THE TRUMP FOUNDATION
קרן טראמפ

WORKING PAPER FOR DELIBERATION AND FEEDBACK

STRATEGIC DIRECTION

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The following paper has been prepared towards a meeting of the foundation's Advisory Council

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INTRODUCTION

The Trump Foundation is a spend down foundation which aims to serve as a catalyst for inspiring high quality teaching of mathematics and the sciences in Israeli secondary schools over the next decade. We assume that high quality teaching will be instrumental in a collective effort to help increase the number of students who choose, preserve with, and successfully complete advanced level (five units) matriculation in mathematics and the sciences.

Now, more than ever, this is a worthwhile effort. The last decade has witnessed a continuous decrease in the number of students who have graduated high school with five units of mathematics matriculation. Moreover, the number of high schools offering science tracks, especially physics and chemistry, is troublingly low, largely due to a shortage of qualified teachers and interested students.

The foundation's decision to concentrate its resources on teaching and teachers is based on experience of countries around the world that have improved their educational achievement in recent decades and have done so by investing in high quality teaching. These countries attract talent into the teaching profession; they nurture the clinical skills of teachers; and create support networks for quality teaching in schools and school districts.

The government of Israel is similarly committed to education reform which is designated to improving student performance. In recent years the government has decided to invest significant resources in raising teachers' salaries and increasing their work hours in schools. It has also initiated large scale intervention programs aimed to elevate student outcomes in the core subjects, with special emphasis on mathematics and the sciences.

We believe that philanthropy can play an important role alongside government as catalyst for innovation with the ability to convene the players and gather the capabilities required for a more coordinated action. We are however persuaded that in order for philanthropy to be effective and for its efforts to be sustainable, it must work hand-in-hand in a collaborative manner with the government and with all parties involved.

In the year since it was formed, the foundation prepared an initial strategy to advance the above goals and has begun to initiate projects which address them. Among the first projects are - the establishment of a virtual high school as a vehicle to provide access to high quality teaching, instructional coaching for teachers through the use of classroom videos, pedagogical support for

department coordinators and for teachers, and a prize for outstanding teaching of mathematics and the sciences.

This is a working paper written at the end of the first year of operation of the Trump Foundation. It expresses the thinking, the practical rationale and the dilemmas as perceived by the foundation staff at this point in time. The paper was prepared as a vehicle to receiving feedback and advice from the foundation's international Advisory Council, which will meet in Israel in November of 2012.

OUTLINE

The following paper is comprised of four chapters; each of them presents data, assumptions and alternatives, and rationalizes the choices made by the foundation in the past year since it was launched. Questions and dilemmas are woven into the document focusing on open issues and challenges for which we seek feedback and advice:

a. Need and Opportunity. This section describes the importance of math and science studies and presents our goal to expand the circle of excellence in these areas. It concludes with a discussion of factors which impact student learning these subjects;

b. Strategy Choice. Alternative philanthropic venues which can have an influence on our goal are debated in this chapter. We subsequently explain the underlying rationale for our decision to concentrate on improving the quality of instruction;

c. Towards a Theory of Change. This section is the heart of the document, portraying the three strategic tracks in which we operate. Each track is discussed on the basis of relevant lessons from abroad, the current trend in Israel and our planned activity;

d. Implementation and Sequencing. The paper ends with a recommendation for guiding principles and success measures. These elements are presented as first steps towards the preparation of an implementation plan for the foundation's strategy.

BACKGROUND

Israel is rightly identified with scientific and technological excellence and known as a country that continues to thrive despite regional security challenges and worldwide economic crises. Israeli universities are ranked high in international quality indexes; Israeli scientists win prestigious prizes, and due to its successful high-tech industry, Israel has been the "Start-Up Nation."

One of many explanations for the Israeli phenomenon, at least since the 1990s, is attributed to the immigration from former Soviet Union. In a very short period of time Israel absorbed a large wave of immigrants increasing the country's population by 15%. This has greatly influenced Israeli society and its economy, as well as its education system, which grew quickly during these years to accommodate the increase in the number of students.

Nevertheless, Israel is still a small country with fewer than 8 million citizens, of which 1.5 million are students and 125,000 are teachers in some 4,300 schools. With such impressive scientific and technological achievements, an enduring educational tradition, and proven ability in building proficiencies and setting changes in motion, one would expect Israel to have an excellent education system.

Consequently, many in Israel and around the world are astonished by current education data and trends which indicate that our success story may now be at risk. From all perspectives and for all age groups, from international tests assessing competencies and national tests assessing knowledge of the curriculum, a troubling image has come to light.

For example, in the OECD's 2009 PISA assessment of 15-year-old students, Israeli students are ranked 41st among the participating countries in their average grade in mathematics and the sciences. Five percent of Israeli students are ranked outstanding and 40% are weak, as opposed to 20% and 10% among the countries heading the list.

Outstanding students in Israel can be found in all parts of the country and across all sectors, but most inferior students come from families of weak socio-economic backgrounds. The most conspicuous are ultra-Orthodox and Arab students who belong to fast-growing minority communities – this school year members of these two groups fill almost half the first-grade classes in the country.

The fact that in Israel the education system is divided into four separate streams – secular state schools, religious state schools, Arab schools and ultra-Orthodox schools – makes coping with this situation uniquely difficult. The four streams are

governed and budgeted separately, their curricula and teaching staff are different, and each has its own definition of success.

In order to raise the bar, the government and the public have increased their investment in education, which reached more than 8% of this year's GDP. The actual investment per student, however, is not high for various reasons, among which is the relative high ratio of young people in Israel – some 45% of Israelis are aged 0-24 in comparison to an average of 33% in other industrialized countries.

In retrospect one may conclude that the primary objective of the extensive governmental investment in education in previous decades has been the improvement of access to higher learning. Academic colleges were opened around the country, particularly in the Southern and Northern peripheries, the Open University was expanded to hold the largest student body of all Israeli universities, and flexible curricula were introduced to enable as many people as possible to study.

Since a matriculation certificate (granted on the basis of non-calibrated nationwide final exams) is usually required for acceptance to an institution of higher learning, high schools in Israel devote most of their efforts towards increasing the number of students eligible for such certificates. In support of this effort, considerable resources are being invested in helping weak students attain this basic requirement, while other non-matriculation tracks (mostly vocational) have abandoned.

This goal bore fruit – while during the early 1990s only 30% of 18-year-olds in Israel were eligible for matriculation certificates, this year eligibility stood at 48%. Another achievement is the rates of accessibility to higher learning – 23% of high school graduates went on to college in 1990, compared to 47.8% this year.

However, since 2003 the pace of increase in higher learning in Israel has slowed, from an average annual increase of 8.1% during the 1990s to 3.3% during the early 2000s. This decrease matches the almost constant percentage of students eligible for matriculation certificates, which has changed little in recent years.

As a result, voices are starting to be heard which challenge the current policy, pointing to its weaknesses and costs, claiming that it has fulfilled its potential. On the one hand there are those who argue for the return of vocational education as a solution to struggling students who currently fail to reach academic standards. Others stress that strong students are now satisfied with sitting for the lower levels of matriculation exams and call to challenge them to excel and to push them to realize their true potential.

NEED AND OPPORTUNITY

Educational systems around the world attach high importance to mathematics and the sciences and strive to improve achievement in a balanced as possible distribution. In high performing education systems, around 20% of students have very high achievement levels in mathematics and the sciences and only 10% find it difficult to cope with these subjects at a basic level.

