programs have been created by curriculum specialists, who want to design, develop and manage the newest and the most efficient teaching and learning environment (Drijvers et al., 2010). In order to gain better and faster progress in developing and growing educational technologies, twenty-first century skills and the adaptation of

the next generation to technology are considered by educators and curriculum development specialists (Spector, 2014). Through this consideration, attention to learners' perspectives, preferences, and ownership of the learning process has grown exponentially (Molenda & Januszewski, 2008). Particularly, the fact that technology has become easily accessible in the recent years and there are many improvements in technology have improved educational teaching methods, and so required curricula to change. The mobile devices, visual and audio tools and employing various teaching methods are some of these alterations in the use of educational technology.

In conclusion, it can be said that educational technology might allow students to master the previously mentioned twenty-first century skills. Nonetheless, this mastery depends on the way schools integrate technologyinto their education system. Therefore, it is important that educational technology is used in curricula by considering both its history and contemporary usage.

Tools in educational technology

The fast advancement of digital technologies and their utilization in education empower people to associate with new educational areas in different ecologies of learning. Therefore, the use of technological tools in education advance in time with new developments.

When we look at technological developments, whenever a relevant technology is revealed, it is seen that technology has a place in the field of education. The use of contemporary technological tools in education sometimes appears as utilizing the technology to help learning and instruction; and sometimes it appears as planning

understudies for abilities related with utilizing the relevant technology (Spector, 2015). Thus, the technological tools can be incorporated into education via various methods and for different reasons.

Many technological products that have been used with the purpose of communication are still being used as educational technology tools. The examples of technological tools that have a noticeable effect on education include; radio, television, instructional films, audio-visual instruction, individualized instruction, mainframe systems, microcomputers, interactive simulations, internet, digital repositories, distributed and distance learning systems, learning management systems and more (Ward, Moule, & Lockyer, 2009). As the educational environment is changing rapidly with these technologies, it is inevitable that the educational equipment will be renewed together with these innovations, and so technology will be able to meet to the needs of today. Huang, Spector and Yang (2019) stated that:

> Educational technology approaches have evolved from early uses of audio-visual aids to individual and networked computers, and now have evolved to include various mobile and smart technologies, as well as virtual and augmented realities, avatar -based immersive environments, cloud computing, and wearable and location-aware devices. (p. 5)

Among these evolved technological developments, social networks have a significant place in education. According to Ajjan and Hartshorne (2008), social networks are tools that improve learning, and thus, they increase students' satisfaction with lesson. They also reduce students' anxiety, improve their writing and reading skills, and help integrate these skills into courses. Furthermore, Arroyo (2011), stated that social networks support informal learning and are high-performance communication tools in terms of information structuring through collaboration, social relationships and task sharing. Similarly, as a result of computer and the internet evolution, the use of

social network, which is an educational technology tool, has advanced. It has taken such an important place that social media can be examined in a wide range of educational technology tools. Social media, indeed, can be associated with education, and also with young people, most of whom are students in generation Y that continue their higher education (Bolton et al., 2013). Thus, the current technological developments have a considerable effect on education in the twenty-first century.

The next phase of educational technology, regarding the positive results of the combination of social media and education, is a new era in which machines can be asked questions, they can contact each other and search for answers to these questions. There are several studies on whether this experience has yet to be fully implemented or what the adoption situation will be even if it is implemented. Finally, perhaps the current artificial intelligence technology and virtual reality technology can be combined to give education a new direction (Ochoa, 2016).

Advantages of educational technology

Today, it is an indisputable fact that information and communication technologies are used extensively, increasing the knowledge accumulation, and so it is necessary to make more use of this knowledge. Thanks to technology, people communicate with each other very quickly, make meetings and lectures, share resources with other people and reach all the information that they want. In this modernization, the change of qualifications expected from individuals causes adjustments in educational understanding, the importance of technology and even educational technologies' teaching/learning processes.

With these developments in technology, various educational technology applications are used to eliminate some of the deficiencies encountered in traditional education. For instance, the utilization of technology can assist with improving learning, because it will decrease the measure of direct instructions given to students. Hence, the use of technology offers educators a chance to assist students to understand the instructions easily and continue with further guidance to improve learning (Bingimlas, 2009).

Learning theories and technologies are connected and intertwined by information processing (Spector et al., 2014). As educational technologies and learning theories are linked, positive results are obtained in education when they are used together. These positive results reveal how educational technology can be turned into an advantage. Some advantages of using educational technology in education, obtained from the review of the literature are (Bamiah, Brohi, & Rad, 2018; Costley, 2014):

1. The use of educational technology helps improve students' interest in courses, and so it enables students' success, understanding and motivation to increase.
2. The use of educational technology enables to getting objective feedback to evaluate teachers' teaching assessments, processes, methods and the structure of courses.
3. Educational technology helps students to feel privileged because they can self-learn and so be confident about themselves.
4. Using educational technology gives students the chance to communicate via internet and reach necessary information easily.

5. Technology helps eliminate the problem of carrying books by making information easily accessible via the use of educational technology and its tools. For instance, technology permits each student to carry their personal belongings rather than books.

As there are many advantages of the use of technology in education as listed above, it is an undeniable fact that technology will improve teaching and learning in classrooms. However, there are some obstacles regarding the use of technology, as well.

Obstacles of educational technology

The development of knowledge and people's access to information triggered the necessity of many educational reforms, which enabled the increase of future information and the ability of accessing it to survive. In late 1990s, as the internet and worldwide web (WWW) became widely used in a short period of time, the schools had to arrange the necessary facilities quickly (Pelgrum, 2001). Also, these alterations forced schools to make educational reforms in curricula to integrate technology into lessons.

The use of technology in education brought at least one new role to each user; teachers, students, school administration, even parents. Of course, these roles have provided the users with a variety of feedbacks in the use of technology and its tools in education. Even if some positive points are raised in these feedbacks, there are also some barriers. These barriers include some significant problems in both complexity and scope that tackle with theoretical issues in today's education.

Especially, for teachers and students who use technology in a school, these barriers that can be shown as a negative point in the use of technology in education include; inadequate number of computer, difficulties of integrating technology to a specific subject, lack of technical assistance, lack of students' knowledge and information skills, slow network performance, poor material quality, lack of students' interest in technology (Lim, 2007; Liu & Szabo, 2009; Tearle & Golder, 2008; Yildirim, 2007; Watson, 2001).

These current barriers in the use of technology in education are often determined by the influx of relevant technologies into educational practice (Molenda & Januszewski, 2008). As Ribble and Miller (2013) said:

> As social communities including parent and school leaders can realize, there can be vital issues related to digital literacy of students and teachers in terms of the level of knowledge in the use technology. Educational leaders may not be able to get ready for a digital era as they do not comprehend how these technologies work themselves. (p. 138)

One of the main problems in this issue is teacher technology competency which depends on teacher interest in change towards the use of contemporary educational technologies. Consequently, for teachers to coordinate technology in their instructive practice is a challenge that they are progressively faced with (Ping, Schellings, & Beijaard, 2018).

Another obstacle that technology creates in today's world is cyberbullying. While technologies, such as online social networks do provide a place to express and explore students' ideas across all social lines, which they use in classrooms as an educational technology. However, these tools can also cause younger people to be a victim of cyberbullying. Therefore, cyberbullying as an obstacle for the use of

technology and its tools, is to be addressed by educational leaders in order to help educators solve this issue (Ribble & Miller, 2013).

Bringing technology into classrooms can also have neutral and negative impacts such as a decline in learning using technology due to students' and teachers' lack of knowledge, or not having efficient tools for all students (Yildirim, 2007). However, if improvements for using technology during teaching and learning in classrooms are made to minimize the negative impacts, which will be the first step in turning the disadvantages into advantages.

Considering these obstacles, the use of technology in education can be seen as a challenge. Nonetheless, these challenges can be overcome by educator and school leader with enough efforts. Therefore, the use of technology can be further improved through effective feedback.

