

Preparing Israel's Education System for the Challenges of the 21st Century

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Abstract

The fact that times are changing is reflected in many areas. There is a natural expectation that schools – the institutions responsible for the education of the next generation – will prepare for and adapt to the changes taking place outside their walls and equip their students with the competencies, knowledge, skills, and values that they will need in the 21st century.

More specifically, many educational researchers note that in the 21st century, the education system must change its emphasis from studying defined material and learning by rote, to imparting those competencies, thereby enabling students to contend with a changing world throughout their lifetime. Findings based on a meta-analysis of a large number of studies indicate that these include: information management, critical thinking, creativity and innovation, problem solving, collaboration, communication, technical skills, self-direction, lifelong learning, ethical and cultural awareness, and flexibility.

The need for adapting the education system is no secret to its leadership, and over the years various reforms have been launched aimed at generating change. From 1994 to 2014, nine pedagogic reforms were implemented, each of which aimed at adapting specific components of the educational system to the needs of the 21st century.

Despite these efforts, the education system is still struggling to adapt itself to the needs of today, as is evidenced by the significant gap between the stated goals and objectives of these reforms and what is actually happening on the ground in school classrooms.

Furthermore, PISA and PIAAC test results (despite the sometimes justified criticism of their validity) reflect the Israeli education system's low level of achievement, in comparison with that of other countries. This is especially the case with regard to the achievements of students on Israel's socioeconomic periphery, Arab citizens of Israel, and the ultra-Orthodox.

Barriers to Adaptation

The first step towards promoting needed reforms is to identify and analyze the barriers to their implementation. On the basis of a comprehensive review of the literature which we undertook for our current research and based on the experience of the Israeli educational experts whom we interviewed, we can identify seven main barriers standing in the way of adaptation of the system:

The competencies required of students for matriculation exams and the admission requirements of the higher educational system are not compatible with those needed to meet the challenges of the 21st century.

School principals and teachers lack adequate mastery of 21st century competencies.

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The education system is over-centralized, making it difficult to implement tailored policy that addresses local needs .

There is a tendency to standardize and focus on specific tests, at the expense of pedagogic autonomy on the school and local levels .

The education system is unwieldy; it includes many departments, often working simultaneously at promoting incompatible, or even contradictory, goals.

Israel's population is particularly heterogeneous, with various groups differing in both their characteristics and their needs, making it difficult and inefficient to attempt to implement uniform changes on a system-wide level .

Frequent political changes make it difficult to promote long-term goals. Reforms launched by politically-affiliated ministers are often discontinued or are not budgeted by their successors.

Recommendations

We must continue our research in order to fully address and analyze the main barriers impeding on the adaptation of the education system, including the in-depth study of each specific barrier and its implications .At this current stage of our research, we are presenting preliminary recommendations on how to deal with three specific barriers and create the basis for a systematic model to update curricula.

1. Adapting national matriculation exams and the criteria for admission to higher education to the needs of the 21st century :

The competencies which schools must impart must be clearly and concretely defined.

Clear evaluation criteria must be developed for each competency, so that each can be measured through testing, theoretical and experiential tasks, feedback processes, and by formative and summary evaluation .

Consensus must be achieved between the Ministry of Education and the leadership of the higher education system as to the competencies with which each student must be equipped in the course of his/her studies, on the basis of the above evaluation criteria .

These two systems must engage in active cooperation in order to develop more appropriate testing and evaluation methods to replace the existing matriculation exams .

2. Equipping school principals and teachers with 21st century skills :

There is a need for greater incentives for entering into the teaching profession, including raising salaries for first-year teachers.

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Admission standards for teacher training institutions must be raised, and academic supervision of training must be more stringent .

Reforms should be planned and implemented to provide 21st century competencies to those in charge of preservice training, professional development, and in-service teacher training .

Incentives must be provided to develop“ teacher communities ”which will introduce innovative pedagogic processes and tools.

Both positive and negative incentives should be provided for the integration and implementation of innovative educational technology in pedagogic processes; positive—through grants and public recognition; negative—by delaying promotions and using organizational means.