These countries adopted a notion that in the twenty-first century, mathematical and scientific training are basic skills required by its adult citizens. This rationale should be even more true in a country such as Israel, which bases its economy on science and technology and is therefore in constant need of a large supply of outstanding graduates in those fields.

The leaders of Israel's education system adhered to this perception many years ago when they made mathematics an obligatory matriculation exam and science a mandatory subject in middle school. These areas have taken priority and precedence over others, and during the last twenty years the number of teachers and classroom hours in these subjects has increased considerably.

In light of this and due to the emphasis on improved eligibility for matriculation certificates, the number of students taking the basic level of 3 or 4 unit exams in mathematics is consistently rising. Nevertheless, in the past ten years there has been a continuous decrease in the number of students taking the more advanced five-unit exam.

During the 1990s, as a result of a change in the curriculum, Israeli middle school science courses were reduced from three separate subject matters (chemistry, biology and physics) to one general science course. However, since most teachers had studied biology in their higher education, biology tends to be over-represented at the expense of physics and chemistry.

In high school, only a few thousands students take five unit matriculation exams in each of the scientific subject disciplines. Physics and computer science are studied mostly by boys in the secular state school system, and over 60% of schools do not teach those subjects at all. Biology is popular mostly among female students, while chemistry is not taught in around half of Jewish schools. Chemistry studies however are widespread in Arab schools due to unique employment opportunities in pharmacies and pharmaceuticals.

In mathematics and physics, the drop-out rate from advanced classes is high and students either transfer to other majors or to less challenging class levels. Classes are usually small and between the tenth and eleventh grades many students give up studying these subjects altogether.

EXPANDING THE CIRCLE OF EXCELLENCE

The current condition of math and science studies in Israel is complicated and it is difficult to define one silver bullet that will bring about fundamental change. In such a situation a philanthropic foundation must ask itself if and to what extent can it help, and how can it focus its resources in the most effective way possible.

The Trump Foundation examined the possibility of focusing on one of three important goals to advance the teaching and learning of mathematics and the sciences in Israel – helping weak students attain basic levels of knowledge; devoting itself to advancing the existing outstanding students; or expanding the circle of excellence in order to help more students succeed in advanced studies.

Despite its great national importance, we recognize that our foundation lacks the ability to systematically help weak students attain basic levels of knowledge. This type of effort exceeds our resources and shelf-life because it requires investment and expertise not only in education, but in welfare and health as well; it demands cultural and language adaptations; and it calls for a continuous intervention beginning from early childhood education up until higher learning and employment.

We also chose not to devote ourselves to the existing outstanding students, despite them being Israel's scientific and technological elite. In our opinion, this group is already well taken care of by their families, universities, the military and special programs operated by government and other philanthropic and academic institutions. We therefore assume that the foundation would have a marginal effect on the success of gifted students.

The Trump Foundation chose to dedicate its resources to assisting the expansion of the circle of students studying advanced-level mathematics and science. We therefore decided to focus on the 55% of Israeli students who are neither struggling nor excelling - helping the suitable candidates choose to study mathematics and the sciences at higher levels, with the aim of succeeding in a five unit matriculation track.

Our basic rationale for this choice rests first and foremost on the existence of an important need, but even more so, it is based on an emerging potential that has yet to be realized:

A. Many Israeli high school students are capable of achievements in math and science on advanced levels, but for various reasons do not realize their potential. These students are found in all geographic areas, both in the center of the country and in the periphery, and they belong to all sectors of the population – Jews, Arabs, religious, secular, girls, and boys;

B. There is a large nucleus of outstanding mathematics and science teachers in Israeli high schools who have been trained in universities, colleges, and at institutes in Israel and abroad. However, many of them will be retiring within the next decade and the demand for new teachers is rising;

C. The education system has recently set a goal to increase the number of students in advanced tracks, particularly in math and science. This trend will put greater pressure on teachers and will ultimately result in larger and more diverse classrooms in these subjects. We assume teachers will need tools and methods helping them to adapt their teaching to different student needs and abilities in order to coop with this goal.

Questions

1. *Is the foundation's choice to focus on expanding the circle of high school students studying five units for matriculation a wise one, taking into consideration its content, the periodic changes in the curriculum and the shaky un-calibrated structure of the matriculation system?*
2. *Does the foundation need to adapt its efforts to include the various sectors of Israeli society? Should it first develop programs for general use and then during implementation make adjustments for the special characteristics of the various sectors, or should we carry out separate development from the beginning?*
3. *Is it advisable to focus on mathematics and physics, for which the need is especially strong, or would it be more worthwhile to expand into other spheres of science and technology as well, to include, chemistry, computer science, or other technological subject matters?*

INFLUENCING FACTORS

We do not yet have enough evidence available on the factors that influence high school students' decision to choose (or refrain from choosing), persevere with, and succeed in mathematics and science at an advanced level. However, during the past year while in the field we have investigated the topic, especially when meeting with students, teachers, and school principals. The following are our main findings:

Students

- Advanced level mathematics and science courses are difficult and require devotion and effort. They compel students to compromise in other classes and give up some enrichment and leisure activities;
- The classroom pace is very fast; teachers progress through the material quickly, unable to help each student, and even find it hard to identify who is having difficulties and in what areas;
- Especially in mathematics, if parents have the means to pay, students receive private tutoring adapted to their personal needs and abilities, while other keep on struggling;
- Advanced studies are carried out in a competitive atmosphere that does not enable students to learn actively or express themselves. For the most part, boys participate in these courses and girls prefer to study in classes where they feel more comfortable;
- Teachers and advisors suggest that students who receive low test grades in advanced classes not take any chances and transfer to less advanced ones;
- In the past, during the application process universities gave bonus points to students who took 5-unit matriculation exams in mathematics and the sciences. Currently, students also receive bonus points for taking 5-unit matriculation exams in less challenging subjects. As a result, there is less incentive to preserve despite the difficulties.

Teachers

- A large amount of material must be taught in matriculation preparation classes. This creates a workload that requires rapid progress and does not offer teachers the opportunity to pay personal attention to individual students, especially the weaker ones;

- Because the learning material and exams consist of a large number of exercises, the teachers must solve them with their students on the blackboard. This makes it difficult to delve deeper into the material, or to accommodate for different learning styles;
- Students enter high school with low motivation for learning, with an insufficient knowledge base and with large gaps between their abilities. Because for the most part the only science subject they studied in middle school was biology, they are ill-prepared to study physics and chemistry at advanced levels.

School Principals

- When students are having difficulty studying in 5-unit matriculation tracks, there is a risk that they will fail the exam and not receive their matriculation certificate at all. For this reason there is a tendency to suggest and even dictate that they transfer to 4-unit matriculation courses;
- Schools are driven to offer a wide variety of courses. If too few students register for a class it is difficult to justify opening one that is smaller than regulations allow – this frequently happens in the sciences, especially physics and chemistry;
- It is very difficult to recruit mathematics and science teachers at an advanced level – there is sometimes a need to compromise and recruit teachers with inadequate training and experience, transfer another teacher from the school, or not open the course at all.
- Science classes are more expensive because of the need for laboratories, but no special budgets are allocated for them. Since biotechnology and robotics are allotted extra budgets there is a tendency to favor them.

STRATEGY CHOICE

The factors listed above suggest many and various reasons for the present situation. They invite philanthropic intervention that could come from a variety of directions and via different channels. At this junction the foundation needed to choose its modus operandi which suits its size and the duration of its activities.

