

Shoresh Research Paper

Impact of parental education on their children's achievements

A comparison of Israel to the leading countries in PISA exams, 2006-2018

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Abstract

Education systems' success in dealing with pupils' gaps from home is vitally important in providing equal opportunities and for accelerating intergenerational mobility in society as a whole. Focusing on all of the international PISA exams in reading, mathematics and science during the years 2006-2018, this study examines how successful Israel's education system has been in reducing these gaps. The impact of parental education levels on their children's achievements in the PISA exams over the years is measured for Hebrew-speaking and Arabic-speaking pupils in Israel and compared with a benchmark group of the highest scoring countries.

The findings indicate that while even the leading education systems were unable to completely eliminate achievement gaps resulting from differences in parental education, Israel's education system has performed considerably worse in this regard. Gaps in exam scores between Hebrew-speaking pupils, on the basis of their parents' education levels, are much higher – sometimes more than double – the gaps in the leading countries. Even after statistically controlling for additional explanatory variables, the relationship between parents' education and their children's achievements remains much stronger in Israel than in the leading countries. In lieu of a substantial improvement in the ability of Israel's education system to overcome the gaps with which the pupils come from home, the hurdles on the path toward intergenerational mobility may become insurmountably high.

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Introduction

Children of more educated parents tend to have a relative scholastic advantage over children of less educated parents. Many years ago, Coleman, et al. (1966) showed that the family's impact on pupil achievement may be stronger than the impact of other environmental factors – and in particular, more substantial than the school's impact on the pupil. However, good public education systems can reduce the link between parental education and their children's educational achievements.

This study examines the link between parents' education and their children's achievements in the international PISA exams. Since no education system is capable of completely eliminating this link, the examination conducted here compares Israel to a benchmark group of the best-performing countries on the PISA exams.

Israel is considered a country with high intergenerational mobility. However, this mobility has become weaker in recent decades, in Israel and in other developed countries (Levy, Boukay and Karni, 2021). The Central Bureau of Statistics (2019) found a strong correlation between the education of Israelis and the education of their parents. For example, about 15% of Israelis aged 30 and over whose parents were uneducated attained an academic degree, compared to 70% of those whose parents had an academic education. However, there has recently been a growing recognition that quantitative measures of education such as number of years of study and academic degrees are less important than quality measures. For example, Ben-David and Kimhi (2021) showed that there are large differences in the salaries of academic degrees holders, depending on the field of academic studies and the type of educational institution. Gdaliahu (2021) found that the quality of pupils' high school had a substantial effect on their subsequent intergenerational educational mobility (measured through the difference in the number of years of schooling between the pupils and their parents).

The higher the positive correlation between children's human capital levels and that of their parents, the lower the chances of reducing future socioeconomic disparities. For this reason,

one of the main goals of public education systems is to provide equal educational opportunities to all pupils, regardless of the abilities of their parents – thus enabling children from weaker socioeconomic strata to attain higher educational achievements than their parents. This phenomenon is referred to as upward intergenerational educational mobility. The more widespread this phenomenon, the lower the inequality in education in the children's generation than in the parents' generation. The importance of upward intergenerational educational mobility lies in the fact that it also leads to upward intergenerational income mobility (Gdaliahu, 2021), which in turn reduces future income inequality.

PISA exams

The PISA exams include three key fields: reading, mathematics and science. A representative sample of 15-year-old pupils is tested in each of the participating countries.¹ The PISA exam's objective, as noted by Barcelevsky, Lipstadt, Hilo and Gatushkin (2019), is to assess how well pupils are able to use the knowledge and skills they have acquired to deal with challenges they will face later in life. The exams also enable each country to examine the outputs of its education system while providing international benchmarks for domestic evaluations.

There are two key motivations for evaluating educational outputs. The first is the growing need to acquire an ability to locate and filter information in an era characterized by ever-growing amounts and rapidly rising availability of data. Second, as Barcelevsky, Lipstadt, Hilo and Gatushkin (2019) point out, this ability can be linked to pupils' future economic success, type of employment, in a way that will have an affect not only at the individual levels, but on the entire nature of the society and country in which the pupils will live as adults.

