



**Shaping the future of maths  
and science education**

**ISRAEL**  
**National Needs Analysis on STEM**  
**School-Industry Collaboration**  
Dov Winer

February, 2013



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## EXECUTIVE SUMMARY

Knowledge intensive industries are the growth engine of Israel economy. The rate of exported products based on high technology grew in the last years and is now 50% of the industrial exports. Export of computing related services, research and development are a third of the exported services of Israel. These achievements take place while only 7% of the employed population work in the high technology industries and services.

The growth of the economy based on high technologies that took place in the last twenty years was supported also by an immigratory influx of mostly well educated people; such influx is now exhausted and the new immigrants aging. Immediate actions are required to adequate the educational system so it is able to provide for the STEM related national needs. Issues related to STEM education became a national priority. Lately several discussions took place in the relevant Committees of the Knesset (Parliament) and national initiatives have been launched to cope with such critical issue.

We got an excellent responsiveness from top level officers when invited to participate in the inGenious National Needs Analysis workshop. It expressed the importance they attribute to this matter and their commitment to cope with it. The workshop served as an opportunity for pooling relevant documents and information, for the personal acquaintance between the participants and for a lively exchange of ideas.

### Summary:

There is agreement on the need of interventions aimed at increasing the availability of well qualified human resources in the area of STEM. This agreement is related to the identified needs of Israel economy; the relatively small numbers of secondary students who excel in their STEM related baccalaureate examinations; the data related to the availability of qualified STEM the teachers and their aging.

The Ministry of Education **stresses system wide interventions** with the purpose of bringing substantial increase in the number of students who excel in an increased STEM related baccalaureate examinations. The paper jointly authored by the head of the Administration for Science and Technology, Dr. Ofer Rimon, is called **“Treading on diamonds: Israel’s unrealized potential of excellence”** and well expresses the issues being tackled. The leading program is **“Adapting the Educational System to the 21<sup>st</sup> Century”** with an initial investment of 400 million NIS. Its flagship program for STEM education is that of the **“Science and Technology Leadership Reserve”** program. Other important program to which participants repeatedly referred is TOV – Technicians with Baccalaureate Examinations with the purpose to have the number of students in Technology studies reach the OECD mean of 46%; the establishment of Advanced Technological Regional Centres for exercising and experiencing in technological studies with a 50 million NIS investment in a joint initiative of the Ministry of Education; the Ministry of Trade Industry and Employment; and the Manufacturers Association of Israel. Several other system wide interventions are being explored.

Complementing the initiatives led by the Ministry there is a plurality and richness of high quality interventions targeted at specific populations. Many of them target the higher achieving population while other seeks to advance diverse disadvantaged groups.

Best practices: The NNA workshop and related documentation enabled the identification of **STEM best practices** targeted at specific segments of student population, some of them already well qualified. Examples include the Hemda Center for Science Education which teaches Physics, Chemistry and now began a program on Computerized Science catering for all schools in Tel Aviv; the program for industrial relevant advanced physics and others at the Davidson Center for Science Education; interventions initiated by the STEM disciplines Chief Inspectors at the Ministry of Education; the network for “Science Oriented Youth” that operates at the universities, research centres and colleges with the participation of 59,503 students in 2001.<sup>1</sup> The presenters stressed the need to increase support and widen the participation in such programs.

Industry: There are several ambitious and well succeeded programs run by the industry in cooperation with the educational system. While CISCO and Microsoft focus mainly in programs focussed on ICT related skills and disciplines other companies like INTEL and TEVA have a wider approach supporting a broad spectrum of scientific and mathematical disciplines from the curriculum.

The largest program of cooperation of industry with the educational system is that run by the Israel

<sup>1</sup> [http://he.wikipedia.org/wiki/%D7%A0%D7%95%D7%A2%D7%A8\\_%D7%A9%D7%95%D7%97%D7%A8\\_%D7%9E%D7%93%D7%A2](http://he.wikipedia.org/wiki/%D7%A0%D7%95%D7%A2%D7%A8_%D7%A9%D7%95%D7%97%D7%A8_%D7%9E%D7%93%D7%A2)

Manufacturers Association through their Ta'asyeda program. The program now reaches 300,000 students a year. However, as explained by Michael Oren its deputy director, **the focus of the program is not STEM but entrepreneurship** and the provision of alternative role models for girls encouraging them to consider careers in industry.

Encouraging women and minorities to consider scientific careers: There is a consensus on the need to develop programs encouraging specific target populations that are underrepresented in STEM education. Girls have an excellent potential and several programs were presented. The ambitions program "Cracking the Glass Ceiling" by the Alliance Israelite Universelle is accompanied by close evaluation; the international programs TWIST and GENDERA; and other nation-wide interventions. The inspector coordinator for Machine Engineering said that girls excel in this area better than boys. The need to change preconceived ideas among teachers, parents and counsellors was emphasized. Programs targeted at the Haredi (ultra-orthodox) and Arab population are being implemented with the purpose of integrating them in the technologically advanced work force.

The detailed agenda including links to the presentations and relevant documents is brought below in this document. The structure of the workshop included the following phases:

- The opening featured **Dr. Florence Azran**, Deputy Director of the Administration of Science and Technology of the Ministry of Education, the main institutions with responsibilities for STEM education. It was complemented by explanations about the workshop by **Dov Winer** (MAKASH) who coordinates inGenious in Israel and by **Charmaine Kerr** (EUN/inGenious) who described the purpose of the project and its deployment.
- A panel on Israel National needs for human resources in STEM. It was moderated by **Yuval Vurgan** from the Research and Information Center of the Parliament which has issued many documents on this matter. Participated **Dr. Moshe Oron** the former chair of the Committee for Academy-Industry relations at the National Council for Research and Development (Civil) and **Dr. Avital Darmon** from the Israel Academy of Sciences and Humanities.
- The Scientific Reserve and Leadership is the flagship program of the Ministry of Education for STEM and it was presented by **Yigal Dor** its director at the Administration for Science and Technology.

