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The comparison of math textbooks in Turkey and Singapore in terms of technology integration

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Abstract

This study aimed to compare the math textbooks for 5th – 8th grades in Turkey and Singapore in terms of their integration of educational technology. In this regard, the textbooks a) approved by Turkey's Ministry of Education, and b) Singapore's New Syllabus series of math were analyzed via document analysis method. For the analysis, this study drew on the framework developed by Sevimli and Kul (2015). Based on this framework, the contents were evaluated according to the type of educational technology, learning area and the integration of technology. As a result, it was observed that technology integration is quantitatively more in Singapore textbooks. However, this difference is largely due to the use of a calculator. However, the usage purpose of technological tools is similar in both countries. The distribution of technological tools according to learning areas has shown a more homogeneous structure in Singapore. The use of technological tools distribution in Turkey has focused on "numbers and operations" and "geometry and measurement" in the learning area. From this point of view, it is thought that the technology integration in the textbooks of both countries should be improved in terms of quality.

Keywords: Textbook comparison, Mathematics, Turkey, Singapore, technology integration

1. Introduction

1.1. Introduce the problem

Technological integration has failed to meet the expectations that it will help to overcome the problems in learning environments and increase the success of students; on the contrary, it has revealed the exact opposite. Many technological tools, computers in particular, are at the focus of orientation of the students with low school achievement towards non-teaching activities (Drijvers, 2016; OECD, 2015)). However, technology-related organizations expressed technological literacy as a must-have quality in today's world and emphasized that it should be the product of learning-teaching environments [International Educational Technology Association (ISTE, 2008)]. Official institutions in many countries, including the institutions in Turkey, define Information and Communication Technologies (ICT) as a component of every course curriculum. Further, these institutions put emphasis on the importance of integrating technological tools into courses while implementing the standards in curricula (MoNE, 2018;

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NCTM (2000). Considering the difficulties experienced by students in learning mathematics and the unsuccessful results obtained in international and national exams, it is significant to answer the questions of "Why cannot the expectations be met?" and "What is missing in technology integration?" (Wenglinsky, 1998).

Many countries, especially the Far East countries, which rank at the top in international exams such as the Trends in International Mathematics and Science Study (TIMMS) and the Programme for International Student Assessment (PISA), place emphasis on incorporating technology in learning environments in order to increase mathematics achievement and ensure the sustainability of this success (Koay, 2006; Lavicza, 2010; Severin & Capota, 2011; Sevimli & Kul, 2015). Despite this importance given and the efforts of many researchers, the gains from the integration of technology into mathematics education have remained below expectations (Geiger, Faragher, & Goos, 2010; Reed, Drijvers, & Kirschner, 2010). Studies on this show that the problem is related to how and for what purposes technology is used in mathematics education(Bray & Tangney, 2017). According to the PISA results, the effect of the quality of technology integration into curricula on student learning varies between (-16%) and (12%) (Denoël et al., 2017; Viberg, Grönlund, & Andersson, 2020). Accordingly, given the importance of where and why integration is performed rather than the implementation of integration, the misuse of integration may have negative impact on students' achievement.

The lack of success in integrating technology into learning environments is attributed to economic-physical, cognitive-affective, social-epistemological and pedagogical reasons (Lin & Yuan, 2013; Viberg et al., 2020). Effective integration of technology is attributed to pedagogical reasons and the way to ensure it is discussed in this regard. Implementing teaching technologies by blending them with appropriate pedagogy has the potential to provide integrity and context to overcome the difficulties in mathematics education (Hoyles, 2016). This present study seeks to help revealing this potential. The presentation of technology in a pedagogically appropriate manner supports students to learn mathematics by improving their skills such as critical thinking and problem solving (Viberg & Mavroudi, 2018).

While integrating technology into mathematics education, various difficulties may arise, such as the role of the teacher, the method used and the preparation of related-content (Bray & Tangney, 2017; Donnelly, McGarr, & O'Reilly, 2011). Another problem involves failing to appropriately incorporate technology integration in curricula and textbooks, which are reflectors of these curricula in practice (Bray & Tangney, 2017; Denoël et al., 2017). According to Drijvers (2015), the effort to integrate technology into mathematics education depends on three important factors: technology design, educational context, learning activities and tasks. Studies on integration of technology into mathematics education also focus on students and teachers along with the difficulties mentioned above (Sevimli & Kul, 2015). However, studies on the learning environment and the variables that affect this environment as well as educational contexts have remained on the periphery (Sevimli & Kul, 2015). Moreover, the lack of content that is suitable for the use of teachers in teaching environments and is prepared for rich technological integration may be one of the reasons for the limited use of technology in these environments (Lavicza, 2010). In this regard, it is important to explore how teaching contents are associated with instructional technologies as well as what information is presented to students in what manner.

Only increasing the use of technology and the number of technological tools in classrooms do not make success achievable. The success of technology implementation depends on the choice of tools (Means, 2008), and the nature of the tasks used, albeit to a certain extent (McCulloch, Hollebrands, Lee, Harrison, & Mutlu, 2018). If attention is not paid to the selection of technological tools and the quality of learning tasks, the use of technology may prevent the acquisition of problem solving and higher-order thinking skills rather than supporting learning. The use of technology for the sole purpose of practicing and repeating the procedures either fails to produce a successful result or results in a negative way.