Beginning in 2000, seven examination cycles were held, once every three years.² Exam results are calibrated, thus enabling comparisons over time. Israel joined the PISA program after

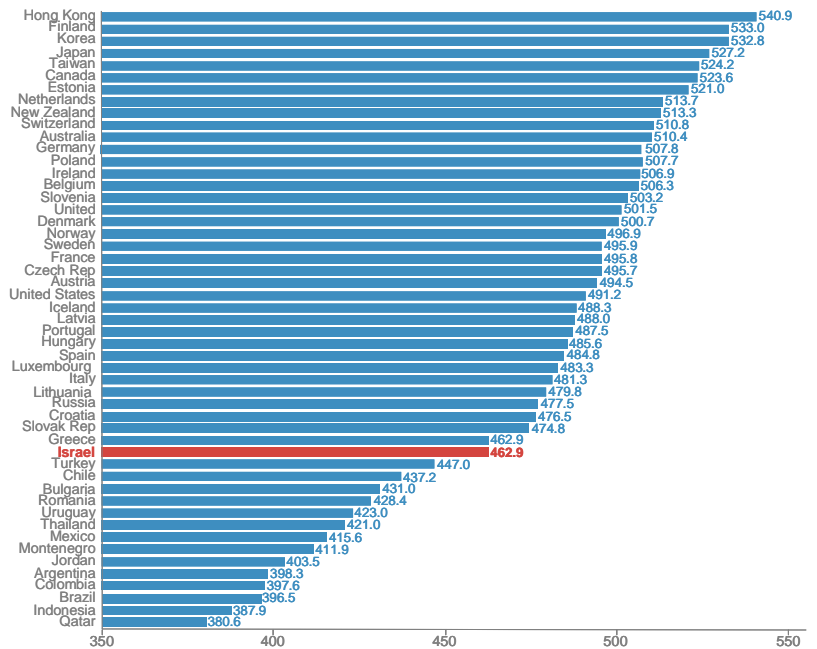
¹ A detailed description of the exam can be found in <http://www.oecd.org/pisa/aboutpisa>

² This is true for all exams except for those originally planned 2021, but postponed due to the Covid pandemic. As of the time of the writing of this paper, the results of the 2022 exams have not yet been released.

it had already begun. As such, the 2000 exam was administered in Israel two years after it was administered elsewhere. Furthermore, the data that was made available for the 2000 exam did not include the language (Hebrew or Arabic) in which it was taken. Since this information played an important role in the analysis below, it was decided not to include that year's exam in the study. Furthermore, Israel did not participate in the 2003 PISA exams. As such, this study focuses on the five remaining cycles of exams, held since 2006 (with three different exams – in mathematics, science and reading – in each cycle).

A total of 51 countries participated in at least 14 of the 15 PISA exams held in the years 2006-2018.³ Figure 1 shows the average national scores in the three fields over the five exam cycles held during the selected period. The average score of Israeli pupils across all PISA exams conducted since 2006 places the country below 36 out of the 51 nations. It is important to note that most of the ultra-Orthodox (haredi) pupils do not study the material and do not participate in the exams, which probably biases upwards Israel's reported results. Nonetheless, all of the developed countries are ranked above Israel.

Figure 1
Multiyear national average of PISA score in all exams
all countries participating in at least 14 of the 15 exams, 2006-2018*



* Average scores in math, science and reading

Source: Ariela Savin, Ayal Kimhi and Dan Ben-David, Shoresh Institution
Data: PISA

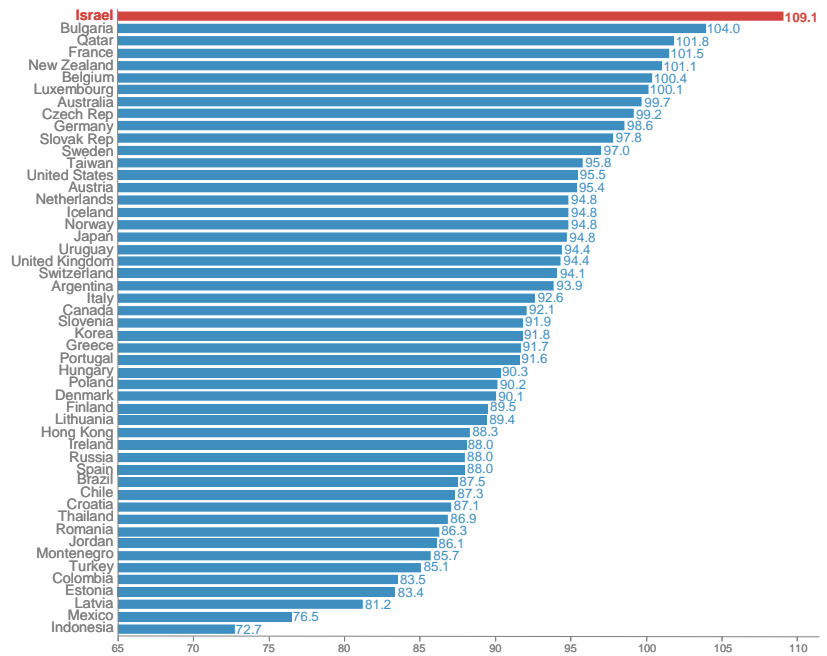
³ 49 of the 51 countries participated in all 15 exams (in math, science and reading in each of the 5 exam cycles). The two remaining countries are the United States, which participated in all exams except reading in 2006, and Spain, which participated in all exams except reading in 2018. China was omitted from the list because its test sample is based on no more than four districts, and the composition of the districts was not constant over the years.