The remaining panels enabled the presentation of a varied sample of on-going interventions that cope with the main issues:

- The involvement of industry: **Dr. Ronit Ashkenazi** the deputy director of the AMAL network of colleges and schools of science, technology and arts moderated it. The participants included **Michael Oren** from the Manufacturers Association of Israel (Ta'asyeda); **Tal Shemer** from Intel; and **Zika Abzuk**, CISCO.
- Innovative Science Education Initiatives: The participants included **Maya Halevy** director of the Bloomfield Science Museum Jerusalem; **Dr. Avi Golan** from the Davidson Center for Science Education; **Dr. Tehila Ben Gal** director of the Hemda Center for Science Education; and **Esty Magen** from Fourier Education. The discipline inspectors from the Ministry of Education and other participants took part in the ensuing debate indicating a plenty of ideas and on-going initiatives in the field.
- Encouraging women and minorities to consider scientific careers **Maya Halevy** the director of the Bloomfield Science Museum Jerusalem moderated the panel – she also participates in the project [TWIST](#) (Towards Women in Science and Technology). The participants included Dr. Judith Abrahami from the ORT Braude Technological College and project [GENDERA](#); Dr. Naama Azulay from the program for Girl's empowerment and increasing their interest in Science careers (Alliance Israélite Universelle – Israel); Dr. Ronit Ashkenazi, Deputy Director of the AMAL network of Colleges and Schools of Science, Technology and Arts. Dr. Ronit Kark from the Bar Ilan University who advice the AIU program couldn't be present but contributed her article on Women and Technology in Israel (2007).

## NATIONAL NEEDS WORKSHOP PROCEEDINGS

### Opening

**Maya Halevy** who chaired the workshop welcomed the participants at the Bloomfield Science Museum Jerusalem.

**Dr. Florence Azran** welcomed the participants in the workshop for the Ministry of Education. She stressed in her intervention the importance of the matter expressed by the substantial enlargement of the programs being carried by the Administration for Science and Technology and in particular the program for Adapting the Educational System to the 21<sup>st</sup> Century<sup>2</sup> for which 400 million NIS have been earmarked.

Technological education is the basis for the economy; low technology enterprises are leaving the OECD countries. However 50% of the students in Israel do not complete the baccalaureate examinations. The Ministry is taking responsibility and intends to double the number. There is close cooperation with industry – students are brought to visit industrial plant and now 50 million NIS are being applied in a joint initiative with the Manufacturer’s Association to establish technological employment training centres both in the north (Haifa) and in the south (Beer Sheva). There is urgency to develop technological skills and enhance the chances of employment for the ultra-orthodox community (Haredim).

Concerning STEM education she stressed the role of the flagship program for the Scientific and Technological Reserve that was later presented by **Yigal Dor**. The baseline is the present share of 6.5% of students who excel in their quality baccalaureate examinations. A quality baccalaureate examination is one in which the student chooses to take most of the available units in the following disciplines: (a) Five units of Mathematics (b) Five units in Exact Sciences (c) Five units in an additional Scientific or Technological course of studies. The goal of this program (that began two years ago) is to intervene in a way that in nine years Israel reaches a share of 20% of students that excel in these quality baccalaureate examinations.

Dr. Azran emphasized that the priority of the Ministry is for system wide programs able to offer solutions to large populations of students tackling also the disparities between different sectors of the population that characterize Israel. There is a vast unrealized potential for advancing STEM studies achievement among peripheral and disadvantaged populations and the involvement of girls and these are at the top of the Ministry considerations.

She referred to the fact that Israel students did not get good scores and ranking in the international comparison examinations and the steps the Ministry took to cope with the problem. At the time of her presentation Dr. Azran told the participants that at the same time there was a press conference at the Ministry to announce the results of the TIMSS international comparisons. She was happy later to tell the participants that the results for Israel have improved substantially. In the TIMSS international examinations Israel students obtained 516 points in Mathematics (7<sup>th</sup> rank) and 516 points in Sciences (13<sup>th</sup>), ahead of all other Western countries.

### Israel National needs for human resources in STEM

**Yuval Vurgan** opened the panel by making reference to a recent document prepared by Dr. Ofer Rimon, head of the Administration for Science and Technology and the Chief Scientist of the Central Bureau of Statistics, Dr. Dmitri Romanov, concerning “The potential for excellence of Israel that is not realized”. They point out in that document that “In the long run Israel may lose its relative advantage if there it does not intervene in a well-planned and focused way on the early education stages.<sup>3</sup> He then discussed different approaches concerning STEM education mentioning also the views that do not accept to see students as resources for the purposes of industry. The provision of adequate professional and vocational capacities in this view is a responsibility of the industry itself, to be supported by the government, but not a national need of the whole society as the title of the workshop implies.

Yuval brought hard data based on the research documents prepared for the Parliament that indicates that the

<sup>2</sup> [http://cms.education.gov.il/EducationCMS/Units/MadaTech/englishsifria/AdaptingtheEducationSystemtothe21Century/Vision\\_and\\_rationale.htm](http://cms.education.gov.il/EducationCMS/Units/MadaTech/englishsifria/AdaptingtheEducationSystemtothe21Century/Vision_and_rationale.htm)

<sup>3</sup> Ofer Rimon and Dmitri Romanov, Stepping over diamonds: the non realized potential for excellence of Israel, <http://www.cbs.gov.il/www/publications/pw67.pdf> (Hebrew with English summary), The Central Bureau of Statistics – Working Papers Series, Paper No. 67, April 2012.

number of study hours dedicated to Sciences has become lower and there are problems concerning the aging of the teachers for sciences; and the low number of University students who take the Teaching Diploma course of studies.