Even though there are findings that prove the benefits of technology integration into mathematics learning, the effect size of these findings is low (Drijvers, 2016). Knowledge on how to effectively integrate information communication technologies (ICT) into learning-teaching environments in order to facilitate, support student learning and increase long-term retention of information is limited. To achieve the benefits of technology integration in mathematics education, external and internal needs from lecture planning to teacher training must be met properly. It is can be argued that physical infrastructure, as an external need, has reached a certain level thanks to the FATİH (Movement to Increase Opportunities and Technology) Project and EBA (Educational Informatics Network) (Baz, 2017; Dursun, Kirbas, & Yüksel, 2015) . However, internally, teachers and documents to guide teachers are deficient. The efforts of curricula to integrate technology are rather futile, especially when it comes to textbooks (Arslan & Ozpinar, 2009). As a result, teachers cannot find a way on what stage and how to bring technology to the learning environment. Textbooks provide significant guidance in shaping learning environments and determining the route of learning.

Textbooks are teaching tools inspected by state institutions following certain laws and criteria. These books, which must be designed based on the curriculum, determine the scope and order for education and training. According to the TIMMS reports, the use of textbooks as the main source is at 77%. While this rate is anywhere close to 99% in countries with high success, it varies between 81% to 91% in our country (Kandemir & Yildiz, 2019; Mullis, Martin, Foy, & Arora, 2012). Textbooks are a primary information source for planning what to teach for teachers who establish the relationship between the curriculum and the learning environment. One may look at the textbooks of a country and understand the learning-teaching environment it offers for its students (Sevimli & Kul, 2015).

The study of textbooks in relation to technology is still premature in Turkey; there are even less studies when mathematics education is involved. Arslan and Ozpinar (2009) as well as Sevimli and Kul (2015) examined textbooks in Turkey and concluded that the level of utilization from instructional technologies in Turkey is low. Erbas, Alacaci, and Bulut (2012) studied the textbooks in Turkey, the United States and Singapore, albeit without focusing on technology, and found out that the textbooks in the US differed from those in Turkey and Singapore in terms of the use of a calculator. A comparative study on technology integration into mathematics education will contribute to curricula, textbooks, teacher and student training. At the very least, such study will make it possible to reveal the differences that need to be made or studied.

Cross-country comparisons yield important data in the field of education as in many other fields. They contain suggestions that can be drawn not only for countries involved but also for other countries. Comparative studies make the education systems shaped by each country based on its own culture, understanding and experiences more objective and scientific. In this way, the similarities and differences between countries enrich educational practices, and comparison allows for translating this richness into theory and practice (Cramer & Browne, 1982; Keskin, 2018; Türkoglu, 1999). In comparative studies, many countries prefer to compare themselves with countries that rank high in international arena. Given its international success and availability of resources and its claim that they are ahead in terms of technological infrastructure and use (Ng, Teo, Yeo, Ho, & Teo, 2019), Singapore is included in this study.

Considering the failure of technological integration to meet the expectations in mathematics education, the insufficient efforts of Turkey in this regard, the current situation of Singapore, the use of textbooks as an important resource for cross-country comparisons, this study seeks to analyse the differences and similarities between the mathematics textbooks in Turkey and Singapore in relation to technological integration.

1.2. Research Problem

What are the differences and similarities between the mathematics textbooks in Turkey and Singapore in relation to technological integration?

Sub-Problems

Of the technological tools integrated to the textbooks in Turkey and Singapore,

1. How are they distributed by grade level?
2. How are they distributed by type?
3. How are they distributed by the purpose of use?
4. How are they distributed by learning area?
5. How are their different types distributed by grade level?
6. How are their different types distributed by the purpose of use?
7. How are their purpose of use distributed by grade level?
8. How are their different types distributed by learning area?

2. Method

This study drew on document analysis technique (Bowen, 2009), one of the qualitative analysis methods that allow for understanding and interpreting data in printed or digital materials through systematic examination and interpretation. Below, the textbooks used in the study, the data collection and analysis process, and the validity and reliability of the study are described.

2.1. Textbooks Used in The Study

The student ages and the content of mathematics education in both countries were compared; the secondary school mathematics curriculum for the 5th to 8th grades in Turkey was found to be equal to the curriculum for the 5th and the 6th grades at the primary school level and the 1st and 2nd grades at the secondary school level. Then, the textbooks examined in this study were identified. In this study, the mathematics textbooks for the 5th to 8th grades, prepared by the Turkey Ministry of Education, were included to represent Turkey. As for Singapore, the New Syllabus series, which are commonly used in Singapore and published by Shinglee Publishers, were included in this study. Table 1 presents the detailed information on the textbooks analysed.

Table 1. Textbooks Analysed in the Study

Grade level/Country	Turkey	Singapore
5th Grade	Middle School Mathematics Textbook 5., MoNE Publishing, 2019	New Syllabus Primary Mathematics 5A and New Syllabus Primary 5B, Shing Lee Publishers Pte Ltd., 2018
6th Grade	Middle School Mathematics Textbook 6., MoNE Publishing, 2019	New Syllabus Primary Mathematics 6A and New Syllabus Primary 6B, Shing Lee Publishers Pte Ltd., 2018
7th Grade	Middle School Mathematics Textbook 7., MoNE Publishing, 2019	New Syllabus Mathematics 1, Shing Lee Publishers Pte Ltd., 2018.
8th Grade	Middle School Mathematics Textbook 8., MoNE Publishing, 2019	New Syllabus Mathematics 2, Shing Lee Publishers Pte Ltd., 2018

2.2. Framework for data analysis and process

For the purpose of comparing the mathematics textbooks for the 5th to 8th grades in Turkey and Singapore in terms of the integration of technology, teaching content such as examples, activities, problems, projects in the textbooks were examined. For the analysis of these content, this study drew on the framework developed by Sevimli and Kul (2015). Based on this framework, the content was assessed according to the type of teaching technology, learning area and purpose in terms of the integration of technology. The framework of Sevimli and Kul (2015) discusses dynamic software, Internet, spreadsheet, calculator and projector tools under the title of type of technology. It also looks into computer aided programs such as dynamic geometry software, web-supported applications, internet research, excel applications under spreadsheets, electronic spreadsheets under the title of dynamic software.