National standard deviations reflect the size of the average gap in scores within each country. Each nation’s average standard deviation was calculated across the five cycles of the PISA exams and across the three fields. The average gap in scores between Israeli pupils, across all 15 exams over the entire time period was the highest of all countries – well above the number two country, Bulgaria (Figure 2). Particularly high gaps in achievement were found between the Hebrew-speakers and Arab-speakers in Israel. As noted

above, the extraordinarily high gaps between Israeli pupils were attained even though most haredi pupils do not study the material and were not tested in PISA. Had the haredi pupils – whose relative share in the population is increasing annually – also participated in the PISA exams, it is likely that Israel’s domestic achievement gap would have been much higher (Ben-David, 2021).

These findings highlight one of the Israeli education system’s most fundamental failures, with extremely problematic implications for pupils’ personal futures, and for the future of Israeli society as a whole. The goal of this study is to examine the relationship between parental education and children’s PISA scores in Israel and compare it to the relationship between parental education and children’s achievements in a benchmark group of countries with the highest PISA scores. The selection process of this benchmark group – to be referred to as the “leading countries” group – is

Figure 2
Multiyear average domestic gaps in PISA scores in all exams
all countries participating in at least 14 of the 15 exams, 2006-2018*



* Average standard deviations within countries in math, science and reading

Source: Ariela Savin, Ayal Kimhi and Dan Ben-David, Shoresh Institution

Data: PISA

detailed in Appendix 1. The leading countries are Finland, Japan, Taiwan, Canada and Estonia.⁴ This study's comparison between Israel and the leading countries will illuminate the extent to which Israel's education system does – or does not – overcome the gaps that its pupils inherit from home. Israel's ability to provide equal opportunities for its pupils, and to support intergenerational educational mobility, is highly dependent on this.

Data

PISA exam data includes information, based on pupil self-reporting, on the highest level of education attained by their parents. To examine the impact that parental education had on their children's scholastic achievements, the pupils were divided into four groups according to their parents' levels of education:

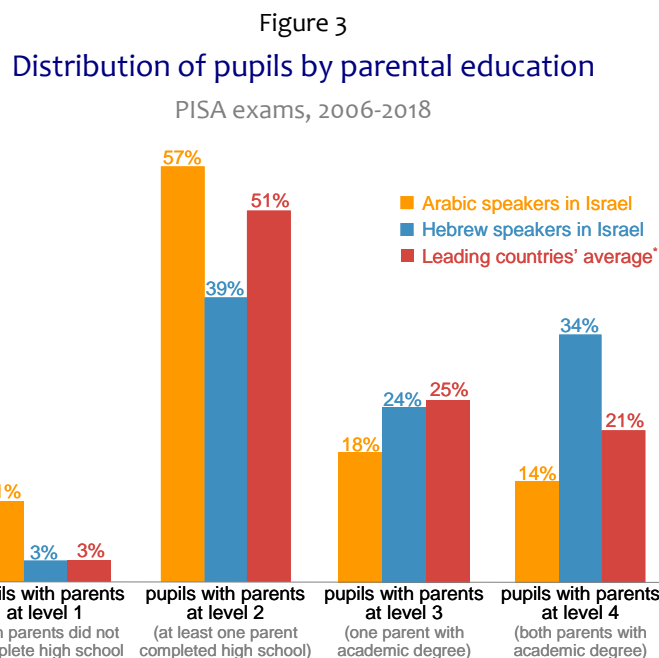
- Level 1 – pupils whose parents do not have an academic degree and did not finish high school.
- Level 2 – pupils whose parents do not have an academic degree and at least one of them graduated from high school.
- Level 3 – pupils who have one parent with an academic degree.
- Level 4 – pupils whose parents each have an academic degree.

The sample population in this study includes pupils for whom information is available on each parent's level of education, alongside additional explanatory variables related to the pupil and his/her family.⁵ In light of substantial differences between the results of the Hebrew-speaking and Arabic-speaking Israeli pupils, the analysis was conducted for each of these two groups separately.