He said that remains to be seen whether the different actions taken by the Ministry, like the T"OV Programme (Technicians and Baccalaureate), the Scientific and Technological Reserve, and others, bring about a steady and clear change in trends, concerning both general share of those entitled to a Baccalaureate and the share of those with a quality Baccalaureate that entitles their holders a wide variety of channels for continuing their higher education.

**Dr. Moshe Oron** provided basic data and indicated the main problems. The number of scientists and researchers in Israel is .6% of the population (42,000) one of the highest rates in the world; the number of engineers is about 100,000 that are 1.4% - also high. The number of application engineers and technicians is 286,000 (4% of the population). The Israel universities rank high in the international comparison on quality of higher education and research institutions.

However these positive elements should be considered against several troubling issues. The present number of graduates and post-graduates in Sciences and Engineering studies at the universities is not enough to substitute those retiring due to aging. There are missing teaching faculty in Israel and its average age is high; the number of Israeli faculty at American universities is a quarter of their number in Israel itself. There are some disciplines in which there is clearly not enough human resources – Medicine, Chemistry, Electrical Engineering and lately also Machine Engineering. Among the 110,000 yearly graduates from secondary education only half of them are entitled to the Baccalaureate Diploma. Among them only 10,000 have taken 4 or 5 units in Mathematics and in another scientific discipline. They are the potential students of Science, Engineering, Economics and Accounting, practical Engineering and technicians. This is the bottleneck.

**Dr. Avital Darmon** – the director of Initiative for Applied Research in Education at the Israel National Academy of Sciences posed several questions that should be considered when discussing national needs. First of all what is the goal, the purposes of Scientific Education. She made reference to 12 goals and among them: the role of science for in nurturing in all students rational thinking and civic discussion of societal goals; educating future researchers, educating future engineers; capabilities for working in teams. She also observed that industry may compete with the universities for the better qualified graduates. Dr. Darmon stressed that the scarcest resource in the education process is the time of the students and it is not clear whether we know enough about science learning in today's reality to guide the best use of students' time for learning by the education system. She mentioned that National Academies are involved in many ways in Science Education in their respective countries. She suggested that there is need for openness to the experiences of other countries, as well as to sharing expertise between many interested bodies in Israel. The MoE should keep in mind the whole picture and see to the learning of science by all students while making the best of the contribution of various bodies with specific goals.

In the ensuing discussion **Ronit Ashkenazi** expressed her concern over the availability of teachers; they are involved with the ICT based program for teaching sciences "Nahshon" but it is clear that teachers in direct presence are essential. Virtual learning will not solve the problem. **Moshe Oron** pointed out that one possible source of good teachers are engineers and scientist working in industry who volunteers; he himself for many years enjoys teaching at a secondary school. He told about small villages in Denmark that provide supplementary living money for students who commit themselves to return as teachers. It was observed that for the Hemda centre there are 40 candidates for each teaching opening and this is due to the excellence of the equipment and quality of the teaching force. Participants from the Davidson centre observed that demographics are also involved - for example in Ashdod was there is a lack of Physics teachers but there are no openings for young teachers.

#### The involvement of industry in promoting STEM education in Israel

**Dr. Ronit Ashkenazi** opened the panel asking that the participants discuss how students can be integrated in industry and which model the participants propose for this purpose.

**Tal Shemer** from Intel said that when needs of the industry and those of the educational system meet one another then there is a true bond. Intel carries a continuous dialogue with the Ministry of Education thinking together. The results are the comprehensive programs now being carried out for a 4 years' time span. Its influence encompasses the whole system in Israel including secondary education, the army and the



universities.

**Zika Abzuk** from CISCO emphasized their interest in absorbing workers that were trained by the company. They wish to share with their customers the process of product development, to think together. Ten years ago they understood that the Ministries of Education were unable to provide for their human resources needs. They established a Virtual School that operates in 65 countries including Israel and about a million students have taken courses. There are now additional initiatives including those directed to the Arab population and the ultra-orthodox community (Haredim).

We think that the diversity in the working force contributes to the creativity of the firm.

We have established a coalition of 30 companies and so far have trained 500 Arab technicians/ engineers and we look forward reaching a 1,000 still this year.

I think that it should be a right of every student to learn like in Hemda.

We have much to contribute and will be happy to be part of a comprehensive process of deliberation and associate with you.

**Michael Oren** from Ta'asyeda the educational branch of the Manufacturer's Association described their initiative. It is based on a virtuous circle involving the industry, Ministries with an emphasis on Local Authorities. We worked a few years ago with 10,000 students a year and have now reached 200 thousand with plans to reach 300 thousand in the upcoming school year. We begin developing interest in industry at an early age and seek to emphasize the entrepreneurial elements that are part of industry world.

I have difficulty with the concept of high technology. We seek to change the image of industry so it is attractive showing that also the traditional industry has its hi-tech elements.

Some of our programs targeted to girls bring to the schools lecturers/moderators of group discussions who are themselves women managers and engineers in industry with the purpose to offer positive role identification models for girls.

**Dr. Moti Elkaslasi**, director of the ORT Givat Ram College intervened and said that industry and the educational system work in parallel line. There is need for a deeper connection between the two realms. To enlarge the number of students in the technological education. The student should be able to be integrated in the industrial environment so as better prepare him for an industrial occupation. There is an urgent need for more mentors of students' projects that come from the industry.

