TAUB CENTER
FOR SOCIAL POLICY STUDIES IN ISRAEL

# Technological Education: Trends and Developments, 2006 to 2017

**Hadas Fuchs, Guy Yanay, and Nachum Blass**

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## Taub Center for Social Policy Studies in Israel

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## Abstract

Under the last four education ministers, the Ministry of Education has focused much of its efforts on increasing the number and share of high school students in technological-vocational education. A second, related goal has been to increase the number and share of students taking the bagrut (matriculation) exams in math and English at the highest study level (five units). This chapter takes an in-depth look at the profile of students in high school technological-vocational education, according to a new achievement-based classification system of educational tracks proposed by the authors. This proposed system replaces the traditional and more arbitrary classification into engineering, technological, and VET tracks.

Study findings indicate that the Ministry of Education has succeeded in attaining its declared goals: the share of students in technological education has risen and the majority of growth has taken place in the highest level track where bagrut attainments are also positive. Achievements are particularly impressive for girls in the Arab, Bedouin, and Druze education systems. The share of students in Arab education enrolled in the highest and most prestigious technological majors is higher than among their peers in the Hebrew education system. Achievements of these students — in the Arab and Hebrew education system alike — are similar despite the fact that students in the Arab sector have far lower socioeconomic profiles. The study's findings give rise to optimism about reducing educational and economic gaps between Israel's different population groups.

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# Introduction

Over the last decade, the Ministry of Education's policies for high school education have focused on several issues, including two that have received particular attention: (1) increasing the share of students in technological education; and (2) increasing the share of students who study for and qualify on the bagrut exams (matriculation) at the highest level of math and English (five units).[1, 2]

This chapter evaluates the extent to which the Ministry of Education has achieved these two goals, and shows how progress in one goal is connected to progress in the other. The chapter first looks at technological education in Israel. The second part of the chapter describes changes in the share of students taking math and English (as a second language) at the highest level (five units).

## Data

This chapter is based on available data on 12th grade students in Israel enrolled in regular education (not including Special Education) between 2006 and 2017 (the years since the last reform in technological education was completed). Student data, as well as the data relating to schools and bagrut exams, were taken from the Ministry of Education's virtual research room. Data from the website *A Broad Perspective* (*B'mabat Rachav*) was used as a validity check.[3] The study covers 12th grade students from all schools under Ministry of Education supervision (not including vocational education and training schools managed by the Ministry of Labor, Social Affairs and Social Services).[4] This includes students in East Jerusalem, the vast majority of

1 Technological education includes the three traditional tracks: engineering, technology, and VET (vocational education and training). Students not in technological education tracks are in academic tracks. In the new classification system proposed in this chapter, technological education includes three achievement-based tracks: high, medium, and low technological tracks.

2 The Israeli bagrut exam is a matriculation exam that is often compared to the NY State Regents Examination. A bagrut certificate is awarded to students who pass the examinations in each subject. The bagrut certificate should not be confused with a high school diploma, which signifies the completion of 12 years of study. Students are tested in subject matter at a level of one to five units where five units is the highest level of study.

3 *A Broad Perspective* (*B'Mabat Rahav*) is an Online database of the Ministry of Education.

4 Students in Ministry of Education schools are the vast majority of technological students in Israel — 92 percent in 2015 (Winninger 2016).

whom do not take Israeli bagrut exams and are listed in the database files as enrolled in academic tracks, and Haredi students, who also do not, for the most part, take bagrut exams. Hence, it is likely that the share of Arab Israeli students actually enrolled in the technological track is somewhat higher than reported. With respect to Haredim, the small number of observations makes it difficult to draw decisive conclusions.

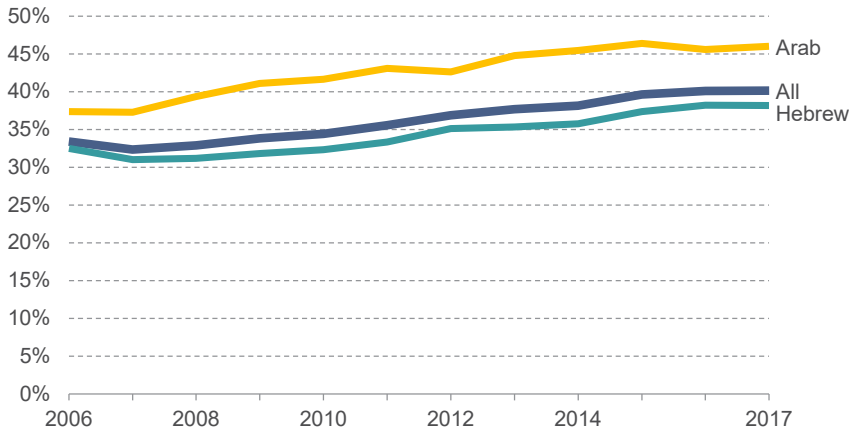
## 1. The development of technological education in Israel

As of 2018, there are 25 different study majors for students enrolled in the technological educational tracks that begin in the 10th grade and run through 12th grade (Ministry of Education website). The majors are very diverse and range from software engineering and robotics to hair design and cosmetology. Most of the technological students (74 percent) are enrolled in comprehensive schools, which offer both academic and technological majors, and a minority (26 percent) are enrolled in purely technological education schools.

The share of students enrolled in technological education has experienced various changes since the 1960s, which can be divided into three distinct time periods. From 1960 to 1980, there was massive growth in the share of technological education as part of total high school education, primarily in the Hebrew education sector.[5] In the 1990s and early 2000s, the proportion shrunk, for the most part due to a drop in the share of the technological education in the Hebrew education sector, while at the same time there was a rapid increase in the Arab sector. Since then, there has been a rise in the share of students in technological education both in the Hebrew and Arab education systems (Blass and Shavit 2017) and, in the last three years (2015 to 2017), the share of students has remained stable at 40 percent (Figure 1). The share of technological track students in the Arab education system is higher than in the Hebrew sector.

5 The Hebrew and Arab education systems are based on the supervisory authority and language of instruction. The Hebrew education sector includes Hebrew State, State-religious, and Haredi schools. The Arab sector includes Arab, Druze, and Bedouin education. Bedouin education includes Bedouin schools in the North and South. Christian and Muslim students who are not Bedouin are usually enrolled in schools in Arab education. The majority of students in Hebrew education can be assumed to be Jewish, and the majority of students in the Arab sector can be assumed to be Arab Israelis. Nevertheless, the division by the Central Bureau of Statistics is based on the language of instruction and not the religion or sector of the students.

**Figure 1. Share of technology students out of all 12th graders**
**By education sector**




Source: Hadas Fuchs, Guy Yanay, and Nachum Blass, Taub Center | Data: Ministry of Education

Figure 1 shows the progress made over the last decade towards the Ministry of Education goal of increasing the share of technological education, as well as the stabilization of this trend in the last three years. The figure, though, does not show the real revolution that has occurred in technological education, especially in the Arab sector (Arab, Bedouin, and Druze education). This revolution has to do with the distribution of students within the technological tracks, as explained in the next section.

## Technological education — definitions, data, and a proposal for a new classification

The nature of technological education has changed greatly over the years. While in previous decades technological tracks had more rigid curricula and overall bagrut qualification rates among technological education graduates were lower than among academic education graduates, changes in the 1990s and 2000s adjusted the curricula to reflect changing technological and economic realities. These changes included an expansion of the academic and science studies in the technological education curricula with a resulting improvement in its students' prospects of taking and qualifying on the bagrut exams (Vurgan and Gilad 2008).

In 2006, a structural reform of technological education was completed. Since then, technological studies in high school have been comprised of three subject areas organized according to three selection groups. The first selection group requires that students take one of four science majors (physics, chemistry, biology, or "technological sciences") at a level of between one and five units. The second and third selection groups are determined by the study major, and include expert level and specialization subjects. These subjects can also be studied at a level of one to five units. In other words, students in technological education take a science subject plus two subjects associated with the major in which they enroll (Ministry of Education 2002).