Technology in classrooms

There are several technologies and their tools in teaching and learning such as internet, mobile phones, tablets, social media etc. One of the most important tools of integrating technology in classrooms is computers because of the tools that comes with it. These tools include various media types such as devices that make it easier and faster to reach information.

Furthermore, the use of technology in classrooms provides opportunities for both students and teachers. For teachers, it is very important to use technology because it gives a new perspective to education with differentiated instruction and teaching

techniques (Mantri, 2014). As for students, it helps develop their abilities for independent learning (Bulun, Gülnar, & Güran, 2004). Nowadays, technology usage in education revolves around the twenty-first century skills. According to Bransford et al. (2000), the current ideas about learning restricts the use of technology in schools by both students and educators, considering the twenty-first century skills. However, for the last two decades, there is a considerable increase in the use of technology in classrooms due to constant improvements in ICT. ICT is a tool that adjust access to knowledge and learning source (Girgin, Kurt, & Odabasi, 2011). Furthermore, technology in the classroom can, in and of itself, lead to more student-centred practices being used by teachers, which could be beneficial for improving learning in the twenty-first century (Smaldino, Lowther, Russell, & Mims, 2008).

Use of technology in classrooms

The use of technology has caused a profound change in learning and teaching in classrooms. Nowadays, with the help of technology learners can focus more on the settings and programs and be more involved in it. Together with the improvements in technology, there are to be vital alterations in teaching methods and learning theories like constructivism. Constructivism posits that students actively construct their own knowledge and meaning from their experiences, while technology refers to the designs and environments that engage them (Badia & Iglesias, 2019). There is a close relationship between technology and constructivism (Sabzian, Gilakjani, & Sodouri, 2013). So, the latest technology has a significant role in education to facilitate the teaching and learning process based on the constructivist approach. According to Schrack (2014) study, using ICTs during lesson has a positive or neutral impact on 10691 teachers and 102231 students. There are many advantages

of using ICTs in classrooms supported by several studies. For instance, the use of ICTs has improved students' cognitive learning, and so their grades. Likewise, Wong et al. (2006) stated that technology plays a part in supporting teaching and learning in the classroom. Thus, integrating ICTs in lessons enhances learning and teaching exponentially.

On the other hand, there are a few disadvantages of using ICTs in classrooms. According to researchers, a common problem is the lack of synchronization between curriculum materials and the incorporation of ICT for teachers. Many countries have revised their education systems and created numerous materials to encourage the use of ICTs in schools because teachers find it difficult to combine their materials with technology (Hepp et al., 2015). Thus, owing to this synchronization issue about materials, the expected positive outcomes have not been achieved yet.

Although there are some disadvantages, as a result of the use of ICTs in education, technology changes the teacher-student dynamics in classrooms. Therefore, using technology in classrooms as an instructional method would be helpful for educators if they are upheld by proper educational speculations and models (Sabzian, Gilakjani, & Sodouri, 2013).

Use of technology in biology classrooms

In the past few decades, biology curriculum has changed with respect to new findings in science. These alterations have also showed increase in the use of ICT in science teaching and learning, with the change of perspectives on the nature of science and the role of science education (Sjøberg, 2002).

Instructing about science as opposed to experiment with it will require a noteworthy change in its educational methods in addition to the improved knowledge and comprehension of educators (Osborne & Hennessy, 2003).ICT usage in science classrooms has been researched in many studies (Mayes et al., 2011; Thompson et al., 2010; Feser, Vasaly, & Herrera 2013; Waldrop et al., 2015; Chiel, McManus & Shaw 2010; Brewer 2004; Gross et al., 2015; Colon-Berlingeri & Burrowes, 2011; Haak et al., 2011; Waldrop, 2001) which have found out that there are potential benefits of this such as communication and collaboration according to pedagogical resources for science teachers and students. The benefits of using ICTs as tools for promoting science teaching and learning in schools include the following: it makes learning more effective, provides valuable feedback, increases teacher confidence and pedagogical effectiveness (Skinner & Preece, 2003).

Although it was thought that ICTs could not replace traditional teaching techniques in classrooms, it can positively enforce the understanding of the concepts and principles of science curriculum (Incantalupo, Treagust, & Koul, 2014; Ross, Morrison, & Lowther 2010). In biology curriculum, using online tools, enrichment or differentiation of the course by the teacher is a great advantage for students with different learning styles. Hence, in order to achieve differentiation and withdraw from traditional teaching methods, educators integrate technology to biology curriculum.

In particular, because biology is a rote-based course it reveals problems for students to learn or to remember the subject content. Students learn a lot of information in a teacher-centred classroom as a requirement of the curriculum (Aydin & Yel, 2011).

Learners should transfer all this information to their short-term memory. Since students cannot transfer the knowledge in their short-term memory to long-term memory their success declines Therefore, differentiation in teaching and learning techniques should be employed so as to ensure that students do not detain the information, they have learned in short-term memory (Kelley & Whatson, 2013). For this purpose, it is important to use materials such as audio and visual materials within the activities teachers use to teach content in biology curriculum and to support students with technology. In order to achieve learning in biology classrooms students are to be able to use such tools efficiently (Akram & Khatoon Malik, 2012). Additionally, students should work collaboratively to support each other's learning as they use these tools, which will make the education more learner-centred and help transfer new knowledge to long-term memory (Hannafin & Hill, 2002).

Students attitudes towards technology use

The development of technology has encouraged young generation to use it further in their everyday lives. However, this interest in and enjoyment of technology do not cover its use in education. Even though young people are interested in technological outputs, their thoughts on education and their careers in technology are not particularly positive (Johansson, 2009).

However, young people's opinions about technology has changed throughout years and their attitudes have been positively affected about the use of technology in education. The researchers (Capar, 2012; Erşen, 2014; Kablan, Topan & Erkan, 2013) have investigated the effects of using technology and its tools in classrooms in terms of students' knowledge and attitudes towards using technology. Most indicate

that students have positive attitudes towards using technology in biology classrooms. Access to information keeps changing and transforming, which influences all areas of study particularly the education system. Traditional classes are being replaced with ICT classes which is a new learning and teaching environment. Today, interactive white boards and smart boards are being used rather than the chalk and black board used previously, today, interactive white boards and smart boards are being used (Elmas et al., 2012; Tarman, 2011). According to the study conducted by Yapıcı and Karakoyun (2016), students generally have positive attitudes towards smart board use in biology lessons. They report that smart board use in biology lessons helps students understand the subject more easily, improves time management for teachers, provides opportunities to learn the subject from different sources and make learning more entertaining.

Correspondingly, there are many positive effects of ICT on students' attitudes in biology curriculum, which also makes their learning more meaningful. Many technologies and its tools are designed as educational aids for teachers and students to make learning more efficient (Akram, Sufiana, & Malik, 2012). Integrating technology in high school biology curriculum is an opportunity for the teachers to bring nature in the classroom and to increase students' attitudes towards technology use in biology education. For example, with the laboratory activities, which are available online, students' understanding is reinforced, and teachers can explain the content through the use of ICT (Stavreva-Veselinovska & Kirova, 2016). So, ICT positively affects students' interest in biology and support their meaningful learning. Achieving this is possible in biology classes because a key conclusion of several studies is that high school biology lessons are suitable for the use of technology in

terms of its field and scope. Yakısan, Yel and Mutlu (2009) describe the extensive content of biology lessons mostly with their abstract and dynamic structure and suggest that moving visual and audio tools make teaching and learning more effective with the use of technology. Therefore, it is important to understand that to increase students' positive attitudes towards technology use in lessons and to overcome the disadvantages of technology use in biology classrooms, educators should be encouraged to use technology more in their classes.

Students' knowledge level of technology

The development of technology in line with people's needs has enabled them to acquire information easily and quickly, so technology has increased our access to information. Additionally, technology and its tools extend students' skills in understanding, producing and presenting new information. At this point, knowledge of using technology is the most significant factor in achieving this.