When it came time to decide on strategy, the Trump Foundation examined a number of possibilities and analyzed which of them offered the best opportunity for success. The alternatives listed below are grouped under two very different directions of action – one that is more professional and pedagogic in nature, and the second which is more outgoing, public and engaging:

PEDAGOGIC STRATEGIES

A. Operating direct interventions with student learning to increase knowledge; skills; and motivation. This would include supplemental teaching hours in schools, distance-learning opportunities, after-school enrichment classes, learning marathons before exams, summer camps, and special courses for interested youth in universities and in science museums;

B. Establishing a school or a network of schools that will display excellence, as well as proven methods and quality teaching practices in mathematics and the sciences. These schools would demonstrate that our goals are feasible and act as a learning model for other Israeli schools to follow;

C. Collaborating with the Ministry of Education to upgrade the curriculum and the consequent development of innovative and attractive learning materials in mathematics and the sciences. Special emphasis would be placed on the middle school science curriculum, in order to help build the students' knowledge base and thereby expand the pool of suitable candidates for advanced high school courses;

D. Supporting the development and implementation of teaching and learning technologies, including the integration of virtual experiments, computer simulations, distance teaching and drilling, monitored learning, and adaptive teaching and learning systems. The goal is to use technology as a catalyst to upgrade the quality of teaching and learning;

E. Working to improve the quality of classroom teaching so that teachers can reach every student and offer them individual responses to their needs and abilities. Emphasis would be placed on strengthening the professional capabilities of the teaching staff

with the support of the school and local authorities, while drawing more talented people to the teaching profession.

PUBLIC OPINION STRATEGIES

F. Implementing a media campaign addressing parents and children in order to increase the prestige of learning mathematics and the sciences. Such a campaign would use television, digital media, and public role models to generate interest in these subjects.

G. Advocating in the public sector with the goal that government increases its expenditure for mathematics and science studies, that universities and employers give preference to graduates in those fields, and that the city mayors, district leaders and school principals promote the advanced learning track in schools;

H. Convening influential stakeholders in government, local authorities, professional organizations, universities, schools and civil society for systematic and on-going deliberations with the goal of coming to an agreement on common objectives and measures, and on practical ways to work together.

This list continues to present the foundation with a serious dilemma. On one hand, it is clear that a philanthropic foundation cannot operate systematically along all of these tracks. On the other, it is also clear that without a comprehensive and coordinated effort, it is unlikely that any one of these tracks will be sufficient to turn the wheels of the rest of the education system.

Despite our decision to focus on improving the quality of teaching, during the last year we also have devoted some efforts towards communications, government relations, the development of teaching materials, and integrating technologies. These activities served to consolidate our feelings regarding the special importance and contribution of each, but at the same time made us realize that our efforts will not accumulate to any substantial effect if we were to extend our activities along all of them.

We believe that for the resources of a philanthropic foundation to be used most effectively, it must concentrate its efforts in one area of interest. Therefore, we chose to focus on improving the quality of instruction, making it the foundation's primary path of action. In our opinion, even if better teaching is not sufficient in itself to generate significant change, sustainable improvement in student performance in mathematics and the sciences would be impossible without it.

HIGH QUALITY INSTRUCTION

We chose to help advance the quality of teaching because hard evidence from research suggests that the quality of instruction in the classroom has an enormous impact on student achievement. This evidence indicates that investment in quality teaching is the cornerstone of reforms in countries that have successfully improved their educational achievements.

However, the key question is "What is high quality teaching?" How can we differentiate between high quality teaching and teaching of lower quality; and in light of that, how can one improve the quality of teaching? Despite there being extensive agreement regarding the importance of good teaching, a variety of opinions exist regarding if and how to define it, and how best to develop quality teaching so it will have a systemic impact.

Some argue that the more knowledge and education teachers possess in their subject field, the better they will teach. Others place more importance on pedagogic skills relating to managing heterogeneous classrooms; while still others maintain that quality teaching is a combination of knowledge and skills adapted to the subject being taught, the age of the students and their previous knowledge.

In Israel, the debate revolves around the tension between deeper learning and testing - can good teaching be measured in matriculation exams, or does quality teaching mean nurturing student understanding and in-depth learning of the material? Many teachers and local scholars advocate for deeper learning and argue that it is more difficult to realize because of the high influence the matriculation exam system has on Israeli schools.

Meanwhile, the Trump Foundation has chosen a somewhat different perspective - to foster teaching that focuses on reaching all students in the classroom. We did so because the goal of the foundation is to help teachers expand the circle of students who persevere and succeed at an advanced level, and because expanding this circle entails providing a response to a wider range of students.

The foundation therefore places emphasis on the clinical skills of teachers in the classroom – skills that enable teachers to adjust the teaching and learning climate to meet the different needs, the learning styles, and the rate of progress of each student, in keeping with the uniform demands of the curriculum and matriculation exams.

The objective is for teachers to be able to know their students well; believe in them; create mutual commitment; and with them, set ambitious learning goals. This notion of high quality instruction expects teachers to closely follow their

students' learning progress, provide them with positive and reinforcing feedback in real time, and adapt content and methods to suit each individual student.

For this teachers will need to create a classroom atmosphere that allows students to ask questions and make mistakes, that encourages them to express knowledge and opinion in writing and orally, that challenges students to confront complex problems, and that opens the classroom to discussions between students.

We recognize that high quality instruction is practiced by individual teachers, but it is feasible only when the surrounding culture is supportive. For effective teaching to take place, the whole school needs to adhere to a coherent pedagogic approach, to design its joint routine to foster such teaching and learning, to cater to the learning needs and abilities of each student, and to work transparently and collaboratively with students, teachers and parents.

Questions

4. *Is choosing to improve the quality of teaching a realistic approach? Is it at all sufficient to lead to systemic improvement? Or, perhaps, is it recommended that we act through other paths as well?*
5. *How can we define the meaning of 'high quality instruction' in mathematics and the sciences more clearly and practically, and what steps are necessary to reach this definition?*
6. *What does the foundation's approach to quality teaching have in common with other approaches in Israel and abroad? How is it different? And how can we convince others of the importance of the approach offered by the foundation?*

TOWARDS A THEORY OF CHANGE

How can we help improve the quality of teaching, what components are necessary, what are the required stages and how can philanthropy be of meaningful assistance? These questions and others faced the foundation as it began its journey - and as a first step we attempted to investigate what has been done in these spheres in other countries around the world.

We have found out that successful education systems work to improve the quality of teaching in schools. In these high performing education systems, measures are taken to attract talent into teaching, to nurture the clinical expertise of teachers, and to create support networks for quality instruction in schools.

However, it is evident that countries that concentrated on only one or two of these three measures experienced a limited success. Only when all three were set in motion together and in alignment with one another did the expected improvement take place. That is, though each of these measures is essential, only a combination of all three brings about systemic change.

Moreover, recent evidence indicates that some countries that adopted this model of raising the quality of teaching were more successful than others. Those which gave teachers a leading role in the process, and recruited stakeholders in government, academia, the school districts, teachers unions, and civil society to work together in a coordinated manner, met greater success.

Nonetheless, this formula for reforming an education system has been conceptualized and practiced as a comprehensive policy abroad, and it had not been used for specific subject areas and age groups. We estimate that with adaptations is could also be practiced to suit our goals, due to the shortage of math and science teachers in Israel and the relatively high drop-out rate of students. However a deeper answer to this question requires further and more specific investigation, which will be presented in the following paragraphs.