**Gershon Cohen** the director of the Technological Area at the Administration for Science and Technology observed that there are 106 schools in which students are integrated in the industry, 20 of them in the ultra-orthodox (Haredi) sector. We intend to reach 150 schools in three years. There is close cooperation with Intel and CISCO. One main problem is that the agents in this area are split between the Ministry of Education, the Ministry of Trade, Industry and Employment and the Employment Service. There is need to provide solutions for the future industries and for this purpose we have prepared a Working Paper presented to the government.

**Dr. Avi Golan** from the Davidson Centre said that if the educational system failed perhaps the industry can take the responsibility for the tasks ahead. The industry demonstrated that when it is in its convenience it is able to intake Haredim (ultra-orthodox) to train and usefully employ them.

**Yair Matiash** from Community Relations at TEVA Pharmaceutical expressed the fact that there is a constant deficit of hundreds of workers. It is not a problem only at the level of academics; we need Chemists, Materials Engineers; application engineers and technicians. TEVA employs 7000 people in Israel and there is always the danger, in case the conditions are not adequate, that plants may move to the far East.

Innovative Science Education Initiatives in Israel: successes and challenges Moderated by Esty Magen from Fourier Education – the presentations provide a detailed account of this session.

**Maya Halevy** described the activities of the Bloomfield Science Museum Jerusalem which stands between the formal and informal educational systems. She stressed the excellent support the Museum gets from its collaboration with industry and its participation in European projects.

**Dr. Avi Golan** describe in detail the program developed at the Davidson Centre for Physics and Industry. He

stressed the fact that Science, unlike music or visual art, is hierarchical. You can be the Beatles without knowing all about Verdi or Mozart, but you cannot do 21<sup>st</sup> century Physics without being familiar with the work of Faraday and Newton. That is why high school physics devotes most of its time and energy to 19<sup>th</sup> century physics. The program developed in Davidson is oriented to enable good secondary students with an interest in Physics to cope with real planning and design of advanced projects that simulate a project in the industry in the 21<sup>st</sup> century. The program is highly selective and very successful; each year 30 to 40 students start to participate and 20-30 complete the program. They get tutors from the industry and there is very good cooperation with very high technology enterprises like Elop.

**Dr. Tehilla Ben-Gai**, director of Hemda- Science Education Center of Tel-Aviv-Yaffo said that Science has importance by itself and is entitled to get the investments needed. Science education is not a pipe to bring human resources to industry. The kind of language we use is important in defining the purposes of our actions. Hemda is an initiative of Prof. Haim Harari, former president of the Weizmann institute of science. Hemda was built by the help of the Rothschild Foundation and is supported by Tel-Aviv-Yaffo municipality and the Tel-Aviv Foundation. The main purpose of Hemda is to teach Physics, Chemistry and Computational Science at the highest level at cutting edge laboratories, support the students who encounter difficulties and promote the excellent. There is a pooling of the resources and equipment. Number of students per class is up to 24. 17 high schools send their students to study at Hemda. There is much interest of teachers to work at Hemda: the prospect of becoming part of a good team, in well- equipped surrounding and getting the appreciation of students and support to every initiation.

The team of Hemda has developed a new 5 unit course for highly motivated, math and physics oriented students: Computational Science ( MOACH in Hebrew). The students learn how to use a computer as a science tool. This is a special program and the students receive a bonus on their application to the university. We teach MOACH in two Tel Aviv classes at the 9th to 12th grades – and in the Davidson Institute .

**Esty Magen** described two programs developed by Fourier Education that employed the monitoring and sensor system in two educational programs that intervened to increase the interest in science of disadvantaged girls. One of the programs dealt with Fertilizers in Gardening and another was carried out in the framework of the Israel Nature Protection Association.

Fighting stereotypes by giving a more realistic view of scientific jobs, and encouraging women and minorities to consider scientific careers.

**Dr. Yaron Doppelt** Inspector Coordinator for the Discipline Machine Engineering said that there are 12,700 students of Physics, half of them come from the Technological Area. Girls always are most successful than boys in Machine Engineering. There is an urgent need to change the images and concept among parents and vocational counsellors. He stressed that it is easier to learn the concepts of Physic in an applied engineering context that in a theoretical one. Most of the secondary students haven't reached the highest level of cognitive development (following Piaget). Providing concrete tasks facilitates very much the acquisition of higher level concepts.

**Maya Halevy** said that this seems to be a good approach not only for girls. The question is how do we overcome the obstacles. She presented **Ety XXXX** who coordinates in the Bloomfield Museum the activities of the project TWIST: Towards Women in Science and Technology. Women hold only 12% of top science positions in Europe. At the same time we know that gender diversity is essential for creativity and innovation. TWIST is raising awareness about the role and representation of women in science through ambitious programmes and activities in science centres and museums. The project targets young people, their teachers and parents as well as the general public.

**Dr. Naama Azulay**, the deputy director for Pedagogy at the Alliance ( AIU), presented an ambitious program they developed and focused on the social periphery. It is called "Cracking the Glass Ceiling". The program promotes a comprehensive process spanning over five years (girls aged 13-18) and focuses on four major aspects: (1) Each school is "adopted" by a leading high-tech company, which is actively involved in exposing the participants to the various career paths available for them. (2) Personal coaching held in a group. It includes setting one's goals for the coming school year and encouraging personal ambitions. (3) Modelling: a series of

meetings with leading women in the field of STEM which act as role models for the young women. (4) Extra tutoring and scholastic assistance focusing on math and science.

Evaluation of the program is being carried out by Dr. Ronit Kark from the Bar Ilan University who founded the "Gender in the Field" program at the university. It was found that more girls now choose to take 4 or 5 units in Science disciplines as a result of this intervention.

