



Review Article

The PISA Results in Mathematics and Science: A comparison between Israel and Turkey

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Abstract

Comparing the PISA 2012 achievements of Turkey and Israel in Mathematics and science has been an intriguing challenge. Israel was one of the first 12 countries taking part in the first International Mathematics assessment: The TIMSS 1995/4; it had the best achievements both in grade 4 and 8 (ibid). Turkey started participating in International evaluations only in 1999. Since the 1995/4 first international examinations, the Israeli situation has changed substantially by the 80ies, and not in any desirable direction. Turkey, on the other hand, has demonstrated a gradual, constant improvement in the PISA achievements – both in mathematics and science. In this study a brief comparison between these two countries will be presented regarding the achievement in the first decade of the 21st century. This article consists of three main parts: Why comparing Israel and Turkey?, Achievements comparisons between Israel and Turkey, and Why are the Israeli PISA 2012 results actually lower than reported.

Key words

PISA, TIMSS, gifted young scientists, science and mathematics education

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INTRODUCTION

Why comparing Israel and Turkey?

The main two reasons for comparing the international achievements of turkey and Israel are:

- Both countries belong to the same geographical area. Turkey is located both in Asia and Europe; Israel is located in Asia but a large part of its population is European and its culture is a mixture of West and East.

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- Both Israel and Turkey are Middle Eastern non-Arabic countries; all countries with whom Israel has a common border are Arabic (Egypt, Jordan, Syria and Lebanon); Turkey has a common border with Iraq and Syria.

In addition to these reasons a few more reasons for making this comparison should be mentioned.

- Turkish and Jews have well documented common history. There is evidence of Jewish community in Smirna, the old Izmir, dating back in the 2nd century BC (Virtual Jewish World, Izmir, Turkey, 2015). Sardis is believed to have gained its Jewish community in the 3rd century BC, as that was when King Antiochus III (223-187 BCE) encouraged Jews from various countries, including Babylonia, to move to Sardis. The synagogue of Sardis is a most impressive evidence of this period. The first references of Jews living in Lydia (part of Anatolia, close to Izmir), can be found in Flavius (2013 [93/94 AD]). After the area became a part of the Ottoman Empire in 1424, many Jews started settling in Ottoman cities (Ghiuzeli, 2015). According to the Jewish Virtual World (2015):

Two Ottoman Sultans extended invitations to the Jews persecuted in Western Europe, mostly from Spain and Portugal – from Muhammad II in the mid-15th century and from Bayazid II in 1492, during the time of the Spanish Expulsion.

Since the 15th century the Jewish community had been an integral part of Ottoman as well as of Modern Turkey (Ghiuzeli, 2015).

- Turkey started negotiating towards being a part of the European Commission it in 2005; Israel started this process in 2000 (EURO-MEDITERRANEAN AGREEMENT, 2000). In 2015 both countries have not been an integral parts of the European Commission.
- Growth Domestic Product (GDP). The Gross Domestic Product (GDP) in Israel expanded 2.60 percent in 2014. In Turkey the GDP was but 1.8% in 2014, but it is expected to raise to 2.3% in 2015 and to 2.6% in 2016 (OECD Report, November 2014). These numbers are substantially higher than in the EU countries (European Economic Forecast, Winter 2014).
- The population median age: both Turkey and Israel have comparatively young populations. According to Genç (2014), the median age in Turkey has been 30.4 in 2014. In Israel it has been 29.9 (CIA World Factbook, 2015). Apart from the similarity among these two countries, it should be noted that both in Israel and in Turkey the median age is well below that of their geographical neighbors, and certainly below the European median age (ibid).
- Compulsory education: Up to age 18. Both in Israel and in Turkey the law of compulsory education in until the end of high school (The law of compulsory education, 2007; Seda & Erkan, 2013). In the table: “Student's age-groups and duration of compulsory education, 2014/15” including 42 countries, the only countries with compulsory full-time education/schooling of 12 [or 13] years are Luxemburg, Portugal, Northern Ireland, and Turkey (Compulsory Education in Europe 2014/15, 2015). Of these 4 countries, only in 2 – Portugal and Turkey – the ending age of school is 18 (ibid), as in the other two compulsory education starts at age 4 and includes two years of kindergarten and only 10 years of formal school. In Israeli compulsory full-time education/schooling is currently of 13 years (The law of compulsory education, 2007), but it will be 15 starting from the 2015/16 school year (Compulsory education from age 3, 2015).

