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The Assessment of Technology Integration into Science Lesson Textbooks

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Abstract

Textbooks are still accepted as one of the most influential materials used during instruction today. On the other hand technological devices and processes have been used more during instruction as in every field in our lives. Therefore, this study aims to assess technology integration into textbooks for students' motivation. In this context, science lesson textbooks from 3rd to 8th grades were examined in terms of included technological concepts or technology use in the activities and handled digital competences. The study is carried out with the document analysis method in a qualitative research and it is found that technology, television, telephone and computer are the most used concepts in textbooks. And also it is found that "information and data literacy" and "communication and collaboration" competences identified in the European Digital Competency Framework are used most in the textbook activities. "Digital content creation" and "problem solving" competences are included less in the textbook activities. Depending on the data obtained from the study, it is seen that the use of only QR codes in textbooks is not sufficient to improve the students' digital competency. For this reason, it is suggested that different technological methods and techniques should be used more.

Key Words

Digital competence • Motivation • Science • Technology • Textbook

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People have undergone changes with the developments seen both in science and technology fields and their effect to each other. To reach the information through fast-growing technology has become easier and to reach this correct and reliable information through convenient sources has also become one of the competences of this era. Also, the importance of digital competency has become more prominent with the development of technology, high demand to it and the transfer of information to digital media. This competency includes various concepts like digital literacy, digital communication, digital security and digital trade in it (Şimşek, 2022). Since most of the work is performed with different technological devices and processes in daily life, people's acquisition of specific information and skills in obtaining this competency becomes compulsory. Therefore, technology literacy and digital literacy skills that require the correct understanding of technology and using it for correct purposes (Bakioğlu & Çevik, 2022; Direkçi et al., 2019) have become one of the important education matters.

Since the philosophy and aims of education are considered, the importance of the information, skills and competences come forward in terms of daily life. Students should not only acquire information and skills but also use them for their emerging desires or against encountered difficulties (Saputra & Abdulkarim, 2021). The pandemic, for example, affected almost the entire world and the global climate crisis effects led the spread of distance education implementations. Therefore, as an alternative to face-to-face education, a learning process, which is independent of time and place has become effective (Aslan & Güner, 2022; Birhan & Doğru, 2022; Kılıç Koçak, 2019). In addition to the scientific and technological developments, similar situations like this increase rapidly the relationship between education and technology.

Various educational technologies and digital content are used for students to be active during instruction processes nowadays (Kabak, 2020; Kılıç Koçak, 2019). Because thanks to scientific and technological developments, there are new educational tools and equipment that help students learn easier by taking their attention and increasing their motivation (Heafner, 2004; Puspitarini & Hanif, 2019). Learning motivation is one of the key factors for achieving learning goals. Since using just learning methods is not sufficient alone, media is a necessity as a means for students (Puspitarini & Hanif, 2019). Likewise, it is emphasized in the study by Lee and Hwang (2022) that learning opportunities compliant with technology should be provided for instructors as a means for sustainable education.

Technology use in science lessons in schools is expected to increase students' motivation and make learning easy. In this way, it is possible to say that students are provided with a better educational setting. Because computer, simulation, animation, digital image, video and internet use helps to achieve educational goals and also enable to improve students' development processes (Birhan & Doğru, 2022). Thus, in their study on hybrid education that come out because of pandemic Kumaş and Kan (2022) state that interactive simulation, video, online experiments and infographic designs are the applications that equalize the opportunities for students attending face-to-face or online lessons. In the study by Kılıç Koçak (2019), it was concluded that e-contents of biology lessons should be enriched with different applications such as interactive applications, virtual experiments and 3D visuals.

There has been quite a lot of research about technology use in science lessons. According to Büyükcengiz (2017), the digital storytelling method applied in science lessons in secondary schools has a positive impact on students'

academic performance and scientific process skills. It also helps students to have a positive attitude toward the lesson. In Becit İşçitürk and Coşkunserçe's study (2022), it is concluded that teachers' think about technology use in science lessons affected teachers' performance positively and decrease the effort they spend. Also, teachers think experiences have a positive effect on technology use. In the study of Akçöltekin et al. (2022), it is concluded that there are opinions that technological opportunities are utilized, time is used effectively, the personal learning opportunity is created and technology use competence is developed in science lessons. According to Bakioğlu and Çevik (2022), science lesson teachers use information technologies more during face-to-face education following distance education and they take the information technologies to the center of learning and teaching approaches. In the study of Kabak (2020), it is concluded that the use of digital contents developed by the students themselves during lessons affect their academic success, attitude towards the lesson and computer assisted education.

