

Choosing Excellence in Middle School Mathematics and Science Studies

Philanthropic Roadmap 2019–2024

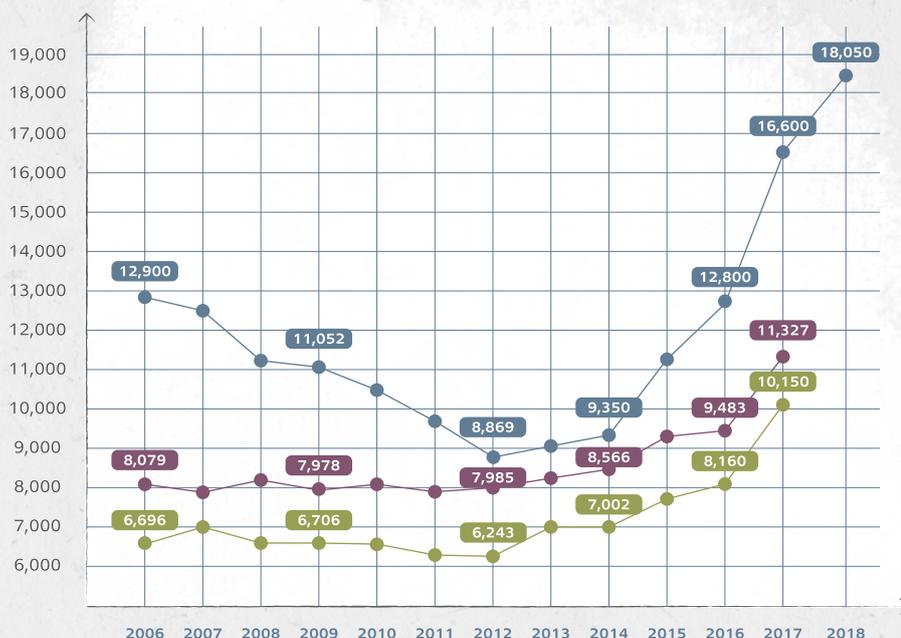
The Trump Foundation was founded in 2011 to help the education system in Israel expand the circle of excellence in the fields of mathematics and science. Together with many partners, we invest in excellence because strong capabilities in mathematics and science are “golden keys” in the 21st century to technological innovation, economic growth, scientific breakthroughs, narrowing of the social gaps and success on a personal level.

When learning in classes of excellence, students must tackle new challenges and complex problems. This requires the development of character traits and values such as initiative, creativity, persistence, hard work, in-depth thinking and analytic abilities. This challenging educational journey depends on outstanding teachers who apply strong expertise in clinical teaching, and mentor each student along the way.

We have focused our main efforts on increasing the number of students studying the five-unit tracks in mathematics and physics. In Israel, these tracks have already proven effective in fostering excellence and producing graduates who go on to do ground-breaking work. We are very pleased with the upturn in these tracks in recent years, the result of a shared and ongoing effort by dozens of organizations and hundreds of professionals.

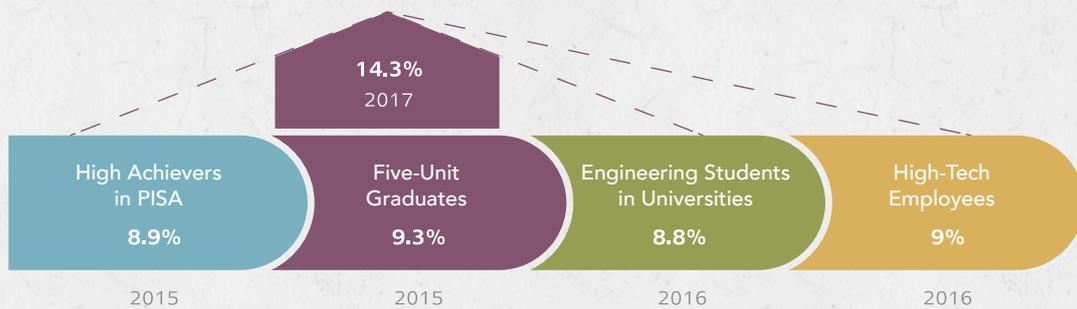
**Five-Unit Graduates
(2006-2018)**

- Mathematics
- Physics
- Chemistry



Israel's "engine of excellence", which was accustomed to pulling only a few "rail cars", is now powering a full load. Over the coming years there will be a growing need for outstanding teachers who believe in each student, challenge them with ambitious goals, assess the progress of learning, adapt their teaching and provide supportive feedback. Towards this objective we are working with our partners to establish a strong professional infrastructure for these outstanding teachers, whose combined effect is to cultivate high-quality teaching.

However, the durability of this emerging success is not guaranteed. Long term change will happen only when the foundations of excellence are strengthened at middle school level and more students from diverse communities and backgrounds are included. To achieve this, we will need to generate systemic momentum in middle schools - we must raise the bar of teaching, focus on learning, build capabilities and recalibrate the teaching and learning to a higher level.



Based on this understanding, in recent months we have conducted an immersive study into middle schools in Israel. We have gathered data and research and consulted with teachers, policymakers and experts in Israel and abroad. In this short working paper, we have tried to document what we learned and propose a first draft of a "roadmap" for our role in the shared journey of strengthening the foundations of excellence in mathematics and science in middle schools.

Our International Advisory Council, headed by Prof. Lee Shulman and including Israeli teachers and educators, will convene soon to discuss the document. Before, during and after the meeting, we want to hear your insights, critiques and suggestions. Your experience and knowledge are a priceless asset and we see our shared partnership as a great privilege and opportunity, and are very thankful for it.