The proliferation of majors in technological education, as well as reforms in the system over the years and the expansion of the academic and science foundation given to students, have led to a great deal of variance between study majors in technological education. This variance is reflected not only in the learned material but also in bagrut qualification rates and the quality of bagrut certification.[6] Some of the study majors include high-level engineering studies and preparation for higher education, while others focus on more traditional vocational subjects. Traditionally, technological education is divided into three groups: engineering and high tech majors, technological majors, and other vocational education and training (VET) majors. According to the division, determined by the Central Bureau of Statistics, students in the engineering majors have the highest achievements with good chances of qualifying for bagrut certificates, and are more likely to ultimately earn higher wages in the labor market (Weissblei 2018; Ministry of Finance 2017). The achievements of students in the technological track, and especially those in the VET track, are considerably lower than students in the academic track, and their students are characterized by weak socioeconomic backgrounds and lower wages (Blank, Shavit, and Yaish 2015; Ministry of Finance 2017).

While the current classification system definitely has some utility, it does not adequately account for the variability of majors within the different technological tracks.[7] The Ministry of Education has already expressed its dissatisfaction with the classification system (Vurgan and Gilad 2008) and

6 The "quality" of a bagrut certification is determined by the level of study of the subject matter. Thus, a student who studies and takes the bagrut exam at the three unit level is considered to be of "inferior quality" to a student who takes the exam at the five unit level.

7 This argument has also been made by Vurgan and Gilad (2008), and it is implicit in deliberations within the Central Bureau of Statistics (CBS) about whether to continue its use (reported to the authors by sources within the CBS).

the Central Bureau of Statistics intends to discontinue its use.[8] That being said, some form of classification is needed to differentiate among groups of students within technological education. To that end, this chapter proposes, then employs, a new classification and division of the technological majors. This new classification is not based on a subjective evaluation of the curriculum of each major. Rather, it is based on:

- the rate of those taking the bagrut;
- the bagrut qualification rate;
- the rate of students taking five units in math and English.

These parameters distinguish between the majors based on the share of those taking the bagrut exams, and the level of the bagrut certificate with which they are expected to graduate (the full list of majors by the Central Bureau of Statistics' classification and by the proposed division appears in Appendix Table 1).

Even though this categorization does not take into account some potentially important aspects, such as the relevance of the learned materials to the labor market, it has other advantages, and, in particular, it avoids clustering students with very different abilities into a single category. An example of one such misleading categorization can be seen in the medical systems major, which was traditionally classified as a VET (weak) major despite the fact that 90 percent of the students in this major qualify for bagrut certification, and the share of students taking five units in both math and English is nearly 20 percent. Another such example is the hair design and cosmetology major, which is currently categorized in the technological (middle) cluster. This major is by far the weakest among all majors in the technological education track, and only 5 percent of its students qualify for the bagrut. Categorizing it alongside majors in the technological track with a qualification rate of 70 percent is misleading. In an achievement-based classification system, these two specific examples clearly belong to the strongest and weakest achievement-based tracks respectively.

To avoid arbitrarily assigned majors to different groups, this study proposes a division based on the k-means algorithm,[9] for which the variables were the share of students taking the bagrut exams, the share

8 Private conversation with sources at the CBS.

9 The k-means algorithm divides the data into clusters based on each data point's attributes.

of those receiving a bagrut qualification, and the share of students who took five-unit bagrut tests in each major. In order to reduce the influence of fluctuations in these rates over the years, the rates were calculated for the entire time span, and for majors where the average annual number of students per class was more than 20. To maintain comparability to previous studies and publications, the new classification maintains a division into three groups. The three groups are high, medium, and low technological. The vast majority of students in the engineering and technological tracks did not move from one group to another (that is, they stayed in the high or medium technological group as appropriate) with the new classification, while changes in the VET-lower group are substantial; the majority of its students move to the medium (formerly "technological") group (Appendix Table 2).

A comparison of the tracks and bagrut data in the old and new classification system is presented in Table 1. In the past, the bagrut qualification rate in the engineering group was higher than that of the technological group, and that in turn was higher than in the VET group; so, too, in the new division, the level of bagrut entitlement of the high technological group is the highest, and, in the low technological group, bagrut qualification rate is the lowest.

According to the new division, the high technological group includes all of the study majors in which the rate of bagrut qualification exceeds 70.5 percent. In the medium technological group, the levels of qualification range from 20.7 to 70.5 percent, and, in the low technological group, the level of qualification in any single major does not exceed 20 percent. On almost all of the indices and in all cases, the groups are more homogeneous than in the traditional model, and their internal variance is lower (Appendix Tables 1 and 3). The division does not retain the same number of study majors and students in each group, but it does identify the majors that most resemble each other.

The main differences emerging from the re-classification are in the low track, which is now smaller and more distinct. It now includes a total of seven study majors and the share of students taking and qualifying for a bagrut is the lowest of the three tracks. There is a substantial increase in the size of the medium track. These changes reflect the changing image of technological education. While this used to be perceived as a track where graduates had slim chances of going on to higher education, its old image has changed since 2006, and no longer squares with the new reality for many technological education graduates. Although it is far from the truth, the poor image of technological education continues to color the opinions of many. The highly publicized spat between the Prime Minister and Minister Silvan

Shalom over how technological education dooms its students to become blacksmiths and carpenters feeding off of start-ups reflects the persistence of this poor image (Zinger 2014).

**Table 1. Distribution of tracks and bagrut results in the technological tracks: A comparison between the CBS classification (old) and this study's classification system (new), 2006-2017**

| | Percent of technological students | | Percent taking bagrut exams | | Percent with bagrut qualification | | Percent taking 5-units math and English | |
|---|---|---|---|---|---|---|---|---|
| Classification system | Old | New | Old | New | Old | New | Old | New |
| Engineering track/High | 32.8% | 37.7% | 97.6% | 97.9% | 82.9% | 83.9% | 27.5% | 26.9% |
| Technology track/Medium | 41.9% | 57.0% | 85.3% | 87.6% | 45.7% | 45.9% | 2.6% | 2.1% |
| VET track/Low | 25.3% | 5.4% | 84.2% | 61.3% | 38.7% | 10.3% | 1.3% | 0.1% |

Source: Hadas Fuchs, Guy Yanay, and Nachum Blass, Taub Center | Data: Ministry of Education

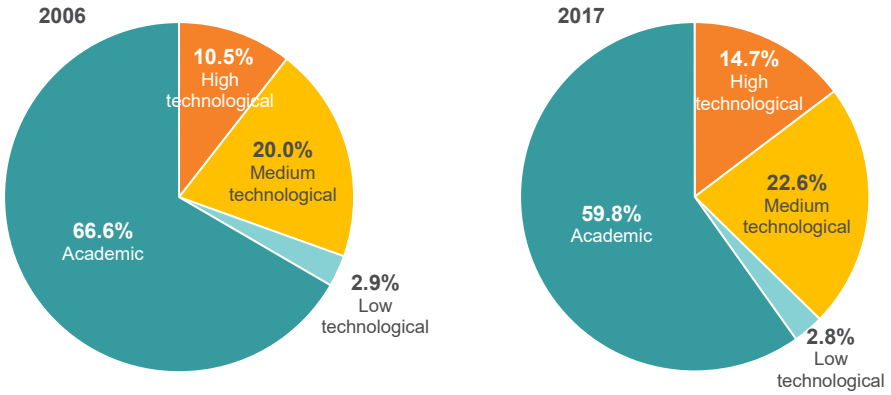
## The growth of technological education

As of 2017, 40 percent of 12th grade students are enrolled in technological education. Within that, 15 percent of the students study majors in the high track, 23 percent in the medium track, and less than 3 percent in the low track. Figure 2 shows that the share of 12th grade students in medium and low tracks rose from 23 percent in 2006 to 25 percent in 2017.[10] Of more interest, though, is a decline in the share of students in the academic track from 67 percent in 2006 to 60 percent in 2017, which coincided with a 4 percent rise in the share of students in the high technological track. In 2006, the number of students in this high track was only about one-sixth of the number of students in academic tracks, but, in 2017, it was about one-fourth. There is no doubt that this is an achievement for the Ministry of Education and its policy of strengthening high technological education. However, it appears that this trend is not primarily caused by students moving from the medium to the high technological track; rather, it is fueled by the movement of outstanding students out of the academic track. The question is whether

10 It is possible that the growth in the share of these tracks is a result of rising enrollment rates in high school education, with more additional students of lower academic abilities joining the ranks.

the students transferring are those who already have an inclination towards science, who would probably have turned to a technological-science track in any case, or if these are students who would naturally have favored the humanities but were persuaded to study in the technological track.