Thus it can be concluded, that a comparison between the mathematics and science achievements of Turkey and Israel is of interest because of the similarity between them in three important aspects: Growth Domestic Product (GDP), their comparatively young populations and the educational system with compulsory education up to age 18. Unlike other studies, comparing the TIMSS achievement of Turkey with those of the US (Incikabi et al., 2012) or with those of Singapore (Seda & Erkan, 2013), without a firm base – geographical, political or cultural – a comparison between Israel and Turkey, who had similar achievement in the TIMSS 2012 math and science examinations might be quite fruitful.

Method of Comparison

In order to compare the attainment of Turkey and Israel in the PISA examinations I have used a double-comparison approach: 1. using the published data from the 3 PISA examinations that included both Turkey and Israel, comparing the mathematics and science results to the international means and the place Turkey and Israel reached with regards of the number of participants on that examination; 2. Showing only the Turkish and Israeli results in the 3 relevant examinations in a new table and discussing their meaning. The final stage would be adding special circumstances

Comparison of the Results: Israel and Turkey

Israel and Turkey participated in 4 of the 5 PISA assessments: both participated in 2006, 2009 and 2012. In addition, Israel took part in the 2000 assessment; Turkey – in the 2003 one (Participation in PISA by Year, 2012). Since 1963/4, when Israel soared at the top of the international examinations in Mathematics and science (Husen 1968), the level of learning these subjects had deteriorated rapidly. However:

The publication of the 1999 TIMSS sample results had placed Israel among the third world countries regarding math and science achievements. [...] Israel scored similar to its geographical neighbors and other under-developed countries, at the last third of the attainment table (David, 2008, p. 105).

As already analyzed:

While in 1963 /4 Israel had the best achievements of 12 developed countries in math both in grade 4 and 8 (Husen, 1967), the situation changed substantially in the 80s. Lewy's (1990) analysis of the results of the 1980/1 International study in math show, that out of 11 subjects examined, Israel's results placed her in the last quarter in 2, in the third in 4, and in the second in the remaining 5. There was not even one subject where Israel got into the upper 25%. The results did not reach the mean international achievements in about 70% of the items (ibid).

Taking into consideration that “The correlation between PISA and TIMSS country mean scores is 0.84, [...]” (Wu, 2010, p. 52), it should have been but expected that in PISA 2000 Israel scored 433 in the “Multiple comparisons of mean performance on the mathematical literacy scale” (OECD PISA database, 2003, p. 100) and 434 in the “Multiple comparisons of mean performance on the scientific literacy scale” (ibid, p. 109).

As Turkey participated for the first time in the PISA 2003 and Israel did not participated in the PISA of that year it is possible to compare only between the Israeli 2000 results and those of Turkey 3 years later. In 2003 Turkey scored 423 in the mathematics examinations (34th of the 40 participants), just 10 points lower than those of Israel in 2000 (OECD 2004, p. 57) and 434 in science (no. 35 of the 40 participants) – exactly like Israel 3 years earlier (ibid, p. 59).

Let us see the actual comparisons in the achievements of 15-year old students in Israel and in Turkey in the three PISA international examinations they both took part.

Let us look at the PISA 2006, 2009, and 2012 results.

The first PISA examinations taken both by Israel and Turkey were in **2006**. In the PISA 2006 Israel scored 442 in **mathematics** and Turkey – 424: The OECD average was 498 (Baldi et al., 2007). In the PISA 2006 Israel scored 454 in **science** and Turkey – 424: The OECD average was 500 (ibid). In these examinations the gap between the results – both in mathematics and science – was significant, favoring Israel. The second PISA examinations taken both by Israel and Turkey were in **2009**. In the PISA 2009 Israel scored 447 in math and Turkey – 445: The OECD average was 496 (OECD, December 2010); In the PISA 2009 Israel scored 455 in science and Turkey – 454: The OECD average was 501 (ibid).

Unlike in 2006, when the Turkish and Israeli results showed a large gap favoring Israel, the math and science results of Israel and Turkey in PISA 2009 were almost identical. The tendency towards closing the gap was mainly due to the advancement Turkey had made: Israel's achievements in math improved slightly, but in Turkey both the math and the science achievements improved substantially: math – by 25 points and science – by 30 points.