Questions

7. *Do the three measures relate enough to the objectives of the foundation and do they interconnect well enough to provide a comprehensive solution?*
8. *What added value does philanthropy contribute to such a process, and do examples and evidence from elsewhere indicate that philanthropy can play a significant role?*

9. *How can the stakeholders be brought together around these measures? And how can we overcome doubts and apprehension?*

ATTRACTING TALENT INTO TEACHING

During the last two decades, immigrants from the former Soviet Union have reinforced the ranks of math and science teachers in Israel. Around on third of physics teachers and one fifth of math teachers who currently teach in Israeli high schools immigrated to Israel during the 1990s – some of them were even trained and worked abroad before moving to Israel.

Despite this addition of teachers, the number of students taking 5 units matriculation exams in mathematics is decreasing and was less than 10,000 students last year. The number of physics students has remained almost constant at around 7,700 per year and some two thirds of high schools still do not offer physics courses at all.

In addition, during the next decade many teachers of mathematics and the sciences will be retiring and new teachers will have to be found to take their place. The traditional teacher-training programs are finding it difficult to recruit enough candidates in these areas, and the teacher shortage is becoming more acute.

As a result of this shortage, teachers without appropriate backgrounds and training are sometimes assigned to teaching required courses. In other cases, classes are not opened until suitable teachers are found which can particularly affect the elective and exclusive 5 unit track. This is problematic because schools that close courses may find it difficult to later re-open them and may also find it impossible to replace the unsuitable teachers they hired.

This situation creates an atmosphere of great urgency and opportunity that would be a shame to miss. It is clear there is a dire need to build a new generation of qualified and skilled teachers and open more courses in schools. However, the crucial question is who will be able fill the shoes of teachers from the last generation, and what needs to be done in order to draw the most qualified candidates to take on this mission.

Necessary conditions

Successful education systems recruit top level graduates from universities and effectively train them to serve as classroom teachers. Experience from these

countries points to the conditions necessary for qualified people to choose teaching as a career:

- The economic conditions are such that alternatives to teaching have become less attractive, or, at the least, are perceived as more risky;
- Achievements in education are gaining ground, providing an optimistic feeling that improvement or a "change of course" is taking place. This helps recruit the public and society to the mission of advancing education;
- The image of teaching is positive, the teaching profession is considered important and respectable, and the public and its leaders trust and support their teachers and consider them valued public emissaries.
- Although teachers' salaries are not competitive, they are reasonable - they provide teachers with occupational security and the opportunity to live their lives in a respectable manner;
- Teacher training is professional, relevant to actual school practices, flexible, and adapted to the needs of the teaching students, bridging between training and work in the field. The threshold for being accepted for training is high, the admission process is meticulous, and many candidates are filtered out;
- Schools and teachers are granted professional autonomy, their performance is evaluated in a clear manner, and they are rewarded for improvement and excellence. Teachers work together with their colleagues to focus on the individual learning progress of students;
- The teachers' working conditions and teaching methods are focused on responding to the needs and abilities of each student in the class, and allow teachers to enjoy the fruits of their labor and to feel satisfied with their accomplishments.

The present situation in Israel

In a recent public opinion survey we found that teaching in Israel is perceived as an important profession, but not an attractive one, due to low salaries and challenging conditions. Teaching math and science is perceived to be somewhat more prestigious; teachers of these subjects are considered professionals and the public assumes that their salaries are respectable, because they can supplement them by giving private lessons.

However, since Israel's economy is based on science and technology, there will always be more attractive options open to math and science candidates in

industry and academia. No matter how much the salary and working conditions of teachers improve, choosing to be a teacher will probably always entail making economic concessions.

In the center of the country and in large cities, especially near universities and industrial centers, there is a larger pool of people that would be qualified to teaching math and science. On the other hand, in these areas there are more employment alternatives than in peripheral areas, as well as in Jerusalem, and Judea and Samaria, where the competition is more limited.

Nevertheless, recent years have seen the first signs that more people are being drawn to teaching - the result of an expected slowdown in the economy; growing concern about unemployment; the anticipated improvement in teachers' salaries; and the opening of flexible teacher training programs. We hope that teaching will now regain its status as a work setting that provides occupational security and at the same time offers personal fulfillment and the chance to contribute to society.

Polls and focus groups we conducted recently indicate that the main pool of potential candidates for math and science teachers in Israel is among older adults who work in relevant careers but are considering a career change. 8.6% of the public holding academic degrees were very interested in teaching high school math and science.

In order to balance rising demand with supply that is only beginning to show signs of awakening, the Ministry of Education has opened special flexible training courses that offer intensive short-term study, scholarships, and tangible support when the candidate joins the teaching profession. It is clear that this is an important policy direction that requires investment both in content and implementation, but not enough time has passed to evaluate the extent of its success.

Proposed plan of action

Our point of departure is that during the coming decade qualified people must be recruited to teach mathematics and the sciences in Israeli secondary schools. It appears that some necessary conditions, most of which are beyond the scope of philanthropy, are beginning to realize and a window of opportunity has been opened.

The relevant target population is relatively small and is made up of a few hundred teachers for each of the advanced courses of study for 5 unit matriculation. Since the average seniority of teachers presently teaching these

courses is relatively high, we estimate that there is a need to recruit a few dozen new teachers each year for each of these courses.

Identifying, filtering, training, placing, and supporting new teachers is the responsibility of the Ministry of Education, but philanthropy can play a role in assisting the government in its efforts in the following areas:

- Supporting the establishment of prestigious training programs for high school math and science teachers, selecting only the best candidates, and providing practical training that focuses on student-centered teaching;
- Developing methodologies of instructional coaching for new teachers, with an emphasis on pedagogic support that would lead to expanding the number of students while adhering to their individual capabilities and needs;
- Creating accessible databases which provide information about training programs for teaching candidates, and about available teaching positions, job requirements and salary for training course graduates;
- Exposing outstanding math and science teachers and their high quality teaching to the public in order to strengthen the support for teachers and increase the motivation for recruitment of qualified people.

Questions

10. *Should the foundation focus only on teachers of 5 unit matriculation in math and science courses, or should it also deal with those who teach required courses in middle school and/or in 3 or 4 unit high school matriculation courses?*
11. *Should the foundation only involve itself with special prestigious training courses, or should it also strive for cooperation with regular university and college-based teacher-training courses?*
12. *What are the important and measurable indications of success for attracting qualified people to the teaching profession, and should the foundation's goal be to recruit a specific number of teachers or open a specific number of new classes in schools?*

CULTIVATING THE CLINICAL EXPERTISE OF TEACHERS

Middle school mathematics and science classes have 30-40 students, each with their own knowledge base, capabilities, and learning styles. In an effort to overcome consequent difficulties, some schools carry out ability grouping, dividing students according to achievement level. Some are even able to divide the students among more teachers.

In most cases, students must choose their majors in tenth grade, when relatively large gaps in knowledge and skills already exist. Those who choose five unit matriculation courses in mathematics usually come from high-ability-level middle school classes, while their choices in the sciences are usually made in keeping with personal preferences and school recommendations.

Advanced five units high school classes in these subjects usually begin with 20-30 students, but for various reasons the drop-out rate is high. Students usually quit between tenth and eleventh grades and many times only 10-20 students remain in math and physics courses by the end. Students and teachers are aware of the potential for drop-out and it is sometimes structured into the teaching and learning process.