3. Establishing a National Education Council:

To ensure greater consistency and introduce educational reforms, we recommend the establishment of a National Education Council to initiate, promote, and implement reforms on the basis of a long-term perspective ,and in partnership with various relevant sectors. We propose two alternative models for the Council’s work:

A council with executive and operational authority, created through the merger of several Ministry of Education units, to analyze the education system and formulate and promote long-term policy.

An advisory council whose activity will be based on the work of the National Economic Council and the National Security Council, operating in the Prime Minister’s Office .

4. Developing and implementing a systematic model for ongoing update of the curriculum:

We propose to develop a model for systematic and ongoing updates of the educational curriculum so that it is better suited for meeting the rapid changes in the competencies and jobs of the21 st century. This model’s main features are based on the comprehensive research carried out by Waks, Eisenberg and others.(1988)

Adaptation of the curriculum to address 21st century needs and challenges should relate to all its components: pedagogic approaches; teaching and study methods; physical infrastructure and equipment; experiential learning in workshops and laboratories; and testing, evaluation, and feedback methods.

The timing and regulation of curriculum updates should be clearly defined, to ensure that the default process will be systematic and continually updated, rather than a reactive response to the specific demands of professional committees in charge of each study subject.

Introduction

As part of the sweeping, rapid changes taking place in the 21st century, many tasks that were performed by humans in the past are undergoing processes of optimization and digitalization. The virtual world has become central to daily life, and innovative technologies have opened a window to a variety of exciting opportunities. Yet it seems that the education system has not adapted to the pace of change and is not preparing the future generation to meet the challenges ahead.

In recent decades, researchers in the field of education have shown that the pedagogical foundation that today's schools give their graduates was adapted to the needs of the Industrial Revolution. During that period, most jobs required a standard set of knowledge and skills. Now completely different skills are needed. The education system must therefore abandon its focus on knowledge based on memorization. This knowledge is now available by merely pressing a button or typing into a search engine. Instead, today's education must develop the deep thinking that is required in a changing technological world (Schleicher, 2010).

Against this background, a lively debate is being held across the globe on the need to make a fundamental change in the education system and design programs that will focus on the development and strengthening of relevant skills, instead of teaching defined content. Many researchers think that schools must focus on strengthening skills necessary for successful integration into 21st century society and economy. These include deep thinking skills (such as critical thinking, creativity and problem-solving); digital skills (such as information management skills in addition to the technical abilities required for use of advanced technology); and general life skills necessary in a changing world (such as cooperation, communication, self-direction, lifelong learning, ethical awareness, cultural awareness, and flexibility).

The educational approach that focuses on learning skills and not on content and information has taken hold in recent decades in many education systems around the world. In this field, the State of Israel has been a pioneer. As early as the 1970s, a reform was conducted in biology teaching (the biotope project), with significant weight given to individual research that promoted skills now defined as 21st-century skills. Since the 1990s, the demand to adapt the Israeli education system to modern needs has occupied an increasingly important place in the public conversation in the field. In fact, no less than ten reforms have attempted to adapt various aspects of the education system's pedagogical methods to 21st century needs – on average, one reform every two years (in addition to structural reforms made in the education system during those years).

Despite the abundant reforms, it seems that the education system has difficulty supplying the expected results. Grades in Israel are relatively low on international tests, such as PISA (which tests students during their school years) and PIAAC (which tests adults on skills). It has been found that a particularly high number of students and graduates of the education system have not acquired skills that are considered basic by international standards. Even when examining the specific areas addressed by the reforms, the situation in Israel is gloomy: the probability that an Israeli student will implement strategies based on rote learning is twice as

high than the probability that s/he will implement strategies based on deep analysis of a problem (OECD, 2016). The situation is similar with regard to communication technology. Although we do not have enough information about the level of integration of technological applications in the education system or their rate of success, the existing data indicates that the technology used in schools is not appropriate for life in the world outside the classroom. (The teaching aids and exam aids are almost all based on paper booklets, writing in notebooks and use of a standard class black- or whiteboard.)

Thus there is room for improvement in this field, as well as in the level of satisfaction of parents and students. Parents in Israel are less satisfied than parents in most of the developed nations, and most junior high and high school students do not think what they do in school is relevant to life outside the educational institution (National Authority for Measurement and Evaluation in Education [RAMA], 2017).

We believe that in order to create real change in the education system and adapt it to the needs of a changing world, we must map the fundamental barriers that prevent its adaptation to the changes of the 21st century and examine ways to overcome these barriers.