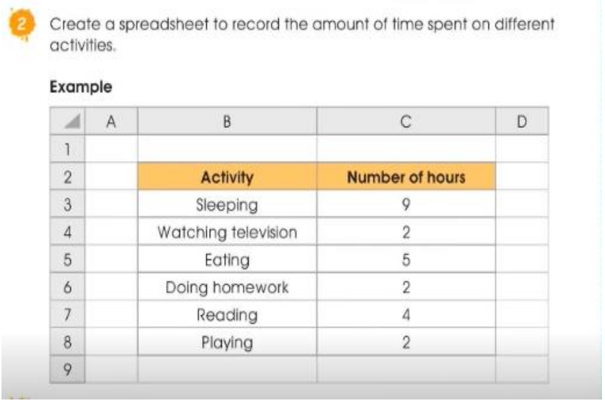
As for learning area, this study drew on the learning areas in the mathematics curriculum in Turkey. Accordingly, technology-integrated teaching contents was evaluated under five main learning areas: numbers and operations, algebra, geometry and measurement, data processing, and probability.

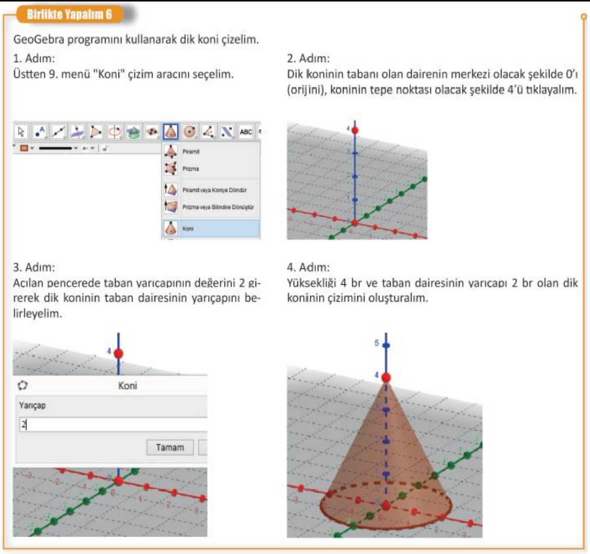
As for purpose of technology use, using technology to obtain information through Internet was analyzed under the category of “accessing information.” Also, using technology to display content with tools such as a projector and to create graphs and tables were respectively evaluated under the category of “presenting information” and “visualization.” Lastly, using it to calculate with calculator and to support students' calculating skills with tools such as dynamic geometry and calculator were respectively assessed under the category of “calculating” and “confirming.” Table 2 presents the analysis framework and Table 3 shows the details of a sample application of the analysis performed in the study.

Table 2. The framework for analysis used in relation to the integration of technology

Analysis Topics		Categories	
Technological Type	Tool	❖ Dynamic Software ❖ Internet ❖ Calculator	❖ Spreadsheet ❖ Projector
Learning Area		❖ Algebra ❖ Geometry and Measurement ❖ Numbers and Operations	❖ Probability ❖ Data processing
Purpose of Use		❖ Accessing information ❖ Presenting information ❖ Calculation ❖ İnformation	❖ Visualization ❖ Association ❖ Confirming ❖ Exploring

Table 3. Sample application of the analysis of the learning content in the textbooks

<table>
<tr><th>Learning Content</th><th>Technological Tool Type</th><th>Learning Area</th><th>Purpose of Use</th></tr>
<tr><td>


Singapore 6B, page 85</td><td>Spreadsheet</td><td>Data processing</td><td>Visualization</td></tr>
<tr><td>


Turkey 8th grade, page 219</td><td>Dynamic Software</td><td>Geometry and Measurement</td><td>Confirming</td></tr>
</table>

2.3. Validity and Reliability

The mathematics textbooks in Turkey, which were analysed in this study, were accessed through one of the official web-sites of the Ministry of Education via https://eba.gov.tr/arama?q=Matematik%206. The Turkish textbooks included in this study were first used in the 2019-2020 academic year. The textbooks in Singapore were accessed via https://www.shinglee.com.sg/. In Singapore, the mathematics textbooks for the 5th graders and the 6th graders were first used in 2008 and 2009, respectively. The textbooks for the 7th graders (New Syllabus 1) and the 8th graders (New Syllabus 2) were printed in 1982 and reprinted in 2018. The Ministry of Education of Singapore has approved these textbooks for use.

3. Findings

The Findings section presents the findings of this present study which compares the mathematics textbooks in Turkey and Singapore in terms of the integration of technology. Table 4 outlines the findings. This table is given in sections below.