**Figure 2. Distribution of students by education tracks, 2006 and 2017**




| Educational track | Sample study majors |
|---|---|
| High technological | Computer systems; Biotechnology systems; Mechatronics |
| Medium technological | Systems control; Design; Human resource management; Telecommunications |
| Low technological | Culinary arts/Hospitality; Car mechanics; Cosmetology/ Hair design |

Source: Hadas Fuchs, Guy Yanay, and Nachum Blass, Taub Center | Data: Ministry of Education

To better understand changes in the structure of high school education, it is important to look at more than just fluctuations in the relative share of the different tracks; it is important to examine the absolute increase in the number of students (Table 2). For example, while the total number of students in the 12th grade increased between 2006 and 2017 by almost 18 percent, the number of students in academic track education increased by only about 4,000 students (a 6 percent increase), and the number of students in technological education increased by about 14,000 students (a 42 percent rise). On closer examination, the biggest increase was in the number of students in high technological education — about 7,000 students, or a 65

percent increase. As noted previously, if the Ministry of Education's goal was to motivate students with the highest academic skills to study educational tracks that encourage employment in high tech and advanced industries, it appears to have achieved its goal to some extent.

**Table 2. All 12th grade students by educational tracks**

| | Academic track | Technological track | | | | Total |
|---|---|---|---|---|---|---|
| | | High | Medium | Low | Total | |
| 2006 | 66,708 | 10,546 | 19,987 | 2,920 | 33,453 | 100,161 |
| 2017 | 70,640 | 17,360 | 26,700 | 3,340 | 47,400 | 118,040 |
| Percent increase | 5.9% | 64.6% | 33.6% | 14.4% | 41.7% | 17.9% |

Source: Hadas Fuchs, Guy Yanay, and Nachum Blass, Taub Center | Data: Ministry of Education

Along with the growth in the share of students enrolled in technological education, the number of schools offering these studies has expanded. The number of schools offering only an academic track increased by only 17, whereas the number of schools offering technological tracks rose by 291 (207 comprehensive schools, and 84 technological schools). The comprehensive schools are larger than the academic and technological schools, and the average number of students in their senior classes is more than double. They comprise 44 percent of all schools, and 69 percent of the students who graduated in 2017 (Tables 3a and 3b).

**Table 3a. Number of students in 12th grade by type of school and tracks offered**

| | | | Comprehensive schools | | |
|---|---|---|---|---|---|
| | Academic schools | Technological schools | Total | Academic majors | Technological majors |
| 2006 | 28,678 | 8,192 | 63,291 | 38,030 | 25,261 |
| 2017 | 24,501 | 12,286 | 81,253 | 46,139 | 35,114 |
| **Their portion of the cohort** | | | | | |
| 2006 | 28.6% | 8.2% | 63.2% | 38.0% | 25.2% |
| 2017 | 20.8% | 10.4% | 68.8% | 39.1% | 29.7% |

Source: Hadas Fuchs, Guy Yanay, and Nachum Blass | Data: Ministry of Education

## Table 3b. High schools, by type of school and tracks offered

| | | Academic high schools | Technological high schools | Comprehensive high schools | Total |
|---|---|---|---|---|---|
| Hebrew, State | 2006 | 102 | 54 | 222 | 378 |
| | 2017 | 75 | 56 | 267 | 398 |
| | Difference | -27 | 2 | 45 | 20 |
| Hebrew, State-religious | 2006 | 121 | 38 | 67 | 226 |
| | 2017 | 107 | 48 | 128 | 283 |
| | Difference | -14 | 10 | 61 | 57 |
| Haredi | 2006 | 233 | 28 | 12 | 273 |
| | 2017 | 266 | 76 | 54 | 396 |
| | Difference | 33 | 48 | 42 | 123 |
| Arab | 2006 | 45 | 22 | 58 | 125 |
| | 2017 | 76 | 40 | 95 | 211 |
| | Difference | 31 | 18 | 37 | 86 |
| Druze | 2006 | 7 | 4 | 10 | 18 |
| | 2017 | 4 | 4 | 13 | 21 |
| | Difference | -3 | 0 | 3 | 3 |
| Bedouin | 2006 | 3 | 2 | 18 | 23 |
| | 2017 | 0 | 5 | 37 | 42 |
| | Difference | -3 | 3 | 19 | 19 |
| Overall | 2006 | 511 | 145 | 387 | 1043 |
| | 2017 | 528 | 229 | 594 | 1351 |
| | Difference | 17 | 84 | 207 | 308 |

Source: Hadas Fuchs, Guy Yanay, and Nachum Blass, Taub Center | Data: Ministry of Education

## Trends in technological education by sector and gender

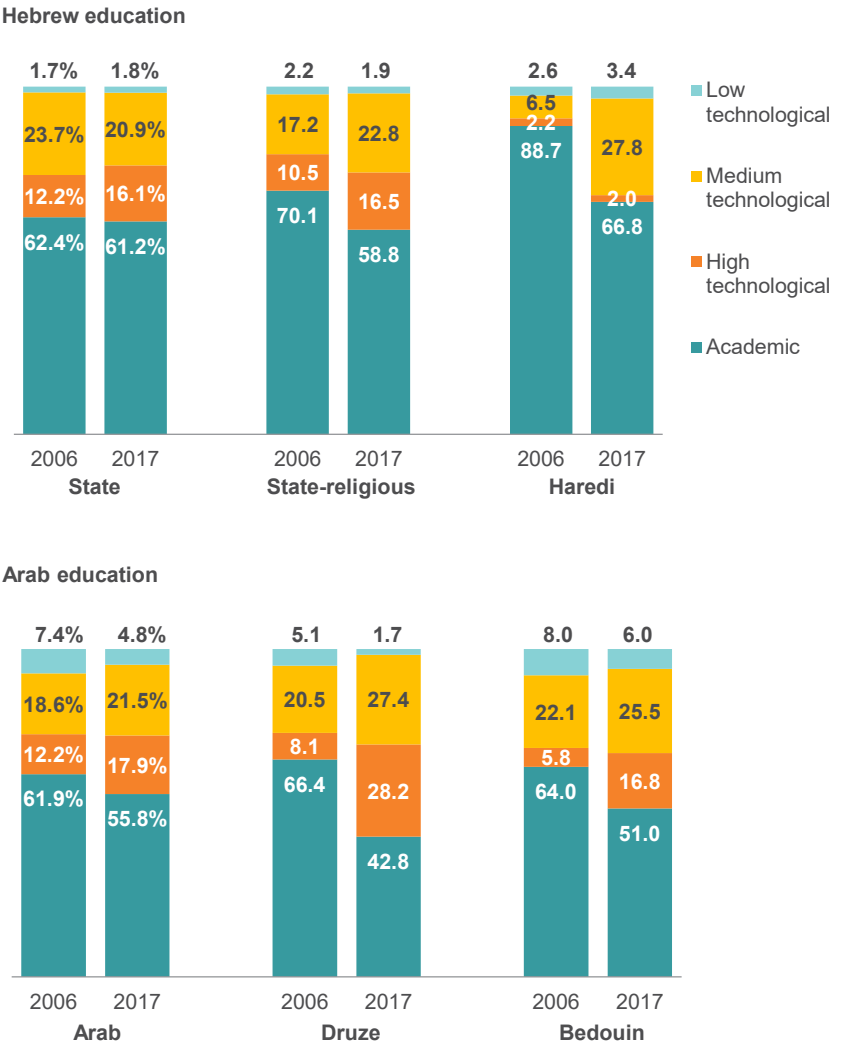
The share of students in technological education increased in all of the education streams (Hebrew and Arab), but there are large differences between sectors and genders. Figure 3 presents the composition of study tracks in technological education across the different education streams. In all of the education streams, there was an increase in the share of students enrolled in technological education, with a particularly noteworthy rise in Haredi and Druze education.[11]

A look at the high technological track shows that its share of students increased in all streams of education except the Haredi stream, and that the increase in Hebrew State education was the lowest (only 4 percent). In the Arab sector, the increase was larger, and the share of students in this track is higher than in the Hebrew sector. The increase was especially large among the Druze and Bedouin — 20 percentage points in Druze education and 11 percentage points in Bedouin education. Here, too, the change primarily reflects student preferences, and the driving force comes from students transferring from academic education to high technological education. The change is substantial and could lead to greater integration of the Arab Israeli population, especially the Druze and Bedouin, into more prestigious occupations in the Israeli labor market.