The use of textbooks in schools is also another important matter during instruction as well as technology use. Textbooks, which are accepted as basic materials during instruction (Çiftçi et al., 2007; Durakoğlu & Coşkun, 2019; Kahveci, 2020; Kurt & Demir, 2019; Tenekeci & Dursun, 2019) are prepared in accordance with curricula and students' age and cognitive level. The basic principle in the preparation of these books is to guide the activities prepared for students to get the knowledge, skills and competencies involved in curricula. Also, textbooks are basic sources, which enable teachers to present lesson contents systematically (Altay, 2020; Bayır & Kahveci, 2022; Erdoğan & Azizoğlu, 2022; Saputra & Abdulkarim, 2021; Ünsal & Güneş, 2002) and textbooks are easily accessible educational materials for students (Şimşek, 2022).

Rationale and Purpose of the Study

The education of children complies with today's conditions, changes occurring in the world are reflected in curricula and textbooks should be prepared according to this. Textbooks, maintaining their characteristics such as having pages including texts and visuals among front and back pages and providing the interaction among the teacher, students and content have become multiple learning materials providing different applications with external visuals and contents nowadays (Kurt & Demir, 2019). The preparation of curricula or textbooks incompatible with technology will have a negative effect on instruction (Alın Uran, 2009) and be challenging for students' learning process. Therefore, to state the quality of a textbook it is necessary to analyze it (Saputra & Abdulkarim, 2021).

It is stated in the study (Direkçi et al., 2019), which is one of the studies about the development of digital literacy in textbooks, there are activities for providing these skills. But there aren't any learning outcomes about digital literacy in activities in secondary school textbooks and any questions about this subject in evaluation parts of some themes in Turkish lesson textbooks. Likewise, in the study of Şimşek (2022), it is understood that digital competence isn't mentioned sufficiently, there are a few digital competences related to digital literacy and digital security and other sub-skills are not mentioned except for a text. According to the study by Maden et al. (2018), which assessed 5th grade Turkish lesson textbooks within the context of digital literacy, it is found that computer is the most used concept in textbooks and technology, internet and media concepts are used too. In the study of Yüksel and Taneri (2020), it is found that digital competences used at a low level in life science lesson textbooks in all grades.

On the other hand, science lesson curriculum was updated in accordance with the Turkish Qualifications Framework in 2018. In this context, there are eight qualifications defined in curricula and digital competence is one of them. But Eren and Dökme (2021) in their study, which examined science lesson curriculum in terms of digital competence stated that there were only a few learning outcomes about the competency and indirect learning outcomes were more prominent than directly related learning outcomes. In the study of Erdoğan and Azizoğlu (2022), it was concluded that the transfer percentage of life-based learning outcomes was low in science lesson textbooks in secondary schools. In Altun and Bangir Alpan's study (2021), it was found that computer and internet were the most used, tablet, smartphone, smart board, hardware and browser were the least used words related to digital literacy skill in science lesson textbooks. Tezcan (2019) stated that, teachers were of the opinion that science lesson textbook activities were inadequate in terms of digital knowledge applicability in secondary schools.

The important point here is to get people to use technology in daily life within the frame of ethical principles in the digitalized world. Therefore, content about digital competence and the way this content is handled, play a key role in science lessons. In this context, the key frame describing digital competence is the European Digital Competence Framework which was developed by The European Commission. According to it, digital competence consists of participation in social life, safe and critical use of digital technology in academic life and its responsibility. The Digital Competence Framework identifies in detail five key areas about knowledge, skills and attitudes, which people need. They can be used by employers, educators, policy makers or other actors interested in digital competence. This competence consists (1) information and data literacy, (2) communication and collaboration, (3) digital content creation, (4) safety and (5) problem solving (DigComp: The European Digital Competence Framework, 2018).

The reference framework for digital competence is Turkish Qualifications Framework in Türkiye. In Science lesson curriculum, which was updated in accordance with this framework digital competence was included (Ministry of National Education, 2018). In this context, skills for digital competence are expected to be included in textbooks, which are prepared in accordance with the curriculum. Because textbooks, which are accepted as basic materials used during instruction still maintain their effect on students' developments. It is also a must to educate students in accordance with technological developments and even with the qualifications that will make them lead the technology. For this reason, this study aims to examine the existence of technology related content and methods which increase students' motivation and provide an easy learning in textbooks. "Is there any technological information in science lesson textbooks?" and "Do science lesson textbooks support the use of technology or digital competence?" It is thought that the results of the study, which is based on these main subjects, may give an idea to the writers, teachers and researchers about how much the digital competence of students is considered in science lessons.

Method

The aim of this study is to assess the technology integration into science lesson textbooks from 3rd to 8th grades, which are used in primary and secondary schools in Türkiye. Because science lesson textbooks are considered important factors in increasing students' motivation during lessons.

Research Design

The qualitative research design is utilized for this study and the data are obtained with the document analysis method. Document analysis is known as the analysis of written materials, which contain information about the facts for the aimed study and textbooks can be used as data sources for educational studies (Yıldırım & Şimşek, 2021).