Students are starting to use technology at a very young age and grow up with it, making them digital natives (Prensky, 2001). Since they use technology as a daily routine, their knowledge of technology is increasing day by day, which enables students to give direction to technology in line with their needs and wants. Teens and students, aged 12 to 28 years, have immediately grasped online technologies that empower social, communicative and imaginative uses, which enabled them to use technological tools more efficiently (Anderson & Rainie, 2012).

Many studies have stated that (Beckman, Bennett, & Lockyer, 2014; Ranieri, Manca, & Fini, 2012), as the years go by and the generations change, students are more

knowledgeable the use of technology. Therefore, the future generations need to have the abilities to use instructional technology effectively in the next decades. According to Parry and Urwin (2011), a generation is a lot of historical occasions and related marvels that makes a particular generational gap. In order to recognize an occasion as a generation, it should be "some type of social 'proximity' to shared occasions or social phenomenon" (p. 84). With innovations and wide availability of small, incredible versatile technology (mobile phones, tablets, laptops and gaming consoles), the Millennials are the first users to survive in a fast-changing world through the information superhighway known as the internet. The development of mobile tools shows extraordinary potential to assist students with developing data and knowledge for learning through computers or cell phones (Pence, 2002). Likewise, after millennials, the internet consumption of younger internet users, the so-called generation Z, are more knowledgeable in technology use than the Millennials with reference to web 2.0 technologies. It is generally recognized that students are heavy users of web 2.0 technologies for recovering and storing data, just as for communicating and collaborating via social networking sites (Lichy & Kachour, 2016).

However, there is not enough data to support the idea that students utilize these technologies in an educational or productive sense (Lichy et al., 2014). That's why the use of technological tools in education should be supported more in the twenty-first century. In particular, the combination of education and technology affects the further improvement of technology tools, and the young people in this and next generations are informed about the use of these tools. The use of technological tools is also connected with students' family's technological knowledge in terms of their

effects on the students' curiosity and the time they spend online (Creswell, 2007). Accordingly, the difference between males and females in technology knowledge is another topic of interest. Although many studies in the literature (Jackson et al., 2001; Goswami & Dutta, 2015; Mazman et al., 2009; Nysveen et al., 2005; Venkatesh et al., 2003) have observed differences in the use of technology in terms of students' gender, nowadays, neither the use of technology nor the knowledge about technology are different between male and female students (Calvert et al., 2005). For instance, students' knowledge level of technology is not reliant on the amount of time spent in front of the computer by both females and males. As technology is getting considerably more universal than at any other time, technology becomes a significant part of life particularly for young people. As many studies suggest female students have more difficulty using technology in classrooms compared to males because of their lack of technological knowledge (Li & Kirkup, 2007). Nonetheless, females' attitudes towards technology use has changed across time as they have used it more often (Buccheri, Gürber, & Brühwiler, 2011). Nowadays, most females do not see computers difficult anymore due to the increase of technology use in everyday life (Bain & Rice, 2006).

As the future is being equipped with technology, the use of technology becomes a need in the twenty-first century. The utilization of technology in future jobs makes it especially significant for both male and female students to create abilities that will assist them improve their level of technological knowledge and prepare them to work in a technological society (Bain & Rice, 2006)

CHAPTER 3: METHOD

Introduction

In this chapter the research design of this study explained. Then, further information regarding the context, participants and the instrumentation of this study is provided. Consequently, study focuses the methods of both data collection and data analysis.

The research questions below are examined in this study:

1. Which technology tools are used in high school biology classrooms?
2. What are high school students' level of knowledge and attitudes towards the use of technology in biology classrooms?
    a. Is there a significant difference between female and male students in terms of their level of knowledge and attitudes towards technology in the biology classrooms?
    b. Is there a significant difference between the students who follow the Turkey's Ministry of National Education (MoNE) program and the International Baccalaureate Diploma program (IBDP) together, and the students who follow only Ministry of National Education (MoNE) program in terms of their level of technology knowledge?
    c. Is there a relationship between the students who follow the Turkey's Ministry of National Education (MoNE) program and the International Baccalaureate Diploma program (IBDP) together, and the students who follow only Ministry of National Education (MoNE) program in terms of their level of knowledge and attitudes towards technology?

Research design

In this research study, quantitative design method is used to investigate high school students' level of knowledge and attitudes towards the use of technology in biology classrooms. Quantitative research is employed while explaining phenomena with numerical data by using general formulations of steps that guide researchers in their work (Fraenkel, Wallen, & Hyun, 2012). Therefore, this is a research study that used a questionnaire as a method of quatitative research. The researcher collected data from the students of four different high school by using a paper-and-pencil questionnaire. After that, the researcher statistically compared high school students level of technology knowledge and attitudes towards the use of technology in biology classrooms quantitatively.

Additionally, this study is a quantitative research study that analyses relationships between the students who follow the MoNE program and the IBDP program together, and the students who follow only MoNE program in terms of their attitudes towards and knowledge of technology and technology tools. The reason why quantitative research was used in this study is because main characteristics of this type of research includes "the use of questionnaires (usually with closed questions)" (Goertz & Mahoney, 2012; Newman et al., 1998; Singh, 2006). Besides, it consists of statistical analysis and interpretation, which requires gathering data using measurements. Thus, this research study employed quantitative research so as to analyze statistical data using measurements. Additionally, in some questions, correlational analysis was used to understand the relationship between variables and investigate characteristics of a group in their natural environments that does not include researcher treatments (Simon & Goes, 2011). Because the relationship

between students' level of knowledge and attitudes towards the use of technology and its tools was investigated, correlational analyses were employed in this study. Descritive and inferential analyses are used in the design of this research study in order to explore which technology tools are used in high school biology classrooms and the researcher use numerical data via statistics to establish relationships between variables and explain the causes of such relationships without their belief, facts and feelings, that the world is a single reality made up (Fraenkel, Wallen, & Hyun, 2012). Hence, firstly the researcher analyze the significant difference between female and male students; and between the students who follow MoNE and IBDP program together, and the students who follow only MoNE program in terms of their knowledge level of using technology and attitudes towards technology by using independent sample *t*-test. Also, correlational analyses were used to investigate the relationship between the students who follow MoNE and the IBDP program together, and the students who follow only MoNE program in terms of their attitudes towards and knowledge of technology and technology tools.

Context

This study aims to investigate high school students' level of knowledge, and attitudes towards use of technology in biology classrooms. Therefore, the researcher implemented a questionnaire in four different high schools in Ankara between May and June 2018. The researcher coded the private names of the participant schools in this study as school A, B, C and D. School A and school B are foundation schools in Ankara. These schools follow both the MoNE program and the IBDP. School C and school D are public schools in Ankara; these schools only follow the MoNE program.

Schools A, B and C are located near the city center while School D is located in a more rural area (see Table 1).

Table 1
The schools where the questionnaire was implemented

City name	Town	School
Ankara	Çankaya	School A
Ankara	Çankaya	School B
Ankara	Çankaya	School C
Ankara	Gölbaşı	School D

Participants

In this study, convenience sampling method was used because it allows to reach a convenient source of data where people are sampled simply. Convenience sampling, also known as nonprobability sampling, is when respondents are chosen based on their convenience and availability (Babbie, 1990; Creswell, 2009). This study involved 612 (58% female; 42% male) high school students. In Table 2, the number of the female and male students in each school and their percentages are showed.

Table 2
The distribution of the participants in each school

School name	*n*	Female	Male	%
School A	94	59	35	15.36
School B	129	74	55	21.08
School C	280	157	123	45.75
School D	109	64	45	17.81

Instrumentation

In this study, by using a paper-and-pencil questionnaire it was aimed to find out the students' level of knowledge and attitudes towards the use of technology. The original questionnaire was created by Incantalupo, Treagust and Koul in 2014 to analyze high school students' level of knowledge and attitudes towards the use of

technology in biology classrooms. Furthermore, in order to present the purpose of this study the part of demographic information was included in the questionnaire which consist of three parts (see Appendix A):

The initial part of the questionnaire has questions about the participants' demographic information. The participants were asked for gender, age, grade, the followed program, their mothers' and fathers' educational backgrounds.