The share of students in the medium technological track dropped in Hebrew State education and rose slightly in the rest of the educational streams except for Haredi education, where there was a significant increase. The share of students in the low technological track is very low in the Jewish population, and declining in the Arab Israeli population as well.

11 It is important to note that the number of students in Bedouin and Druze education is small. The number of Haredi students enrolled in non-yeshiva high schools is also very small, so percentage changes should be interpreted cautiously.

## Figure 3. Composition of educational tracks, 2006 and 2017

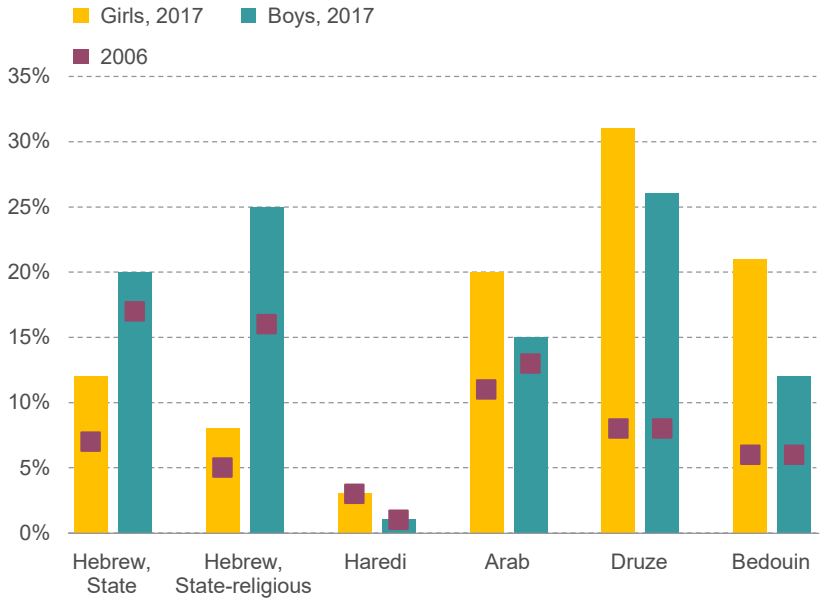



Source: Hadas Fuchs, Guy Yanay, and Nachum Blass | Data: Ministry of Education

Another data point that highlights the change in the Arab sector is the rise in the number of girls choosing the high technological track. Generally, in all of the education streams except for the Haredi streams, the share of boys in technological education is higher than the share of girls. In the Hebrew sector, the share of girls in the high technological track is considerably smaller than the share of boys, whereas in the Arab sector, the opposite is the case (Figure 4). Here, too, the most noteworthy change is in Druze and Bedouin education. In Druze education, the share of girls enrolled in the high technological track rose from 8 percent in 2006 to 31 percent in 2017, and the share of boys in that track rose during those years from 8 percent to 26 percent. In Bedouin education, the gap between girls and boys is the largest: the share of girls enrolled in the high technological track rose from 6 percent to 21 percent, whereas among boys it rose from 6 percent to only 12 percent. The greater increase in the share of girls in the high track is accompanied by a large increase in the bagrut qualification rate and in the number of Arab Israeli women pursuing academic studies (Fuchs 2017). The effects of these trends can already be seen in the sharp drop in the birth rate within the Arab Israeli population from 2006 to 2017, and the rapid growth in the last two years (2017-2018) in the employment of Arab Israeli women (Fuchs and Weiss 2018) — trends that are expected to continue. The advancement in educational achievements of Arab Israeli girls, and, in turn, in their employment, will no doubt impact future developments in Arab Israeli society, although in exactly what additional ways is still unknown.

In contrast to the changes in the Arab sector, girls are still a minority in high technological education in the Hebrew education sector, as in all the science studies. Particularly noteworthy is the low share of girls enrolled in the high technological track in State-religious education. Most of the students in State-religious high schools are in single-sex schools, and the schools in this educational stream are relatively small. It appears that the small number of students per class, alongside segregated education for girls, makes it difficult to open high technological tracks in these schools with the result that there are fewer options for girls wishing to study technological majors. Indeed, the number of girls' schools in State-religious education that offer technological tracks is small: 19 schools, which is only 18 percent of the girls' schools, compared to 48 percent in all other non-Haredi schools. This figure deserves special attention, because there may be religious girls who would choose high technological education, but are denied the opportunity. One possibility for increasing the options open to these girls is combining technological classes between a number of religious schools.

**Figure 4. Share of students in the high technological track, 2006 and 2017**




Source: Hadas Fuchs, Guy Yanay, and Nachum Blass, Taub Center | Data: Ministry of Education

In contrast to enrollment in the high technological track, in the medium and low tracks, the portion of boys in the Arab sector is higher than that of girls, and shows the largest gender gap (Appendix Figure 1). In State-religious and Haredi education, the share of girls in the medium track is relatively high, and is higher than the share of boys: 28 percent of religious girls were enrolled in the medium technological track in 2017 (a 6 percent rise since 2006) compared to 17 percent of religious boys. Most of that growth comes from students in the design major.

In Haredi education, most of the boys are listed as being in academic education. Among the girls, on the other hand, there has been a significant increase in the portion of students in the medium technological track, increasing from 9 percent in 2006 to 46 percent in 2017, with most of these students studying bookkeeping and human resources majors. The large increase in the share of Haredi girls enrolled in these majors seems to indicate a change in Haredi seminaries and an expansion of educational opportunities

offered to Haredi women. Whereas in the past the vast majority of women in the Haredi sector went into the teaching profession (Regev 2013), today, partly due to a surplus of Haredi teachers, they are pursuing other areas of study that direct them towards different occupational tracks.

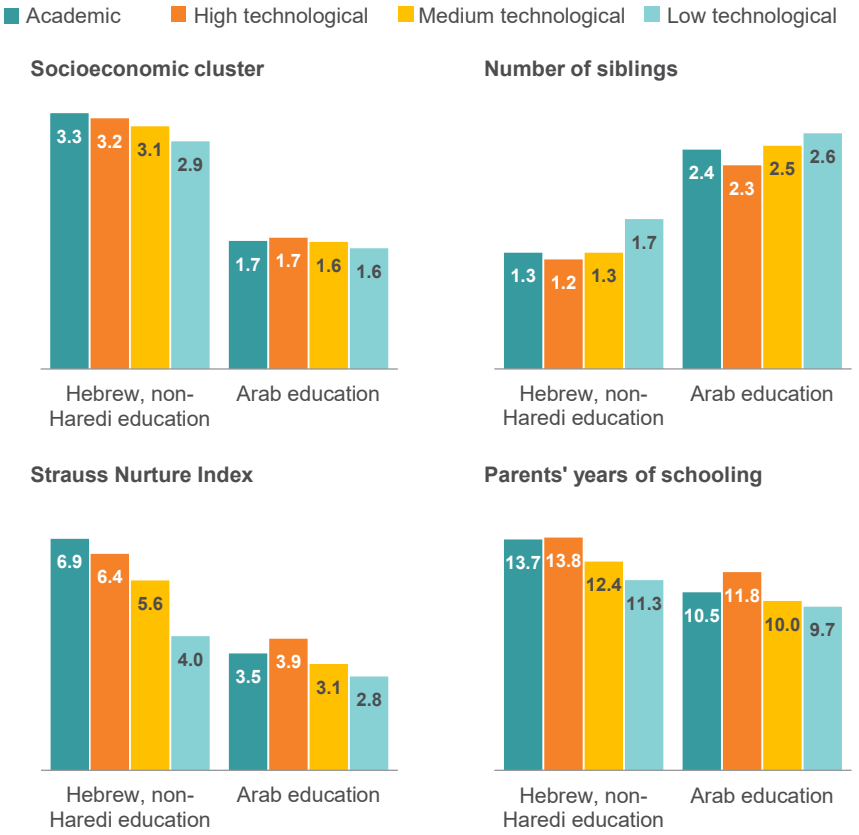
## The socioeconomic and academic background of students in technological education

The socioeconomic and academic profile of technological students is a particularly interesting topic.[12] The graphs in Figure 5 show that, as expected, students' socioeconomic background is highly correlated with the level of academic achievement in each of the technological tracks: the students in the high technological track come from the strongest backgrounds, followed by the students in the medium and low tracks (Blank, Shavit, and Yaish (2015) showed a similar result). Among students in Hebrew education, those in the academic and high technological tracks have similar socioeconomic backgrounds. In Hebrew education, parents' average years of schooling for students in the high technological and academic tracks is 13.7 years, while in the Arab sector, parents' average years of schooling is 11.8 years in the high track and 10.5 years in the academic track. The same holds for other variables, with the socioeconomic level of the Arab students in the high track being much lower than that of their peers in Hebrew education. In the Arab education sector, there is a smaller gap between students in the medium technological track and students in academic education, which shows how widespread technological education is in Arab Israeli society.