⁴ The scores of Korea and the Netherlands were sufficiently high to enable their inclusion in the group of leading countries. However, their reported distribution of parental education changed so dramatically over the years that it called into question the reliability of the reported parental education data and led to their omission from the group.

⁵ Sample weights provided in the PISA data were used to calculate the reported results (Monseur, 2009).

Figure 3 highlights the distribution of pupils according to the level of their parents' education.⁶ As shown in the figure, the parental education level of the Hebrew-speaking examinees is considerably higher than that of the Arabic-speaking examinees. The low-level education group (level 1) constitutes a very small share (about 3%) both among Hebrew-speaking Israeli pupils and leading country pupils. The proportion of pupils whose parents have a level 3 education is also quite similar among Hebrew-speaking Israeli pupils and among pupils from the leading countries. The difference between these two groups is reflected in the fact that the proportion of parents with education level 2 is higher in the leading countries, while the proportion of parents with the highest education level (level 4) is higher among Hebrew-speaking Israeli pupils.



* Finland, Japan, Taiwan, Canada and Estonia

Source: Ariela Savin, Ayal Kimhi and Dan Ben-David, Shoresh Institution
Data: PISA

Descriptive Results (without controlling for additional explanatory variables)

Differences in achievement scores between examinees differing from one another on the basis of their parent's education levels are shown in Figure 4.⁷ The differences in percentages are relative to pupils whose parents have the lowest level of education (level 1).

⁶ The average of the leading countries was calculated as a weighted average, where the weights are the numbers of pupils in the sample in each country. The results over the years were also examined using a simple average, in which each country has equal weight. No significant differences were found between the distributions in both methods. Throughout the work, when the term "average of the leading countries" is used, it will mean a weighted average.

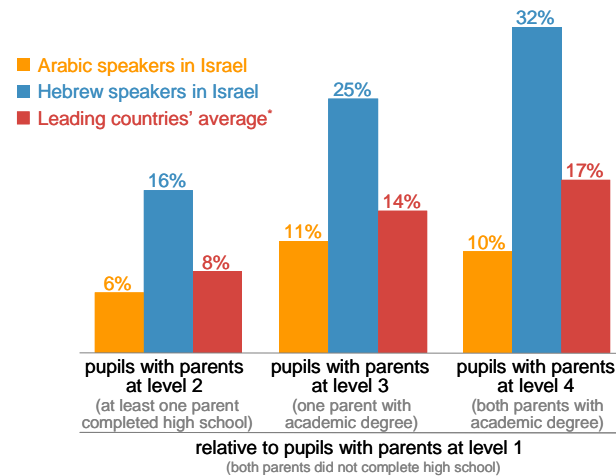
⁷ Analyses of the scores were also carried out in each of the years separately. The conclusions were not substantially different from those reported here and it is not possible to identify any trend in the score gaps over time.

As shown in Figure 4, the smallest gaps in pupil scores between any given level of parental education and the lowest level are among the Arabic-speaking test takers. In particular, no difference was found between the average achievement of Arabic examinees whose two parents have an academic degree and the average achievement of those whose only one parent has an academic degree.

One possible reason for this is the relatively low quality of the Arabic-speaking population's academic degrees, making them less relevant for explaining differences in their children's scholastic achievements.⁸ However, it is possible that the primary problem lies in the self-reporting of Arabic-speaking pupils tested in the PISA exams with regard to their parents' education. There is a large discrepancy between the actual distribution of education levels among Arab-Israelis according to the Central Bureau of Statistics (CBS) data, and their distribution according to the self-reporting in PISA by Arabic-speaking pupils.

These discrepancies are highlighted in Figure 5, which shows the gap between the two sources of data regarding parents with a low level of education (did not finish high school) and a

Figure 4
Gaps in average scores between children with at least one parent with high school education and up, and children with two parents who did not complete high school



* Finland, Japan, Taiwan, Canada and Estonia

Source: Ariela Savin, Ayal Kimhi and Dan Ben-David, Shoresh Institution
Data: PISA

⁸ An analysis of administrative data (Appendix 2) indicates that a higher proportion of Arab-Israelis with an academic degree studied in non-research colleges, particularly in teaching colleges, compared to non-haredi Jewish-Israelis. Psychometric exam scores (serving a similar academic point-of-entry function as SAT scores in the US) of students in non-research colleges were significantly lower than those of students in research universities. Furthermore, psychometric scores of Arab-Israelis were substantially lower than those of Jewish-Israelis, even when both attended the same type of academic institution.