**Dr. Ronit Ashkenazi** said that teachers have lower expectations from girls than from boys in the mathematics, sciences and engineering disciplines. This reflects in their responses to girls in the classroom and the guidance process. We must raise the awareness of the teachers to this and help them change their behaviour in relation to girls at their lessons, in the teaching/learning processes, and also in the unbearable easiness with which they waive the girls from coping with these disciplines.

Dr. Ashkenazi also made reference to the research carried out by Dr. Anat Zohar concerning the effect of the text that accompanies questions in exams in physics and mathematics. While for the boys the text has no significance at all, for girls texts that include masculine contents significantly lower their success in coping with the question. It is important to study the issue of ways of learning that are characteristic of girls and adapt the teaching to the learning styles of girls and not only of boys.

She also referred to findings that show girls having better achievements when studying in gender separated class. She does not accept to implement this approach as it is not the natural environment in which will need later to study and work. **Dr. Judith Abrahami** intervened and asked to diverge on this point.

**Dr. Judith Abrahami** from the ORT Braude Engineering College in Karmiel described the project GENDERA which sought to identify good practices for encouraging women to study science and engineering that bring about lasting cultural changes that are not dependent of the "committed entrepreneur". GENDERA assumed that the role of women in scientific careers and in decision making positions will be strengthened through interventions such as those identified as best practices, and observance of specific policies. GENDERA partners collected, classified and analysed existing policies and programmes in order to **identify good practices that are already having a positive effect on ensuring that women enjoy equal opportunities in science and technology, first in education, and later in promotion in their careers in research organisations and higher education institutions and achieve decision-making positions.**

**Maya Halevy** summarised the discussion pointing out the need to identify and cope with opportunities and obstacles to achievement of better expression of the potential of women in Science and other highly qualified careers.

## NATIONAL KEY FIGURES ON STEM EDUCATION

		Year of data	[ISRAEL]	EU 27	Source
Population		End 2011	Total 7,836.6 Jews 5,907.5 Moslems 1,354.3 Christians 155.1 Druze 129.8		<a href="#">CBS Israel</a>
Population by age	0-14 years	End 2011	2,206.9		<a href="#">CBS Israel</a>
	15-24 years	End 2011	1,195.8		<a href="#">CBS Israel</a>
Total expenditure on Education		End 2011	73.4 billion NIS (1 Euro = ~5 NIS Feb 2013)		<a href="#">CBS Israel</a>
Expenditure on education as % of GDP		End 2011	8.4%		<a href="#">CBS Israel</a>
Financial aid to pupils as % of total expenditure at primary and secondary education*		2008	77% Pre-primary 78% Primary 94% Post-primary 74%		<a href="#">CBS Israel</a>
Financial aid to pupils as % of total expenditure at tertiary education		2008	78% (Universities) 37% (Other tertiary institutions)		<a href="#">CBS Israel</a>
Mathematics, science and technology enrolments and graduates		2009	Enrolment: 38,671 Graduates: 8625		<a href="#">CBS Israel</a>
PISA Scores in STEM		2009	Sciences 455 (41 <sup>st</sup> ) Mathematics 447 (41 <sup>st</sup> ) Lecture 474 (36 <sup>th</sup> )		OECD <a href="#">MOE</a>
TIMSS/PIRLS		2011	TIMSS Maths 516 (7 <sup>th</sup> ) TIMSS Sciences 516 (13 <sup>th</sup> ) <a href="#">PIRLS</a> 541 (18 <sup>th</sup> )		<a href="#">MOE</a>

\* This data is the % of public expenditure in education - not exactly "Financial aid to pupils"

### Students at Tertiary Education by Level and Area of Study 2009

From [http://cbs.gov.il/webpub/pub/text\\_page.html?publ=71&CYear=2009&CMonth=1](http://cbs.gov.il/webpub/pub/text_page.html?publ=71&CYear=2009&CMonth=1) (Table 2.6)

	Doctorate	Master	Bachelor		First year Bachelor
Humanities	2,651	7,665	14,513		4,755
Social Sciences	1,736	12,980	23,799		7,868
Law	171	2,283	3,143		777
Medicine and para-medical	689	4,475	7,299		2,146
Natural Sciences and Mathematics	3,950	3,958	11,463	19,371	3,879
Agriculture	289	568	795	1,652	324
Engineering and Architecture	816	2,407	14,425	17,648	3,914
Total	10,272	34,336	75,437		23,663
Total STEM				38,671	

### Graduates of Tertiary education by level and area of studies 2008/2009

From [http://cbs.gov.il/webpub/pub/text\\_page.html?publ=71&CYear=2009&CMonth=1](http://cbs.gov.il/webpub/pub/text_page.html?publ=71&CYear=2009&CMonth=1) (Table 3.6)

	Doctorate	Master	Bachelor	
Humanities	327	2,132	3,192	
Social Sciences	212	4,647	6,749	
Law	19	1,310	932	
Medicine and para-medical	101	1,142	2,052	
Natural Sciences and Mathematics	556	1,393	2,711	4,660
Agriculture	26	143	184	353
Engineering and Architecture	132	861	2,619	3,612
Total	1,373	11,628	18,439	
Total STEM				8625

## PRESENTATIONS AND KEY RESOURCES

### **Presentations at the inGenious National Needs Analysis Workshop – Israel**

**The European Coordinating Body for Mathematics, Science and Technology inGenious program**  
Charmaine Kerr, inGenious, EUN – The European Schoolnet, **Online Lecture.**

pptx:

[http://makash.org.il/ecb/Charmaine\\_Kerr\\_ECB\\_National\\_Needs\\_Analysis\\_presentation-Israel\\_201212\[V1\].pptx](http://makash.org.il/ecb/Charmaine_Kerr_ECB_National_Needs_Analysis_presentation-Israel_201212[V1].pptx)

pdf:

[http://makash.org.il/ecb/Charmaine\\_Kerr\\_ECB\\_National\\_Needs\\_Analysis\\_presentation-Israel\\_201212\[V1\].pdf](http://makash.org.il/ecb/Charmaine_Kerr_ECB_National_Needs_Analysis_presentation-Israel_201212[V1].pdf)

### **Israel National Needs for Human Resources in STEM- Science, Technology, Engineering and Mathematics**

Panel moderated by Yuval Vurgan

**Yuval Vurgan**, Team Head, Research and Information Center of the Knesset (Parliament).

Opening English: [http://makash.org.il/ecb/YuvalVurgan\\_Opening\\_English.pdf](http://makash.org.il/ecb/YuvalVurgan_Opening_English.pdf)

Opening Hebrew: [http://makash.org.il/ecb/YuvalVurgan\\_Opening\\_Hebrew.pdf](http://makash.org.il/ecb/YuvalVurgan_Opening_Hebrew.pdf)

**Dr. Moshe Oron**, Chief Scientist, KiloLambda Technologies; Vice President, ICO International Commission for Optics; former Chairman of the Committee for Academy-Industry relations at the National Council for Research and Development (Civil).

summary:

[http://makash.org.il/ecb/Moshe\\_Oron\\_IsraelNeeds\\_Science\\_HR\\_needs\\_workshop\\_201212.docx](http://makash.org.il/ecb/Moshe_Oron_IsraelNeeds_Science_HR_needs_workshop_201212.docx)

presentation: [http://makash.org.il/ecb/Moshe\\_Oron\\_Israel\\_HR\\_Science\\_needs\\_workshop\\_201212.ppt](http://makash.org.il/ecb/Moshe_Oron_Israel_HR_Science_needs_workshop_201212.ppt)

**Dr. Avital Darmon**, Israel Academy of Sciences and Humanities

summary: [http://makash.org.il/ecb/Avital\\_Darmon\\_questions\\_needs\\_workshop.docx](http://makash.org.il/ecb/Avital_Darmon_questions_needs_workshop.docx)

### **The involvement of the industry in promoting Science education in Israel**

Panel moderated by **Dr. Ronit Ashkenazi**, Deputy Director, Amal Israel

**Michael Oren**, Deputy Director, Ta'asyeda Industry for Advancement of Education, Manufactures Association of Israel

description translated by MAKASH to English:

[http://makash.org.il/ecb/Oren\\_Israel\\_FutureGenerationHiTechInIndustry\\_EN\\_needs\\_workshop\\_201212.pdf](http://makash.org.il/ecb/Oren_Israel_FutureGenerationHiTechInIndustry_EN_needs_workshop_201212.pdf)

presentation pptx:

[http://makash.org.il/ecb/Michael\\_Oren\\_PresentingTaasyedaActivities\\_needs\\_workshop201212.pptx](http://makash.org.il/ecb/Michael_Oren_PresentingTaasyedaActivities_needs_workshop201212.pptx)

presentation pdf:

[http://makash.org.il/ecb/Michael\\_Oren\\_PresentingTaasyedaActivities\\_needs\\_workshop201212.pdf](http://makash.org.il/ecb/Michael_Oren_PresentingTaasyedaActivities_needs_workshop201212.pdf)

**Tal Shemer**, Education manager and Academic Relations manager(Intel)

Education, Social Dialogue in CSR Full CSR Report :

[http://makash.org.il/ecb/Tal\\_Shemer\\_Education-SocialDialogue\\_Pages18-24\\_Intel\\_Israel\\_2011\\_CSR\\_Report-Final.pdf](http://makash.org.il/ecb/Tal_Shemer_Education-SocialDialogue_Pages18-24_Intel_Israel_2011_CSR_Report-Final.pdf)

Israel Education: [http://makash.org.il/ecb/Intel\\_Education\\_needs\\_workshop\\_201212.pdf](http://makash.org.il/ecb/Intel_Education_needs_workshop_201212.pdf)

**Zika Abzuk**, Senior Manager, CISCO.

Education in CSR Report:

[http://makash.org.il/ecb/CISCO\\_Education\\_Pages\\_70-72\\_CSR-Report-2012-Full-Report.pdf](http://makash.org.il/ecb/CISCO_Education_Pages_70-72_CSR-Report-2012-Full-Report.pdf)

**Full CSR Report:**

[http://makash.org.il/ecb/CISCO\\_see-page-70-72\\_CSR-Report-2012-Full-Report.pdf](http://makash.org.il/ecb/CISCO_see-page-70-72_CSR-Report-2012-Full-Report.pdf)

**The Scientific Reserve and Leadership program of the Administration for Science and Technology, Ministry of Education**

**Yigal Dor**, Director of the Scientific Reserve Program, Administration for Science and Technology, Ministry of Education.

presentation [pptx:](#)

[http://makash.org.il/ecb/Yigal\\_Dor\\_AtudaMadait-2013\\_needs\\_workshop\\_201212.pptx](http://makash.org.il/ecb/Yigal_Dor_AtudaMadait-2013_needs_workshop_201212.pptx)

presentation [pdf:](#)

[http://makash.org.il/ecb/Yigal\\_Dor\\_AtudaMadait-2013\\_needs\\_workshop\\_201212.pdf](http://makash.org.il/ecb/Yigal_Dor_AtudaMadait-2013_needs_workshop_201212.pdf)

**Innovative Science Education Initiatives in Israel: successes and challenges**

Panel moderated by Esty Magen from Fourier Education

**Maya Halevy**, Director, Bloomfield Science Museum Jerusalem.

[http://makash.org.il/ecb/MayaHalevy\\_needs\\_workshop201212.pptx](http://makash.org.il/ecb/MayaHalevy_needs_workshop201212.pptx)