The second part consists of 11-statements which are closed-ended questions (Yes or No) about technology and its tools that students use in biology classrooms. The participants were asked whether they use technology and its tools, and to tick the necessary boxes considering their answers for each statement.

There are nine items to explore participants' attitudes towards technology in the last part of the questionnaire. Five-point Likert scale (1=strongly disagree, 2 =disagree, 3=neutral, 4=agree and 5=strongly agree) was used in this part. Also, there were 14 items to describe participants' level of knowledge in technology in the third part of questionnaire. Three-point Likert scale (1=disagree, 2=neutral and 3=agree) was used in this part. The parts, questions and number of the items in questionnaire are presented in Table 3.

Table 3
The parts, questions and number of the items

Parts	Questions	Number of Items
Part I (demographic information)	1, 2, 3, 4, 5, 6, 7	-
Part II (technology and technology tools)	1	11

Table 3 (cont'd)
The parts, questions and number of the items

Parts	Questions	Number of Items
Part III (attitudes towards technology)	1,2,3,4,5,6,7,8,9	9
Part III (knowledge level of technology)	1,2,3,4,5,6,7,8,9,10,11,12	12

Method of data collection

There were three main stages of the data collection process of the research study: The first stage provides information about the way the instrument was prepared between November and December 2017. Throughout this process, firstly Incantalupo, Treagust and Koul (2014), who created the original questionnaire were asked for permission to use it (see Appendix B). Afterwards, the items of questionnaire was first translated from English to Turkish, and then re-translated into English so as to improve its validity. Back translation – the 're-translation' of a translated version of a questionnaire into the original language and the final examination of the original form and its back translation – is an assessment strategy for questionnaire translations (Behr & Shishido, 2016). As for validity, it is the degree of gathering proof to shield the choice made according to the dependency of the results coming about the structure from an instrument (Fraenkel & Wallen, 2006). In addition, four questions were added to the original questionnaire of Incantalupo, Treagust and Koul to acquire the participants' demographic information.

Secondly, MoNE permission was obtained as required in order to implement the questionnaire in the participants schools. These schools were informed about the permission in April 2018. Thirdly, the data collection was collected by the

administration of the questionnaire between May and June 2018. The questionnaire was given to the high school guidance counsellor of School A by the researcher. At School A, the questionnaire was completed by the participants in guidance courses with the help of the guidance teacher. The researcher collected the completed questionnaires from the high school guidance counsellor. As for School B, the principal led the completion of the questionnaire. During guidance course the participants completed the questionnaires with the help of the guidance teacher. The researcher collected the completed questionnaires from the principal of the School B. At School C, the researcher delivered the questionnaires to the secretary of the high school. The questionnaire was completed by the participants in guidance courses with the helo of the teacher/s. The questionnaires were received from the secretary by the researcher. At School D, the questionnaires were given to the assistant director by the researcher. The participants filled in the questionnaires in guidance courses and the questionnaires process was managed by the guidance teacher/s. The collected data were received from the assistant director by the researcher. The completion of the questionnaire took around 15-20 minutes for participants.

Method of data analysis

Quantitative data analysis was done for each research questions in this study. Independent variables were measured by questionnaire items. Statistical Package for Social Sciences (SPSS, v.24.0) was used as software to analyze items in the questionnaire.

All statistical assumptions were checked prior to the correlation analysis. To check normality of the variables, histograms, skewness and kurtosis values and coefficients

were checked. The results showed that all skewness and kurtosis values for the dependent variables were between +0.5 and -0.5 value. It means the data is normally distributed (Garson, 2013).

Cronbach's alpha coefficient is used in statistics in order to "estimate the reliability of a psychometric test" (Nunnally, 1978). The researchers who first conducted and applied the questionnaire also checked the reliability with Cronbach Alpha. A reliability check with Cronbach Alpha resulted in the score of knowledge level of technology is .83 and the score of attitudes towards technology is .78 (Incantalupo, Treagust, & Koul, 2014). Since, the questionnaire was adapted for current study, reliability checked with Cronbach Alpha and resulted in the score of knowledge level of technology is .88 and the score of attitudes towards technology is .80. If the value of the coefficient is found greater than .70, it shows a strong correlation, however if the value of the coefficient is found lower than .70, it shows a weak correlation between correspondents (Nunnally, 1978). Therefore, there is a strong correlation between correspondents of both the score of knowledge level of technology and the score of attitudes towards technology.

For research question 1, data were analyzed with descriptive statistics to investigate the examples of technology tools typically used in high school biology classrooms. Also, for research question 2, students' level of knowledge in technology and their attitudes towards it in biology classrooms were analyzed. For the research question 2a, the researcher investigated whether there was a significant difference between female and male students in terms of their level of knowledge in technology and their attitudes towards it in biology classrooms by using independent sample *t* test. Thus,

the mean values of female and male participants' knowledge level and attitudes towards technology were compared with each other. For the research question 2b, the researcher analyzes if there was a difference between the students who follow MoNE program and the IBDP together, and the students who follow only MoNE program in terms of their knowledge of technology and its tools by using independent sample *t* test.

Finally, correlational analysis was carried out for research question 2c to investigate the relationship between the students who follow MoNE and the IBDP together, and the students who follow only MoNE program in terms of their level of knowledge and attitudes towards technology and its tools. During analysis, the appropriate techniques; the scatterplot and the correlation coefficient were analyzed to increase validity and reliability. Because the graphs were linear the researcher analyzed the data for sub-second questions c and d with the computation a Pearson product-moment correlation coefficient.

CHAPTER 4: RESULTS

Introduction

In this chapter, the questionnaire' results were presented with the analysis of the data. First, the demographic data are given in detail. Second, the findings of the main research questions are presented by categorizing them into sub-sections. The results of research questions and sub questions share the results of participants' level of knowledge and attitude towards technology when compared and correlated for the following demographic features:

- Gender
- Age
- Program followed

The findings of the first research question present the technology tools used in biology classrooms. As for the second research question and its sub-questions, various analyses are made in terms of the differences between female and male students and program differences; and the relationships among students' curricular relationships through the analysis of students' level of knowledge and attitudes towards technology. SPSS was used to analyze the collected data.

Demographic information

The demographic data about the participants were collected from the first part of the questionnaire. Participants were asked for their gender, age, the followed program in their schools, parents' educational background and their monthly income.

As seen in Table 4, 612 students who were 15-17 age range completed the questionnaire (*N*=612 students; 58% female, 42% male). The number of the female participants were 354 (57.84%), whereas the number of the male participants were 258 (42.16%).

Table 4
The distribution of the participants at each school

Participants	School A	School B	School C	School D	Total *n*
The total number of the participants	94	129	280	109	612
The number of the female participants	59	74	157	64	354
The number of the male participants	35	55	123	45	258

Furthermore, the number of the students who were following only MoNE program was 492 (80.4%). One hundred twenty (19.6%) of the participants were following the IBDP program in addition to MoNE program (see Table 5).

Table 5
The distribution of the participants according to the program they follow at each school

Curriculum	School A	School B	School C	School D	Total *n*
IBDP program in addition to MoNE program	43	46	182	33	304
Only MoNE program	21	82	280	109	492

As given in Table 6, most of the participants' mothers (34.64%) and fathers (38.24%) had Bachelor's degree. In a total of 521 participants; 73 (14.01%) participants' both mother and father had middle school diploma, 164 (31.48%)

participants'' both mother and father had high school diploma, 212 (40.89%) both mother and father had Bachelor's degree and 72 (13.82%) participants' both mother and father had Master's diploma. However, 91 participants did not give family background information.