Research Sample

In this context, the criteria were specified for the examination of textbooks at the beginning of the study. (i) Textbooks should be appropriate for the curriculum, (ii) be prepared and delivered to the students by the Ministry of National Education, (iii) be at least a textbook in each grade, (iv) be issued on EBA (Educational Information Web) platform, (v) be used during 2022-2023 academic year. There isn't any science lesson textbook prepared by the Ministry of Education for 8th graders in secondary school. Therefore, a textbook, which was prepared by a private publishing house was included in the study. The textbook meets the criteria and it is delivered to the students by the Ministry of Education. The aim of doing this is to maintain the unity of the study and present the educational content in primary schools as a whole.

Research Instruments and Processes

Science lesson textbooks are handled in two dimensions to assess the technology integration into them in this study. First, it was analysed if there was any information about technological knowledge, changes and developments in texts, activities or images in textbooks. Therefore, it was examined if there were any technological concepts (analysis units), which were determined at the beginning of the study in any text, visual (picture or photograph), activity, assessment and evaluation question (open-ended, multiple choice etc.) or warm up (at the beginning of the unit or section) part. Also, the contents of science lesson textbooks that provide students to learn and use the technology were determined. Therefore "Technological Information Acquire" and "Technology Use" concepts were used. Second, the state of utilized technological methods was analyzed in textbooks. For this, a literature review was carried out and five key concepts (information and data literacy, communication and collaboration, digital content creation, safety and problem solving) identified in the European Digital Competence Framework and the description of these concepts were taken as a reference. After the examination, analysis units were determined in accordance with the descriptive analysis, which is one of the methods used in qualitative research. At this stage, the opinions of three field experts, who studied during the preparation, updating, examination and assessment of the science lesson curriculum and textbooks were taken. The accounting log developed by Miles & Huberman (1994) was utilized to check the reliability of analysis units created for the study. The percentage of experts' conformity was calculated and it was found 83 %. After the determination of this percentage reliable, the examination was carried out according to the analysis units. Therefore, "smart board, computer, informatics, digital, hardware, internet, social media, tablet, technology, telephone, television and software" analysis units were utilized during the examination of textbooks.

Data Analysis

Textbooks, which meet the criteria determined at the beginning of the study were reached from the web page (www.eba.gov.tr) of the Ministry of National Education. A comprehensive reading to understand the content of

textbooks was carried out in the first phase of the study. After the result of the examination, which was carried out in accordance with analysis units, contents related to the codes were handled under the "text, activity, image, evaluation question and warm up" categories. The existence of each of the analysis units in textbooks was stated with numbers and presented in tables. Except for analysis units, the other contents, which are related to technology in textbooks were also identified and presented. In the second phase of the study, each activity in textbooks was examined one by one and the relevance of each activity with the digital competence was determined. In this way, technology integration into textbooks in each grade was explained with two different tables.

One of the ways to ensure the reliability of qualitative research is to explain each stage of it and explain the way followed in detail (Büyüköztürk et al., 2022). Since the examined textbooks were reached from the official web page (www.eba.gov.tr) of the Ministry of National Education and it was understood after the interviews made with the authorities of the institution that they were the last updated version, the documents were accepted to be reliable and valid. On the other hand, for the internal validity of the research, the researcher made the research impartial and unbiased. Therefore, the data were rechecked thanks to the detailed notes that took a long time on the studied subject (Büyüköztürk et al., 2022). Since the external validity is based on the generalization of the results, the comparability concept is used for this kind of research (Büyüköztürk et al., 2022) and a path that enables the comparability has been followed for the accessibility of textbooks to everyone. All of this process was conducted by having a consensus among the researchers.

Results

In this study, the examination of the integration of science lesson textbooks into technology in primary and secondary schools in Türkiye was carried out and the obtained data were handled separately in each grade and presented in tables. For this reason, there are two presented tables in each grade. One of them is used to express the state of inclusion of technological information in science lesson textbooks. On the other hand, the other one identifies the technology use in textbooks or the state of digital competence support.

Inclusion of Technology in Primary School 3rd Grade Science Textbooks

The state of technological concepts and content use in science lesson textbooks in 3rd grade in primary schools and findings on technology use in textbook activities are presented in Table 1 and Table 2.

Table 1

Inclusion of Technology in Primary School 3rd Grade Science Textbooks The Existence of Research Analysis Units in Textbooks

Content Type	Smart Board	Computer	Informatics	Digital	Hardware	Internet	Social Media	Tablet	Scanner	Technology	Telephone	Television	Software
Text	x	3	x	x	x	x	x	1	x	2	4	8	x
Activity	x	x	x	x	x	x	x	x	x	x	x	x	x

Visual	x	4	x	1	x	x	x	1	x	14	7	4	x
Evaluation Question	x	4	x	x	x	x	x	x	x	2	5	6	x
Warm up	x	x	x	x	x	x	x	x	x	x	2	1	x

Other Contents about Technology in the Textbook

	Page Number	*Content Type*
Technologic Information Acquisition	47	The Story of Bionic Ear (Biyonik Kulağın Öyküsü)
Technology Use	13, 37, 67, 99, 137, 177, 209	QR Codes

When Table 1 is examined, it is understood that the most used analysis units created for the research are television, technology, telephone and computer and tablet and digital concepts are used less. It is understood that these concepts related to technology are used mainly first in images and then in texts. In textbooks activities, these concepts are not used at all. On page 47 of the textbook, there is a definition of a technological device in the text named "The Story of Bionic Ear (Biyonik Kulağın Öyküsü)" that can take the students' attention. Apart from this, students are directed to the use of technology with QR codes. The page numbers of these codes are presented in Table 1.