[http://makash.org.il/ecb/MayaHalevy\\_needs\\_workshop201212.pdf](http://makash.org.il/ecb/MayaHalevy_needs_workshop201212.pdf)

**Dr. Avi Golan**, Director of the Students Unit, Davidson Institute for Science Education at the Weizmann Institute

[summary:](#)

[http://makash.org.il/ecb/Avi\\_Golan\\_Davidson\\_PI\\_needs\\_workshop\\_201212.doc](http://makash.org.il/ecb/Avi_Golan_Davidson_PI_needs_workshop_201212.doc)

**Dr. Tehilla Ben Gai**, Director, Hemda - Center for Science Education

[summary:](#)

[http://makash.org.il/ecb/Tehilla\\_Ben\\_Gai\\_Hemda\\_needs\\_workshop\\_201212.doc](http://makash.org.il/ecb/Tehilla_Ben_Gai_Hemda_needs_workshop_201212.doc)

**Esty Magen**, Fourier Education

[summary:](#)

[http://makash.org.il/ecb/Esty\\_Magen\\_Fourier\\_InnovationScience\\_needs\\_workshop\\_201212.docx](http://makash.org.il/ecb/Esty_Magen_Fourier_InnovationScience_needs_workshop_201212.docx)

**Fighting stereotypes by giving a more realistic view of scientific jobs, and encouraging women and minorities to consider scientific careers.**

Panel moderated by **Maya Halevy**, Bloomfield Museum and the project [TWIST](#) - towards Women in Science and Technology.

Higgs Boson at the Science Café: <http://www.the-twist-project.eu/he/event/20/>

**Dr. Judith Abrahami**, ORT Braude Carmiel and project [GENDERA](#)

[summary:](#)

[http://makash.org.il/ecb/Judith\\_Abrahami\\_Fighting\\_stereotypes\\_needs\\_workshop\\_201212.docx](http://makash.org.il/ecb/Judith_Abrahami_Fighting_stereotypes_needs_workshop_201212.docx)

**Dr. Naama Azulay**, AIU, AIU Program for girls' empowerment and increasing their interest in Science careers. Possibly with [Dr. Ronit Kark](#), Senior Lecturer at the Gender Studies Department, Bar Ilan University and the AIU program.

[summary:](#)

[http://makash.org.il/ecb/Naama\\_Azulay\\_KIAH\\_CrackingGlassCeiling\\_needs\\_workshop\\_201212.doc](http://makash.org.il/ecb/Naama_Azulay_KIAH_CrackingGlassCeiling_needs_workshop_201212.doc)

brochure: <http://makash.org.il/ecb/CrackingTheGlassCeilingBrochure.pdf>

evaluation report by Dr. Ronit Kark:

[http://makash.org.il/ecb/CrackingTheGlassCeiling\\_EvaluationReport\\_2011-2012\\_Kark.pdf](http://makash.org.il/ecb/CrackingTheGlassCeiling_EvaluationReport_2011-2012_Kark.pdf)

**Dr. Ronit Ashkenazi**, Deputy Director and head of the Pedagogical Administration, Amal Israel.

Presentation: [ppt](#) [pdf](#)

[http://makash.org.il/ecb/Ronit\\_Ashkenazi\\_AMAL\\_girls\\_to\\_STEM\\_needs\\_workshop\\_201212.ppt](http://makash.org.il/ecb/Ronit_Ashkenazi_AMAL_girls_to_STEM_needs_workshop_201212.ppt)

[http://makash.org.il/ecb/Ronit\\_Ashkenazi\\_AMAL\\_girls\\_to\\_STEM\\_needs\\_workshop\\_201212.pdf](http://makash.org.il/ecb/Ronit_Ashkenazi_AMAL_girls_to_STEM_needs_workshop_201212.pdf)

## **Sources concerning STEM education policy in Israel**

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### **Treading on diamonds: Israel's unrealized potential of excellence (Hebrew with English Executive Summary)**

Working Paper series No. 67, Central Bureau of Statistics, Jerusalem, Israel

Ofer Rimon\* and Dmitri Romanov\*\*, April 2012

\*Ministry of Education, Science and Technology Directorate; \*\*Central Bureau of Statistics, Chief Scientist Department

<http://www.knesset.gov.il/committees/heb/material/data/mada2012-06-11.pdf>

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### **Education and Business: Israel**

Authors: Osnat Hachmon and Dr Eli Eisenberg, ORT Israel

ETF/ Ministry of Education, Science and Technology Administration, 2011

[http://etf.europa.eu/web.nsf/pages/Education\\_and\\_Business\\_Israel](http://etf.europa.eu/web.nsf/pages/Education_and_Business_Israel)

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### **המועצה הלאומית למחקר ולפיתוח**

דוח לשנים 2010 ו-2011 מוגש לוועדת השרים לענייני מדע וטכנולוגיה ולוועדת המדע והטכנולוגיה של הכנסת  
תמוז תשע"ב – יולי 2012

[Report of the National Council for Civil RTD for 2010-2011 \(Hebrew\)](#)

<http://knesset.gov.il/committees/heb/material/data/mada2012-10-15.pdf>

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### **Israel Education Policy: How to move ahead in reform**

Philip Hemmings, 04 June 2010 Pages 35 OECD Economics Department Working Papers

[http://www.oecd-ilibrary.org/economics/israeli-education-policy\\_5kmd3khjif0-en](http://www.oecd-ilibrary.org/economics/israeli-education-policy_5kmd3khjif0-en)

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### **Women in the land of milk, honey and high technology: the Israeli case**