Please do not hesitate to challenge what is written in this paper and to propose other, complementary or opposing perspectives. Please ask yourselves: Have we identified the need and opportunity in a correct and precise way? Are the working assumptions valid and is the theory of change we present based on sufficient evidence? Are the proposed programs convincing and are the measures of success attainable?

We would be very glad to hear your opinions, in writing or orally, in whatever form or means you choose. This is also a good and fitting opportunity to thank you for your partnership, friendship and candor.

The Trump Foundation team

“Excellence is never an accident. It is always the result of high intention, sincere effort, and intelligent execution. It represents the wise choice of many alternatives - Choice, not chance, determines your destiny.” - Aristotle

Need

Our children get lost in middle school¹. From the graduating class of the neighborhood elementary school, where they learned the basics, together with children from a familiar environment, they arrive as the youngest students at a regional “railway station” that is seething, bustling and diverse. The nurturing homeroom teacher in the elementary school class, who taught all subjects and was always there in the event of difficulties in learning or in social interaction with friends, is replaced by large classes with a busy schedule involving frequent transitions between classrooms and teachers.

Middle School Data

7th-9th grade students: 413,677
 Secular: 177,503 (43%)
 Arab: 112,613 (27%)
 Ultra-Orthodox: 60,997 (15%)

Number of schools: 2,564

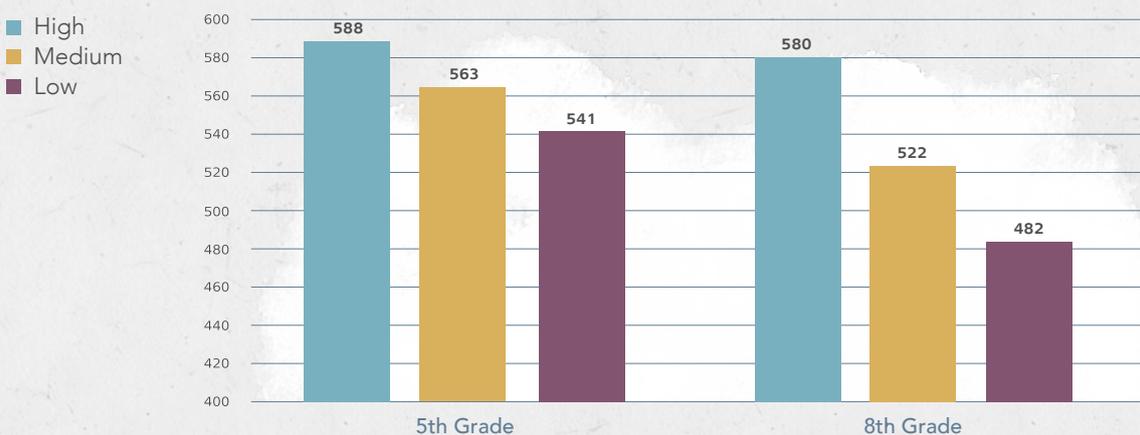
Percentage of students in large schools (at least four classes in each year): 63%

Keren Dvir, mapping of middle school characteristics in 2017-18 (July 2018)

Students enter middle school at an age when their hormones are raging and teenage rebellion begins. Their thinking becomes more abstract and complex, and they challenge authority and convention. They are occupied with the search for a different self, with what they like and where their strengths lie; they experiment with independence and start to formulate their identity. Amidst this flurry and confusion, their parents are less directly involved – just when they need the guiding hand of a responsible adult to light the way for them.

The data on what occurs today in Israel’s middle schools is troubling. The level of difficulty in learning is on the rise, achievement is declining and the gaps are widening in alignment with parents’ level of education and economic situation. Students report waning curiosity, chaos in the classrooms and many cancelled lessons. Teachers complain that the gaps between students are impossibly wide and that the classrooms are overcrowded. Students tend to develop an imprecise perception of their strengths and weaknesses, however it is difficult for teachers to offer them significant feedback and an individualized response.

MEITZAV 2017 Mathematics – Socio-Economic Background:



¹ Middle schools were instituted in Israel 50 years ago (Rimlat Committee, 1968). The education leaders at that time were intent on ensuring equal public education for all. Two years were deducted from elementary education and one year from high school to create a new educational level. The goal was to better prepare students for academic studies and encourage social and educational integration of students from families of diverse backgrounds. Over the years, most of the middle schools have joined high school campuses, but retain independent administration, curricula, union affiliation and professional operation.

During the past decade, various committees have recommended combining, separating, dismantling or redefining middle schools. They have argued that middle schools lack a clear objective. Students acquire the fundamentals in elementary school and focus on the matriculation exams in high school, but there is no agreed-upon goal for middle schools. The committees have proposed various solutions – helping students make a judicious choice by providing a “tasting menu”, expanding the students’ foundation of knowledge, focusing on learning skills, starting a specialization, encouraging curiosity and emphasizing social aspects and values – but no agreement or decisions have been made.

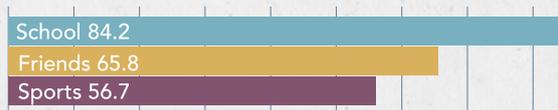
Middle School Data
 Average number of students in one classroom: 32.7 (OECD average 23.7)
 Teacher-student ratio: 1:12.2 (OECD average 1:13.7)
Itay Pollak, a selection of data on middle schools in Israel and the world (December 2010)

This situation poses a challenge for the study of mathematics and science. These subjects are considered difficult and demand focus and persistence. Students must concentrate, practice and contend with increasing difficulty because knowledge, skills and expertise are built together. In order to succeed, teachers must have a mastery of the material, believe in each student, set ambitious goals, and adapt the teaching to the student's abilities, difficulties, ways of thinking and pace of learning. Outstanding teachers require advanced clinical teaching skills.