Table 2

The Relationship of 3rd Grade Science Lesson Textbook Activities with Digital Competence Skills in Primary Schools

Page Number	*The Name of Activity*	*The Content of Activity*	*Digital Competence Skill*
163	Let's Recognize the Sound Magnitude (Sesin Şiddetini Fark Edelim)	The discovery of the relationship between the sound magnitude and hearing by using radio	Information and data literacy Communication and cooperation
214	Let's Make a Wheel (Çarkıfelek Yapalım)	The determination of the aim of electrical cars' use	Information and data literacy Communication and cooperation
227	Let's Determine the Source of Electricity (Elektrik Kaynağını Belirleyelim)	The determination of electric source type, which is used by cars	Information and data literacy Communication and cooperation
230	I Make A Waste Battery Box (Atık Pil Kutusu Yapıyorum)	The consciousness about waste batteries	Safety

It is concluded that four 3rd grade science lesson textbook activities can be related to technology in the context of different units' scope and content. The page number and activity names are stated in Table 2. When this relationship is handled, it is concluded that information and data literacy and communication and collaboration skills are focused more as the digital competence skills of the students.

Inclusion of Technology in Primary School 4th Grade Science Textbooks

The state of technological concepts and content use in 4th grade in primary schools and findings on technology use in textbook activities are presented in Table 3 and Table 4.

Table 3

Inclusion of Technology in Primary School 4th Grade Science Textbooks

The Existence of Research Analysis Units in Textbooks													
Content Type	Smart Board	Computer	Informatics	Digital	Hardware	Internet	Social media	Tablet	Scanner	Technology	Telephone	Television	Software
Text	x	8	x	x	1	1	x	x	x	11	10	11	x
Activity	x	x	x	x	x	1	x	x	x	1	1	x	x
Image	x	x	x	4	x	x	x	x	x	35	1	x	x
Evaluation Question	1	3	x	x	x	x	x	x	x	4	6	1	x
Warm Up	x	x	x	x	x	x	x	x	x	5	x	x	x

Other Contents about Technology in the Textbook

	Page Number	*Content Type*
Technologic Information Acquisition	108, 109	The expression of the samples of technological products in which magnets are used
	182-191	Lightning Technologies Section
	186	The inventions (such as tape recorder) of Thomas Edison under the section of "People Shaping the Future"
	206-216	"Sound Technologies from Past to Present" Section
	236	Japanese inventors, who invented Blue LED and their inventions under the section of "People Shaping the Future"
	263	The invention of first electric battery by Alessandro Graf Volta under the section of "People Shaping the Future"
Technology Use	18, 50, 84, 120, 180, 230, 254	QR Codes

When Table 3 is examined, it is understood that the most used analysis units created for the research are television, technology, telephone and computer and smart board, digital, hardware and internet concepts are used less. It is understood that these concepts related to technology are used mainly in images and then in texts. In textbook activities, internet, technology and television concepts are used once. In addition to this, there are reading texts about the relationship of the magnet with today's technological devices such as external hard drive, CD/DVD, MR device and Maglev train. Also, under the section of "People Shaping the Future" there are reading texts about scientists, who have technological inventions. There are two different sections "Lightning Technologies" and "Sound Technologies from Past to Present" in the textbook. It is found that these sections are directly related to the instruction of technology. Apart from this, students are directed to the use of technology with QR codes. The page numbers of these codes are presented in Table 3.

Table 4

The Relationship of 4th Grade Science Lesson Textbook Activities with Digital Competence Skills in Primary Schools

Page Number	*The Name of Activity*	*The Content of Activity*	*Digital Competence Skill*
184	Let's Make a Poster of Lightning	The preparation of a poster about	Information and data

	Technologies from Past to Present (Geçmişten Günümüze Aydınlatma Teknolojilerinin Posterini Hazırlayalım)	lightning devices from past to present with images	literacy Communication and cooperation
198	Light Pollution (Işık Kirliliği)	The search for the awareness about light pollution and poster preparation	Information and data literacy Communication and cooperation Safety
207	Let's Make a Simple Telephone (Basit Bir Telefon Yapalım)	The modelling of working principle of telephones with simple materials	Information and data literacy
214	How Salt is Affected by the Loudspeaker? (Tuz Hoparlörden Nasıl Etkileniyor?)	The visualization of the high sound magnitude effect	Safety
248	Let's Try Ourselves (Kendimizi Deneyelim)	Drawing attention to the saving with the digital form of electricity bills	Information and data literacy Safety

It is concluded that among 4th grade science lesson textbook activities, only five of the activities can be related to technology in the context of different units' scope and content. The page number and activity names are stated in Table 4. When this relation is handled, it is understood that *information and data literacy*, *communication and collaboration* and *safety* skills are focused more as the digital competence skills of the students.