Dr. Ronit Kark, University Bar Ilan, Departments of Psychology and Sociology

Chapter 6 (pp. 152 to 191] in: R. Burke & M. Mattis (Eds.). Women and minorities in science, technology, engineering and mathematics: Opening the pipeline. New York: Edward Elgar (2007)

[http://makash.org.il/ecb/Ronit\\_Kark\\_Women\\_and\\_Technology\\_Israel\\_2007.pdf](http://makash.org.il/ecb/Ronit_Kark_Women_and_Technology_Israel_2007.pdf)

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### **Technological Education and Professional Training**

Program for 2012 and status of projects, Education Committee, The Manufacturer's Association of Israel, December 2011 (Hebrew)



[http://makash.org.il/ecb/itahdut\\_taasianimHinuchDec2011.ppt](http://makash.org.il/ecb/itahdut_taasianimHinuchDec2011.ppt)

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### **The best girls to Science: promoting women in technology (Heb)**

Article by Dr. Judith Abrahami-Einat on the occasion of the 2013 World Women Day analysing the situation in Israel concerning the integration of women in the STEM professions.

<http://www.ynet.co.il/articles/0,7340,L-4352216,00.html>

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### **A renewal of science education in Europe**

Views and Actions of National Academies -Analysis of surveys conducted in 2010 and 2011

A report of the ALLEA Working Group Science Education (IAP Science Education Programme Regional European Council)

<http://www.allea.org/Content/ALLEA/WG%20Science%20Education/Helsinki/Report%20ALLEA%202012%20last.pdf>

(Last retrieved on 04.12.2012)

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## **STEM Education in Israel: resources translated to English by MAKASH**

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### **Information about Education for Sciences and Technology**

Translation by Makash of the background paper of the Center for Research and Information of the Israel Parliament. The original paper is available (in Hebrew) at <http://www.knesset.gov.il/mmm/data/pdf/m02978.pdf>

The Knesset (Parliament), Center for Research and Information, Jerusalem, November 7, 2011

[http://makash.org.il/ecb/20111107\\_Background\\_Knesset\\_ScienceTechnologyEducation\\_.pdf](http://makash.org.il/ecb/20111107_Background_Knesset_ScienceTechnologyEducation_.pdf)

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### **The Israel Program: Science and Technology Leadership Reserve**

From (Hebrew)

[http://cms.education.gov.il/EducationCMS/Units/MadaTech/technology/AtudaMadaitTechnologit/atuda\\_madait\\_tnologit.htm](http://cms.education.gov.il/EducationCMS/Units/MadaTech/technology/AtudaMadaitTechnologit/atuda_madait_tnologit.htm)

[http://makash.org.il/ecb/201207\\_Israel\\_program\\_MST\\_leadership\\_reserve.pdf](http://makash.org.il/ecb/201207_Israel_program_MST_leadership_reserve.pdf)

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### **TEVA and PERAH**

The outstanding programs of TEVA Pharmaceuticals in promoting excellence in education and science education are HavaYeda Teva and Mezuian Teva. The file includes a description of the PERAH national program for tutoring secondary students by university students who receive scholarships for this purpose

From (Hebrew)

<http://www.teva.co.il/CorpResponsibility/Partnerships/Pages/ExcellenceInEducation.aspx>

[http://makash.org.il/ecb/201207\\_Israel\\_TEVA\\_and\\_PERAH\\_programs.pdf](http://makash.org.il/ecb/201207_Israel_TEVA_and_PERAH_programs.pdf)

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### **The project “Dor Eatid in Hitech BeTaasia” The generation of the future in industry’s HiTech**

Israel Manufacturer’s Association:

[http://makash.org.il/ecb/201207\\_Israel\\_FutureGenerationHiTechInIndustry\\_english.pdf](http://makash.org.il/ecb/201207_Israel_FutureGenerationHiTechInIndustry_english.pdf)

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Originally in English:

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### **Mind the (Gender) Gap: Can a Two-hour Visit to a Hi-Tech Company Change Perceptions about Computer Science?**

Larisa Eidelman et al. (2011) ACM Inroads 2011 September • Vol. 2 • No. 3

[http://makash.org.il/ecb/google\\_mind\\_the\\_gap\\_64-eidelman.pdf](http://makash.org.il/ecb/google_mind_the_gap_64-eidelman.pdf)

## ANNEX I

# Central Bureau of Statistics

Abstract of the report

WORKING PAPER SERIES NO. 67

## Treading on diamonds: Israel's unrealized potential of excellence

Ofer Rimon\* and Dmitri Romanov\*\*

**April 2012**

\* Ministry of Education, Science and Technology Directorate

\*\*Central Bureau of Statistics, Chief Scientist Department

Available at:

[http://www.cbs.gov.il/reader/paper\\_work/pw\\_e.html](http://www.cbs.gov.il/reader/paper_work/pw_e.html)

## ANNEX II

### Executive Summary of the Report

## Education and Business: ISRAEL (2011)

ETF – Working together / Learning for Life

Ministry of Education Science and Technology Administration

Available at:

[http://etf.europa.eu/web.nsf/pages/Education\\_and\\_Business\\_Israel](http://etf.europa.eu/web.nsf/pages/Education_and_Business_Israel)

Acknowledgements

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1. Dr Florence Azran, Ministry of Education
2. Nisim Ohana, Ministry of Education
3. Ron Bar Yoseph, Ministry of Industry, Trade and Labor
4. Sofi Artzev, Central Bureau of Statistics
5. Dr Tal Lotan, Manufacturers' Association of Israel
6. Michael Oren, Manufacturers' Association of Israel
7. Dr Eli Eisenberg (Chairman), ORT Israel network
8. Osnat Hachmon, ORT Israel network
9. Dr Ronit Ashkenazy, AMAL network
10. Refaella Ballas, AMAL network