12 The data at an individual level available from the Ministry of Education's virtual research room are parents' education, number of siblings, and locality of residence. Figure 5 presents data both according to the "Strauss Nurture Index" — the school Nurture Index used by the Ministry of Education — and by socioeconomic ranking of the student's place of residence by the Central Bureau of Statistics. In the Strauss Nurture Index, a high rank indicates a weak socioeconomic population, whereas, in the Central Bureau of Statistics index, it indicates a strong population. For clarity, the index that represents the school-level Nurture Index for this chapter is the reverse of the Strauss Index, so that in both indices presented here a high rank indicates a strong population. The CBS's socioeconomic clusters of the students' localities are based on 2013 figures, and as part of the Ministry of Education's policy to protect the identity of students, they omitted 47 localities with a population of less than 5,000. The total residents in these localities is 51,000, which constitutes less than 1 percent of the general population. It should be emphasized that the authors of this article estimate that the Nurture Index is a more reliable measure than the socioeconomic cluster by locality because of processes of selection and choices in high school education enrollment. The high school student population is usually more homogeneous than the population of the localities where students live.

## Figure 5. Socioeconomic profiles of 12th grade students, 2006-2017

**Averages by track and sector**




Note: Socioeconomic cluster and Strauss Nurture Index quintiles run from 1 to 5, with 1 being the weakest socioeconomic group and 5 the strongest. See footnote 12 for a more detailed explanation.

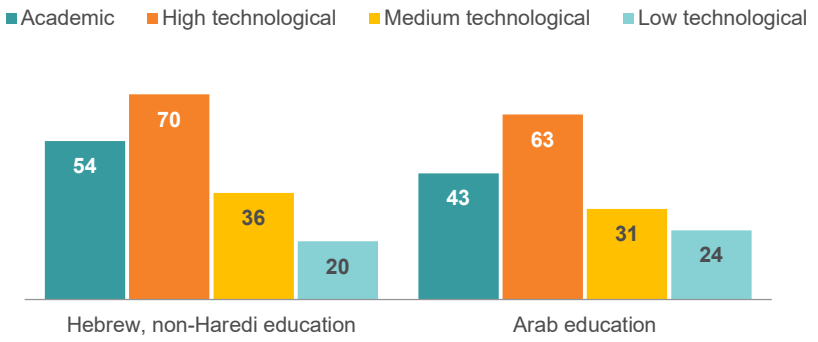
Source: Hadas Fuchs, Guy Yanay, and Nachum Blass | Data: Ministry of Education

As expected, the mathematics skills of students in high technological education, as measured before high school in the quantitative portion of the 8th grade Meitzav exams, are higher than those of students in academic education and medium and low technological education (Figure 6).[13] The

13 Meitzav is the Hebrew acronym for Measurement of School Growth and Efficiency.

average percentile of the students in the high technological track is 16 points higher in the Jewish population and 20 points higher in the Arab population than that of students in academic education. The skills of students in the medium track are lower, and the skills of the students in the low track are the lowest.

**Figure 6. Average percentile in the Meitzav math exam, 8th grade students, 2006-2017**

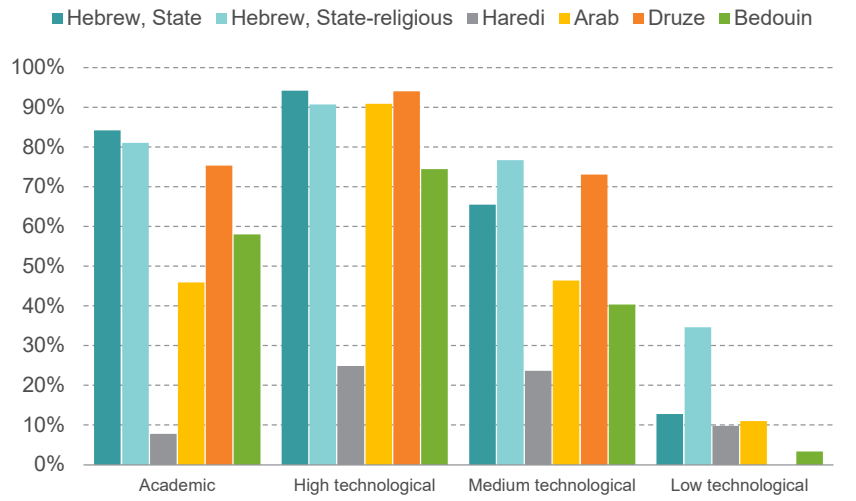



Source: Hadas Fuchs, Guy Yanay, and Nachum Blass, Taub Center | Data: Ministry of Education

In the Arab education sector, the association between mathematical skills and study track is stronger. In the lowest quintile of Meitzav achievements, the share of students in the high track is very low in both the Arab and Hebrew education system, but in the top Meitzav quintiles, that is, among those with the strongest mathematical skills, Arab students' prevalence in the high track is notable. This difference is also especially notable among girls in Hebrew education with the highest mathematical skills. Among boys in Hebrew education technological tracks, the share placing in the top quintile of Meitzav scores in the quantitative portion of the exams is 47 percent; among girls, it is only 26 percent.

Figure 7 shows the level of bagrut qualification across the different tracks. The figure shows that the qualification rates of the Arab and Druze students in the high track are identical to those of students in Hebrew education, ranging around 90 percent. This is a noteworthy finding considering that their socioeconomic profiles are lower. Even in Bedouin education, some 74 percent of the students in the high track receive bagrut qualification.

**Figure 7. Bagrut qualification by educational sector and track, 2017**




Source: Hadas Fuchs, Guy Yanay, and Nachum Blass | Data: Ministry of Education

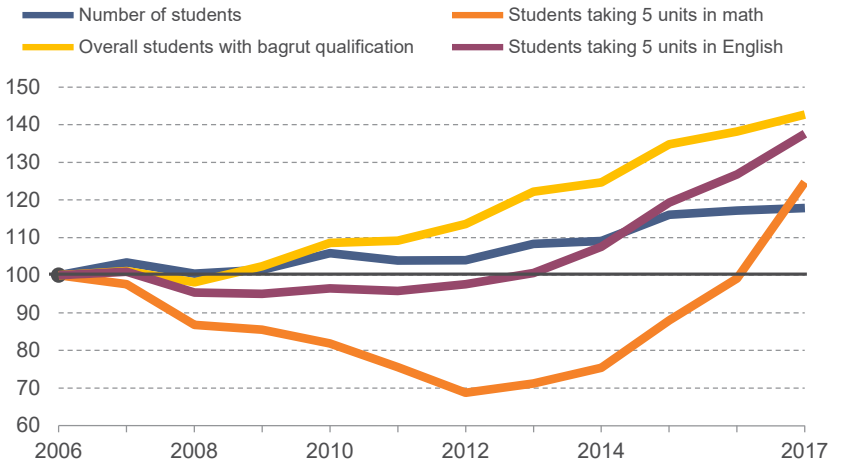
However, there are still significant disparities in the share of students who take math and English at the five-unit level. Despite the considerable achievements of the Arab and Druze students in the high track (the Druze students' achievements are even higher than those of students in Hebrew State and State-religious schools), the differences between the populations remain large, as the following section shows.