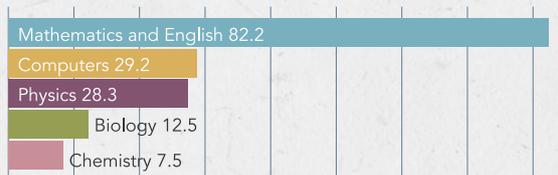
Many schools find that the gaps in the levels of knowledge and understanding among students are too wide to accommodate in a single classroom. Therefore, and in order to retain the outstanding students, these schools form special tracks of study for high achievers and highly motivated students. A limited menu of such tracks exists today, and a relatively small number of students participate in them. Ambitious parents who are still dissatisfied with this solution, transfer their children to designated schools.

9th Grade Students Survey, 2016

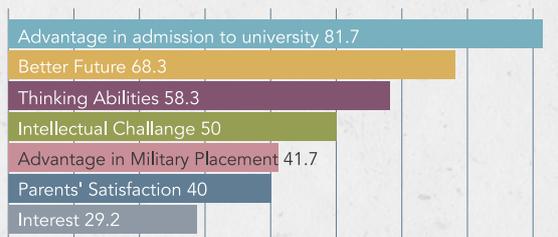
What are the most important areas to invest in and to not give up?



In what subject areas in school is it worthwhile to invest?



What will you gain from learning five-units in Mathematics?



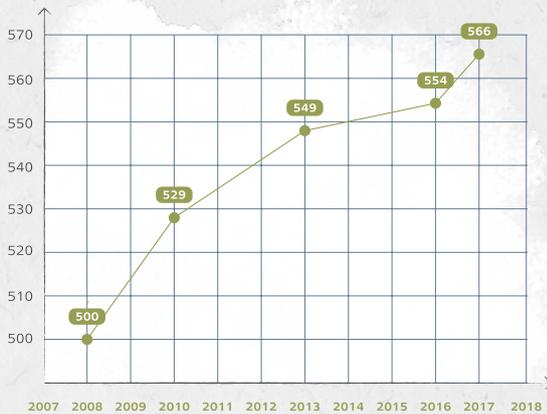
Opportunity

The two-fold increase in the number of five-unit graduates in mathematics between 2012 and 2018, and the substantial increase in the number of high school graduates specializing in the sciences can serve as a 'magnetic force' pulling middle schools in an upward direction. Many students say they recognize that studying mathematics and science is important for their future. There is clearly a growing public “appetite” for these studies and a dynamic of momentum towards them in the education system. Middle schools are expected to develop a broad and solid foundation to feed the excellence tracks in high school.

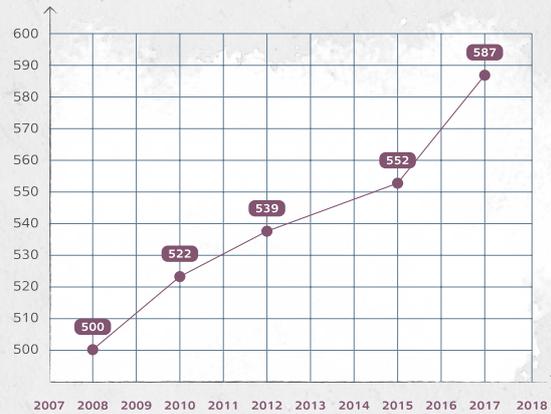
Progress in middle schools is also developing as a response to changes originating at their points of entry. During the past decade, there was steady improvement in the academic achievements of elementary school students. This is having a positive

impact on middle schools, where there are already initial signs of improvement and an increase in the percentage of outstanding students. Achievement is still low and the gaps are wide, but the trend is positive. This advancement is in parallel to implementation of the agreements with the teachers' unions that aim to raise teachers' pay, expand the scope of teaching jobs and encourage an individual response to student learning.