Table 4. Overview of the integration of technology in the textbooks in Singapore and Turkey

	Learning Area	Numbers and Operations				Algebra				Geometry and Measurement				Data processing				Probability			
Purpose of Use	Country/Grade	5	6	7	8	5	6	7	8	5	6	7	8	5	6	7	8	5	6	7	8
Calculation	TR	C(2)	C(1)	C(4)	C(1)	-	-	-	-	-	-	-	D(1) C(7)	-	-	S(1)	-	-	-	-	-
	SGP	C(24)	C(44)	C(5)	-	-	-	D(1)	-	C(5)	C(58)	-	-	-	C(3)	-	-	-	-	-	S(1)
Accessing information	TR	-	İ(7)	-	İ(9)	-	İ(2)	-	İ(6)	-	İ(3)	-	İ(14)	-	-	-	İ(3)	-	-	-	İ(2)
	SGP	İ(4)	-	İ(8)	-	-	-	İ(6)	İ(1)	-	-	İ(4)	İ(3)	-	-	İ(1)	İ(1)	-	-	-	İ(2)
Confirming	TR	C(3)	-	-	-		-	-	-	D(1)	-	-	-	-	-	-	-	-	-	-	-
	SGP	C(13)	C(2)	C(7)	-	-	-	D(4) C(1)	-	-	-	-	-	-	-	-	-	-	-	-	-
Exploring	TR	C(1)	-	-	-			-	-	D(1)	D(1)	D(2)	D(5)	-	-	-	-	-	-	-	-
	SGP	-	-	C(1)	-	-	-	-	D(1)	-	-	D(2)	-	-	-	-	-	-	-	-	-
Presenting information	TR	-	-	-	P(1)	-	-	-	P(1)	-	-	-	P(6)	-	-	-	-	-	-	-	-
	SGP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Association	TR	-	-	-	-			-	-	-	-	-	-		-	-	-	-	-	-	-
	SGP	-	-	-	-	-	-	-	-	-	-	D(1)	D(1)	-	-	-	-	-	-	-	-
Visualization	TR	-	C(1)	-	-	-	-	-	-	-	-	D(1)	D(10)	S(1)	-	S(1)	-	-	-	-	-
	SGP			D(2)				S(1)	D(7)			D(5)	D(1)	S(1)							

Calculator: C, Dynamic Software: D, Internet: I, Projector: P, Spreadsheet: S

3.1. Comparison of technological tools in the textbooks by grade level

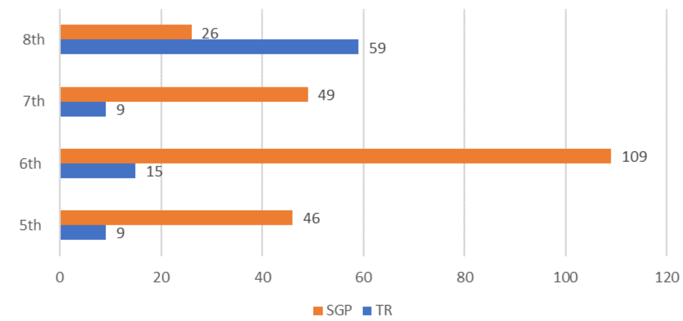


Figure 1. Distribution of Technological Tools Used in the Math Textbooks in Singapore and Turkey by Grade Level

The graph in Figure 1 shows the comparison of the technological tools used in the mathematics textbooks in Turkey and Singapore by grade level. It is notable that the technological tools in the textbooks for the 5th, 6th and 7th graders in Singapore were much more than those in the textbooks in Turkey. Further, a higher number of technological tools was integrated to the mathematics textbooks for the 8th graders in Turkey compared to those in Singapore. While, in Turkey, the highest number of technological tools were integrated to the math textbooks for the 8th graders, the textbooks for the 6th graders in Singapore featured the highest number of technological tools.

3.2. Comparison of technological tools in the textbooks by type

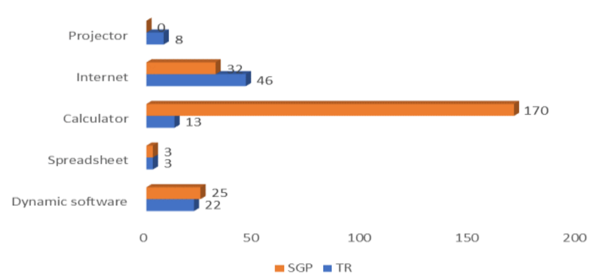


Figure 2. Distribution of technological tools used in the math textbooks in Singapore and Turkey by technological tools type

The graph in Figure 2 shows the comparison of the technological tools used in the mathematics textbooks in Turkey and Singapore by type. It is remarkable that whilst the most commonly used tool in the mathematics textbooks in Singapore was calculator, it was Internet for Turkey. The use of calculator and dynamic software in the textbooks in Singapore was higher relative to Turkey. On the other hand, the use of projector and Internet was higher in Turkey. It is also notable that no projector was used in the textbooks in Singapore, the least common tool in the textbooks in Turkey was spreadsheet.

3.3. Comparison of technological tools in the textbooks by the purpose of use

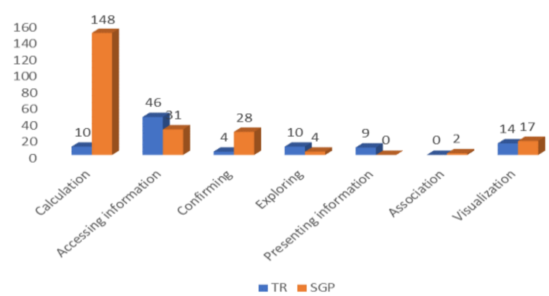


Figure 3. Distribution of technological tools used in the math textbooks in Singapore and Turkey by the purpose of use

The graph in Figure 3 shows the comparison of the technological tools used in the mathematics textbooks in Turkey and Singapore by the purpose of use. It is notable that the technological tools in the textbooks were most used for calculation, followed by accessing information and confirming. While the technological tools in the mathematics textbooks in Singapore were most used for calculation, most of the tools in the textbooks in Turkey were used for accessing information. In general, the tools in the textbooks in Singapore were most used for calculation, confirming, association and visualization; on the other hand, the tools in the textbooks in Turkey were most used for accessing information, exploring and presenting information.