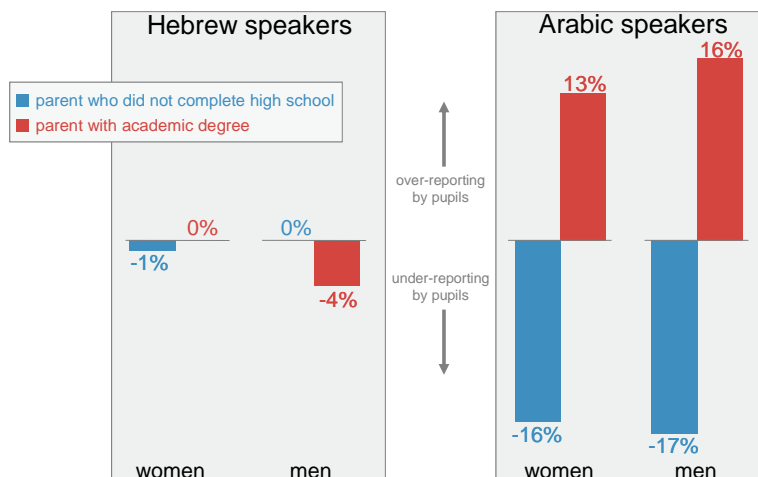
high level of education (an academic degree).⁹ While there are minimal discrepancies regarding parental education levels between the CBS data and Hebrew-language pupils' self-reporting, the gaps for the Arabic-speakers are very large.

In light of the large gaps between Arabic-speaking pupils' self-reporting and administrative data published by the CBS, Arabic-speaking pupils are excluded from the next section's analysis.

Figure 5

Parental education in Israel: the gap between pupils' self-reporting and their actual education

percentage point differences between education levels according to pupils in PISA exams and actual education levels according to Central Bureau of Statistics*



* The CBS data pertains to individuals aged 35-54 in 2021. PISA data refers to self-reporting on parental education by pupils tested in PISA in 2018.

Source: Ariela Savin, Ayal Kimhi and Dan Ben-David, Shoresh Institution
Data: Central Bureau of Statistics and PISA

Regression results (while controlling for additional explanatory variables)

The positive relationship between the pupils' achievements and their parents' level of education (Figure 4) is not surprising. Parents greatly influence the accumulation of their children's human capital via two main channels. The first is the genetic correlation between parents and children, which is a natural effect not subject to parents' decisions (other than to marry one another). The second channel is via investments in the children's human capital, which are the result of parents' decision. More educated parents tend to have financial means that allow them to invest more in their children's human capital. They may also be more aware of the economic and social importance of investing in human capital. In addition, they usually live in areas characterized

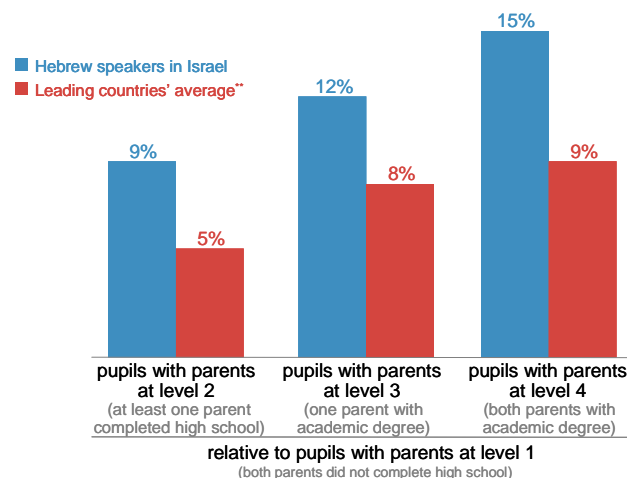
⁹ The gap between the self-reporting of the pupils in the PISA exam's leading countries in 2018 and the OECD data for the same countries in 2021 was also examined. Self-reporting by the leading countries' pupils turns out to have been quite accurate, except for mothers at the highest education level. Since the OECD data was analyzed based on the year 2021, the CBS data was also analyzed based on this year.

by higher socioeconomic levels, with schools providing higher levels of teaching as well as peers with better achievements.¹⁰

The strength of the relationship between parental education levels and their children’s educational achievements may be influenced by various socioeconomic characteristics of the parents’ home. To neutralize these effects, a regression analysis was used in which relevant explanatory variables were statistically controlled.¹¹ The results of this analysis (Figure 6) show the gaps in scores between children with at least one parent with high school education and up, and children with two parents who did not complete high school.