## 2. Bagrut data: Five units in math and English, achievements, and study majors

As noted previously, increasing the rate of bagrut qualification at the five-unit level in math and English is one of the main goals set by the Ministry of Education. Figure 8 shows that, after years of decline in the number of students taking the bagrut at those levels, the Ministry of Education is on the right track to achieve its goal. From 2006 to 2017, the number of students in the 12th grade grew by 18 percent, and the bagrut qualification rate rose by a total of 42 percent.

The number of students taking math and English at the five unit level dropped at the beginning of this period, despite an increase in the overall number of students. However, this trend did not continue and, in recent years, there has been a significant increase in the number of students taking the bagrut exams. Following several years with almost no change in the number of students taking the English bagrut exam at the five-unit level, there has been a 20 percent increase in the number of students testing at this level since 2013. The number of students who take five units in math dropped substantially between 2006 and 2012. Following incentives initiated by the Ministry of Education, the number has since risen significantly and, in 2017, for the first time in a decade, exceeded the 2006 number (with a 56 percent rise since 2012). These impressive results are solid evidence that when the Ministry of Education and its leaders set concrete and defined objectives, they have the means and the ability to achieve them.

**Figure 8. Change in student achievements**
**Index year: 2006 = 100**



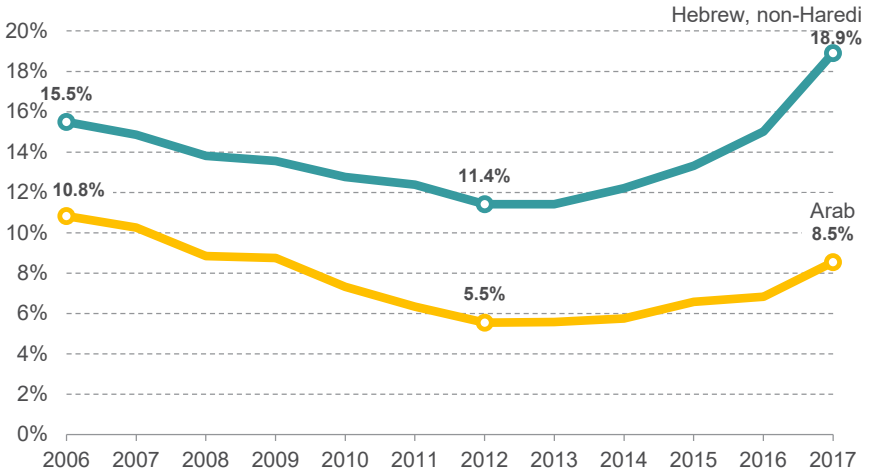

Source: Hadas Fuchs, Guy Yanay, and Nachum Blass | Data: Ministry of Education

The rise in the share of students studying math and English at the five-unit level is different in the Hebrew and Arab education sectors.[14] In the Arab

14 The rate of Haredim taking the bagrut exams is low, and therefore they are not included in this analysis.

sector, in 2006, the share of students studying math at the five-unit level was lower than in the Hebrew sector — 11 percent compared to 15.5 percent. Furthermore, until 2012, the decrease was larger in the Arab sector, and the recovery since has been slower (Figure 9). Though not examined in depth in this study, one possible explanation is that the desire to see higher rates of bagrut qualification has come at the expense of students studying math at the highest levels.

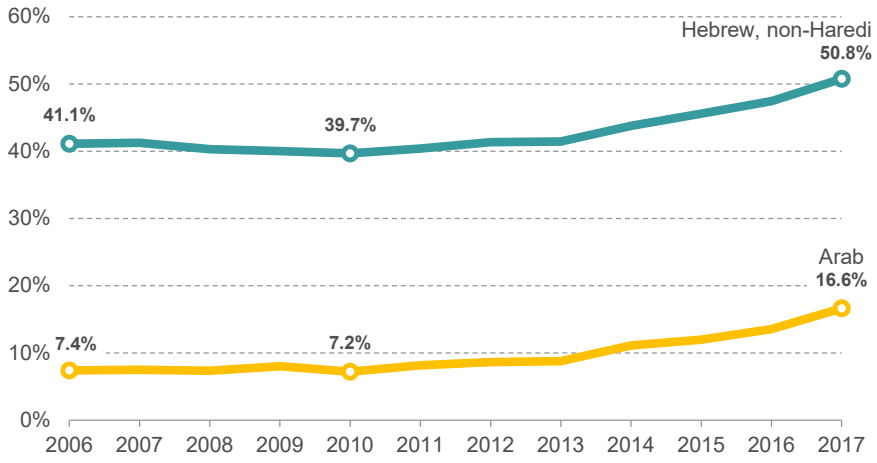
**Figure 9. Share of students taking the bagrut in math at the five-unit level**




Source: Hadas Fuchs, Guy Yanay, and Nachum Blass, Taub Center | Data: Ministry of Education

As previously noted, the number of students taking five units in English has risen. In non-Haredi Hebrew education, that rate is very high, and more than half of the students take the bagrut exam at that level (Figure 10). In the Arab sector, the share of students studying English at the highest level is much lower — only 16.6 percent in 2017. Nonetheless, this represents a significant increase. The 2017 figure is nearly double the 2011 rate. The low level of English in the Arab education sector has a negative impact on the ability of these young adults to integrate into occupations with higher wages (Brand 2018). Continued improvement in English proficiency in the Arab education sector is critical to closing labor market gaps.

**Figure 10. Share of students taking the bagrut exam in English (as a second language) at the five-unit level**



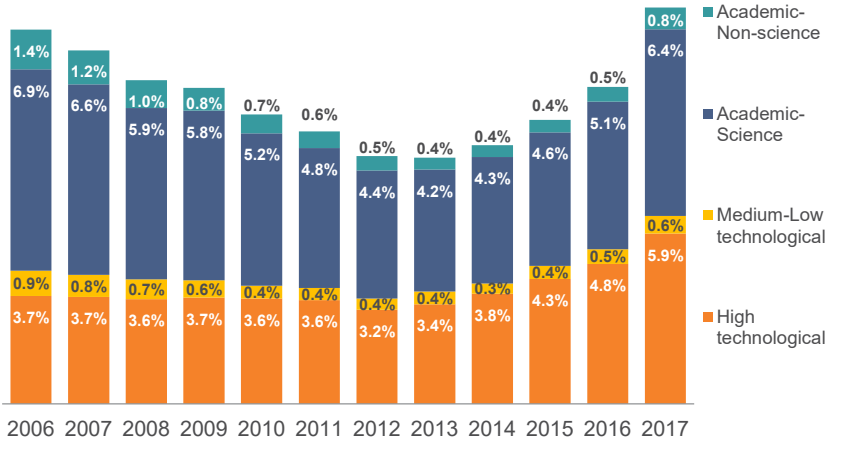

Source: Hadas Fuchs, Guy Yanay, and Nachum Blass, Taub Center | Data: Ministry of Education

Although science and technological education are more common in the Arab sector than in Hebrew education, the quality of the bagrut certificate is still lower, with fewer students taking high-level math and English (though there are indications of improvement). It should come as no surprise, then, that the percentage of students taking five units in math and English is lower in the Arab sector when broken down into study tracks as well (Appendix Figures 2 and 3). The share of students taking high-level math and English is low in each of the technological tracks in the Arab sector, especially in Bedouin education. The gaps are especially wide in English, and, except for students in the high technological track, the share of students taking English at the five-unit level is very low.

However, there has been improvement in the Arab education sector. This is particularly noteworthy in Bedouin education, where bagrut results in 2006 were very low (the rate of bagrut qualification was only 41 percent), and the number of students who took five units in math was only a few dozen. By 2017, enrollment rates through 12$^{th}$ grade rose sharply, and the number of Bedouin students in the 12$^{th}$ grade almost doubled. At the same time, the number of students with bagrut qualifications rose 2.5-fold, the number of students taking five units in math rose 4-fold, and the number of students taking five units in English increased more than 11-fold.