Table 6
The educational background of the participants' parents at each school

Variables	School A	School B	School C	School D	Total *n*
Participants' parents who had middle school diploma	-	2	37	34	73
Participants' parents who had high school diploma	2	18	112	32	164
Participants' parents who had Bachelor's diploma	37	75	91	9	212
Participants' parents who had Master's diploma	37	21	12	2	72

Research question 1: Technology tools used in high school biology classrooms students'

The second part of the questionnaire, which includes 11 items, determined technology and its tools which students use in high school biology classrooms. The participants were asked to identify if they used those technology and its tools in their biology classrooms or not. Frequencies and percentages of the results are presented at Table 7.

Table 7
Technology and its tools used by the participants

Variables	(Yes) n	%	(No) n	%	*n*
1. Video, animations etc.	328	53.6	284	46.4	612

Table 7 (cont'd)
Technology and its tools used by the participants

Variables	(Yes) n	%	(No) n	%	*n*
2. Interactive board	292	47.7	320	52.2	612
3. Projection device	239	39.1	373	60.9	612
4. Teacher computer	217	35.5	395	64.5	612
5. Office applications	137	22.4	475	77.6	612
6. Laptop	118	19.3	494	80.7	612
7. Overhead projector	100	16.3	512	83.7	612
8. Web 2.0 applications	72	11.8	540	88.2	612
9. Others	42	6.9	570	93.1	612
10. Social media	39	6.4	573	93.6	612
11. Tablet	30	4.9	582	95.1	612

According to Table 7, all of the participants identify at least one technology and its tools which students use in their biology classrooms. The lowest percentage belongs to "Tablet" (4.9%) item. Also, 6.4% of the participants identify that "social media" as one of the lowest technology tools used in the classroom. The highest percentages belong to "video, animation etc." (53.6%) and "Interactive white board" (47.7%) respectively. However, more than half of the participants (64.5%) are not using "computer" in their biology classrooms. The technology tools used in high school

biology classrooms according to participant responses are presented in the Figure 1.

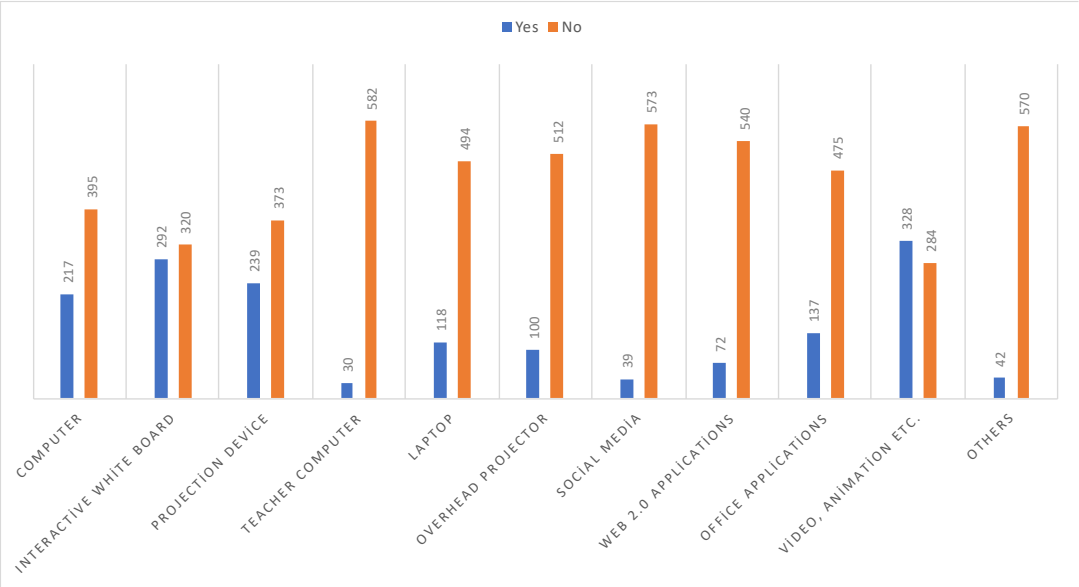

Figure 1. Participants' use of technology and its tools in biology classrooms

As seen in Figure 1, nearly more than half of the responders stated that they are not using technology and its tools in their biology classrooms except "interactive white board" and "video, animation etc." items.

Research question 2: Students' level of knowledge and attitudes towards technology in high school biology classrooms

Students' level of knowledge and attitudes towards of technology in high school biology classrooms were categorized into six sub-sections according to the research questions:

- Difference between female and male students in terms of their level of knowledge and attitudes towards technology in the biology classroom
- Difference between the students who follow MoNE and IBDP program together, and the students who follow only MoNE program in terms of their level of technology knowledge

- Relationship between students' level of technology knowledge and the program that they follow
- Relationship between students' attitudes towards technology and the program that they follow

Difference between female and male students' in terms of their level of technology knowledge in biology classrooms

Students' level of technology knowledge was explored with 14 questions of the questionnaire in part three's "knowledge of technology" section. Independent sample *t* test used to compare female and male students' level of technology knowledge. While Table 8 shows the mean value and the percentage of responders' level of technology knowledge, Table 9 shows the results of independent samples *t* test.

Table 8
Level of technology knowledge: Gender

Variable	Gender	*n*	Mean	Std. Deviation
Level of technology knowledge	female	355	2.42	0.42
	male	257	2.55	0.37

Table 9
Independent samples *t* test for the level of technology knowledge: Gender

Variable		F	Sig.	*t*	df	p
Level of technology knowledge	Equal variances assumed	5.96	.015	-3.97	610	< .001
	Equal variances not assumed			-4.04	582.57	< .001

The results in Table 8 show that male students' level of technology knowledge (M = 2.55, SD = 0.37) is more than female students' level of technology knowledge (M = 2.42, SD = 0.42). According to Table 9, independent sample t test for both genders' level of technology knowledge, the sig value of the Levene's test is lower than .05, so we reject the null of Levene's test and conclude that the variance in level of technology knowledge is significantly different than that of both genders. Therefore, the assumption of equal variances has not been met. Since the equality of variances assumption has not been met, we follow the second line, which has p value .00. In this case we reject the null hypothesis. So, there is a statistically significant difference between female and male students' according to their level of technology knowledge (t (582.574) = -4.042, p < .001). Thus, the results of the data regarding students' level of technology knowledge are in favor of male students.

Difference between female and male students' in terms of their attitudes towards technology in biology classrooms

Students' attitudes towards technology were explored with nine questions of the questionnaire in part three's "attitudes towards technology" section. In order to compare female and male students' attitudes towards technology independent sample t test was employed. While Table 10 shows mean value and the percentage of responders' attitudes towards technology. Table 11 includes the results of independent samples t test.

Table 10
Attitudes towards technology: Gender

Variable	Gender	*n*	Mean	Std. Deviation
Attitudes towards technology	female	355	2.31	0.75
	male	257	2.16	0.76

Table 11
Independent samples *t* test to analyze attitudes towards technology: Gender

Variable		F	Sig.	*t*	df	p
Attitudes towards technology	Equal variances assumed	0.271	.603	2.38	610	.018
	Equal variances not assumed			2.37	543.47	.018

According to the results in Table 10, female students' attitudes towards technology (*M* = 2.31, *SD* = 0.75) is more than male students' attitudes towards technology (*M* = 2.16, *SD* = 0.76). In Table 11, independent sample *t* test is computed of both genders' attitudes towards technology, the sig value of the Levene's test is higher than .05, so we failed to reject the null of Levene's test and conclude that the variance in attitudes towards technology is not been significant than that of both genders. Therefore, the assumption of equal variances assumed. Since the equality of variances assumption has been met, we follow the first line, which has *p* value of .018. In this case, we reject the null hypothesis. So, there is a statistically significant difference between female and male students in terms of their attitudes towards technology (*t* (610) = 2.382, *p* = .018). Thus, the results of the data regarding students' attitudes towards technology are in favor of female students.