One type of barrier relates to the need to change the education system from the traditional format that focuses on acquisition of defined knowledge, to focus on improving skills. The major barriers of this type are:

1. The skills required of students for matriculation exams and the admission requirements of the higher educational system are not compatible with those needed to meet the challenges of the 21st century.
2. The educational system tends toward excessive standardization, and the number of external tests harms deep pedagogy.
3. School principals and teachers lack adequate mastery of 21st century skills.
4. The teacher training institutions are not adapting sufficiently.

Another type of barrier relates to the institutional and organizational character of the Israeli education system and characteristics of Israeli society:

1. The education system is over-centralized, making it difficult to implement tailored policy that addresses local needs.
2. The education system is unwieldy, and the accompanying system does not support implementation of reforms that require cooperation among numerous entities and stakeholders.
3. The operation of the political system and frequent turnover of ministers obstructs formulation of a coherent, long-term policy. Instead of adhering to the reforms of his predecessors, each minister aspires to launch a new reform that will bear his name.
4. Israel's population is particularly heterogeneous, impairing implementation of overall system-wide reforms and harming their efficacy.

In this document, we examine how the education system should act in attempting to adapt to the 21st century. In Chapter 1, we define what skills are necessary today, relying on a broad literature survey and on interviews with researchers and experts in the field. In Chapter 2,

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we review reforms conducted in the Israeli education system that aimed to adapt pedagogy to the 21st century. Chapter 3 examines indicators for performance of the system, and checks its success in adapting itself to today's needs, based on several indicators. In Chapter 4, we map the main barriers that stop the education system from adapting itself to these needs, and in Chapter 5, we offer several suggestions for improving the system's performance to enable graduates to meet 21st century challenges successfully.

Chapter 1: 21st Century Skills

In order to determine which set of skills the education system must impart to its students, we must first understand the contemporary and future needs of the job market and society. This understanding is a central challenge to researchers and education professionals, and thus an extensive body of research has attempted to map the skills needed in the 21st century.

Research focuses on examining the changes required to adapt skills used in the past for current and future needs, and identifying new skills that have become vital in the 21st century but are not taught in the education system (Dede, 2010).¹

In presenting policies to decision-makers for adapting the education system to current and future needs, the first task we face is to clarify the field of discussion – in other words, the terms used to describe the skills of tomorrow. We find that the results of existing studies are problematic, because they do not agree on the definition of the required skills.² In addition, studies may focus on varying characteristics of these skills, so that although the name of the skill they discuss is identical, the content it represents is may differ. This phenomenon of researchers using the same terms to describe different things is known as the “reverse Tower of Babel problem.” Some assert that because of this ambiguity, many reforms throughout the world have worked in opposite directions in their attempts to adapt the education system to 21st century needs (ibid.). Therefore, our first task in this study will be to outline a shared terminological framework based on a comprehensive literature review.

Defining 21st century skills

In attempting to outline the set of skills required in the 21st century, researchers usually rely on the distinction between skills considered unique to human beings, or in which we reasonably assume that people have a significant advantage, and operations that computers or other machines can perform at a satisfactory level. The 20th century has witnessed a steady increase in the number of jobs requiring the performance of non-repetitive operations. Simultaneously, machines began to take over the jobs that demanded repetitive operations. These jobs became irrelevant for people, or else those who did them had to adapt themselves to the new technological environment and develop a different skills set (Autor, Levy and Murnane, 2003). This trend is expected to intensify (Jaimovich and Siu, 2012).

Many studies have identified specific skills that are necessary for the needs of the 21st century. In our study, we attempt to define 21st century skills based on the level of academic

¹ We emphasize that this does not mean neglecting old important skills that are taught to students. Rather, we must examine which of these are still relevant in the 21st century, which must be adapted, and which are no longer relevant today (Dede, 2010).

² Furthermore, some have argued that defining 21st century skills is deficient, because the connections between teaching the skills and the future performance of graduates of the education system are not well-established in the academic research (National Research Council, 2012).

consensus regarding the necessity of each skill. For this purpose, we rely on a broad meta-analysis performed by Ester Van Laar et al. (2017).