Inclusion of Technology in Secondary School 5th Grade Science Textbooks

The state of technological concepts and content use in science lesson textbooks in 5th grade in secondary schools and findings on technology use in textbook activities are presented in Table 5 and Table 6.

Table 5

Inclusion of Technology in Secondary School 5th Grade Science Textbooks

The Existence of Research Analysis Units in Textbooks													
Content Type	Smart board	Computer	Informatics	Digital	Hardware	Internet	Social media	Tablet	Scanner	Technology	Telephone	Television	Software
Text	x	3	1	x	x	x	1	x	x	1	x	2	x
Activity	x	x	x	x	x	x	x	x	x	x	x	x	x
Image	x	x	1	2	1	x	x	x	x	25	x	1	x
Evaluation Question	x	x	x	x	x	x	x	x	x	2	x	1	x
Warm Up	x	x	x	x	x	x	x	x	x	x	x	x	x

Other Contents about Technology in the Textbook

	Page Number	*Content Type*
Technologic Information Acquisition	26	The news about the sending of Dragon Z space craft to the Moon in the newspaper
	32	Informative texts about space crafts
	107, 108	The stories of "Hürkuş" plane and "Devrim" car
	182	A reading text about the invention of camera obscura by

		İbn-i Heysem
	260	Introduction of Nikola Tesla and Thomas Alva Edison
Technology Use	17, 51, 79, 117, 163, 207, 247	QR Codes

When Table 5 is examined, it is understood that the most used analysis unit created for the research is *technology* and *smart board, internet, tablet, scanner, telephone* and *software* concepts are not used at all. Other analysis units are the least used ones. It is found that these concepts related to technology are used mainly in images and then in texts. In textbook activities, these concepts are not used at all. In addition to this it is found that there are news or informative texts about space crafts, the story of Hürkuş plane and Devrim car, which can be related to technological developments and the introduction of scientists such as Nikola Tesla. Apart from this, students are directed to the use of technology with QR codes. The page numbers of these codes are presented in Table 5.

Table 6

The Relationship of 5th Grade Science Lesson Textbook Activities with Digital Competence Skills in Secondary Schools

Page Number	*The Name of Activity*	*The Content of Activity*	*Digital Competence Skill*
25	Show Yourself (Göster Kendini)	The imagination of the design of space craft traveling to the Sun	Digital content creation Problem solving
29	Show Yourself (Göster Kendini)	The investigation of life on the Moon	Safety Problem solving
33	Show Yourself (Göster Kendini)	The imagination of space travel as an astronaut	Digital content creation Safety Problem solving
61	The Revival of Mayas (Mayalar Canlanıyor)	The use of Microscope	Information and data literacy
125 134-135 137 140 141 143 147	• Is It Evaporation? or Is It Boiling? mı? (Buharlaşma mı? Kaynama) • Let's Discover the Melting and Freezing Points (Erime Noktası ve Donma Notasını Keşfedelim) • The Freezing Point (Donma Noktası) • It's Your Turn (Sıra Sende) • Show Yourself (Göster Kendini) • Heat and Temperature (Isı ve Sıcaklık) • Let's Mix Hot and Cold Tea (Sıcak Çayla Soğuk Çayı Karıştıralım)	The use of thermometer and chronometer	Information and data literacy
255	Show Yourself (Göster Kendini)	The design of a toy, which has simple electric circuit	Information and data literacy Digital content creation Problem solving

It is concluded that among 5th grade science lesson textbook activities, only twelve of the activities can be related to technology in the context of different units' scope and content. The page number and activity names are stated in Table 6. It is understood that in the activities where the focus is on imagination, investigation and designing, *digital*

content creation, problem solving and safety skills are also taken into consideration in addition to *information and data literacy.*

Inclusion of Technology in Secondary School 6th Grade Science Textbooks

The state of technological concepts and content use in science lesson textbooks in 6th grade in secondary schools and findings on technology use in textbook activities are presented in Table 7 and Table 8.

Table 7

Inclusion of Technology in Secondary School 6th Grade Science Textbooks

The Existence of Research Analysis Units in Textbooks														
Content Type	Smart board	Computer	Informatics	Digital	Hardware	Internet	Social media	Tablet	Scanner	Technology	Telephone	Television	Software	
Text	x	4	x	1	x	x	x	2	x	3	4	6		1
Activity	x	x	x	x	x	1	x	x	x	x	x	x		x
Image	x	x	x	x	x	x	x	x	x	8	x	x		x
Evaluation Question	x	x	x	x	x	x	x	x	x	4	x	x		x
Warm Up	x	x	x	x	x	x	x	x	x	3	x	x		x

Other Contents about Technology in the Textbook		
	Page Number	*Content type*
Technologic Information Acquisition	134	The thermal camera use subject
Technology Use	20, 46, 86, 112, 150, 174, 208	QR Codes

When Table 7 is examined, it is understood that the most used analysis units created for the research are *technology, television, telephone, computer* and *tablet; digital, internet, tablet, scanner* and *software* are used once. Other analysis units are not used at all. It is understood that these concepts related to technology are used mainly in images and then in texts. Among text book activities, in only one activity *internet* concept is mentioned; other concepts are not used at all. In addition to this, there is an example of a daily technological device by mentioning about the use of thermal camera in a subject related to thermal insulation. Apart from this, students are directed to the use of technology with QR codes. The page numbers of these codes are presented in Table 7.