Difference between the students who follow MoNE program and IBDP together, and the students who follow only MoNE program in terms of their level of technology knowledge

In this research question, the difference between students' who follow MoNE and IBDP program and their level of technology knowledge were explored with nine questions of the questionnaire in part three's "knowledge of technology" section. In

order to assess students' level of technology knowledge independent sample *t* test was used. Mean value, standard deviation and the percentage of responders' level of technology knowledge results are presented in Table 12. Finally, Table 13 includes the results of independent samples *t* test.

Table 12
Level of technology knowledge: Program

Variable	Program	*n*	Mean	Std. Deviation
Level of technology knowledge	IBDP and MoNE	120	2.46	0.37
	only MoNE	492	2.47	0.41

Table 13
Independent samples *t* test for level of technology knowledge: Program

Variable		F	Sig.	*t*	df	p
Level of technology knowledge	Equal variances assumed	1.49	.22	-0.30	610	.76
	Equal variances not assumed			-0.32	198.59	.74

As given Table 12, students who follow MoNE program and their level of technology knowledge (M = 2.47, SD = 0.41) is almost the same with students who follow IBDP program and their level of technology knowledge (M = 2.46, SD = 0.37). The reason for this is that the participation of students who follow MoNE program was higher than participation of students who follow IBDP program. Nevertheless, level of technology knowledge of students who follow both MoNE and IBDP program means were found to be close to each other.

According to the results in Table 13, independent samples *t* test is calculated for students who follow both MoNE and IBDP program in terms of level of technology

knowledge. For this, the sig value of the Levene's test is higher than .05, so we failed to reject the null of Levene's test and conclude that the variance in level of technology knowledge is not been significant than that follow of both curricula. Therefore, the assumption of equal variances is assumed. Since the equality of variances assumption has been met, we follow the first line, which has *p* value .760. In this case, we failed to reject the null hypothesis. So, there is no statistically significant difference between students who follow MoNE program and students who follow IBDP in terms of their level of technology knowledge (t (610) = -.305, p = .760).

Difference between the students who follow MoNE and IBDP program together, and the students who follow only the MoNE program in terms of their attitudes towards technology

For this research question, nine items of the questionnaire in part three's "attitudes towards technology" section was used. In order to compare students who follow MoNE and IBDP program in terms of their attitudes towards technology independent sample *t* test was used. Table 14 shows mean value and the percentage of participants' attitudes towards technology. Finally, Table 15 includes the results of independent samples *t* test.

Table 14
Attitudes towards technology: Program

Variable	Program	*n*	Mean	Std. Deviation
Attitudes towards technology	IBDP and MoNE	120	2.37	0.80
	only MoNE	492	2.22	0.74

Table 15
Independent samples *t* test for attitudes towards technology: Program

Variable		F	Sig.	*t*	df	p
Attitudes towards technology	Equal variances assumed	0.510	.476	1.993	610	.047
	Equal variances not assumed			1.906	172.550	.058

As we can see in Table 14, attitudes towards technology of students who follow IBDP program (*M* = 2.37, *SD* = 0.80) is more than students who follow MoNE program in terms of their attitudes towards technology (*M* = 2.22, *SD* = 0.74). According to results in Table 15, independent sample *t* test calculated for both program students in terms of their attitudes towards technology. For this, the sig value of the Levene's test is higher than .05, so we failed to reject the null of Levene's test and conclude that the variance of students' attitudes towards technology is not been significant that follow of both curricula. Therefore, the assumption of equal variances is assumed. Since the equality of variances assumption has been met, we follow the first line, which has *p* value .047. In this case, we reject the null hypothesis. So, there is a statistically significant difference between students' who follow MoNE program and who follow IBDP in terms of their attitudes towards technology (*t* (610) = 1.993, *p* = .047).

Relationship between the students' level of technology knowledge and the program that they follow

To investigate the relationship between students' level of technology knowledge and the program (MoNE and IBDP together, and only MoNE program) that they follow, a Pearson product-moment correlation coefficient was computed (see Table 16).

Table 16
The relationship among the students' level of technology knowledge and the program they follow

Variables		KOT	Program
The students' level of technology knowledge	Pearson Correlation	1	.012
	Sig. (2-tailed)		.760
Program	Pearson Correlation	.012	1
	Sig. (2-tailed)	.760	

As in other correlation coefficients, a Pearson's correlation was run to determine the relationship among the program and students' level of technology knowledge. Related to the results in Table 16, the Pearson correlation value being calculated as .012. Therefore, the *p* value is higher than .05. So, there is a very weak correlation between students' level of technology knowledge and the program they follow ($r(612) = .012$, $p=.760$).

Relationship between the students' attitudes towards of the technology and the program that they follow

The last research question is about to investigate a relationship between the students' attitudes of the technology and the program (MoNE and IBDP together, and only MoNE program) they follow. Thus, program that participants' schools followed and students' attitudes towards technology computed with a Pearson product- moment correlation by using SPSS (see Table 17).

Table 17
The relationship between the students' attitudes towards technology and the program they follow

Variables		ATT	Program
The students' attitudes towards technology	Pearson Correlation	1	-.080
	Sig. (2-tailed)		.047
Program	Pearson Correlation	-.080	1
	Sig. (2-tailed)	.047	

As we can see in Table 17, the correlation coefficient shows the relationship between program that the participants' schools followed and students' attitudes towards technology.

Eventually, a negative correlation occurs which means the correlation coefficient is less than 0 and both variables move in the opposite direction. The study concludes that there is a negative correlation between the program that the program they follow and students' attitudes towards technology.

The correlation coefficient is calculated to be -.080. This strong negative correlation signifies that when the correlation of the program that participants' schools followed decrease, students' attitudes towards technology might increase.

Therefore, the *p* value is .047. So, there is a statistical relationship between the program that participants' schools followed and students' attitudes towards technology (r (612) = -.080, p=.047).

CHAPTER 5: DISCUSSION

Introduction

This chapter provides the general overview, the major findings, implications for practice and further researches and the limitations of this research. Firstly, the summarized overview of the study is given. Secondly, the major finding of the research are introduced and discussed in seven categories. Then the implications for practice and further researches are analyzed. The final part of the chapter includes the limitations of the study.

Overview of the study

In this study high school biology students' level of knowledge and attitudes towards technology and its tools investigated. The required quantitative data were collected via questionnaire and were analyzed by using SPSS, which were explained in detail in Chapter 4.

In the following section, the eight subtitles of major findings are presented:

1. The distribution of ages, genders and schools of students who participated in the study
2. Technology tools used in high school biology classrooms
3. Difference between female and male students' in terms of their level of technology knowledge in biology classrooms
4. Difference between female and male students' in terms of their attitudes towards technology in biology classrooms

5. Difference between the students who follow MoNE program and IBDP together, and the students who follow only MoNE program in terms of their level of technology knowledge
6. Difference between the students who follow MoNE and IBDP program together, and the students who follow only the MoNE program in terms of their attitudes towards technology

The distribution of genders, ages, schools of students and students' family educational background who participated in the study

Some facts regarding the distribution of genders, ages, schools, grade level of students and students' family education background who participated in the study are listed below:

- The number of female students was higher than the number of male students in the study.
- The ages of the participants of the study were mostly in 15-17 age range.
- There were four different schools; two of them are following only MoNE program and the other two schools are following IBDP program in addition to MoNE program.
- The number of the participants' family who had Bachelor's degree was higher than the number of the participants' family who had middle school diploma or high school diploma or Master's degree.

Examples of technology tools typically used in high school biology classrooms

Technology is used for a variety of purposes in biology classrooms which includes collecting observational data and enabling communication and easily accessible

knowledge via smartphones and computers. Besides the hardware, the use of educational software is also common among teachers with the intention of providing both verbal and visual stimuli. This software such as emails, chats, podcasts and videos contribute to learning by saving more time (Mukherjee, 2013).