This meta-analysis examined 75 articles and academic books written from 2000-2016 that aimed to characterize and define the skills necessary in the 21st century. The Van Laar et al. study identifies twelve main skills based on the level of consensus in the literature on their necessity (the numbers in parentheses indicate the number of studies that addressed each skill):

- Information management (31)
- Critical thinking (30)
- Creativity and innovation (29)
- Problem solving (24)
- Cooperation (24)
- Communication (22)
- Technical and digital skills (18)
- Self-direction (16)
- Lifelong learning (10)
- Ethical awareness (9)
- Cultural awareness (9)
- Flexibility (8)

Meetings that we held with Israeli education researchers who study 21st century skills reinforced our assertion that this list also reflects the skills needed in the Israeli economy and society.

We may divide the 21st century skills into three types:³

1. Skills that require deep thinking, in which humans have a relative advantage over machines.
2. Skills related to familiarity with new technologies – these are particularly necessary in the digital world and in an environment based on information technologies, which have become central in the world outside schools.
3. Soft life skills (emotional and social) – needed for individual and interpersonal behavior in a changing world (see Table 1).

Table 1: 21st century skills

Deep thinking skills	Technological skills	Life skills
Critical thinking	Information management	Cooperation
Creativity and innovation	Technical and digital skills	Communication
Problem solving		Self-direction
		Lifelong learning
		Ethical awareness
		Cultural awareness
		Flexibility

³ Of course, we can sort 21st century skills in several ways. For example, the Partnership for the 21st Century project sorted skills into learning skills, knowledge-based and literacy skills, and life skills. Alternatively, the Assessment and Teaching of 21st Century Skills project divided skills into thinking methods, work methods, work tools and life skills.

In the accepted view, each skill is composed of knowledge, skills and values (for more detail, see Appendix 1). We note here that there are points of interface between the skills, and sometimes a certain type of ability is expressed in several skills. Therefore, in this survey we have combined several abilities, as done in other studies. For example, the critical thinking skill was combined with problem solving, teamwork was combined with communication, and self-direction was combined with lifelong learning and flexibility.

Information management – Information and communication technologies literacy

The current period has been designated “the information age,” and thus the skill that most studies identify as necessary for 21st century needs is the ability to manage information. This is also called “information literacy” or “information and communication technologies literacy” (ICT literacy).

Information literacy is needed because in modern times, the public has been transformed from a passive, limited consumer of information to an active consumer. It has the ability to use the enormous databases available on the internet and to analyze and organize this information in a systematic way so that it will be easy to retrieve and process. In order to filter information based on the level of relevance, level of reliability of the data and its sources, and ethical considerations, a high level of information management is needed (Binkley et al., 2012).

Today, the ability to manage information is not expressed only in the ability to search for and process texts, but also in the ability to handle a variety of types of information. The individual must be able to obtain quantitative data and present it in an informative manner; retrieve information from social networks and learn from it – for example, about varied opinions; and obtain information on digital applications and how to use them. In addition, this skill requires the ability to organize information obtained from several databases and to crosscheck sources; the ability to locate innovative technological applications and use them efficiently; and the ability to exploit direct and indirect access to relevant individuals and entities through the internet. For this reason, the literature emphasizes the need for ICT literacy (Trilling and Fadel, 2009).

In addition to practical skills, ICT literacy requires social understanding and an ethical approach appropriate for the information age. For example, the individual requires understanding of the ethical aspects and laws related to technology – including the implications of collection and distribution of types of information according to their level of sensitivity, and awareness of the risks involved in the digital medium and communication with strangers (ibid.).⁴

Critical Thinking and Problem Solving

Another skill considered particularly necessary for 21st century needs is the ability to think critically and methodically and to solve problems, especially in situations of uncertainty. Critical thinking has many definitions, but the most accepted definition in the literature is by Dianne Halpern (1999), who states that “Critical thinking refers to the use of cognitive skills or strategies that increase the probability of a desirable outcome. Critical thinking is purposeful, reasoned,

⁴ We will discuss this aspect in depth below, in the section on ethical, social and legal awareness.

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and goal directed. It is the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and making decisions” (ibid., p. 69).

Critical thinking is expressed in cognitive and analytical abilities required for methodical analysis of arguments and approaches, aiming to define the extent of their validity. Critical thinking also demands a skeptical attitude and willingness to allocate resources in order to study the assertions and approaches presented and their core underlying assumptions. It also requires the willingness to examine related details and evidence (Cottrell, 2011).