MEITZAV, Mathematics, 5th Grade

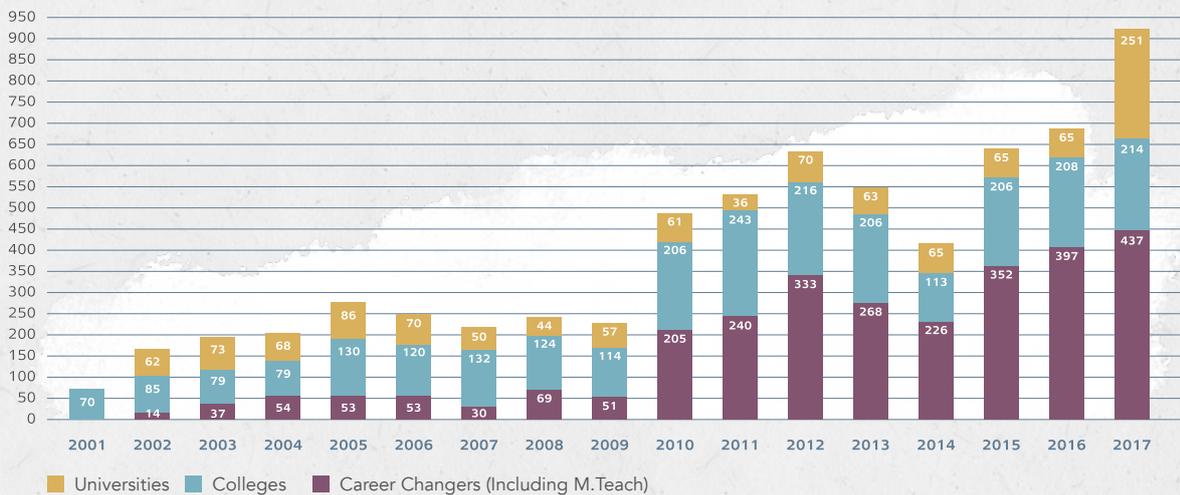


MEITZAV, Science, 8th Grade



The quality of teaching is also on the rise. Some teachers identify middle school as the critical time for shaping students' future. A greater number of talented people are becoming mathematics and science teachers, primarily from the world of high-tech as a second career. Special training tracks have opened that include selection, practice, placement and coaching for new teachers. Professional infrastructure for high-quality clinical teaching is also being developed, designed to enable leading teachers to collaboratively enhance their professionalism based on practice.

Secondary School Mathematics Teachers in Training



Most of the schools in which teachers work are large and diverse. The heterogeneity of the students is a challenge, but also offers an opportunity when managed wisely. Successful schools formulate a coherent instructional system for the six-year learning period, focusing on the learning of each student and helping students fulfill their potential. They analyze the extent of heterogeneity in their classrooms and choose structure and content that organize the teaching and learning appropriately. Educators at these schools adopt methods and tools for individualized instruction and encourage effort and upward movement.

As a result, there is now a window of opportunity to change course toward a systemic improvement in science education in middle schools. All the conditions are ripe for a positive beginning: the harbingers of improvement in students achievements, a new generation of teachers, the infrastructure of clinical teaching, the teachers who choose middle schools, schools that are succeeding and the impact of the “Five Units” endeavor in the high schools. The goal is to ignite a broad and deep process that will provide students with a core of knowledge, develop skills and lay the foundations for specialization.

We must not accept low achievement and large discrepancies. As a country that built itself on excellence in science and technology, and emphasized the value of equality in its Declaration of Independence, Israel cannot accept this sort of reality. Therefore, we must enter this window of opportunity together and mount a coordinated effort, including everyone involved in the sphere of education. We must broaden the foundation of excellence in the fields of mathematics and science, and include more students from diverse communities and backgrounds.



Theory of Change – Choosing Excellence

During middle school and with their teachers’ help, students have the time and opportunity to lay solid groundwork for their future. They must wisely discern what truly interests them, where their strengths lie, what gives them a sense of achievement and to what extent they are ready to exert themselves in order to achieve it. They must treat their studies very seriously, understanding how important they are for their future, and they must build the necessary base of knowledge and proficiency.

Middle school is therefore a highly appropriate time to address students, teachers and parents, and call upon them to take responsibility and invest in mathematics and science studies. This is a significant period of study culminating in an important decision point, when students choose their areas of specialization for high school. This is perhaps their first opportunity to choose a path in the education system. It is a choice that affects the matriculation diploma and, to a certain extent, this choice influences their future in the army, in higher education and in the job market.

Together we must generate momentum through a concerted effort by all those involved in teaching and learning. The focus is on enabling students to deepen their knowledge, develop skills and begin to specialize. A systematic and coordinated effort is required, based on the profound need to raise the bar and set higher goals. This means enhancing learning materials and operating at the level of the individual student, the school and the system.

1. **Focus on Learning.** Students need high-quality teaching that believes in them, connects with them, shows them a vision of the future and sets ambitious goals. They need teaching that stirs their interest, pushes them to invest their efforts and encourages them to make a commitment and be persistent. They need teaching that provides them with a clear learning plan expressed in concrete steps that are achievable and adapted to their progress. They need teaching that provides close support and gives them individualized, constructive and reinforcing feedback.
2. **Ambitious Teaching.** Teachers need knowledge, ability, content and tasks that lift their students to a high level of practical, integrative and profound thinking. They must be able to identify the abilities and needs of their students, adapt the curriculum and make it accessible at increasing levels of difficulty. They must document the teaching and learning in the classroom, share with their colleagues and analyze the findings together in order to improve and enhance their teaching.
3. **Organizing for Excellence.** Schools need a coherent instructional system, methods and tools that enable them to raise the bar, while providing an effective response to heterogeneity. They must responsibly open the excellence tracks and high ability groupings to as many students as possible and push them upwards. In order to do this, they must have data on students, nurture communities of teachers, adopt clinical teaching tools and build a coordinated educational continuum.

We believe that raising the bar and calibrating upward in these three spheres of activity – learning, teaching and the school – can drive significant and systemic expansion of excellence in the study of mathematics and science in the middle schools. In pursuit of this objective, we plan to implement a portfolio of programs, cast convening networks among partners, disseminate practical knowledge and encourage public discourse.