One of the aims of this research was to investigate examples of technology and its tools that are typically used in high school biology classrooms. Regarding the students' responses which were collected with the questionnaire, it can be said that at least one example of technology tools has been used in their biology classrooms. Most of the students' agreed that they use "Interactive white board" and "Video and animations" more than "Tablet-PC" and "Social media". The technology and its tools that are used in biology classrooms are proven to be a successful way for teaching and learning (Kareem, 2018).

On the other hand, the findings showed that students do not use "Computer" in their biology classrooms due to its unavailability. Sorgo, Verckovnik and Kocijancic (2010) found out that only "38.6% of students have access to computers in biology classrooms, and only 5% of the teachers are capable of reaching easily carried computers" (p. 40). Thus, in the current study, it may be derived from the students' common opinions that "Interactive white boards" are sufficient technology via using "video and animations" and "office programs" in their biology classrooms.

In the literature, there are studies (Marzano, 2009; Northcore, Mildenhall, Marshall, & Swan, 2010) about using interactive white boards rather than other technological tools in classrooms. According to findings, interactive white boards are more efficient technological tools compared to computers because teachers find it more effective and useful. Most of the teachers who use interactive white boards expressed

that it improves classroom learning and teaching positively (Pamuk et al., 2013). By allowing teachers to plan their lessons, interactive white boards support student learning with regards to collaboration and thinking abilities through the effective integration of texts and images (Gage, 2006).

Throughout biology lessons, students show further enthusiasm to participate because of "colorful images, shapes and games" (Anatürk Tombak & Ateşkan, 2019, p. 395). Moreover, the use of interactive white boards enables teachers to integrate more multimedia tools. These multimedia tools used by students vary from TV channels to thousands of web pages that includes social media tools (Hsu and Wang, 2010) According to Ito et al. (2008), the students of the 21st century heavily use technological tools such as social network sites, online games, and videos (p. 1). Hence, it can be said that currently students utilize several types of technological tools to gather easily accessible information.

Gender differences in students' level of technology knowledge

The study of gender difference in students' level of technology knowledge has been a particularly interesting topic in education. One of the persistent findings in literature (He & Freeman, 2010; Scherer & Siddiq, 2019) additionally, is that males consider their level of technology knowledge is higher than that of females. Likewise, this study's results indicate that there is statistically significant difference in students' knowledge level of technology in terms of gender. The results of this study prove that male students presented higher level of technology knowledge compared to female students.

The previous studies on students' gender differences regarding their level of technology knowledge show contradictory results: Whereas in some studies (e.g., Fraillon, Ainley, Schulz, Freidman, & Gebhardt, 2014) these differences are inclined towards female precedence, in others (e.g., Calvani, Fini, Ranieri, & Picci, 2012) they are inclined towards male precedence. There are also studies (e.g., Claro et al., 2012; Scherer & Siddiq, 2019) that does not indicate any difference between students' genders and their technological knowledge. These conflicting results require for researchers to investigate the connection between students' gender differences and their level of technological knowledge.

The research on gender differences with regards to students' level of technological knowledge has been expanding since 1980s (Young, 2000). Particularly in educational research, many issues have been examined in relation to students' level of technological knowledge (Asuquo, & Onasanya, 2006). Similarly, according to Shashaani and Khalili (2001), female students' confidence in using technology is lower than males. The results of this study also showed that male students have rated themselves better at technology use in comparison with females (Wong & Hanafi, 2007). The results of research on this issue advised that female students had fewer positive ideas about the use of technology compared to males (Dambrot, Watkins-Malek, Silling, Marshall, & Garver, 1985; Koohang, 1987).

There are many reasons for this situation including society's ideology of seeing men as "experts" in technology. Other reasons such as society's different expectations from genders, various methods used in classrooms and teacher feedback have been analyzed in previous research (Asuquo & Onasanya, 2006). Even though the results

of research that suggest males have superior competency in the use of technology has not changed considerably in the last century, there is a decrease in the percentages of differences between genders about students' level of technology knowledge.

Gender differences in students' attitudes towards the use of technology in biology classrooms

Another finding of this study was related to students' attitudes towards the use of technology in biology classrooms. Female students' attitudes towards technology is more positive than male students' attitudes towards technology.

As technology developed further in the last century, affecting people's lives in many areas like education, there has been an increase in people's focus on the differences between genders in terms of the use of technology (Fraillon, Ainley, Schulz, Freidman, & Gebhardt, 2014). Correspondingly, gender difference in students' attitudes towards the use of technology has been a concern in education.

That's why studies on students' attitudes towards using technology based on their genders have risen considerably (Kadijevich, 2000; Li & Kirkup, 2007). Still, there is a lack of understanding to gender difference because there are inconsistent findings about students' attitudes towards the use of technology in biology classrooms. However, there are many studies that demonstrate male students' attitudes towards using technology is more positive than females, notwithstanding its minor effect. In other words, boys' competence and their attitudes towards technology is slightly more than girls (Cai, Fan, & Du, 2016). The difference between genders with regards to their attitudes towards technology has been found in several studies (Houtz & Gupta, 2001; Margolis & Fisher, 2002; Shashaani & Khalili, 2001) that show males'

experience in computer use is more positive than females. Although some female students mentioned that they feel proficient in computer experience, their anxiety levels increased more compared to males, which shows female students' attitudes towards technology is not as strong as male students (Dhindsa & Shahrizal-Emran, 2011; Kirkpatrick & Cuban, 1998). That's because males use technology more, and so have more positive ideas about using it (Liaw, 2002). Thus, female students' attitudes towards using technology is less positive than males. This conclusion contradicts with the findings of the current study, which might be resulted from the number of female participants.

The relationship between students' level of technology knowledge and the program that they follow

Another finding of the current study was related to the relationship between students' level of technology knowledge and the program that they follow. Regarding the students' responses which were collected with the questionnaire, there is a very weak correlation between students' level of technology knowledge who follow MoNE program and IBDP together, and the students' who follow only MoNE program.

Students' level of technology knowledge is related to the program they follow in terms of the purpose of their use such as reaching data, doing assignments and learning information (Asuquo & Onasanya, 2006). It is also significant that teachers and leaders incorporate technology in the program they follow in order to be able to increase students' level of technology knowledge (Ertmer & Ottenbreit-Leftwich, 2010). The problem with integrating technology in classes is linked with the "overloaded curriculum" (Sorgo, Verckovnik, & Kocijancic, 2010, p. 44). One of the

reasons students are not well-engaged with the course objectives is that technology is not integrated into their programs (Campbell & Bohn, 2008; NRC, 2005; Windschitl, 2003). That's why, the insufficiency of using technology limits students' level of technology knowledge. However, students are not encouraged to improve their learning via technology but rather use technology as a knowledge resource (Cuban, Kirkpatrick, & Peck, 2001). Thus, it is clear that students' level of technology knowledge is not well-related to the program they follow.

Therefore, the result of this study shows a very weak correlation between their level of technology knowledge and the program that they follow because using technology in biology lessons is not related to MoNE or IBDP program. In MoNE program, there are certain objectives related to students' abilities in using technology as part of twenty-first century skills (MoNE, 2018). Likewise, using technology is important for IBDP (Cooker, Crook, & Ainsworth, 2015, p. 7). Hence, the fact that there is a very weak correlation between students' level of technology knowledge and the program they follow could be connected with teachers' lack of knowledge in technology and the limited opportunities provided for them.

The relationship between students' attitudes towards technology and the program that they follow

The final aim of this study was to investigate the relationship between students' attitudes towards technology and the program that they follow. According to results, there is no relationship between students' attitudes towards technology and the program that they follow.

Sorgo, Verckovnik and Kocijancic (2010) investigated students' attitudes towards technology and found that students have positive attitudes to some technological tools such as "presentations, use of data loggers, computer programmes and virtual laboratory", particularly in biology classrooms (p. 37).