3.4. Comparison of technological tools in the textbooks by learning area

The graph in Figure 4 below shows the comparison of the technological tools used in the mathematics textbooks in Turkey and Singapore by learning area.

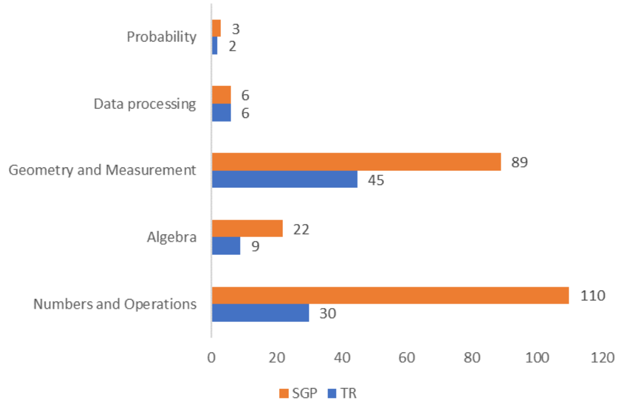


Figure 4. Distribution of technological tools used in the math textbooks in Singapore and Turkey by learning area

It is notable that the technological tools were most used for the learning areas of numbers and operations, followed by the areas of geometry and measurement in general. Also, the technological tools in the textbooks in Singapore were used most for the learning areas of numbers and operations and least for the learning area of probability; on the other hand, the tools in the textbooks in Turkey were used most for the learning areas of geometry and measurement and least for the learning area of probability. Further, the textbooks in Singapore benefited from more technological tools in almost all of the learning areas.

3.5. Comparison of the type of technological tools in the textbooks by grade level

Table 5. Distribution of the technological tools used in mathematics textbooks in Singapore and Turkey by grade level and type

Grade/Type	Dynamic Software		Spreadsheet		Calculator		Internet		Projector		Total
	TR	SGP	TR	SGP	TR	SGP	TR	SGP	TR	SGP	
5th	2	0	1	0	6	42	0	4	0	0	55
6th	1	0	0	1	2	107	12	1	0	0	124
7th	3	15	2	1	4	14	0	19	0	0	58
8th	16	10	0	1	1	7	34	8	8	0	85
Total	22	25	3	3	13	170	46	32	8	0	322

The graph in Figure 5 shows the comparison of the technological tools used in the mathematics textbooks in Turkey and Singapore by grade level and type. It is notable that dynamic software was most used in Turkey in the textbooks for the 8th graders and in Singapore in the textbooks for the 7th graders. Spreadsheets were equally used in the textbooks in Turkey and Singapore; on the other hand, calculator was much more used in the textbooks in Singapore, compared to Turkey. Also, in Singapore, calculator was used most in the textbooks for the 6th graders and least in the textbooks for the 8th graders. By contrast, in Turkey, it was used most in the textbooks for the 5th graders and least in the textbooks for the 8th graders. Also the Internet, was used less in Singapore compared. Singapore and Turkey most used Internet in the textbooks for the 7th graders and in the textbooks for the 8th graders, respectively. While projection was not used in any activity in Singapore, it was included in the textbooks of the 8th graders in Turkey.

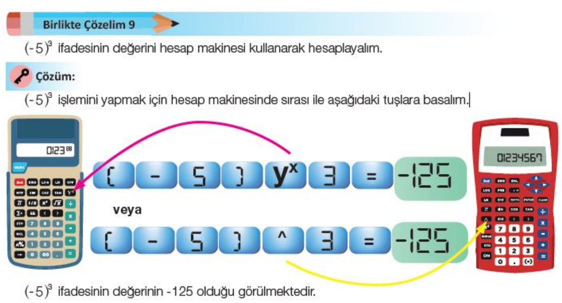


Figure 5. A Sample Use of Calculator in the 7th grade in Turkey

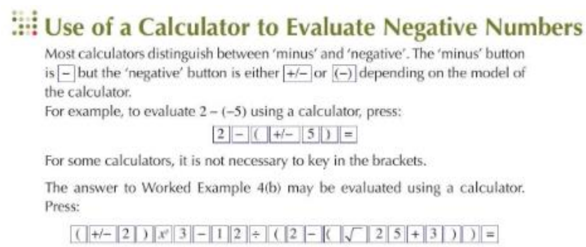


Figure 6. A Sample Use of Calculator in the 7th grade in Singapore

3.6. Comparison of the type of technological tools in the textbooks by the purpose of use

Table 6. Distribution of the technological tools used in mathematics textbooks in Singapore and Turkey by the purpose of use and type

	Dynamic Software		Spreadsheet		Calculator		Internet		Projector		Total
	TR	SGP	TR	SGP	TR	SGP	TR	SGP	TR	SGP	
Calculation	1	1	1	1	8	146	0	0	0	0	158
Accessing Information	0	0	0	0	0	0	46	31	0	0	77
Confirming	1	4	0	0	3	23	0	1	0	0	32
Exploring	9	3	0	0	1	1	0	0	0	0	14
Presenting Information	0	0	0	0	0	0	0	0	8	0	8
Association	0	2	0	0	0	0	0	0	0	0	2
Visualization	11	15	2	2	1	0	0	0	0	0	31
Total	22	25	3	3	13	170	46	32	8	0	322