Growth in the share of students taking advanced math and English came at the same time as the growth in the share of students enrolled in high technological education. Both are goals at the center of the Ministry of Education's agenda, and the source of improvement for both seems to be the encouragement the Ministry of Education offered. It is also likely that employment opportunities in the labor market, the high return on high mathematical skills, and jobs available in the high tech industry, have also pushed students to take advanced math and enroll in the high technological track. Almost all of the students taking advanced math are either enrolled in technological education or are science majors in an academic track. In 2017, of all students taking five units in math, 47 percent (6.4 percent of the total graduating population) were students in technological education, most of them in the high technological track (Figure 11). Another 47 percent were students in the academic track taking science at the five-unit level, and only 6 percent of the students (0.8 percent of the total graduate population) were enrolled in non-science academic majors. Among girls, that rate was somewhat higher than among boys, but still low (7 percent compared to 4 percent, respectively, see Appendix Figure 4), and continuing to decline.

**Figure 11. Share of students taking the bagrut exam in math at the five-unit level by educational track**




Source: Hadas Fuchs, Guy Yanay, and Nachum Blass, Taub Center | Data: Ministry of Education

## Conclusion

Technological education is expanding. There has been a particularly noteworthy increase in the share of students in the high technological track, which has come mainly from students transferring from the academic track. The new classification system presented by this study creates a low technological track that includes fewer study majors and fewer students than the traditional classification system. The trend of more students enrolling in technological tracks is particularly strong in the Arab sector. There are also large differences between girls and boys studying in the technological tracks in different sectors. The share of girls in Hebrew education enrolled in the high technological track, especially in State-religious education, is low compared to that of boys, whereas in Arab education, the share of girls in this track is relatively high. It appears that fewer State-religious schools offer high technological education, thus preventing interested girls from pursuing these majors. In Haredi education, the share of girls in medium technological education is high, and has risen sharply since 2006. With the increase in the share of girls enrolled in this track, new career opportunities are opening up for Haredi women, in addition to the classic teaching track.

Alongside an increase in the share of students in technological education, there has been an increase in the quality of bagrut qualifications, including an increase in the share of students qualifying in math and English at the five-unit level. These trends seem to go hand-in-hand: the share of students taking five units in math who do not study science or technology at a high level is very low, and declining.

Despite progress in the share of students in technological education and the share taking advanced math and English, two important questions remain: one, has the strong emphasis put on these two subjects come at the expense of other subjects, perhaps due to an implicit message that other subjects are less important? And the other, should the increase in the number of students taking five units in math and English be credited mainly to Ministry of Education policies, or are there other factors that contributed to this development? Attempts to answer these questions will be the subject of future research.

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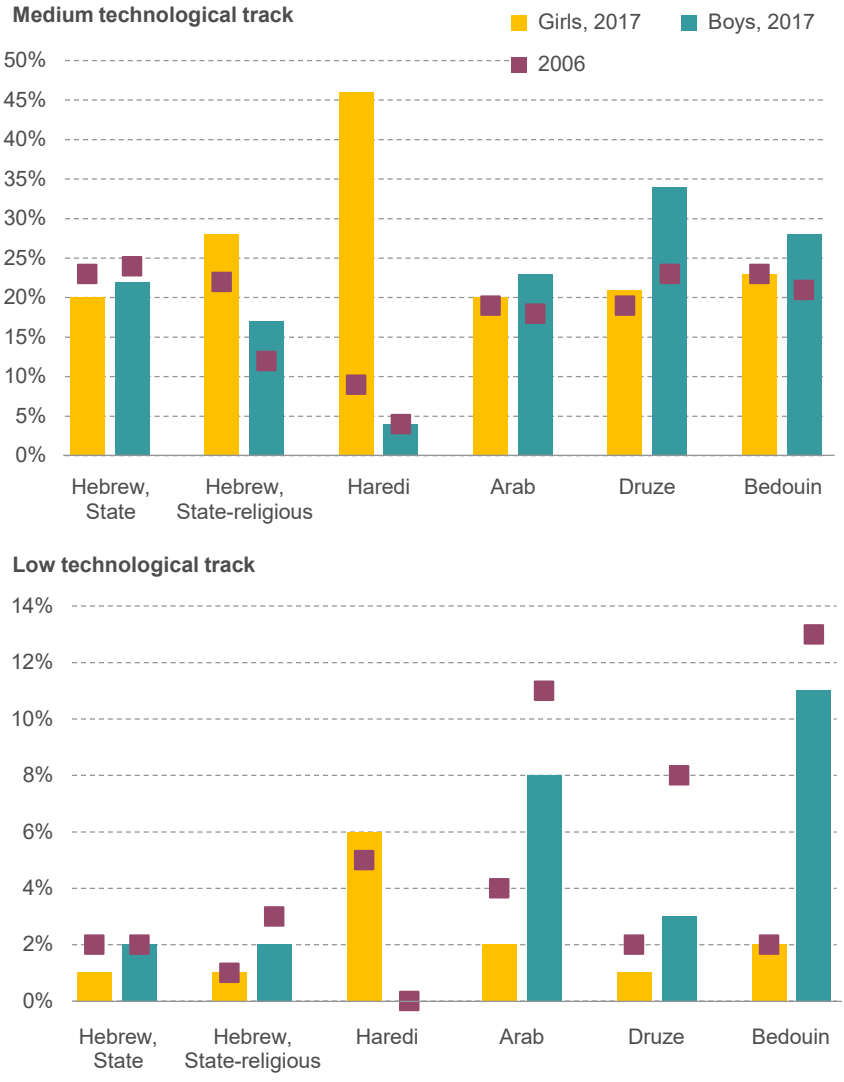
# Appendix

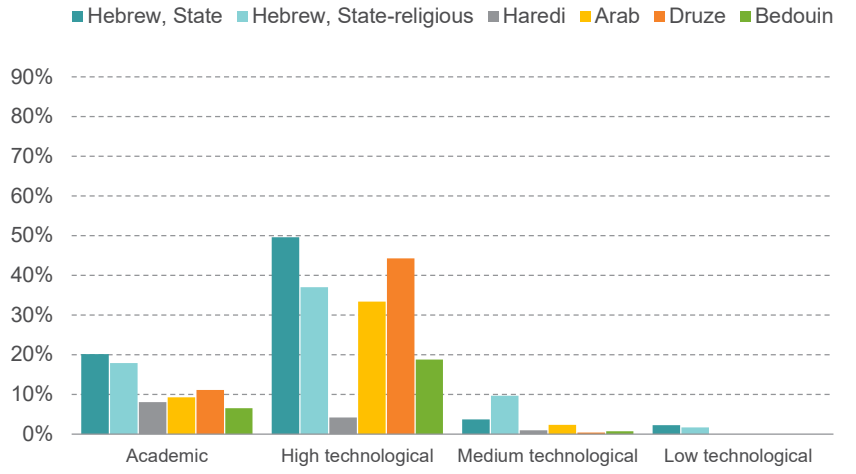
## Appendix Figure 1. Share of students in the medium and low technological tracks, 2006 and 2017




Source: Hadas Fuchs, Guy Yanay, and Nachum Blass, Taub Center | Data: Ministry of Education

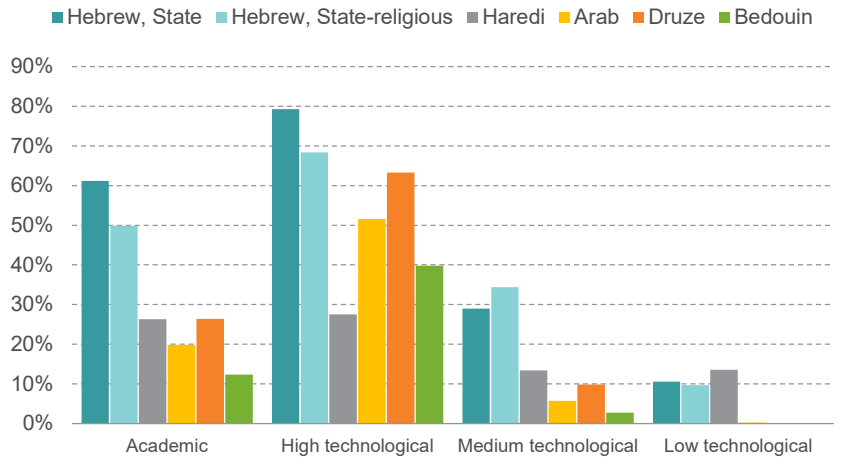
## Appendix Figure 2. Share of students taking the bagrut exams in math at the five-unit level, 2017