Although it may seem that analytical abilities and a critical approach are in large part individual personality characteristics, these are also derived from the skill set and experience that a person acquires. For example, Stella Cottrell asserts that learning rules of logic and practicing identification of faults in various types of arguments can increase the tendency toward critical thinking (ibid.). Furthermore, different systems are characterized by varying levels of openness to disagreement and approaches that attempt to test and question consensus. Thus in the 21st century, educational systems must encourage open discussion, methodical examination and even the questioning of agreed principles (Halpern, 2013). This skill largely overlaps with the skills of flexibility and self-direction that we will discuss further below.

Creativity and innovation

In the 21st century, machines perform a wide variety of repetitive actions or operations that can be characterized in a methodical method, and this trend is expected to increase. Thus it seems that the relative and absolute advantage of humans lies in their creative and innovative abilities. As modern technology enables us to reproduce and distribute new ideas on a large scale, the return on creativity and originality is unprecedented (Brynjolfsson and McAfee, 2014).

The accepted definition of creativity was written by researchers Robert Sternberg and Todd Lubart (1999). In their view, “Creativity is the ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful, adaptive concerning task constraints)” (ibid., p. 3).

Creativity and innovation show a large degree of overlap with entrepreneurship, which is expressed in the ability to identify opportunities for creating value through innovation and to develop projects that enable the expression of creativity (Fayolle and Gailly, 2008). Learning and practicing entrepreneurship is likely to enable creative people to bring innovative products to fruition. Against this background, we emphasize that entrepreneurship is considered a particularly positive ability in the 21st century job market (Lackéus, 2015).

The assertion has been raised that in order to enable creativity and innovation, we must integrate individual approaches and abilities of, building a work process that enables the expression of creativity, and an environment that supports innovation and permits non-standard trials and failures (Plucker, Beghetto and Dow, 2004).

Cooperation and communication

Today’s job market emphasizes the need for cooperation and teamwork, needed for handling complex tasks. In the past, effective cooperation usually required direct interaction among

people who were physically present in the same location. Today, however, due to globalization and the broad presence of digital communications tools, opportunities abound for cooperation among individuals in disparate locations (Friedman, 2005; Plucker, Kennedy, and Dilley, 2015).

Efficient work in groups required the development of cognitive as well as social abilities. Cognitive abilities include high language ability, as fluency in foreign languages has become increasingly important (mainly English). It also includes the ability to manage projects; efficient division of tasks; and integrative learning based on maximum utilization of the knowledge and cognitive resources available in the group. Social abilities include various types communications abilities, not only verbal ones; an active approach; the ability for self-expression within group work; a broad vision of the group work and understanding of correct social functioning (Plucker, Kennedy, and Dilley, 2015; Griffin and Care, 2014).

Technical and Digital Skills

The research literature is divided as to which technical skills the education system must teach its students in the 21st century. On one hand, following the rapid changes in the job market and in social structure, many researchers emphasize that these skills must be as general as possible. In their view, the education system should not teach skills that rely on specific existing technologies (see, for example: Griffin and Care, 2014; World Economic Forum, 2016). On the other hand, other researchers have demonstrated that certain technical-digital skills, such as knowledge of internet applications, have become vital, and lack of knowledge of these skills can lead to a gap that will be particularly difficult to overcome in adulthood. According to some, acquiring certain technical-digital skills and practice in them from a young age is comparable to learning a native language. Thus acquiring these skills at a young age enables intuitive use that is easy and successful, as opposed to acquiring them when older (“digital native” – see Prensky, 2001). Furthermore, technical literacy makes it easier to acquire additional technical skills later. For example, someone who is already fluent in a programming language will find it easier to learn a new one (ibid.).

The academic literature addresses a broad range of technical skills required in the digital age –from use of an internet browser; through downloading, saving and uploading types of information on the internet; to practiced use of advanced digital tools, and many other skills in between (van Deursen, Helsper, and Eynon, 2016). Children who grow up in a digital environment will acquire many of these skills naturally, like learning a language.⁵ But other skills of this type require active practice. Researchers assert that the education system must teach these skills, so that fluency in them will be as intuitive and complete as possible (Prensky, 2005).⁶

⁵ We note that weak populations do not always have access to technology and do not receive sufficient training from their environment. Therefore, they are at a disadvantage, even for skills that most acquire naturally. The public education system thus bears the responsibility to verify that the entire population has access to technology, and to work to impart basic skills from a young age to those who do not have enough exposure outside the school framework.