When only outstanding students are left in a class, most of whom are studying 5 units of both mathematics and at least one science subject, teachers then report they are able to induce students to study the materials in depth. However, when there are other students in class, they report that they must slow the pace of teaching, teach superficially, and go over the material repeatedly.

In view of this situation, it can be assumed that increasing the number of students who choose to study five unit mathematics and science and providing the support required for them to persevere and succeed in their studies' would be a challenge for schools and especially for teachers. Assuming that schools either cannot carry out additional ability grouping, or do not want to; teachers will need to cope with a wide range of student ability in their classrooms.

Trends in professional training for teachers

We believe that to accomplish the mission of increasing the number of outstanding students, teachers will be looking for tools and methods to help them adapt the teaching and learning climate in their classrooms to the abilities, needs, learning styles, and progress of each student, while taking into consideration the demands of the curriculum.

The need for such clinical teaching methods is not limited to the teaching of mathematics and science, but is especially apparent in these subjects. When Israeli physics teachers were asked in a recent survey what skills they would like to acquire, the prominent answer was that they would like to know how to deal with disciplinary problems, to work with individual students, and to adjust their teaching to the needs and abilities of individual students.

Similar answers were received from teachers abroad. As a result, education systems around the world began re-examining the training and professional development they offer teachers, focusing on placing more emphasis on practical skills. Current policy statements and training programs established as a result indicate a trend toward a collaborative effort that includes the following characteristics:

- The emphasis previously placed on academic subjects during training and professional development courses for teachers is shifting to courses based on practical school experience, with academic knowledge interwoven, rather than being taught separately;
- The content of programs now focuses on classroom teaching, so that training and evaluation is centered on developing the ability of teachers to recognize the learning style of each student and adjust their teaching methods accordingly;
- Teacher training courses deal with how to gather and analyze information from the classroom about the abilities, difficulties, and progress of students;
- Paramount emphasis is placed on acquiring a variety of teaching techniques so that teachers can choose from different approaches and adjust them to the abilities and needs of their students;
- In-depth use is made of documenting teaching and learning in the classroom through video recording, observation, case studies, simulations, and gathering evidence relating to student learning, all of which is used as a basis for instruction, feedback, and peer learning;
- Teacher-training staff are experienced professionals with extensive practical experience and clinical expertise who are skilled in the use of data and evaluation and in a variety of teaching methods;
- Training and professional development programs are developed in close cooperation with the authorities in charge of schools (school districts, local authorities, school networks) so that the programs will be suitable for their specific needs. Decisions as to who participates in courses and what is taught, are made together;

- Schools themselves play an active part in the training and professional development of their teachers. Schools act as professional learning communities in which master teachers act as mentors and colleagues provide feedback.

The current situation in Israel

Training for high school math and science teachers presently takes place at seven universities and fourteen teacher colleges that grant academic degrees and/or teaching certificates. The teaching staff of these training programs is made up mainly of academics. The curriculum is divided into courses dealing with the trainee's subject of specialization, theoretic studies, and classroom pedagogy.

Ministry of Education regulations require that eleventh and twelfth grade teachers have a masters' degree in their teaching field, but many schools do not strictly abide by this requirement because of the shortage of qualified teachers. In recent years, masters' degree courses for people making a career change are being offered at teacher training colleges. Consequently, more math and science teachers than before are now graduates of teacher training colleges.

In order to improve teacher training, the government has adopted recommendations made by a Council for Higher Education committee that met in 2006. These recommendations set out new guidelines for pre-service training of teachers that includes emphasis on practical experience with the goal of "exposing future teachers to the role they will fill."

The new guidelines enable the training institution to determine the practical experience component – either by assigning a member of faculty to supervise the student teacher, or by creating a deeper partnership with a school that will provide mentoring by the school teaching staff who would supervise the student teacher.

Furthermore, the Ministry of Education has defined four stages in the professional development of teachers ranging from entering the profession up to full proficiency. Nine career stages have been defined for elementary school teaching, the highest being a "master teacher", however there is still no correlating ladder for high school teachers.

These processes are currently being implemented– a teacher evaluation framework has been formulated, new pilot training programs have been introduced, and partnerships are beginning to be forged between training institutions and schools. At the same time, the Ministry of Education has

increased its investment in regional centers for continuing education in order to advance professional development.

What actions are we considering?

The government priority of teacher training is an encouraging portent of the future. We believe that an opportunity is emerging for improving the quality of teaching In Israel, including the teaching of mathematics and the sciences in high schools.

Despite that, we note that a suitable curriculum, as well as professional tools and teaching techniques are still missing for the implementation of a professional development approach that is student-centered and for trainee teachers to adapt their instruction to the abilities and needs of individual students. It seems there is a need for skilled clinical training instructors in teacher-training institutions and in schools, and it appears that the professional community and the institutional leadership which are needed to generate such change, are yet to emerge.

These are complex changes that entail creating strong partnerships among academic institutions, public authorities and schools. Therefore, we cannot expect quick results, but an obstacle course that can only be completed by facilitating dialogue and agreements, experiments and conclusion-drawing, and augmenting professional capabilities and means of implementation.

We believe that a philanthropic foundation has a role to fill in helping such change to occur, and the more it works in collaboration and coordination with other entities the greater and more enduring the added value of its contribution will be. Taking this into consideration, we have decided to act gradually, carefully and with measured steps, cooperating with stakeholders and professional bodies.

As our a first steps, we are teaming up with academic institutions and development organizations to help them forge the building blocks necessary for professional clinical development of math and science teachers, focusing on student-centered instruction. Against this background efforts are being made to develop:

- Case studies of high-quality teaching that can be used as a resource for training teachers;
- Video-based documentation tools and innovative analysis instruments for teacher observation and feedback;

- Teaching methods for adapting instruction to the abilities, learning styles, and learning difficulties of students;
- Models for developing clinical teaching proficiencies in schools and within professional development communities;
- Instructional coaching to mentor in-service teachers.

Later, the foundation will encourage teaching professionals at policy, development, and training levels to join forces to share knowledge and to increase cooperation between them in building practical knowhow. We believe that an effective professional community is vital for ensuring that the new building blocks will be integrated in existing training settings and practice in the field.

Furthermore, we may then want to study together with the professional community and other partners, the possibility of establishing a center of expertise to nurture clinical teaching in Israel. Our thoughts about such a center are in their infancy ranging from a center for excellence in teaching that will concentrate on fostering clinical skills towards opening a professional home for master teachers.

Questions

13. *Is it logical to concentrate on clinical teaching as contrasted with clinical medicine or non-clinical teaching? Are the steps to development and implementation clearly defined, and are the chances for success positive?*
14. *Is it advisable for the foundation to lean on official definitions of teacher ranks and formal assessment tools for teacher performance?*
15. *What measures of success are both important enough and feasible enough for the foundation to aspire to in its effort to nurture the clinical skills of teachers? Should we define a specific rate of decrease for student drop-out in classes led by teachers who have participated in professional development programs the foundation is involved in?*

CREATING SUPPORT NETWORKS FOR HIGH QUALITY INSTRUCTION IN SCHOOLS

We have learned that the implementation of quality teaching is a task shared by an entire school. The school leadership coordinates most of its available resources to implement a support network for teaching and learning, while members of the staff work as a professional community – they are the ones who define common goals and measures and together employ methods, tools, and work routines.