A comparison of the results in Figure 6 with those in Figure 4 indicates that the gaps in scores are reduced by up to one-half after controlling for the additional explanatory variables. This means that up to about a half of the differences in pupil grades are due to observed differences between the groups of parents. However, even after

Figure 6
Gaps in average scores between children with at least one parent with high school education and up, and children with two parents who did not complete high school gaps after controlling for additional variables*, PISA exams, 2006-2018



* Gaps in logs of average PISA scores. Results significant at the 1% level.

** Finland, Japan, Taiwan, Canada and Estonia

Source: Ariela Savin, Ayal Kimhi and Dan Ben-David, Shoresh Institution
Data: PISA

¹⁰ Gadaliahu (2021) found that school quality is positively correlated with the income level of pupils’ parents. Savin (2021) found that the average score of peers in the PISA exam has a positive and statistically significant effect on pupil achievement.

¹¹ The additional explanatory variables controlled for in the analysis are: pupils’ gender; whether or not the pupil and each of his/her parents are native born; whether the pupil’s home has a desk, a quiet place for studying, educational/learning software, internet connection, reference study books, a dictionary, classic literature, art works and poetry books. Additional control variables are the year of the exam as well as the number of cars, the number of computers, the number of televisions, the number of cell phones and the number of books in the house where the pupil lives. In the regression of the leading countries, dummy variables representing the countries were also included. The averages of the control variables appear in Appendix 3. The dependent variable in the regressions is the natural logarithm of the average grades of each pupil in the three parts of the exam. The results of the main regressions appear in Appendix 4.

controlling for additional explanatory variables, the differences in grades between pupils whose parents have different levels of education are greater among the Hebrew-speaking examinees in Israel than the average in the leading countries.

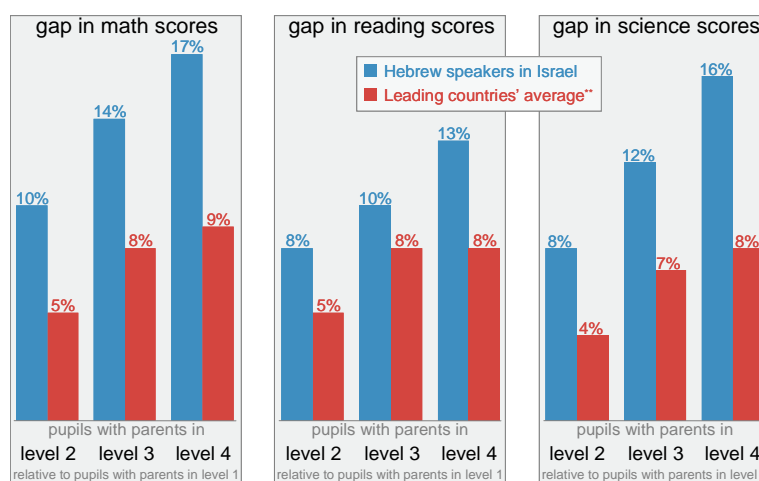
This result is also found when the analysis is performed separately for each of the three subject areas (Figure 7).¹² The lowest gaps between the Hebrew examinees and the examinees in the leading countries are obtained in the field of reading, and the highest gaps are obtained in the field of mathematics. In the fields of mathematics and science, these gaps are up to twice as high among Hebrew-speaking examinees than among examinees in the five leading countries.

In each field, the gap between level 2 and level 1 among the Hebrew-speaking examinees is similar, and sometimes even higher, than the gap between the level 4 (the highest level) and level 1 in the leading countries. This implies that among the Hebrew-speaking population in Israel, the education system is much less effective in dealing with the link between parental education levels and pupil achievement. This relationship in Israel is considerably and consistently stronger than the relationship found in the leading countries.

Figure 7

Gaps in scores between children with at least one parent with high school education and up, and children with two parents who did not complete high school

gaps after controlling for additional variables*, PISA exams, 2006-2018



* Gaps in logs of PISA scores. Results significant at the 1% level.

** Finland, Japan, Taiwan, Canada and Estonia

Source: Ariela Savin, Ayal Kimhi and Dan Ben-David, Shoresh Institution
Data: PISA

¹² The complete regression results are available from the authors.

Summary

There is a positive relationship between the pupils' scores in the PISA exams and their parents' level of education. This relationship exists in both the leading countries and among Hebrew-speaking test takers in Israel. In other words, even the highest quality education systems fail to completely eliminate the gaps between pupils whose parents have different levels of education.