⁶ We may argue that it is appropriate to create parity between the study of technical and digital skills, such as programming, and the study of other core subjects, such as math. For some subjects, like math for

Self-direction, lifelong learning and flexibility

Many researchers describe the modern era as one of increasing uncertainty. Graduates of the education system will be required to adapt themselves to the unknown, to be flexible and to progress along with the changing world (Prensky, 2012).

In the modern job market, change is rapid as compared to the traditional one. For example, studies have shown that the job market is gradually becoming more flexible. Employees are switching from one place of work to another at an increasing pace (Bureau of Labor Statistics, 2017). Non-standard work contracts are more common, permitting employees to work at several flexible jobs for more than one client or employer (Moshe, 2015). Professions are also undergoing change, and will continue to do so – they are increasingly based on technology, and a rising number of professions are disappearing as people are replaced by machines (Barber and Mourshed, 2007; WEF, 2016; OECD, 2017b). Thus during their lifetime, graduates of the education system will be required to acquire new skills and professions to maintain relevance in the modern job market (Frey and Osborne, 2013; Madhala-Brick, 2015).

Self-direction and lifelong learning are based on knowledge and skills such as the ability to search, manage and acquire relevant content, and the ability to implement new learning strategies. The education system must teach all these. In addition, the 21st century worker also must have cognitive flexibility, the ability to take initiative, and awareness of change in the environment (Uzunboylu and Hürsen, 2011).

Ethical, social and legal awareness

Life in the information age offers the future generation new, exciting opportunities. The broad accessibility of digital tools and databases places significant power in the hands of every individual. But alongside the great potential of these innovations, dangers are present as well. For examples, minors have almost unlimited access to unwanted content in digital tools and databases, and this is very difficult to filter and control.

These dangers are derived from the characteristics of the digital environment. A major difficulty arises due to privacy levels – information uploaded through digital means can be spread on the broadest possible scale. It is thus important that individuals who consider uploading information to the internet be aware of the dangers involved, including the ethical and legal implications of spreading information about others (Straker, Pollock, and Maslen, 2009). These implications can be long-term. Information distributed on the internet often remains there for many years and can stain a person's reputation permanently, even if he wishes to remove it (Mayer-Schönberger, 2011).

Due to the broad use of social media networks, it is particularly difficult to identify unethical behaviors and address them. Because adults have limited control over digital content worlds, they are hard-pressed to provide an adequate response. For example, physical bullying

example, there is broad agreement that studying them from a young age enables an intuitive command of these fields that is not necessarily possible when they are studied at a later age.

of school-age children, which is easier to monitor, is decreasing, while internet bullying is becoming more common and often goes unanswered (Law et al., 2012; Shelley and Swearer, 2015).

Researchers assert that we must pay special attention to examining the ethical implications and social influences of future technological developments. Today, public attention is directed toward artificial intelligence applications, expanding the interface between the internet and daily life (the “internet of things”),⁷ digital printing, and technologies for improving brain function.⁸ Alongside the broad benefits of these technologies, their implications for society and their appropriate use remain unclear and raise doubts (Schwab, 2017). In this context, the European Union has emphasized examining ELSA – the Ethical, Legal and Social Aspects of technological developments, through recommendations to adapt the educational program to provide a solution for the ethical aspects.

In order to meet the ethical and behavioral challenges posed by the modern age, the student must develop the independent ability to identify ethical issues and behaviors that are ethically, socially and legally problematic. This ability can and should be taught in the education system.

Cultural awareness

Following globalization processes and international distribution of information technologies, global cooperation has become more common, and sometimes even vital. With this background, clearly it is important to develop cultural awareness and an understanding of how to communicate appropriately with people from other countries and cultures (Yang et al., 2014).