Some Israeli schools successfully work in this manner, but they must also cope with structural problems. Schools in Israeli are organized like an assembly line so teachers teach large classes and are disconnected from one other. In such a setting it is difficult for teachers to form an up-to-date, comprehensive, and in-depth picture of the progress individual students make and respond to each one individually.

The fields of mathematics and the sciences are especially sensitive to this situation since the pace of learning is fast and almost all new material taught is based on familiarity with previously-taught material. Therefore, to prevent wide learning gaps from forming, which may lead to students dropping out of class, careful coordination is required between teachers in the school regarding content and pedagogic choices and concerning the progress of each student.

The Ministry of Education and the teachers' unions were well aware of this when they signed new wage agreements that have begun to be gradually implemented this year. The agreements include extending the number of hours teachers have to be in school – enabling them to both work as a team and give extra help to small groups of students, with emphasis on the core curriculum.

However, schools that are interested in organizing themselves to implement a student-centered pedagogy while adopting ambitious goals for expanding the circle of excellence in math and science will have to go through a substantial change in their practice. This change involves the customization of new pedagogic technologies and instruments as well as instilling appropriate methods and routines of management and organization. We are convinced that philanthropy can help a handful of schools to demonstrate such work, providing examples that will enable others to follow suit.

What steps are we planning?

We recognize that attracting qualified people to secondary school mathematics and science teaching, and providing teachers with professional clinical skills are essential but not sufficient. We foresee that we will then be expected to provide proof that this is indeed a viable path to expanding the circle of excellence in mathematics and the sciences.

Therefore, the foundation decided to act through a third route, one whose goal is to demonstrate how quality teaching is being implemented in schools. This route will unite professional capabilities with the building blocks the foundation plans to help develop and will be operated collectively in order to evaluate the contribution of these elements to increasing the number of students who graduate advanced mathematics and science tracks in high school.

As a first step, the foundation will help to develop a professional set of tools, instruments, and methods of supporting teaching and learning in the field that will be available to high schools interested in advancing excellence in mathematics and the sciences. This toolset would include:

- Measures to monitor and assess the abilities, difficulties, and learning progress of students in real time. They will be used by teachers in classrooms for feedback, adaptive teaching, and coordination with their colleagues;
- Methods of organizing schools' teaching staff as professional communities that make use of information about the progress of their students and cooperate to form a comprehensive picture in order to build individual curricula;
- Technological aids that will provide students with teaching and learning resources, will support assessment processes and adaptation of teaching methods, provide feedback to students, and help increase cooperation between teachers;
- Teaching assistants to help teachers use their time more effectively, including integrating volunteers in the classrooms and recruiting parents and the community in a joint effort;
- Management routines that will enable the school to set focused goals and concentrate its resources on attaining them, including needs assessment, rigorous planning; and optimizing the management of human resources;
- Building an external professional cadre to help school staff and management to adapt their working habits and learn clinical teaching practices in order to expand the circle of excellence in mathematics and science.

Later on, we will examine the possibility of forming partnerships with a limited number of local authorities and school networks that are eager and capable of advancing mathematics and science teaching by introducing the new methods developed. It is still too early to envision how such partnership would evolve, however we assume we would engage in a competitive process based on concrete plans which demonstrate capability and sustainability.

We are inclined to suggest cooperating with the local authorities because education has become an important issue for their elected officials and constituencies. Local authorities are natural partners for effecting changes in secondary schools, since the schools are run under their auspices and budgets. The same holds true for school networks, and we will also be open to partnerships with them.

Questions

16. *Are the foundation's plans for cooperating with local authorities and school networks achievable? Which in-house professional capabilities does the foundation need in order to translate its plans into action?*
17. *What period of time is required to execute development activities in this route? Is this a realistic time frame, taking into consideration the lifespan of the foundation, and is it desirable and possible to plan any shortcuts?*

IMPLEMENTATION AND SEQUENCING

The experience of successful education systems helps us define what is in the realm of the possible. That, however, is not enough to know how to act, what methods to use, the correct pace, the desirable order of business, and with whom to cooperate. We understand that the answers to these questions depend on conditions in Israel and how the foundation chooses to act.

This challenge can be approached by seeing philanthropy as a 'pyromaniac', kindling several flames of innovation and improvement and intentionally fanning them in the hope they will spread the fire of change in ever-expanding circles.

On the other hand, the issue can be approached by seeing philanthropy as an 'engineer', analyzing the way the system works; searching out the wheels of change; identifying the necessary conditions for success; and planning the milestones and measures for progress.

It is easy to get over-excited about setting the forest on fire, but it is just as tempting to drown in an engineer's over-planning. Since there are advantages and disadvantages to both approaches, we are aware that the foundation must identify a balanced strategy that will enable it to plan meticulously and act in a restrained manner, but at the same time be optimistic and decisive and able to respond to developments and changes in real time.

A year ago we asked ourselves if we should act linearly and begin by recruiting people qualified for teaching, and only later train them in clinical skills and to build support networks for implementation in schools. We very quickly came to understand that we must not wait, since the development of content and tools is a slow process, as is the creation of a supportive professional community.

At that point some of us suggested we do the opposite and focus on developing content and tools for clinical teaching skills, with the hope that when teaching is perceived as more "professional" and "clinical," it will draw an increased number of qualified people. This argument was based on the fact that qualified people in Israel are attracted to the clinical professions, almost regardless of pay levels and work conditions.

Since we recognized that before we had experience in the field we would not be able choose one approach over the other, we decided to devote our first year of activity to forming practical partnerships with professional elements in the field. We began with a handful of projects in each of the three routes, which created an initial portfolio that provides us with some experience, information, and initial conclusions.

This enabled us to adopt a series of guiding principles that we implement as we plan and develop recommendations for projects, and that will hopefully serve in developing the foundation's implementation strategy. The principles we adopted are suitable for all philanthropic foundations working to implement systemic goals in education, but are especially crucial for us as a foundation with a short lifespan:

1. Sustainability. We insist that the projects the foundation supports are operated at customary "market prices" and strive to work in partnership with relevant stakeholders. We stress close coordination with the Ministry of Education and local authorities who have sovereignty and responsibility over the long-term functioning and success of the education system;
2. Collective impact. We recognize that the success of the foundation should be measured as more than the success of each of the projects it initiates or supports. Our success will depend on creating a qualified professional community to lead the projects through coordination; cooperation; and mutual learning, while aspiring to achieve impact beyond the boundaries of their individual projects;
3. Alignment and capabilities. We prefer cooperating with established organizations that possess knowledge, experience, presence, and proven capabilities in the relevant fields. We assist organizations that meet most of these criteria to concentrate on developing explicit solutions in alignment with our goals and in agreement about how to achieve them;

   Gradual scale-up. We recognize that public systems are not built for drastic changes, and we are conscious that if existing organizations act too quickly the result may be "more of the same". The foundation staff is also relatively new and is not yet prepared for the juggling of a multi-systemic action. Therefore, we are scaling up gradually and evaluating our progress step by step.

Above all, our most crucial guiding principle is - teacher involvement. All our activities are directed towards helping teachers improve the quality of their teaching, and therefore they occupy a prominent place in the work of the foundation. We insist that each project we are involved in give teachers a voice and a role in leadership.

We are convinced that not only programs financed by the foundation can improve the functioning of teachers: on its side, the foundation will benefit from learning from their experience and knowledge as well. What teachers consider

desirable and possible is extremely important to us, both for strategic planning and for recommending which projects will be awarded with funding.