The graph in Figure 5 shows the comparison of the technological tools used in the mathematics textbooks in Turkey and Singapore by grade level and type. It is notable that dynamic software was most used in Turkey in the textbooks for the 8th graders and in Singapore in the textbooks for the 7th graders. Spreadsheets were equally used in the textbooks in Turkey and Singapore; on the other hand, calculator was much more used in the textbooks in Singapore, compared to Turkey. Also, in Singapore, calculator was used most in the textbooks for the 6th graders and least in the textbooks for the 8th graders. By contrast, in Turkey, it was used most in the textbooks for the 5th graders and least in the textbooks for the 8th graders. Another technological tool, Internet, was less used in Singapore compared to Turkey. Singapore and Turkey most used Internet in the textbooks for the 7th graders and in the textbooks for the 8th graders, respectively. While projection was not used in any activity in the textbooks in Singapore, it was included only in the textbooks for the 8th graders in Turkey.

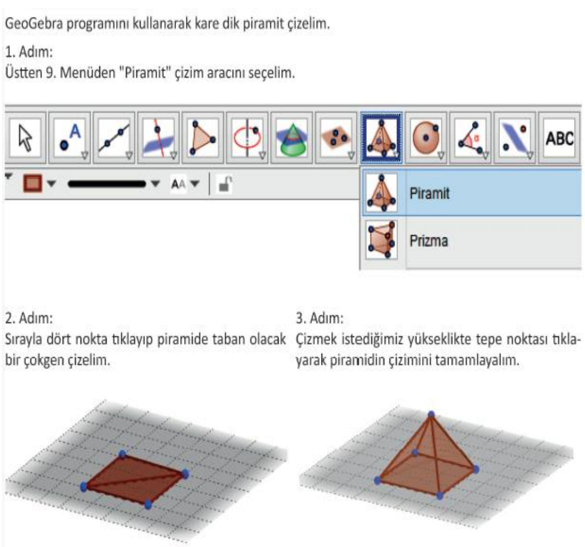


Figure 7. Dynamic Software - Visualization in the Textbooks for the 8th graders in Turkey

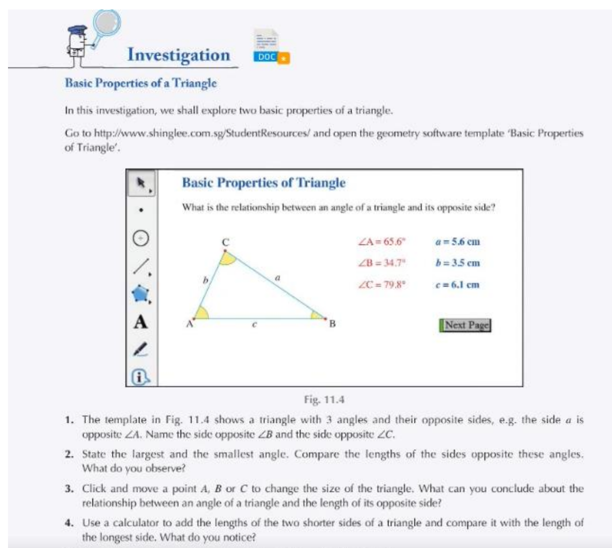


Figure 8. A Sample Use of Dynamic Software for the 7th graders in Singapore – Visualization

3.7. Comparison of the purpose of use of technological tools in the textbooks by grade level

Table 7. Distribution of the technological tools used in mathematics textbooks in Singapore and Turkey by the purpose of use and grade level

Grade Level		Calculation	Accessşng information	Confirming	Exploring	Presenting information	Association	Visualization	Total
5th	TR	2	0	4	2	0	0	1	9
	SGP	29	4	13	0	0	0	0	46
6th	TR	1	12	0	1	0	0	1	15
	SGP	105	1	2	0	0	0	1	109
7th	TR	5	0	0	2	0	0	2	9
	SGP	6	19	12	3	0	1	8	49
8th	TR	2	34	0	5	8	0	10	59
	SGP	8	7	1	1	0	1	8	26
Total		158	77	32	14	8	2	31	278

Table 7 shows the comparison of the technological tools used in the mathematics textbooks in Turkey and Singapore by grade level and the purpose of use. The technological tools in the math textbooks for the 5th graders were most used for confirmation in Turkey and for calculation in Singapore. Further, these tools in the textbooks for the 6th graders were most used for accessing information in Turkey and for calculation in Singapore. As for the 7th graders, these tools were mostly benefited for calculation in Turkey and for accessing information in Singapore. The textbooks for the 8th graders in Turkey utilized these tools for accessing information, visualization, presenting information, exploration and calculation, respectively. On the contrary, the textbooks for the 8th graders in Singapore used these tools mostly for calculation and visualization, followed by accessing information, confirmation, exploration and association.