The third PISA examinations taken both by Israel and Turkey were in **2012**. In the PISA 2012 Israel scored 466 in math and Turkey – 448: The OECD average was 494 (OECD, December 2014); In the PISA 2012 Israel scored 470 in science and Turkey – 448: The OECD average was 501 (ibid).

In 2012 a gap favoring Israel opened between the achievements of Israel and Turkey. While turkey scored in math 46 below the international average, Israel scored just 28; while Turkey scored 53 points below the international average in science Israel scored only 31 below it.

Here is table 1 summarizing the achievements of Israel and Turkey in the 2006, 2009 and 2012 PISA examinations.

Table 1. The achievements of Israel and Turkey in the 2006, 2009 and 2012 PISA examinations

	2006			2009			2012		
	Israel	Turkey	Inter-national	Israel	Turkey	Inter-national	Israel	Turkey	Inter-national
Mean score: math	442	424	498	447	445	496	466	448	494
Difference from the international average: math	56	74		49	51		28	46	
Mean score: science	454	424	500	455	454	501	470	448	501
Difference from the international average: science	46	76		46	47		31	53	

As we can very well see, while in Turkey the main improvement in the PISA results was between 2006 and 2009, and since then it has maintained – more or less – the same achievement level, in Israel there has been no improvement from 2006 to 2009, but a huge one from 2009 and 2012. As the TIMSS examinations have showed by no means any improvement, and the high correlation between the PISA and the TIMSS results, further investigation is needed into this inconsistency.

DISCUSSION

The OECD report also “praises Brazil, Chile, Germany, Israel, Italy, Mexico, Poland, Portugal, Tunisia and Turkey who it claims have “shown a consistent improvement” over time in maths performance (Sedghi et al., 2013).

Indeed, there has been improvement from the PISA 2009 both in Turkey and in Israel. The report says:

The relationship suggests that 21% of the variation in countries' mean scores can be predicted on the basis of their per capita GDP (12% of the variation in OECD countries). Countries with higher national incomes are thus at a relative advantage, even if the chart provides no indications about the causal nature of this relationship.

This should be taken into account particularly when interpreting the performance of countries with comparatively low levels of national income, such as Viet Nam and Indonesia (Mexico and Turkey among OECD countries) (ibid).

However, there have been major faults in the Israeli sample, and thus the Israeli supposedly improvement should be regarded quite suspiciously. In fact, this was similar to the 2003 situation (David, 2008), when a substantial improvement in the Israeli international achievements had proved to be closely connected to the sampling system that left out “weak” sub-populations. Here are the reasons why the Israeli PISA 2012 results should be regarded at least suspiciously if not completely erroneous.

1. There are two main reasons why the Israeli results of the PISA 2012 should be dismissed:

A substantial error in the sampling of the PISA 2012: the age of the supposedly “15-year old” was actually wrong, as the rate of class repeating in Israel is much higher than informed.

2. Two large sub-populations, whose achievements were probably the lowest among all Israeli sub-populations, were not taken into consideration when sampling “15-old Israelis” for the PISA 2012 (Chai, 2013).

Let us look deeply into these two claims.

1. The median age of the supposedly “15-year old” Israeli students was much higher than 15.

According to OECD 2013 (Table 4.1.6), the number of 15-year-old Israeli students who have repeated a grade at least once in primary, lower secondary or upper secondary schools was 2059.

In Turkey, 123,117 15-year-old students repeated a grade at least once in primary, lower secondary or upper secondary schools; the total cost was 0.8%. According to the Turkish Statistical Institute (2015), the Turkish population was about 77,695,904 in 2014; the growth birthrate was 1.3% per annum (population growth, 2015). According to OECD Statsextracts (2015), the Israeli growth birthrate has been 2% per annum. Thus, with an Israeli population of about 8 million (CBS, Statistical Abstract of Israel, 2014), it should be expected that the number of 15-year olds repeating a class should be about 10% of the Turkish number, namely about 12,000, rather than 2059.