**By education track and sector**



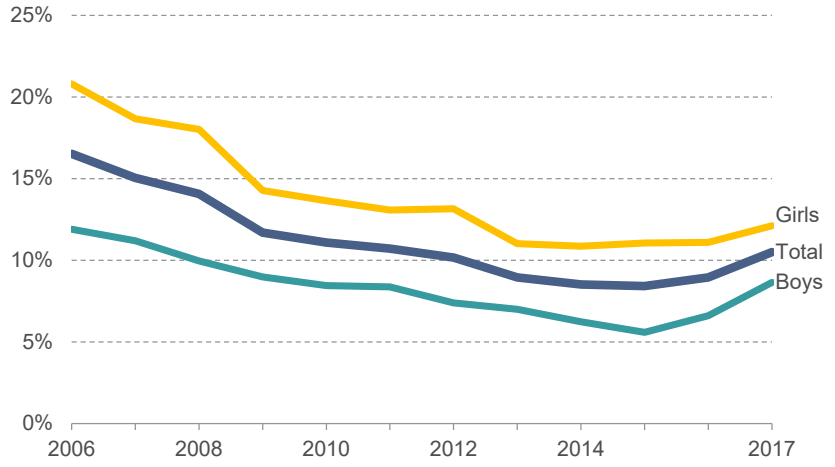

## Appendix Figure 3. Share of students taking the bagrut exams in English (as a second language) at the five-unit level, 2017

**By education track and sector**




Source for both figures: Hadas Fuchs, Guy Yanay, and Nachum Blass | Data: Ministry of Education

**Appendix Figure 4. Share of students studying math at the five-unit level (in the academic education track) who are not in STEM studies**




Source: Hadas Fuchs, Guy Yanay, and Nachum Blass, Taub Center | Data: Ministry of Education

## Appendix Table 1. List of study majors in technological education, 2006-2017

**Percent taking bagrut exams, percent with bagrut qualification, percent studying 5-units math and English, CBS classification, and new classification**

| No. | Study major | Percent taking bagrut exams | Percent with bagrut qualification | Percent studying 5-units math and English | CBS track | New track |
|---|---|---|---|---|---|---|
| 2030 | Hair design/Cosmetology | 43.0% | 5.4% | 0.0% | Technological | Low |
| 3410 | Culinary arts | 48.0% | 5.9% | 0.0% | VET | Low |
| 1040 | Computerized vehicle systems | 72.9% | 7.5% | 0.0% | Technological | Low |
| 3320 | Climate control systems | 88.8% | 8.6% | 0.0% | Technological | Low |
| 1030 | Mechanics | 69.1% | 10.0% | 0.0% | Technological | Low |
| 1020 | Mechanical systems maintenance | 68.3% | 11.7% | 1.3% | Technological | Low |
| 3250 | Mechanical engineering equipment | 100.0% | 12.5% | 0.0% | Engineering | * |
| 2020 | Fashion/Fashion design | 61.4% | 18.1% | 0.2% | Technological | Low |
| 2510 | Early education | 84.6% | 27.3% | 0.0% | VET | Medium |
| 3510 | Telecommunications | 83.9% | 29.9% | 0.4% | Technological | Medium |
| 1710 | Human resource management | 82.6% | 33.2% | 0.3% | VET | Medium |
| 1920 | Hotel management | 85.5% | 33.4% | 0.1% | VET | Medium |
| 2120 | Photographic systems | 79.6% | 40.4% | 0.5% | Technological | Medium |
| 1010 | CAD/CAM systems | 88.4% | 40.5% | 3.7% | Technological | Medium |
| 3310 | Supply/Supervision/Quality control systems | 87.3% | 40.7% | 1.6% | Technological | Medium |
| 1720 | Bookkeeping | 84.4% | 41.8% | 0.5% | VET | Medium |
| 1220 | Building engineering | 94.8% | 45.9% | 0.1% | Technological | Medium |
| 1910 | Tourism management | 95.8% | 51.8% | 0.7% | VET | Medium |
| 3210 | Aviation systems | 97.2% | 52.5% | 0.8% | Engineering | Medium |
| 1820 | Marketing management | 95.5% | 53.5% | 1.7% | Technological | Medium |
| 2010 | Design | 86.5% | 53.8% | 3.9% | Technological | Medium |
| 3230 | Thermodynamics | 99.8% | 55.5% | 1.4% | Engineering | Medium |
| 2410 | Nursing care | 97.1% | 56.3% | 0.4% | VET | Medium |

## Appendix Table 1 (continued). List of study majors in technological education, 2006-2017

**Percent taking bagrut exams, percent with bagrut qualification, percent studying 5-units math and English, CBS classification, and new classification**

| No. | Study major | Percent taking bagrut exams | Percent with bagrut qualification | Percent studying 5-units math and English | CBS track | New track |
|---|---|---|---|---|---|---|
| 2520 | Teaching | 96.5% | 56.8% | 0.0% | VET | Medium |
| 1210 | Architecture | 95.0% | 59.2% | 3.6% | Technological | Medium |
| 1120 | Computer/Control systems | 94.9% | 60.6% | 17.4% | Engineering | Medium |
| 3240 | Autotech | 85.1% | 61.7% | 0.0% | Engineering | Medium |
| 3120 | Advertising/Public relations | 92.3% | 63.9% | 2.5% | Technological | Medium |
| 2610 | Marine systems | 99.9% | 65.4% | 1.3% | Technological | Medium |
| 3110 | Electronic communication | 97.5% | 70.4% | 3.1% | Technological | Medium |
| 1830 | Shipping | 100.0% | 70.5% | 6.4% | Technological | High |
| 2110 | TV/Film systems | 98.9% | 72.9% | 4.2% | Technological | High |
| 1810 | Export management | 99.2% | 76.6% | 10.6% | Technological | High |
| 1140 | Communication systems | 98.5% | 79.8% | 17.7% | Engineering | High |
| 3220 | Mechatronics | 99.1% | 81.6% | 21.1% | Engineering | High |
| 1410 | Design/Systems programming | 96.1% | 82.9% | 33.5% | Engineering | High |
| 2420 | Medical systems | 99.8% | 88.2% | 18.9% | VET | High |
| 3010 | Integrated technology | 99.2% | 90.5% | 43.3% | Engineering | High |
| 1610 | Bio-technology systems | 99.9% | 94.1% | 29.4% | Engineering | High |
| 1130 | Computer systems | 99.6% | 95.8% | 42.2% | Engineering | High |
| 1420 | Computer information services | 100.0% | 100.0% | 46.2% | Engineering | * |

* Cannot be classified due to the small number of students.
Source: Hadas Fuchs, Guy Yanay, and Nachum Blass | Data: Ministry of Education

## Appendix Table 2. Number of students in each education track, old and new classifications, 2006-2017

| Number of students transferring between tracks | | New classification | | |
|---|---|---|---|---|
| | | High | Medium | Low |
| Old classification | Engineering | 146,924 | 8,046 | — |
| | Technological | 8,522 | 155,299 | 33,762 |
| | VET | 6,351 | 109,991 | 2,942 |

Source: Hadas Fuchs, Guy Yanay, and Nachum Blass | Data: Ministry of Education

## Appendix Table 3. Standard deviation between study majors by technological tracks, 2006-2017

**Using the old and new classification systems**

| Standard deviation between the majors within each technological track | Bagrut exams | | Bagrut qualification | | 5-units math and English | |
|---|---|---|---|---|---|---|
| | Old | New | Old | New | Old | New |
| Engineering/High | 0.041 | 0.011 | 0.239 | 0.082 | 0.171 | 0.133 |
| Technological/Medium | 0.149 | 0.062 | 0.242 | 0.120 | 0.026 | 0.036 |
| VET/ Low | 0.148 | 0.143 | 0.218 | 0.040 | 0.059 | 0.005 |

Source: Hadas Fuchs, Guy Yanay, and Nachum Blass | Data: Ministry of Education