Bunu Deneyelim **Hangisi Kolay?**

Araç - Gereç: *kâğıt, kalem, hesap makinesi, saat*

- Bir arkadaşınızdan iki basamaklı iki sayı söylemesini isteyiniz ve bu sayıları farklı yöntemlerle en kısa sürede zihinden toplamaya çalışınız.
- Kullandığınız yöntemlere göre işlem sürenizi ve sonucunuzu bir kâğıda not ediniz.
- Arkadaşınızdan işlem sonucunuzu hesap makinesi ile kontrol etmesini isteyiniz.
- Arkadaşınızdan iki basamaklı iki sayı söylemesini isteyiniz ve farklı yöntemlerle bu sayılardan küçük olanı büyük olandan en kısa sürede zihinden çıkarmaya çalışınız.
- Kullandığınız yöntemlere göre işlem sürenizi ve sonucunuzu bir kâğıda not ediniz.
- Arkadaşınızdan işlem sonucunuzu hesap makinesi ile kontrol etmesini isteyiniz.

➤ Kullandığınız yöntemleri arkadaşlarınıza anlatınız. Hangi yöntemi kullanarak işlemi daha kısa sürede yaptınız?

➤ Sizce en kısa ve kolay yoldan zihinden toplama ve çıkarma işlemlerini yapmayı sağlayan işlem stratejisi nedir?

Figure 9. Use of the Technological Tool in the Textbooks for the 5th graders in Turkey for Confirmation

Subtract.

(a) $3\frac{1}{4} - 2$ (b) $4 - 1\frac{1}{7}$

(c) $3\frac{2}{5} - 1\frac{4}{5}$ (d) $2\frac{5}{6} - 1\frac{11}{12}$

(e) $2\frac{1}{4} - 1\frac{1}{2}$ (f) $4\frac{1}{2} - 2\frac{5}{8}$

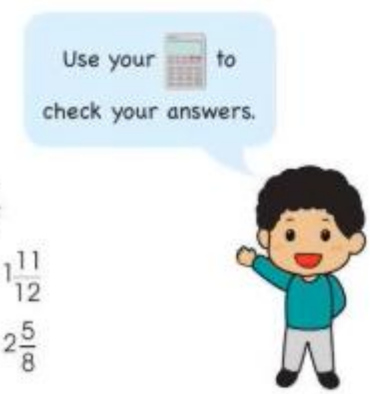


Figure 10. Use of the Technological Tool in the Textbooks for the 5th graders in Singapore for Confirmation

3.8. Comparison of the type of technological tools in the textbooks by learning area

Table 8. Distribution of the type of technological tools in the textbooks in Singapore and Turkey by learning area

		Dynamic Software	Spreadsheet	Calculator	Internet	Projector	Total
Numbers and operations	TR	0	0	13	16	1	30
	SGP	2	0	96	12	0	110
Algebra	TR	0	0	0	8	1	9
	SGP	13	1	1	7	0	22
Geometry and Measurement	TR	22	0	0	17	6	45
	SGP	10	0	70	9	0	89
Data Processing	TR	0	3	0	3	0	6
	SGP	0	1	3	2	0	6
Probability	TR	0	0	0	2	0	2
	SGP	0	1	0	2	0	3
Total		47	6	183	78	8	322

Table 8 presents the comparison of the type of technological tools in the mathematics textbooks in Singapore and Turkey by learning area. It is notable that dynamic software in the textbooks in Turkey were most used for the learning areas of geometry and measurement whereas they were most used for algebra in Singapore. Spreadsheets were most used for data processing in Turkey; on the other hand, they were equally presented in the learning areas of algebra, data processing and probability in the textbooks in Singapore. Calculators were most used for the learning areas of numbers and operations in both countries. Calculators were not used in any other learning area except these two areas in the textbooks in Turkey. They were used in the learning areas of algebra, geometry and measurement and data processing in the textbooks in Singapore. In the textbooks in both countries, Internet was most used for the learning areas of geometry and measurement, followed by numbers and operations. Projection, the last technological tool, was used for the learning areas of geometry and measurement in Turkey whereas it was not used in the math textbooks in Singapore.

4. Discussion and Conclusion

The findings of this study, which compares the mathematics textbooks in Turkey and Singapore in terms of the integration of technology, indicated that the integration of technology in the textbooks in Singapore was two times more compared to Turkey. This means that although Turkey has recently focused on technology-supported education through national-level projects (FATİH and EBA), it failed to keep up with Singapore which ranks high in international exams such as PISA and TIMSS when it comes to the quantitative use of technological tools in textbooks. The higher use of technological tools in the textbooks in Singapore may be due to the fact that Singapore realized the importance of technology in education and started to benefit from it before Turkey (Baz, 2017; Dursun et al., 2015; Seng & Ivy, 2006) or/and that Turkey has been lagging behind in making the learning content in the Turkish textbooks compatible with technology. One of the technological tools in Singapore, scientific calculators, have been used in secondary schools since 1981 and in primary schools since 2009, which proves that Singapore encouraged the integration of technology in schools way before than Turkey (Koay, 2006). Moreover, although technological tools in the textbooks in Turkey were less used compared to Singapore, there has been an increase in the use of technological tools in the textbooks in Turkey itself, relative to the previous years. Indeed, Sevimli and Kul (2015) examined the integration of technology in the secondary school mathematics textbooks in Turkey and found out that overall a total of 28 technological tools were used in all books; it is remarkable that this number increased to 92 today. Also, Internet and dynamic software were used more compared to other tools in the mathematics textbooks in Turkey. As for Singapore, calculator was the most used tool. In fact, the major cause of the quantitative difference between Turkey and Singapore was calculator. Another important finding is that whilst Singapore featured calculator and dynamic software more than Turkey, Turkey included projection and Internet more than Singapore. The less use of calculators in the mathematics textbooks in Turkey may be due to the assumption that working with calculators adversely affects students' skills regarding sense of number, estimation, and calculation (Lin & Yuan, 2013; Scott, 1994; Sevimli & Kul, 2015; Upshaw, 1994; Wright, 2010). Calculators, which were first used in the 1970s to facilitate four modes of operations in mathematics at school (Raines & Clark, 2011) are today used for various purposes. In Singapore, on the other hand, calculators are used in solving some practice questions in all the books examined in helping students confirm their own solutions based on the conception that calculators can be used as teaching aids at all levels of education (NCTM, 2000). However, in Singapore, relative to confirmation, calculators are used more for calculation purposes and across learning areas. From this standpoint, the use of calculators in the textbooks in Singapore may be related to the reflection that calculating with a calculator saves time which can be later used by students to participate in exploratory activities to improve their mathematical thinking skills (Sevimli & Kul, 2015).