Table 8

The Relationship of 6th Grade Science Lesson Textbook Activities with Digital Competence Skills in Secondary Schools

Page Number	*The Name of Activity*	*The Content of Activity*	*Digital Competence Skill*
81	Let's Design Together (Birlikte Tasarlayalım)	The design of stethoscope and manometer	Information and data literacy Digital content creation Problem solving
101 102	• Who is Faster? (Kim Daha Süratli?) • Let's Calculate Our Speed (Süratimizi Hesaplayalım)	The use of chronometer	Information and data literacy
125	Let's Find the Density of Different Liquids (Farklı Sıvıların Yoğunluklarını Bulalım)	The use of electronic scale	Information and data literacy
126	Different Matters Different Density (Farklı Madde Farklı Yoğunluk)	The use of electronic scale	Information and data literacy
136	Let's Make Insulation (Yalıtım Yapalım)	The use of thermometer	Information and data literacy
137	Alternative Thermal Insulating Materials (Alternatif Isı Yalıtım Malzemeleri)	The use of thermometer	Information and data literacy
224	Let's Design Together (Birlikte Tasarlayalım)	The design of fruit and vegetable battery	Information and data literacy Problem solving

It is concluded that among 6th grade science lesson textbook activities, only eight of the activities can be related to technology in the context of different units' scope and content. The page number and activity names are stated in Table 8. In activities such as using the chronometer and electronic scale or designing battery or manometer, mostly *information and data literacy* competence is focused. It is concluded that *digital content creation* and *problem solving* skills are used only in two activities.

Inclusion of Technology in Secondary School 7th Grade Science Textbooks

The state of technological concepts and content use in science lesson textbooks in 7th grade in secondary schools and findings on technology use in textbook activities are presented in Table 9 and Table 10.

Table 9

Inclusion of Technology in Secondary School 7th Grade Science Textbooks

The Existence of Research Analysis Units in Textbooks													
Content Type	Smart board	Computer	Informatics	Digital	Hardware	Internet	Social media	Tablet	Scanner	Technology	Telephone	Television	Software
Text	x	4	x	1	x	x	x	x	x	6	2	4	2
Activity	x	x	x	x	x	5	x	x	x	2	x	5	x
Image	x	x	x	6	x	x	x	x	x	16	x	x	x
Evaluation Question	x	x	x	x	x	x	x	x	x	2	x	x	x
Warm Up	x	x	x	x	x	x	x	x	x	2	x	x	x

Other Contents about Technology in the Textbook

	Page Number	*Content Type*
Technologic Information Acquisition	20-29	The relationship between technology and space studies section
	24	Reading text about telescope types
	26	Reading text about the telescope study of Galileo, Newton and Hercher
	43	A question about a technological device used for observing the sky
	57	Description about electronmicroscopy
Technology Use	18, 44, 78, 106, 148, 184, 206	QR Codes

When Table 9 is examined, it is understood that the most used analysis units created for the research are *technology, digital, television, internet and computer*. The least used analysis units are *telephone* and *software* and other analysis units are not used at all. It is understood that these concepts, related to technology are used mainly in images. Among text book activities, while in five activities *internet and television* concepts are mentioned, *technology* concept is mentioned in two activities. In addition to this, it is found that there is a part about technology and space studies on the pages of the textbook from 20 to 29. It is also found that there are texts about technological devices such as telescope and microscope. Apart from this, students are directed to the use of technology with QR codes. The page numbers of these codes are presented in Table 9.

Table 10

The Relationship of 7th Grade Science Lesson Textbook Activities with Digital Competence Skills in Secondary Schools

Page Number	*The Name of Activity*	*The Content of Activity*	*Digital Competence Skill*
57	Let's Search and Discuss (Araştıralım ve Tartışalım)	Discussion of the technology effect to Aziz Sancar's studies	Information and data literacy Communication and collaboration

137	Recycling (Geri Dönüşüm)	The preparation of newspaper, internet or TV advertisement about recycling	Information and data literacy Communication and collaboration Digital content creation Problem solving
141	What Did We Learn? (Neler Öğrendik?)	Producing ideas about recycling with the samples of chips used in the USA	Information and data literacy Problem solving
176	Imaging Device (Görüntüleme Aracı)	The preparation of newspaper, internet or TV advertisement by designing an imaging device	Digital content creation Problem solving

It is concluded that among 7th grade science lesson textbook activities, only four of the activities can be related to technology in the context of different units' scope and content. The page number and activity names are stated in Table 10. In these activities, the focus is on discussion and the preparation of presentation and *information and data literacy* competence is used most. Also, *communication and collaboration*, *digital content creation* and *problem solving* skills are used.