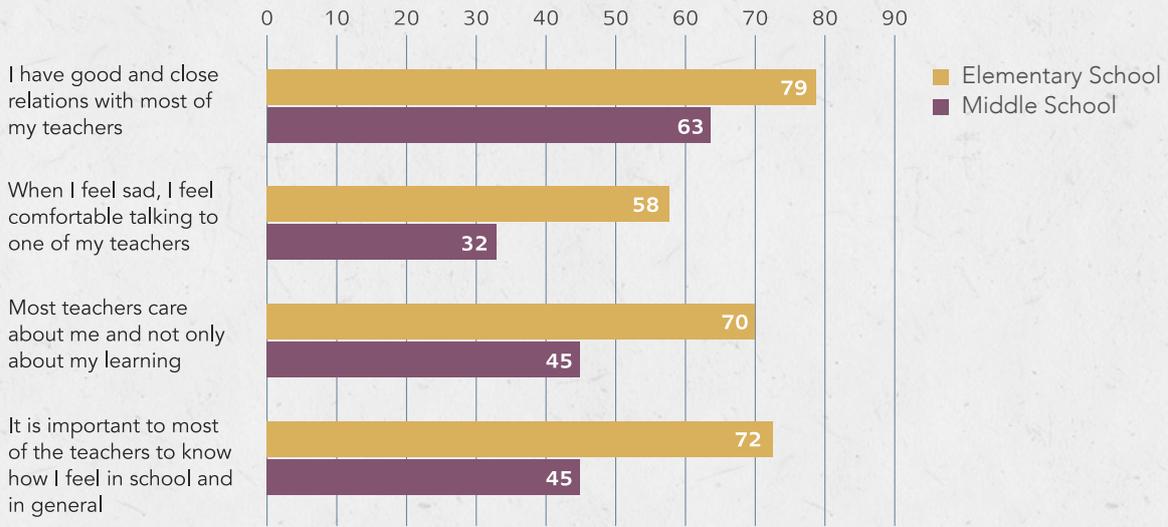
Assumptions Underlying the Theory of Change

- The Ministry of Education is responsible for education in general, including science education in middle schools. In our view, the role and ability of a philanthropic foundation is to help government to fulfill this responsibility. We know there is broad public consensus on the importance of science education, and within this framework we hope that priority will be given to middle schools as well.
- The success of this effort will depend on a deep partnership between many entities – the government, local authorities, industry, academia, education organizations and the field. We intend to work together and rely on partnerships that have developed in recent years, on existing capabilities and on planned teaching infrastructure – such as the National Institute for Advanced Teaching and the High-Tech to Teaching Initiative.
- We do not aim to take a side or propose a specific change in the curriculum, in the array of exams or in the organization of learning. We assume that the curricula for middle schools include the components required for meeting the standards of knowledge, proficiency and specialization; that the array of exams is sufficiently broad and rich; and that the leaders of education in the field exercise responsibility, authority and professional judgment on how to organize their schools.

Program 1: Focus on Learning

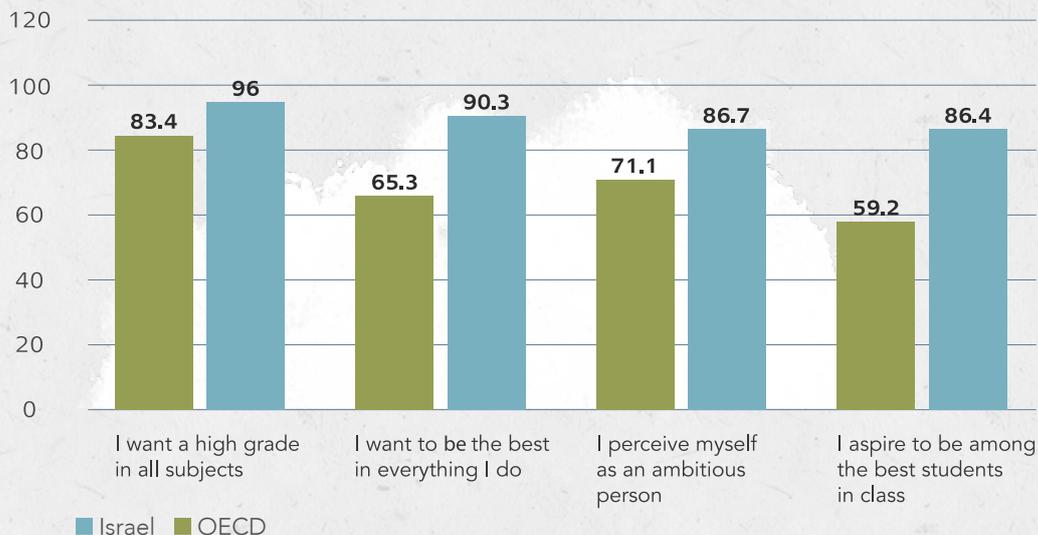
There is an unwritten contract of mutual commitment underlying the connection forged between teacher and student: "I'll invest in you, and you'll invest in learning and thus build a better future for yourself and for all of us." Even years later, when we look back to our period of study, we fondly recall an outstanding teacher who was there for us, connected with us, understood and supported us. Many teachers say that this is precisely why they chose this difficult profession, in order to help students to develop and progress, and to help them navigate their journey into adult life.

Teacher-Student Relations - MEITZAV 2017



Before this connection develops, students arrive in mathematics and science classes with curiosity mixed with apprehension. Many of them note the advantages of studies in these fields for their future in high school, the army, university and the job market. They mention their parents' high expectations and their own aspirations to succeed and excel. However, while most of them report a strong sense of capability and confidence, they rarely translate this into investment in learning.

PISA 2015 - The Value of Competitiveness and Achievement



Motivation is an elusive matter. Teachers note the need to identify what motivates each student and transform it into intensive learning. They help students acknowledge that effort leads to progress. In mathematics and science studies in Israel, a student who succeeds is considered "smart". Therefore, many students already convince themselves in 7th grade that there is no point in investing in studies because they are either talented from birth or have no chance from the outset.