Students' attitudes were positively affected by integrating technology to the MoNE program (MoNE, 2012). A similar positive attitude, using technology in lessons was observed in the IBDP as well (Cooker, Crook & Ainsworth, 2015, p. 7). Nonetheless, teachers cannot use these technological tools due to "the overloaded curriculum, lack of equipment, and inappropriate training" (p. 37). Therefore, it can be assumed that students' attitudes towards technology are not related to the program that they follow but rather to the teachers' efficient use of technology.

Even though there is a link between students' attitudes towards using technology and their gender differences, there is no link between students' attitudes towards technology and the program that they follow.

Implications for practice

The following actions are recommended due to the development of technology and educational tools and the increasing use of technology, especially with the increase in online education compared to the past:

- The technology and its tools used in education should be regulated. The tools that are commonly used such as interactive white board, video, animation and tablet-PC, social media should be better while also promoting the use of tools like computers that are not widely common.

- Girls' level of technology knowledge compared to boys can be increased by supporting teachers with necessary tools and professional development programs.
- Boys' attitudes towards using technology and its tools compared to girls can be increased by supporting teachers with necessary tools and professional development programs.
- Activities and games should be created by identifying technology and its tools that will ensure active participation of students in lessons.

Implications for further research

- One of the aims of the research is to reveal the technology and its tools used in high school biology classes.
- Other researchers can discover the compatibility of teaching resources in terms of the use of technology and its tool into biology lessons.
- In this study, only one questionnaire was used as part of data collection. For other research studies, a set of interviews or other questionnaires can be used for data collection.
- The research was done on technology and its tools used in high school biology classes. Further research can be done in primary schools, high school chemistry and physics classes.
- This research was carried out in four different schools in Ankara. In order to reach a general conclusion about the subject, the research can be used in every part of Turkey.

Limitations

The sample in this study is limited to students who follow the Ministry of National Education (MoNE) and the International Baccalaureate Diploma program (IBDP) together, and the students who follow only the Ministry of National Education (MoNE) program in the Ankara province, and the whole population is not taken. Additionally, the sample only includes high school biology classrooms students in selected schools.

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APPENDICES

APPENDIX A: The Questionnaire

Dear Students,

The aim of this survey is to investigate the attitudes and interests of high school students towards technology tools used in biology classrooms. The survey consists of two parts. The first part includes questions about demographic information, and the second part includes questions that measure your level of knowledge about technology and use of technology. The survey takes about 15-20 minutes.

Your answers will be kept confidential. Please answer all questions. If you have any questions or comments please contact Ecem Yalım, graduate student of Bilkent University, Graduate School of Education.

Contact information:

Tel: 0533 366 65 17

e-mail: ecem.yalim@bilkent.edu.tr

Part 1: Demographic Information

1. **Gender**
   a) Female b) Male
2. **Age/date of birth**

3. **Class:**
4. **Following curriculum**
   a) International Baccalaureate Diploma Programme (IBDP)
      - O Biology standard level
      - O Biology high level
      - O No biology lesson

   b) Ministry of Education (MEB) Curriculum
5. **Your mother's education status**
      - O Elementary school graduate
      - O Middle school graduate
      - O High school graduate

O University graduate

O Master degree

O PhD degree

6. Your father's education status

O Elementary school graduate

O Middle school graduate

O High school graduate

O University graduate

O Master degree

O PhD degree

7. What is your family's monthly income?

Part II:

1. From the technology and technology tools given below, mark the ones used in biology classes.

1.	Computer	
2.	Interactive board	
3.	Projection device	
4.	Tablet PC	
5.	Laptop	
6.	Overhead projector	
7.	Social media	
8.	Web 2.0 applications	
9.	Office applications	
10.	Video, animations etc.	
11.	Other:	

Part III:

Please select a number from 1 to 5 to indicate your attitude towards the following situations and your level of technology use.

Disagree (1) tend to disagree (2) neutral (3) tend to agree (4) agree (5)

	1	2	3	4	5
Attitude toward technology					
1. You have to be smart to study technology.					
2. I do not understand why anyone would want a job in technology.					
3. To study technology you have to be talented.					
4. You can study technology only when you are good at both mathematics and science.					
5. Using technology makes a country less prosperous.					
6. Working in technology would be boring.					
7. Most jobs in technology are boring.					
8. I think machines are boring.					
9. A technological hobby is boring.					

Please select a number from 1 to 3 to indicate your attitude towards the following situations and your level of technology use.

Disagree (1) neutral (2) agree (3)

	1	2	3
Knowledge of technology			
1. I think science and technology are related.			
2. In technology, you can think up new things.			
3. Working with information is an important part of technology.			
4. Technology is as old as humans.			
5. Technology has a large influence on people.			

6. I think technology is often used in science.			
7. Working with hands is part of technology.			
8. In everyday life, I have a lot to do with technology.			
9. The government can have influence on technology.			
10. I think the conversion of energy is also a part of technology.			
11. In technology, you use tools.			
12. Technology is meant to make our life more comfortable.			
13. Working with materials is an important part of technology.			
14. There is a relationship between technology and science.			

Thank you for completing the survey. Your responses will contribute to the development of attitudes and interest towards technology and technology tools used in biology classrooms.

Reference

Incantalupo, L., Treagust, D., & Koul, R. (2014). Measuring students' attitude and knowledge in technology-rich biology classrooms. *Journal of Science Education and Technology, 23*, 98-107. doi: 10.1007/s10956-013-9453-9

APPENDIX B: Permission from the Developer of the Questionnaire

Hello Ecem,
Thank you for your email.
Yes you have my permission to use the survey.
I wish you well with your research.
Best wishes
David Treagust
School of Education
Curtin University

On 2/02/2018 3:31 pm, "ecem.yalim@bilkent.edu.tr"
<ecem.yalim@bilkent.edu.tr> wrote:

> 02.02.2018
>
> Dear Professor David F. Treagust,
>
> I am a master student at Graduate School of Education, Bilkent University. I am carrying out a research related to the use of technology in biology classrooms. I am asking your permisson to use the survey which used in ‘Measuring Student Attitude and Knowledge in Technology-Rich Biology Classrooms[1].
>
> Sincerely,
>
> Ecem Yalim
> ecem.yalim@bilkent.edu.tr

APPENDIX C: Permission from MoNE

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

EBYS GELEN
EVRAK NO: 1499

Sayı : 14588481-605.99-E.9677779 17.05.2018
Konu : Araştırma İzni

BİLKENT ÜNİVERSİTESİNE
(Eğitim Bilimleri Enstitüsü)

İlgi: a) MEB Yenilik ve Eğitim Teknolojileri Genel Müdürlüğünün 2017/25 nolu Genelgesi.
b) 03/05/2018 Tarihli ve E.1386 sayılı yazınız.

Enstitünüz, Eğitim Programları ve Öğretim Yüksek Lisans öğrencisi Ecem YALIM'ın **"Lise Biyoloji Sınıflarında Teknoloji Araçlarının Kullanımı Hakkında Öğrencilerin Tutumları"** konulu tez çalışması kapsamında uygulama talebi Müdürlüğümüzce uygun görülmüş ve uygulamanın yapılacağı İlçe Milli Eğitim Müdürlüğüne bilgi verilmiştir.

Görüşme formunun (7 sayfa) araştırmacı tarafından uygulama yapılacak sayıda çoğaltılması ve çalışmanın bitiminde bir örneğinin (cd ortamında) Müdürlüğümüz Strateji Geliştirme (1) Şubesine gönderilmesini rica ederim.

Vefa BARDAKCI
Vali a.
Milli Eğitim Müdürü

17 Mayıs

Adres: Alparslan Türkeş cad. Emniyet Mah.4/A
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22.5.18

Bu evrak güvenli elektronik imza ile imzalanmıştır. https://evraksorgu.meb.gov.tr adresinden 334e-9ce7-30cd-b296-9fa7 kodu ile teyit edilebilir. EBE