However, Israel's education system is much less successful in reducing this link than are the education systems in countries with the best performing pupils. Even after controlling for many variables that contribute to the relationship between parental education and children's academic achievements, the remaining relationship in Israel is much stronger than in the top education systems. This conclusion is similar to Gruber (2017).¹³

One possible explanation for this result is that Israel is a relatively young country and a country of immigrants. These attributes ostensibly pose greater challenges to Israel's education system in comparison with older countries with more homogeneous populations. However, when the analysis is performed for each year separately, there is no sign of improvement over time in the ability of Israel's education system to reduce disparities. This finding weakens the validity of this explanation.

Another explanation proposed by Gruber (2017), is that parents in Israel pay more attention to their children's education. He found – on the basis of self-reporting by PISA examinees – that the proportion of Israeli pupils who feel that their parents attach importance to the study of mathematics is the highest in the developed world. This importance translates into educational enrichment activities that involve expenditure of money and time, and these activities may be more intense the higher the level of education of the parents.¹⁴ This conclusion corresponds with the result that gaps in mathematics are the highest among the three subjects. However, the very fact

¹³ The leading countries in Gruber's (2017) work were Finland, Canada, Japan, Estonia, the Netherlands, Taiwan, Korea, Switzerland, Singapore, Hong Kong.

¹⁴ Gruber (2017) found that enrichment activities are much less prominent among Arabic-speakers. This may explain, at least partially, the different results obtained for Hebrew speakers and Arabic speakers.

that educated parents in Israel are more involved in their children's educational process may be the result of their understanding that the education system does not provide their children with sufficient knowledge they perceive is required.

The bottom line is that the many objective shortcomings of the education system in Israel – for example, low teacher quality, overcrowded classes, managerial malfunctioning (Ben-David, 2021) and disciplinary problems (Gruber, 2017), all considerably worse than in other developed countries – severely handicap the Israeli education system's ability to deal with the achievement gaps between pupils who come from different socioeconomic backgrounds.

The provision of equal opportunities is a cornerstone of liberal, developed societies (Akiba, LeTendre and Scribner, 2007). A society in which the socioeconomic background of parents has a tremendous influence on the future of their children exemplifies not only unequal opportunities, but also portends higher future unemployment and income inequality. When accompanied by feelings of resentment among weaker populations, these outcomes may lead to social unrest (OECD, 2018).

In light of the findings presented above, it is difficult to over-state the need for Israel to implement a systemic, comprehensive reform of its education system. The objective of such a reform must be to significantly improve pupils' knowledge levels and significantly reduce knowledge gaps among them. This is a national priority of the highest order.

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Findings and points of view expressed in Shoresh publications are the authors’ alone.

Appendix 1: Selection of benchmark group of countries for comparing Israel

The countries were ranked in the following manner.

Stage 1: For each country participating in all five PISA exam cycles from 2006 to 2018, a simple average was calculated for all three fields during all five years. A preliminary list was compiled of the top ten countries with the highest multiyear average score.¹⁵

Stage 2: The countries were compared once again. This time the countries were ranked in each of the five years separately, according to the national average in all three fields. The number of times that each of the top ten countries from stage 1 appeared in each of the five separate top tens (for each exam cycle) was tabulated. Among the top ten countries from stage 1, the seven countries with the highest number appearances in annual rankings were chosen: Canada, Estonia, Finland, Japan, Korea, Taiwan and the Netherlands.¹⁶ Korea and the Netherlands were removed from this group because the distribution of parents' education in each was so inconsistent over the years that it called into question the reliability of their data on parental education. The remaining five countries – Canada, Estonia, Finland, Japan and Taiwan – were chosen as the group of leading countries for the benchmark comparisons conducted in the study. It should be noted that each of the five countries appeared in the list of the top ten countries in each of the five exam cycles.

¹⁵ China was not included in the list because its sample of examinees was based on no more than four provinces, with the composition of the provinces changing over the years. Hong Kong was omitted since it is a city and not a sovereign nation.

¹⁶ Switzerland appeared in the list of leading countries in only three of the years while Poland and Australia appeared only twice.

Appendix 2: Educational institution distributions of academic degree holders and average psychometric scores, by sector and gender

Table A1

Distribution of persons with an academic degree and children born between 1990-1995

Gender	Academic institution	Jewish-Israelis <i>(excluding haredim)</i>	Arab-Israelis
Males	Research university	59.6%	51.8%
	Non-research college	7.4%	7.5%
	Teaching college	2.8%	9.0%
	Studied abroad	30.2%	31.7%
Females	Research university	53.2%	37.2%
	Non-research college	5.8%	8.5%
	Teaching college	13.6%	35.5%
	Studied abroad	27.4%	18.8%

Source: Ariela Savin, Ayal Kimhi and Dan Ben-David, Shoresh Institution
Data: Central Bureau of Statistics