In order to narrow the gap between self-image and reality, **students need a personalized learning plan that places learning at the center.** This means a program that relies on identifying the knowledge, difficulties, ways of thinking and pace of learning, and presents a vision of the future and ambitious goals. This evolving program incorporates a learning routine, the overcoming of erroneous views, an experience of success and the discipline of improvement. It serves as a transparent and open "covenant" between the teacher, the student and the parents, and expresses their mutual and joint responsibility.

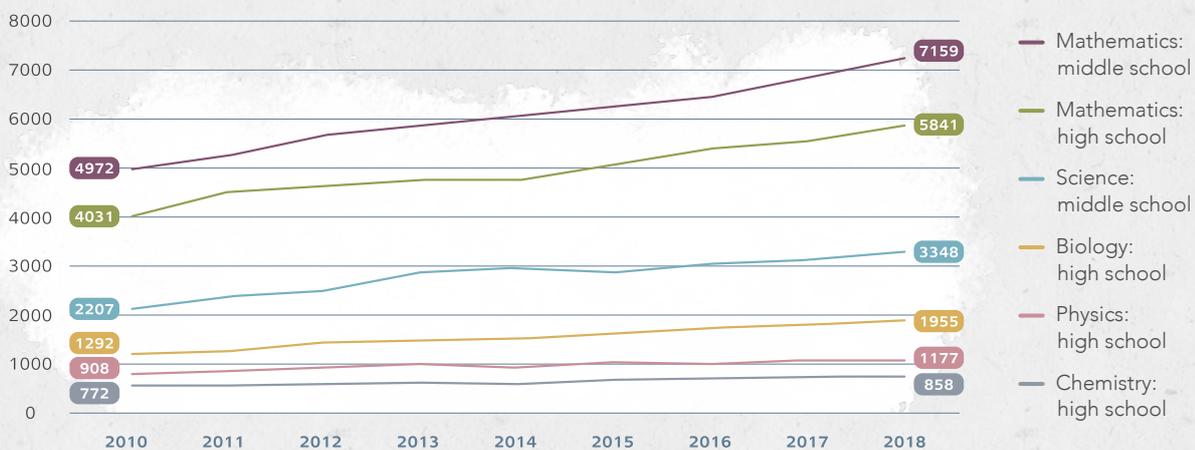
As students advance in their studies, they acquire knowledge, build capability and confidence, and start to specialize. Many of them note at this point that they are proud of their progress, feel satisfaction about meeting the challenge, and even say they enjoy the learning process and the aesthetics of a successful solution. At this stage, teachers say they must nurture these feelings and help students translate them into internal motivation that gives them strength to continue contending with increased difficulties, achieve progress in learning and attain high achievements.

Program 2: Ambitious Teaching

We rely on professionals who have knowledge and proven skills to precisely assess and formulate the best response. The same applies to outstanding teachers. We trust them to be familiar with the path our children tread. They have led many students on this path, know where to go and see the obstacles along the way. They identify and adapt the response and closely monitor the progress. They continually consult with their colleagues in order to learn from similar cases – all with the aim of improving.

There are outstanding teachers like these in middle schools throughout Israel. They chose middle schools because they see great importance in this stage of education. The Trump Foundation's theory of change attributes considerable weight to these outstanding teachers; we should learn from their experience and encourage them to facilitate improvement among their teacher colleagues. We identify **the collective professional capital of teachers as a central driver** and thus aim to encourage frameworks and tools of professional development and collaborative routines that will enable this.

Teachers of Mathematics and the Sciences in Secondary Schools 2016-2018



This will be a complex task because middle schools have a broad curriculum and their quality of teaching varies. The teaching staff needs a professional development program in which teachers draw from their expertise to contribute to each other and receive what they need to improve. There is sometimes a need to help deepen the base of mathematical knowledge and the teachers' expertise in various fields of science. It will require assistance from experts in academia, as well as from high school teachers and leading teachers in middle schools.

The goal is for teachers to jointly build a coherent instructional system – that is, teaching that adapts itself to the students' performance on tasks at a high level of thinking, comprehension and implementation, based on broad knowledge and a good mastery of skills. To achieve this objective, teachers must build clear tasks in a way that enables each student to find a path to deep learning. These tasks should provide teachers with an up-to-date picture of learning progress, allowing them to adapt teaching and offer feedback.

The heart of this effort lies in **challenging learning material at an increasing level of difficulty** that will help teachers generate significant momentum of upward learning among their students. In science studies, materials are needed that rely on a solid mathematical foundation and enhanced mathematical skills. In mathematics, there is a need for tasks at advanced levels of literacy. All this is required to reach a high level of comprehension, thinking and implementation, in which students utilize their acquired knowledge and skills intelligently and creatively in order to contend with a new and complex situation.

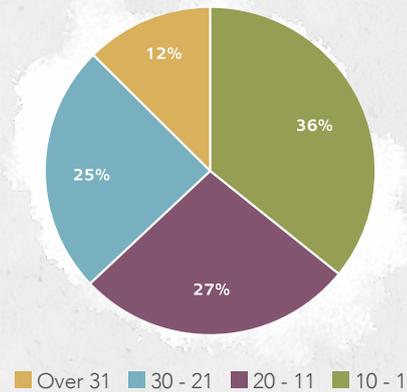
Program 3: Organizing for Excellence

Curriculum and external exams are uniform in middle schools. This is unlike high schools, where matriculation exams are given according to levels in mathematics and only to those who choose to specialize in a field of science. In other words, in middle school dealing with the gaps between students is a school-based responsibility. In practice, most schools employ separate classrooms featuring different content and diverse teaching abilities, together with differential teaching techniques within each classroom, which take into account the disparities among students.