Inclusion of Technology in Secondary School 8th Grade Science Textbooks

The use of technological concepts, contents and the findings on technology use in the activities in science lesson textbooks for 8th grades in secondary schools are presented below in Table 11 and Table 12.

Table 11

Inclusion of Technology in Secondary School 8th Grade Science Textbooks

The Existence of Research Analysis Units in Textbooks													
Content Type	Smart board	Computer	Informatics	Digital	Hardware	Internet	Social media	Tablet	Scanner	Technology	Telephone	Television	Software
Text	x	6	x	x	1	x	x	x	x	14	1	3	x
Activity	x	x	x	x	x	x	x	x	x	1	x	2	x
Image	x	x	x	x	x	x	x	x	x	12	x	x	x
Evaluation Question	x	x	x	x	x	x	x	x	x	5	x	x	x
Warm Up	x	x	x	x	x	x	x	x	x	2	x	x	x

Other Contents about Technology in the Textbook

	Page Number	*Content Type*
Technologic Information Acquisition	56-62	The instruction of biotechnology subject
	129-130	The presentation of chemistry-based jobs involving technology
	184	The electronic waste and descriptions about recycling
	212	An explanatory text about the use of robots
	214	Reading text named "Robots are Everywhere"
	215, 216, 219	The explanation of the production of electrical energy and its usage area

	223, 224	An explanatory text about technological devices and electrical energy save
	228	Evaluation question about technological device and energy transformation
Technology Use	12, 24, 68, 84, 136, 154, 196	QR Codes

When Table 11 is examined, it is understood that the most used analysis units created for the research are *technology, computer and television. Hardware* and *telephone* are used once and other analysis units are not used at all. It is understood that these concepts, related to technology are used mainly in texts. Among text book activities, only in one activity *technology* is used and in two activities *television* is utilized. In addition to this, it is concluded that the emphasis on the relationship of technology with other fields increased. It is also found that there are subjects about biotechnology, chemistry-based jobs including technology; robots, technological devices and energy transformation. Apart from this, students are directed to the use of technology with QR codes. The page numbers of these codes are presented in Table 11.

Table 12

The Relationship of 8th Grade Science Lesson Textbook Activities with Digital Competence Skills in Secondary Schools

Page Number	*The Name of Activity*	*The Content of Activity*	*Digital Competence Skill*
59	Let's Discuss (Münazara Yapalım)	The discuss of advantages and disadvantages of biotechnological practices	Information and data literacy Communication and collaboration
99	Let's Observe Conservation of Mass in Chemical Reactions (Kimyasal Tepkimelerde Kütlenin Korunumunu Gözlemleyelim)	The use of electronic scale	Information and data literacy
110	Let's Search and Present (Araştıralım Sunalım)	The search of acid rain from the sources such as internet, library and video-CD	Information and data literacy Safety Problem solving
115 116 118	• Let's Observe the Effect of Mass of Matter to Heat (Maddenin Kütlesinin Isınmaya Etkisini Gözlemleyelim) • Let's Observe the Effect of Temperature Rise to Heat (Maddedeki Sıcaklık Artışının Isınmaya Etkisini Gözlemleyelim) • I Observe Change of State (Hal Değişimini Gözlemliyorum)	The use of thermometer and chronometer	Information and data literacy
119	Let's Discover the Necessary Factors for Change of State (Hal Değiştirme İçin Gerekli Isının Bağlı Olduğu Faktörleri Keşfedelim)	The use of chronometer	Information and data literacy
213	Project Assignment (Proje Görevi)	The design of robot	Information and data literacy Communication and collaboration Digital content creation Safety Problem solving

It is concluded that among 8th grade science lesson textbook activities, only eight of the activities can be related to technology in the context of different units' scope and content. The page number and activity names are stated in Table 12. It is found that digital competence skills are used through the activities such as discussion of biotechnology practices, the use of electronic scale, the research through the internet, the use of chronometers and the design of robots. In this context, it is found that *information and data literacy* skill is used in these activities and there are also *communication and collaboration*, *safety*, *problem solving* and *digital content creation* skills are included in the activities.