Table A2

Average psychometric score of academic degree holders by ethnic group and academic institution, 2017

Academic institution	Jewish-Israelis	Arab-Israelis
Research university	613	506
Non-research college	558	453
Teaching college	488	418

Source: Ariela Savin, Ayal Kimhi and Dan Ben-David, Shoresh Institution
Data: Central Bureau of Statistics

Appendix 3: Descriptive statistics – sample averages (2006-2018)

	Examinees in Hebrew	Average of leading countries
Female	0.493	0.500
Which of the following exists in the students' home		
Study desk	0.965	0.941
Quiet study environment at home	0.942	0.872
Educational software at home	0.569	0.313
Internet connection	0.951	0.902
Study tutor books	0.839	0.838
Dictionary	0.977	0.969
Classical literature at home	0.511	0.494
Poetry books	0.510	0.343
Works of art	0.708	0.458
Number of televisions in students' home (% of sample)		
Zero	9.0%	0.7%
One	10.6%	20.2%
Two	20.1%	34.0%
Three or more	60.3%	45.1%
Number of mobile phones in students' home (% of sample)		
Zero	0.7%	1.1%
One	2.1%	4.6%
Two	5.7%	9.2%
Three or more	91.5%	85.1%
Number of cars at students' home (% of sample)		
Zero	9.6%	5.9%
One	37.3%	33.5%
Two	42.3%	38.1%
Three or more	10.8%	22.5%
Number of computers in students' home (% of sample)		
Zero	2.7%	7.0%
One	24.7%	41.8%
Two	30.6%	27.8%
Three or more	42.0%	23.4%
Estimation of the number of books at student's home (% of sample)		
0-10	10.8%	9.9%
15 - 20	14.3%	14.1%
26-100	28.8%	33.5%
101-200	19.2%	18.9%
201-500	15.0%	15.6%
more than 500	11.9%	8.0%
Native born		
Student	0.911	0.967
Student's mother	0.702	0.922
Student's father	0.690	0.930
Exam year (% of sample)		
2006	17.9%	21.1%
2009	20.3%	20.6%
2012	21.4%	20.4%
2015	21.5%	19.8%
2018	18.9%	18.1%

Appendix 4: Regression results, 2006-2018 (natural logs of each pupil's average scores as function of parental education and selected control variables)

	Examinees in Hebrew		Average of leading countries	
Parents' combined level of education (base group: level 1)				
Level 2	0.087	***	0.045	***
Level 3	0.120	***	0.075	***
Level 4	0.153	***	0.085	***
Female	0.009	***	0.005	***
Which of the following exists in the students' home				
Study desk	0.053	***	0.021	***
Quiet study environment at home	0.010		0.008	***
Educational software at home	-0.014	***	-0.001	***
Internet connection	0.052	***	0.022	***
Study tutor books	-0.010	**	0.022	***
Dictionary	0.054	***	0.064	***
Classical literature at home	0.033	***	0.054	***
Poetry books	-0.019	***	-0.005	***
Works of art	0.021	***	-0.001	*
Number of televisions in students' home (base group: zero)				
One	-0.004		0.019	***
Two	0.002		0.0003	
Three or more	-0.021	***	-0.015	***
Number of mobile phones in students' home (base group: zero)				
One	-0.019		-0.009	**
Two	0.027		0.024	***
Three or more	0.016		0.019	***
Number of cars at students' home (base group: zero)				
One	0.004		0.009	***
Two	0.017	***	0.001	
Three or more	-0.025	***	-0.025	***
Number of computers in students' home (base group: zero)				
One	0.045	***	0.040	***
Two	0.063	***	0.051	***
Three or more	0.088	***	0.062	***
Estimation of number of books at student's home (base group: 0-10 books)				
15 - 20	0.047	***	0.045	***
26-100	0.094	***	0.076	***
101-200	0.121	***	0.092	***
201-500	0.141	***	0.113	***
More than 500	0.135	***	0.103	***
Native born				
Student	0.019	***	0.027	***
Student's mother	-0.002		0.007	***
Student's father	0.005		0.011	***
Exam year (base group: 2006)				
2009	0.044	***	0.003	***
2012	0.053	***	0.015	***
2015	0.055	***	-0.002	*
2018	0.044	***	-0.012	***
Country (base group: Canada)				
Estonia	-		-0.047	***
Finland	-		-0.014	***
Japan	-		-0.023	***
Taiwan	-		-0.020	***
Intercept	5.684	***	5.898	***
R squared	0.219		0.182	
Number of observations	15,385		194,727	
Number of weighted observations	287,093		7,723,254	

* significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level