MEASURING SUCCESS

We are committed to defining clear measures of success and identifying precise milestones according to which progress will be measured and corrections and improvements made in real time. These measures will need to relate to students, teachers, schools, training institutions, and the general public.

In the foundation's Strategic Direction paper from last year, we employed caution regarding measuring the success of the foundation. We differentiated between measures that are a direct product of the activities the foundation actively supports, and measures that reflect systemic momentum and progress over which the foundation can have only indirect, if any, influence.

For example, we articulated in this paper that our aim is that within 10-12 years there will be a 20% increase in the number of high school students studying in 5-unit physics courses and a 15% increase in the number studying in 5-unit mathematics courses in local authorities and school networks the foundation teams up with.

On the other hand, we noted that we hoped that within 5-7 years the public interest in education would increase, as expressed by more people choosing to join the teaching profession, especially in mathematics and the sciences. We added that we hope to find a keener appreciation of the teaching profession and a rise in public trust in teachers.

We closed by saying that by the foundation's fifth year of operation, a progress assessment would take place to enable mid-course corrections, and that towards the end of the foundation's lifespan, a comprehensive evaluation would be executed to examine the systemic influence of the infrastructure created and implemented through the foundation's support.

At the end the foundation's initial year, we are by now inclined to recommend adding to these measures that by 2017 the present trend showing a deterioration in math and science studies in Israel will have been reversed and there will be an increase of 5% in the number of students taking 5-unit matriculation exams and an increase of 7.5% in the number of advanced-level high school math and science classes being taught, nation-wide.

We recommend that the foundation's final evaluation will also examine whether this improvement persists; if quality professional infrastructures have been laid

for sustainable support of this change; and to what extent the public and its leadership promote, invest in, and support the process.

"Impact" as defined herein, or as the advisory council will recommend, will obligate the foundation staff to develop a clear and concrete articulation of its objectives and measures for short, middle, and long-term outcomes and to put into place more specific milestones for progress.

Questions

18. *Should the foundation adopt the definition of systemic impact as offered here, or should it be satisfied with being responsible only for the direct results of its activities?*
19. *Is the definition offered realistic; is it sufficient? How can the definition of improvement which the foundation aims to influence be better articulated?*
20. *What important circles of influence and crucial milestones should the foundation define in its plans for implementing its strategies?*

APPENDIX A

MAIN FINDINGS FROM DAVID MA'AGAN, "INDICATORS AND TRENDS IN THE TEACHING OF MATHEMATICS IN HIGH SCHOOLS, 1995-2009", THE CENTRAL BUREAU OF STATISTICS, 2010.

- The number of mathematics teachers in high schools grew 82% from 2,734 in 1996, to 4,698 in 2009. The number of hours of instruction in schools grew accordingly, from 4-5 hours of weekly instruction to 6-7 hours. In 2009, 60% of the students were taught up to 3 unit level of matriculation, 25 % were in the intermediate stream of 4 units, and 15% were taught to the highest level of matriculation of 5 units.
- The average age of high school mathematics teachers is however ascending. The number of teachers over the age of fifty has doubled from 20% in 1995, to 41% in 2009. In parallel, the number of teachers under the age of 29 has decreased from 10% in 1995 to 5% in the year 2009. The number of teachers who immigrated to Israel from the former Soviet Union during the 1990's stood at 21% in 2009.
- In 2009, over 60% of new teachers of mathematics in high schools were experienced teachers in the education system. More than half taught another subject in high school the previous year, one third taught at junior high, and over 10% taught at primary school. The majority of these "new" mathematics teachers previously taught a topic which is close to mathematics, such as one of the sciences or computers.
- 20% of high school mathematics teachers are not academically qualified nor hold a mathematics teaching certificate. Less than 50% actually matriculated at 5 unit level in mathematics, however their average psychometric (~SAT) grading has been shown to be improving and in 2009 was found to be 570. In comparison, an average university student has a psychometric grade of 616.
- The number of students studying mathematics at university has decreased, and amongst them, the number who obtain a teaching certificate. In 2007, just 44 such teachers qualified. Despite this, the number of students who qualified with a B.Ed. or a certificate to teach mathematics from a college of education has increased. (According to information issued by the Ministry of Education, the number of students graduating with a certificate to teach mathematics at the education colleges has increased from 70 in 2001, to 549 in 2012.)

APPENDIX B

MAIN FINDINGS FROM EDITH MANNY-IKAN AND DANA ROSEN, "PHYSICS EDUCATION IN ISRAELI HIGH SCHOOLS, 2001, 2010, 2012", THE HENRIETTA SZOLD INSTITUTE, 2012 (NOT YET PUBLISHED)

Data for this report is based on official information from the Ministry of Education and upon the results of a questionnaire filled in by 265 physics teachers from all over Israel.

- In 2010 only 484 high schools in Israel submitted physics students to the advanced level of physics matriculation of five units, constituting less than 30% of the total number of high schools in Israel. In the last 10 years, the proportion of technological (previously vocational) learning tracks teaching physics has grown immensely and in 2010, of all the students taking the physics matriculation test, 48% were students of technological tracks.
- In 2010, the number of high school students studying for the advanced five-unit physics matriculation track was 7,709 students, 65% of which were boys. Physics classrooms are typically small and the dropout rate is high. 47% of schools that offer advanced physics studies have no more than 10 graduating students and in 77% of schools, no more than 20 students successfully graduate.
- The last decade has seen an increase in the number of students in the geographic periphery, and a decrease in the big cities of the central districts. However, the areas with the highest number of physics students are still the northern and central districts. Places like Jerusalem and its surrounding regional education authority, in fact anywhere with predominantly National-Religious and Ultra-Orthodox schooling, show an especially low number of students studying physics.
- The number of physics teachers has grown slightly from 889 in 2001, to 918 in 2010. Very noticeable in those ten years has been the turnover of half the teaching personnel. The average physics teacher has 21.5 years of experience. In 2010, 49% of the physics teachers were over the age of fifty and 18% over the age of sixty. 35% were originally from the former Soviet Union, and over half of them held second degrees and more.
- 57% of physics teachers are employed more than a full-time position, but they rarely devote extra hours as homeroom teachers, subject coordinators, etc. 13% teach physics in two schools and 35% teach additional subjects at the same school (usually mathematics). 59% indicated that they had no interest in participating in the union wage agreement which would increase in-school hours, as the compensation would not be worthwhile for them.
- 25% of physics teachers (including 50% of new teachers) claim that they have not participated in any in-service professional development program in the last five years. They report that the professional development currently offered to them

answers their needs only in part, as it is focused on ways to deepen their knowledge of the material being taught, update them with curriculum changes, enrich them with developments from the world of physics, and train them to perform laboratory experimentations.