Discussion, Conclusion & Suggestions

It is very difficult to mention a field without technology today. Most of the daily actions are performed with the help of technological devices and processes and this requires the necessity of acquiring related information and skills in this field. Therefore, technology literacy, which requires technology understanding and using it in conformity with technological aims and also digital literacy skills (Bakioğlu & Çevik, 2022; Direkçi et al., 2019) have become one of the prominent educational matters. On the other hand, educational technologies and digital content, which are used for students to be active during instruction (Kabak, 2020; Kılıç Koçak, 2019) provide an easy learning by taking their attention to the lesson and increase their motivation (Heafner, 2004; Puspitarini & Hanif, 2019). In this context, technologies utilized in science lessons in schools are expected to motivate students and provide an easy learning. Because the use of a computer, simulation, animation, digital image, video and the internet help realize education goals and provides the improvement of students' development processes (Birhan & Doğru, 2022). On the other hand, textbooks are accepted as basic materials during instruction (Çiftçi et al., 2007; Durakoğlu & Coşkun, 2019; Kahveci, 2020; Kurt & Demir, 2019). Therefore, this research aims to assess technology integration into textbooks, which are accepted as the basic materials for the science lesson.

When science lesson textbooks from 3rd to 8th grades were examined, the state of technology use can be assessed under three dimensions. In the first stage, it is found that among analysis units (*smart board, computer, informatics, digital, hardware, internet, social media, tablet, scanner, technology, telephone, television* and *software*) created for the research *technology, television, telephone* and *computer* concepts are the most used ones in texts or images in textbooks. This case shows similarity with the study of Maden et al., (2018), which was about 5th grade Turkish textbooks. On the other hand, this research shows similarity with the study of Altun and Bangir Alpan (2021), which was about science lesson textbooks in terms of the most frequently used concepts and also least used concepts (*smart board*, *hardware* and *tablet).* It is found that only *scanner* concept is not used at all in any grade. In addition, analysis units created for the research are used in textbook activities in 4th grade (3) times in primary school; in 6th grade (1) time, 7th grade (12) times and in 8th grades (3) times in secondary school in total. The analysis units are not used at all in 3rd grade in primary school and 5th grade in secondary school textbook activities. This case is not sufficient to make a comment about the use of technologic devices and processes in activities. Therefore, all the activities in the textbooks are handled one by one and examined in terms of technological relationship and inclusion of digital competence.

According to the research results, it is found that (4) activities in 3rd grade, (5) activities in 4th grade in primary school; (12) activities in 5th grade, (8) activities in 6th grade, (4) activities in 7th grade and (8) activities in 8th grade in secondary school are related to technology use in terms of technological knowledge and process use. As a result of this association, the activities found related to at most "*information* and *data literacy*" and "*communication* and *collaboration*" among the competences identified in the European Digital Competence Framework (DigComp: The European Digital Competence Framework, 2018). "*Digital content creation*" and "*problem solving*" competences are used less in activities. This case supports the study of Tezcan (2019), which founded that science lesson teachers were of the opinion that textbook activities used in secondary schools were insufficient in terms of applicability to digital information. But we should not overlook that the critical point is that textbooks are prepared in accordance with the curriculum.

In the study of Eren and Dökme (2021), it was found that in terms of digital competence, indirectly related learning outcomes were more prominent than directly related ones in the science lesson curriculum. When the study is also considered, the examination of the textbook in detail is found necessary. In this context, in addition to the examination of analysis units and activities, all of the images and texts in the textbooks are assessed in terms of technology relation. It is found that there are QR codes at the beginning of each unit in all of the examined textbooks as a current technological use. Also, it is seen that there are reading texts about scientists who have technological inventions. There are two different parts as lightning and sound technologies in the 4th grade, in primary school. In secondary school, there is a different part about technology and space studies in 7th grade. There are subjects about biotechnology and robot in 8th grade in secondary school.

As a result, when both this research and the other researches in literature are considered together, it is seen that technological devices such as *television, telephone* and *computer* which are used most in daily life are the most frequently used concepts in textbooks. This case can increase the students' motivation because the taught subjects are related to the daily life. On the other hand, due to the rapid growth of technology; *internet, social media, tablet, digital* and i*nformatics* concepts take much more place in our lives. So, the frequent use of these concepts in textbooks is important in terms of the development of digital competences. Activities in textbooks play an important role in providing the permanence of the learned subjects and they also make learning easy. Therefore, in accordance with both field research and expert opinions, it is suggested that analysis units created for this research should be used more in textbooks activities. In the examination within the context of this research, it is found that activities related to technology are limited and in these activities "*digital content creation*" and "*problem solving*" competences are not used enough. In accordance with the aim that students should be educated as information producers rather than receivers, they should all be provided with equal opportunities. Therefore, it is suggested that the number of technology-related activities should be increased. Also, technology use in textbooks shouldn't be limited to only QR code use. The integration of a wide range of activities stated in Electronic Educational Content: At a Glance (Ministry of National Education, 2022a) such as animation, simulation, video, infographic, digital game, augmented reality practices, artificial intelligence technology practices and online survey into textbook content in accordance with the principles identified in Electronic Educational Content Guide (Ministry of National Education,

2022b) which is issued by the Ministry of National Education will play an important role in the permanence of learning and students' motivation.

Ethic

Since the research is a document and literature review, it is not among the studies that require Ethics Committee Approval.

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This article was written with the joint contributions of both authors.

Conflict of Interest

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