The solution of this “mystery” is that the number of students who repeat a grade reported in Israel is far from being accurate. In Israel a large amount of parents choose to have their children repeat compulsory kindergarten and enter school a year later. Thus, in 2013 16.7% of Jewish parents and about 8% of Arab made this choice; in summa – 15% of age-6 children remained in their kindergartens for an extra year (CBS, Statistical Abstract of Israel, 2014, table 8.5). All these children were not included in the “15-year-old students repeated a grade at least once in primary, lower secondary or upper secondary schools” statistics, as the year they repeated was the one before school.

2. Two large sub-populations, whose achievements are probably the lowest among all Israeli sub-populations, were not taken into consideration

I. In the 2012/2013 school year the number of Arab students learning in the general education system in Jerusalem was 78,676. Only 41,665 of them were a part of the public, general education system, while 36, 515 learnt in in private institutions, partially financed by the government and the local municipality (Eitan et al., 2013, p. 3). The rest were special-education kindergartners.

The main reason for choosing a private institute has been the low level of the public ones (David, 2014). Lack of financial adequate sources has caused this situation, manifested primarily by the physical conditions of the

schools. In 2012 there was a lack of no less than 1100 school classes in East Jerusalem in spite of the fact that almost half of its students – eligible for free, public education – were a part of the private education system. No wonder that 36% of the 18-year olds did not graduate from high school (Eitan et al., 2013, p. 9) – in spite of the fact that they were Israeli citizens, obliged to the Israeli law of free compulsive 12-year education (The law of compulsive education, 2007). This means that in every school grade there were about 8,000 students. According to Eitan et al. (2013), about 20% of Arab students in East Jerusalem had dropped out until grade 10, so the actual number of 15-year olds in East Jerusalem was about 10,000. All these students were not included in the PISA 2012 sample. The number of East Jerusalem students uncounted and thus not included in the PISA sample was thus about one third of the number of Arab students who were part of the PISA 2012 sample: 25,190 (PISA – Programme for International student assessment, 2013, table 3.2). As 85% of the East Jerusalem children lived under the poverty threshold (Ben Shelomo, 2013), not including the poorest children in the PISA sample certainly “contributed” to more favorable results.

Not only did the East Jerusalem students belong to the lowest socio-economic level in Israel, According to Dattel (2013), the 2012 budget allocated per one Arab student in Jerusalem by the Ministry of Education was but 15,158 Shekel while for a Jewish student learning in the general education system it was 26,542 Shekel and for a student learning in the state religious system – 26,732 Shekel. Thus, the very low socio-economic situation of the vast majority of the East Jerusalem children was not compensated by extra investment by the government but rather empowered by financial discrimination against Arab students.

Among the Arabs participating in the TIMSS 2012, “The PISA exam shows substantial gaps between Hebrew and Arabic-speaking pupils” (PISA: Israeli schoolchildren improving, but below OECD average, 2013). “The PISA exam shows substantial gaps between Hebrew and Arabic-speaking pupils. In the math exam, Hebrew speakers achieved a score of 489 points, while Arabic speakers achieved a score of 388 points. Arabic speakers scored 98 points less than Hebrew speakers in the science exam” (ibid).

II. Ultra-Orthodox boys. In the 2012/3 school year 25.5% of Jewish students belonged to the Ultra-Orthodox sector (CBS 2014, table 8.10). According to Dattel (4.12.2013), they did not participate in the PISA 2012 examinations. Taking into considerations that in all internal examinations Ultra-Orthodox students – especially boys – had reaches the lowest achievements in Israel, it is quite clear why their removal from the sample increases the achievement.

CONCLUSIONS

This study shows, first of all, the power of education. In Turkey the literacy rate was but 8.2% in 1927 (Bar-Ilan, 1992); it was still 48.4% for males and 20.7% for females in 1950 (Taeuber, 1958), but it was already almost 99% in 2012 (*The CIA World Factbook*, 2015). On the other hand, a country like Israel, with a long Jewish tradition of learning and studying (e.g. David & Wu, 2009), and a history of winning a variety of international prizes (e.g. David, 2009) has deteriorated during the last 5 decades and is currently considered a third-world country regarding the math and science achievements of its 15-year old students.

This study is but an “appetizer” to a more profound one, namely, a study that will compare the achievements of Turkish with those of Israeli students in the international examinations taking into account as many components as possible. Among them: gender differences in math and science; the percentage of students achieving all levels of proficiency achieved; student performance and national income Relationship between performance in mathematics and GDP per capita; the differences in school systems, the differences in teacher’s formal education, and the differences in class sizes.

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