- When teachers were asked what content they needed, they indicated that the most important subjects were how to deal with unruly behavior and lack of student discipline, and how to adapt their teaching to suite the individual needs and abilities of every student. They also wish to acquire techniques for teaching physics to a heterogenic and multi-cultural class and ways to assess student learning progress towards the matriculation exams.
- Teachers who encounter difficulties when teaching, report that they attempt to find solutions in text books, by surfing Israel's website for physics teachers, or by consulting colleagues. They almost never seek assistance from university lecturers or researchers nor from instructors, guides or mentors of the Ministry of Education. They do not find it useful to use scientific websites or internet forums. New teachers however do say that they consult with the subject matter coordinator in their school.
- The teachers point out that the major challenges they face include generating student interest in the subject matter, the shortage of instruction hours, the immense scope of material for the matriculation exam, and the absence of continuity of instruction due to other matriculation exams and school social events. Teachers site many aspects of their work that do not create a major challenge, such as their expertise in the curriculum and the need to keep themselves updated with scientific developments. They also claim that their relative isolation within the school does not particularly influence their effectiveness.
- 21% of physics teachers surveyed entered this profession as a second career. They typically transferred from careers in industry, the military, and the scientific community. The main reasons for which they decided to change careers include a love of physics, fascination with the challenges of teaching and the comfortable work conditions. New teachers in the system add alongside these reasons, the satisfaction derived by their students' learning process and from their own contribution to it.
- 76% of physics students in high school also study for 5 unit matriculation in mathematics, however their teachers claim that their mathematical knowledge-base is insufficient. When asked about teaching physics to students of 4 unit matriculation, teachers answered that these students had the ability to succeed, but that they required more detailed explanations, they needed to do more exercises, and the needed to be instructed at a slower pace and at a lesser depth. As for their scientific background and learning skills, teachers specifically point to the students' lack of laboratory experience, inadequate ability in scientific reasoning, and lacking expression in writing or in speech.

- Physics teachers report that most lessons are delivered frontally. During these lessons they solve homework exercises with the students and engage them in discussions. They almost never hold individual or small group experiment sessions, institute data processing and simulations, nor investigative tasks or projects, and do not carry out any student assessment related to their educational progress. When a student experiences a difficulty, the teacher will repeat the explanation and if need be, will help them after the lesson has ended.

APPENDIX C

MAIN FINDINGS FROM MINA ZEMACH, "PERCEPTION, ATTITUDE, AND INCLINATION TOWARDS THE TEACHING PROFESSION IN GENERAL, AND THE TEACHING OF MATHEMATICS AND THE SCIENCES IN PARTICULAR", THE DAHAF INSTITUTE, 2012; AND FROM LEAH PASS AND HAIM LAPID, "THE CAUSES OF ATTRACTION TO THE TEACHING OF SCIENCE AND MATHEMATICS IN HIGH SCHOOLS", 2012 (AS YET UNPUBLISHED)

Quantitative and qualitative studies carried out in the summer of 2012 among a representative sample of Israeli society (500 participants) correlated according to ethnicity, gender, and place of residence, and focus groups with engineers, students, and parents.

THE IMAGE OF THE TEACHING PROFESSION

- The Israeli public considers teaching an important profession and assumes that high quality people will choose it, although they wouldn't dream of choosing it themselves, or recommend it to their nearest and dearest. There is clearly a double standard in the public's attitude to teaching. Whoever chooses this profession is perceived as having unique qualities, and capable of ignoring financial considerations, but has the misfortune of finding himself in a situation where he has no other options.
- The outstanding characteristics that the public identifies with teachers are their familiarity with the subject matter (72%), high educational achievements (67%) and dedication to the work (60%). Characteristics that the public do not consider in teachers include being a role model, their involvement in the learning progress of their students, and their providing assistance to students experiencing difficulties.

- The attraction to entering the teaching profession is based on the promise of job security, tenure and good social conditions, especially in a time of general uncertain economic stability. Teaching is considered an easy-going profession with relatively short working hours, long holidays, the possibility of self-fulfillment, the ability to leave one's influence on somebody else, and to contribute something positive to society.
- Only 25% of the general public would recommend to any young man considering a career to choose teaching and 31% to a young woman. The percentages increase as the age of the recommender rises, and if they are more religiously inclined. The main reasons for recommendation are that teaching is an important profession and a social mission, and it is also regarded as a very interesting career.
- In answer to the question as to whether one would consider taking a professional course to become a teacher in a high school, 24% of university graduates replied: "I would certainly accept". The main reason for their willingness is that they perceive teaching as an important and interesting profession, in which one can progress professionally while working reasonable hours and preserving a good family life.
- The hesitation to enter the teaching profession rests on the evaluation that the salary is very low, the profession lacks prestige and respect, and there is neither advancement nor autonomy. In addition, the work place is inadequate and there is a need to take work home. Many claim that parents do not appreciate or respect the teacher, the behavior of students is defective, and the Ministry of Education micro manages.
- However, people do remember, with gratitude, a super teacher who was successful, impressive, and worthy of praise, although he or she was, in that sense, exceptional. Usually the uniqueness of someone who chooses to be a teacher is perceived as an expression of a certain strangeness and weakness, as a sign of modest abilities, and as someone who is lacking ambition, is fatigued, dull, and without self-respect.

THE IMAGE OF MATHEMATICS AND SCIENCE TEACHERS

- Mathematics and science teachers are perceived as having a better standing to other teachers for reasons of professionalism and economics. The subjects they teach are seen as difficult and so these teachers are attributed higher knowledge, greater ability and greater talent. These teachers work in several schools and in addition give private lessons, and subsequently many consider that their income is in fact reasonable.
- The public impression of a mathematics or science teacher is someone who must hold his students' attention and concentration, and who must have a position of authority and strength. A good mathematics or science teacher is seen as someone who does not "tread water". This is the popular image of teachers of non-scientific subjects, who teach topics that are "possible to memorize even when not being understood".
- People assume that the instruction of mathematics and the sciences demands true comprehension and easily exposes whosoever does not fully understand them. They suppose that the majority of students are not really interested in learning these subjects. That is what pushes teachers to invest the maximum to persuade and encourage students to learn, and to assist them to overcome difficulties and to better understand the material.
- Typical mathematics or physics teachers are most often portrayed as immigrants from the former Soviet Union, significantly older than other teachers. Despite the prestige of their expertise and the high estimation of their practice, these teachers are seen as coming from a country not considered technology-oriented, and that they arrived at teaching for want of anything better.

THE TEACHING OF MATHEMATICS AND THE SCIENCES AS A SECOND CAREER

- The public distinguishes between two types of science and mathematics teachers: those that fell into it, and those who are in it by choice, and especially those that turned to teaching at a later age as a second career. Second career

teachers may be found in all manner of subject areas, but the public usually identifies them with mathematics and science teaching.

- People describe these second career teachers as "Hi-Tech" personnel. They are perceived as coming from a background of technological sciences, and as people who have proven their abilities and talents. They are considered as if they sensed they have "done their thing" in the private sector and decided to move over to teaching. The public standing of these teachers is especially high, and they are seen as people who have fulfilled themselves, and are now ready to give up on the good life they enjoyed in their previous employment in order to give back to society.
- Many focus groups participants recommended that the government opens special tracks for the recruitment and teacher-training of people who have left Hi-Tech. They pointed to the need to engage with them individually in a proactive manner and not to suffice with opening new courses and waiting for these candidates to sign up. This recommendation asks for courses with flexible content and timeframe to suit the unique character of this group, and for the State to publicly recognize the importance and prestige of this endeavor.
- In answer to the question: "Would you accept an offer to undergo training to teach mathematics and science in high school?" 8.6% of academic graduates responded: "I would certainly accept". The reasons for this willingness are a love of the subject matter (36%), the possibility of self-fulfillment, occupational security, the decent salary and the prospect contribution to society. These candidates attribute less importance to the low prestige of teaching and to the minimal damage to family life.
- The typical demographics of the positive respondents are - Jewish (76%), born in Israel (84%), male (51%), over 30 years of age (81%), non-religious or traditional (80%), employed and pensioners (69%), lives in the center or the north of the country (64%), and residents of a large city (42%).