Under these circumstances, fostering excellence is a special challenge at the middle school level. How should the school build a system that provides an opportunity for each student, one that creates a culture of effort, grit and persistence? How can we connect with elementary and high schools in order to build a relationship with students that would lead to development of a personalized learning plan for each student? How do we encourage students to join the excellence tracks and generate upward momentum for everyone? And above all, what must be done to extend the opportunity of excellence, which is reserved to only a few today, to many more students?

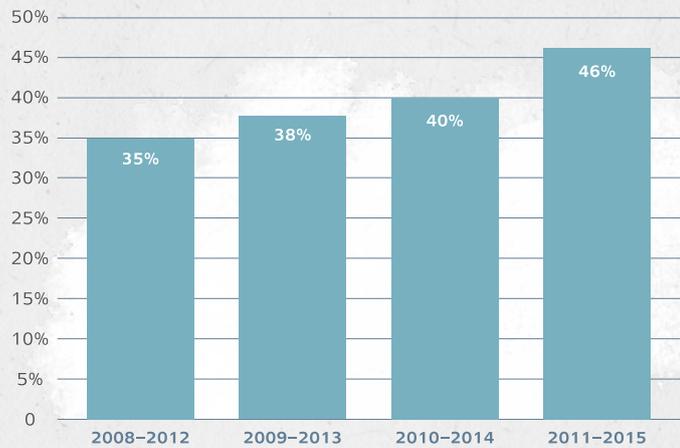
Education of Mathematics Teachers in Middle Schools
 (Central Bureau of Statistics)
 New teachers under 35 in 2011:
 University Degree - 34% (64% in high school)
 Relevant degree to teach mathematics - Secular (80%), Religious (56%), Arab (75%)

Tenure in Teaching – Mathematics Teachers in Middle Schools (2015)



Very precise organization is needed at the school level. Tracks of excellence should be open to every student who is prepared for the challenge. These tracks should be expanded in a balanced and responsible way, enabling and encouraging students to join and move up at any point in time. Expansion that is too rapid, without examining the abilities of students and teachers, is liable to harm the quality of learning and lead to a higher dropout rate in high school. On the other hand, refraining from expansion due to lack of resources or the force of habit is liable to pave the students' path downward and lower the bar.

MEITZAV Outstanding Students who attended the Five-Unit Mathematics Matriculation Exam



This means a clear and consistent school pedagogy that centers on student learning. It is essential to maintain an array of data on the students that reflects their background, preferences, knowledge and difficulties, and allows for monitoring their progress and adapting the response and feedback. This means moving from a "one size fits all" perspective to individualized instruction, and from an approach that seeks a common denominator and suffices with basic knowledge and general skills to an approach that sets ambitious goals for each student.

It requires a rigorous management culture, encouraging and demonstrating excellence. Such schools paint a vision of the future, set high personal goals and employ data to continually improve. They trust the teachers and help them to nurture a clinical community from within, focusing on the learning of each student and working to improve the response provided to the student. These schools utilize routines and tools, and build continuity with elementary schools and high schools, with transparency and through discourse with students, teachers and parents. By doing so, the schools strengthen their gravitational pull and become more attractive to parents and students.

Indicators of Success: Top 15

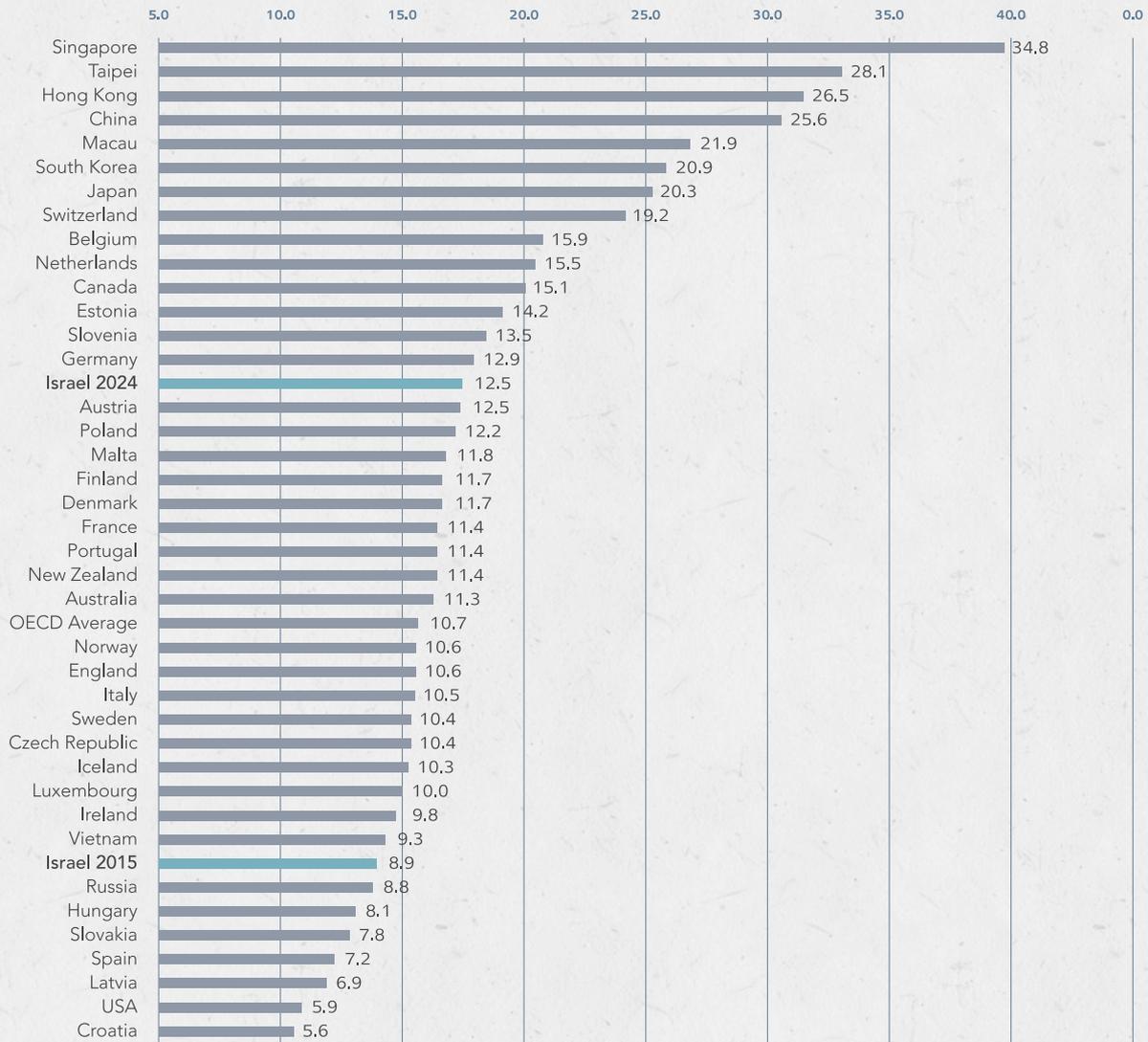
Israeli middle schools administer calibrated national and international exams that consistently measure students' knowledge and proficiency. The picture these exams portray, individually and collectively, is more or less similar: the level of achievement is low and moderately rising, while the gaps among students are very wide. These exams are sample-based and are executed once every few years. They are all low stakes, they do not provide personal feedback to the student, and therefore they have no effect on their future.