If we consider the types of the technological tools in the textbooks in both countries, when calculators are ignored, the total number of the tools is close to each other. Though both countries had similar number of the technological tools in their textbooks, when we considered the type of the technological tools used by grade level, in one year, it was

Turkey which was leading; in the other year, it was Singapore. This may be due to the quality of the gain in the curricula of the countries as well as due to the difference in the transition from primary to secondary schools in the school systems of these countries (Karabork, Yilmaz, & Durmus, 2017).

Based on the findings of the analysis on the purpose of the technological teaching content in the mathematics textbooks, it is remarkable that Internet was most used in Turkey for accessing information and calculators were most used in Singapore for calculating. Turkey started to benefit from 2D barcodes in the textbooks to access information, facilitating the access to content such as images, video and lectures on the related subject. This study also revealed that dynamic geometry applications were used in Turkey for the visual presentation of information and exploration whereas calculators were used in Singapore for confirmation.

If we consider the purpose of use of the technological tools in the textbooks in both countries, when calculators are ignored, the countries overall benefited from same technologies for similar purposes. From the same standpoint, when we considered the purpose of use of the technological tools by grade level, the countries were interchangeably leading; that is, in one year, it was Turkey which was leading and in the other year, it was Singapore. This is in line with the finding that similar technologies are used for similar purposes but there are grade-level differences because of content or the system. While Singapore did not perform any integration for presenting information, Turkey focused on this purpose particularly for the 8th graders. This may be due to the fact that the problems at this grade level are complex (Artut & Ildiri, 2013; Ozmantar, Dapgin, Cirak Kurt, & Ilgün, 2017).Yet, Singapore remarkably did not carry out any integration for such purpose. Also, no integration in Turkey aimed at association; however, Singapore used dynamic software once each for the 7th and 8th graders for this purpose. The use for the purpose of presenting information was low, which is positive for both countries. On the other hand, there was no integration aimed at association, which appears to be an important drawback (Blackmore, 2019; Bray & Tangney, 2017; Getenet, 2017; Kulik, 2003). The OECD reports on integration ranked Singapore just below the average, but Turkey is in the lower ranks (OECD, 2015). Overall, the findings show that Singapore is in a better position than Turkey, but it only achieves an average level of integration at the worldwide level. The reason may be that Singapore does not include high-level purposes and it rather highlights other purposes such as calculation and confirmation. Moreover, given that these highlighted purposes are rather less embraced in the learning areas of data analysis and probability, another reason for this may be that Singapore fails to integrate technology in all learning areas.

As for learning areas, more technological tools were used in Singapore in the learning areas of operations and numbers and in Turkey in the areas of geometry and measurement. Turkey more drew on dynamic geometry software in the learning areas of geometry and measurement and thus aimed to enable students to learn information visually and concretely. Dynamic software were used in both countries in the areas of geometry and measurement, but Singapore benefited from dynamic software in the areas of numbers and operations as well as algebra besides these areas. Similarly, in Turkey, spreadsheets were only used for data processing and calculators were merely used for the areas of numbers and operations. Yet, Singapore used spreadsheets for the learning areas of algebra, data processing and probability and calculators for the areas of numbers and operations, geometry and calculation as well as data processing. That is, technological tools were integrated to a greater variety of learning areas in Singapore, relative to Turkey. This could be a useful reference for Singaporean teachers who are faced with the challenge of selecting suitable learning technologies, teaching models and strategies to attract students' attention and encourage their active participation in the lesson (Radović, Radojičić, Veljković, & Marić, 2020). These being said, it can be argued that Singapore's more frequent and diverse use of tools in learning areas allowed the country to be ahead of Turkey, but this achievement still could not prevent Singapore from falling behind other countries due to the limited use of purpose and distribution of technological tools at certain respects (OECD, 2015). On the other side, disregarding the quantitative differences between the use of the technological tools in both countries, Turkey is similar to Singapore in terms of the type of tool, the purpose of use and learning area. It follows that the resulting differences vary depending on grade level. A quantitative increase in the use of tools, albeit for same purposes, would be helpful for Turkey. The inadequate number of textbooks appears to be in contradiction with the fact that Turkey has a decent physical infrastructure. The limited use of technology in the textbooks in Turkey may be due to that more attention is given to the negative cases of the use of technological tools in educational settings relative to the positive cases. In this sense, this study suggests that those who design these textbooks need to distribute technological tools more homogeneously by considering learning areas and learning objectives and to render these tools to enable students to improve their higher-order thinking skills. Taking into account the differences and similarities in the integration of technology in the textbooks in Turkey and Singapore, one may realize that the difference in success between these two countries in international comparisons cannot be attributed only to technology. Consequently, examining the integration of technology with other factors will potentially help identifying the reasons for the difference in success between countries.

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