In other words, the measures of national success in middle schools are designed to serve as a dashboard indicating the state of the system. Students, teachers and parents on the other hand focus on the individual student, and on his or her success in choosing their future. In middle school, unlike the "Five Units" endeavor, the indicator of national success and the goal for students, parents and teachers, diverges.

Therefore, our call to action for students will be to choose and persist in tracks of excellence in order to be able to better understand the world and to build a better future

for themselves and for all of us. If they do so, we expect to see improvement in national and international measures: In 2024, Israel will be among the top 15 countries excelling in mathematics on the PISA exams (a 12.5% rate of excellence), with an increase of 25 points in the overall average score. The percentage of 12th graders who successfully matriculate at the five-unit level will be at least 16% in mathematics and about 12% in physics.

Israel Could Be Among The Top 15 Countries in Mathematics Excellence (PISA)



Mid-course indicators will show an increase in the measures of trust between teachers and students on the questionnaires regarding the school climate of the MEITZAV test, as well as a 15-point increase in mathematics and science scores. Israel will stand among the leading 15 countries in mathematics and science achievements on the TIMSS exam, with about 15% of the students achieving outstanding scores, and with a narrowing of gaps between high and low achievers linked to socio-economic background. About 40% of ninth graders will complete middle school in the highest ability grouping in mathematics and in one of the special quality tracks in science.

We believe that meeting these measures of success will demonstrate that the foundation of excellence in the middle schools has indeed expanded, with many more students in Israel taking responsibility, learning seriously and succeeding to pave a path to the future.

Indicators of Success – in detail

Knowledge Base -

Knowledge base is measured in a calibrated and comparable way in 8th grade in external MEITZAV exams administered annually in some of the schools and in the TIMSS research conducted on a sample basis once every four years.

In the MEITZAV exams, we expect the upward trend to continue, with a jump of 15 points in the average raw score (70 in mathematics and 56 in the sciences), along with a narrowing of the gaps linked to socio-economic background (from about 100 to 70 points in mathematics and from about 70 to 50 in the sciences).

In the TIMSS research, we expect to return to the trend of improvement. We foresee Israel becoming one of the top 15 countries in mathematics and science (an average score of about 520), while narrowing the spread of scores (from about 330 to 300 and less) and the gaps linked to socio-economic background (from about 130 points to 100 at most).

Skills -

Literacy skills are assessed at age 15 (9th and 10th grade) using the international PISA research test conducted once every three years. The research addresses students who learn full-time or part-time in schools operating in one of the state's official languages.²

We aim for an improvement of 25 points in mathematics achievement (from 470 to 495) that will bring Israel into the top 25 in the world. An improvement in the percentage of high performers to 11.5% will bring Israel into the top 20, and an improvement to 12.5% will bring us to the 15th place.

Climbing 10 places in science, from 40th to 30th (from a score of 467 to 493) will bring Israel up to the OECD average.

Specialization -

The Trump Foundation has been focusing on the percentage of high school students completing five-units of mathematics, as well as science majors in which the percentage of five-unit mathematics students is high (primarily physics).

As an interim measure, we expect to see that in every school offering a comprehensive curriculum, about 40% of 9th graders will successfully have completed their studies in the highest mathematics ability grouping and participate in one of the excellence tracks in the sciences.

We expect continued improvement, with a level of at least 16% of 12th graders who successfully complete the five-unit matriculation exam in mathematics, and about 12% in physics.

² The rate of participation in education in Israel is relatively high. Therefore, only 6.3% of 15-year-olds are not included in the PISA sample, compared to an average of 11% in OECD states. In Vietnam, for example, the rate of non-participation is 51.5%, compared to 2.7% in Finland and 4.2% in Germany.