Accordingly, some researchers hold that in the 21st century, individuals will become “global citizens.” Every individual will need broad knowledge of language and high communications skills. Knowledge of culture, history, geography and economics will also be useful.⁹

Globalization thus presents challenges to the education system. An important challenge relates to the tension between local cultural characteristics specific to each nation and people, which the public and state want to preserve, and global characteristics, which can contribute both on the individual and societal level. This tension is called “glocalization.” In the global age, it is important to distinguish methodically between changes – or trends – taking place in the world, and to evaluate the benefit that can be derived from adopting them and the difficulties

⁷ The internet of things (IoT) is a network of physical objects that are connected to the internet and used to collect and exchange information, to improve their operation and adapt them to the individual needs of their owners (Feng et al., 2012).

⁸ For example, some have mentioned the possibility of providing materials that improve brain ability or inserting implants that improve brain functions (Morgenstern, Pinto, and Asher, 2016).

⁹ Support for this assertion was given in an interview we conducted with Adam Nir, head of the Faculty of Educational Policy and Administration at the Hebrew University of Jerusalem. Nir emphasized that it is vital to train students in the education system to examine the local reality and the changes taking place there through the global lens (interview on January 23, 2018).

that they can raise. We must also understand how to adopt them and identify the best way to join the global trend (Brooks and Normore, 2010).

Teaching 21st century skills

From reviewing the academic literature on 21st century skills, we find that today's education system must emphasize teaching and strengthening skills, instead of the past emphasis on teaching content.¹⁰ An education system that does not adapt itself to 21st century needs will not only fail to contribute to teaching these skills (some argue that some of these skills cannot be taught at all), and it is even likely to prevent individuals with potential from realizing it. In other words, an education system that does not welcome the changes is likely to become a barrier that prevents its graduates from adapting to tomorrow's challenges. Pedagogical researchers note several characteristics that education systems must adopt in order to contribute to teaching 21st century skills.

Using digital tools

Many digital pedagogical tools can contribute greatly to learning processes. These include educational software, which can be much more effective than standard workbooks and textbooks; modern data analysis tools; tools for efficient communication between teachers, students, parents and other entities. The education system must adapt itself to the modern world and exploit the pedagogical opportunities offered by these tools. Furthermore, we emphasize that digital tools play a central role in the world outside the education system. Ignoring them is likely to render the school institution irrelevant (and this might already be happening today) (Christensen, Johnson, and Horn, 2010).

Transferring the source of knowledge from teachers to the internet

With infinite information available on the internet, the role of the teacher is changing from an authority who holds the core of knowledge to a figure whose role is to help the student find and analyze information that comes from several sources. This change can be expressed in focusing instruction on processing and analyzing information that the students obtain from external sources. The teacher is transformed from lecturer to mentor and "maker," and supports the students in independent processes of learning, research and creation (Hobbs and Moore, 2013). In summary, the teacher is supposed to grant the students independent learning skills that will enable them to continue learning relevant and necessary knowledge fields, even after the end of their formal studies (Ran and Sperling, 2016).¹¹

¹⁰ This transition is particularly challenging, and we are lacking methodical studies on curricula that have succeeded in teaching 21st century skills in the long term, with an emphasis on skills that are general and relevant to several fields, not just the field in which they were taught (National Research Council, 2012).

¹¹ This teaching method is called "flipped classroom" (Ran and Sperling, 2016).

Transition from learning defined subjects to inter-disciplinary and multi-disciplinary studies

Today's curricula are based on division into subjects that are usually disparate, with no interaction between them. This approach leads to narrow, sometimes simplistic perceptions of fields of study and types of possible solutions to problems.

Researchers emphasize that a curriculum that aims to teach the student 21st century skills must encourage inter-disciplinary and multi-disciplinary studies. These types of subjects require integration among disciplines, both for the content taught and for the methods used to analyze the knowledge. For example, a certain event can be studied from the historical, geographical, economic and sociological viewpoints. A certain phenomenon of nature can be analyzed using math, physics, chemistry and biology, as well as use of relevant technological tools. Students can even address the philosophical, social and economic aspects of the same phenomenon.

Researchers indicate the educational advantages of inter- and multi-disciplinary studies, and their contribution to the development of critical, creative and flexible thinking, and to teaching skills of cooperation that utilize the relative advantages of teachers from several fields of expertise. Such studies are important for developing learning skills that will serve the student throughout life (see, for example, Fogarty and Pete, 2009).

Project-Based Learning (PBL)

In the existing education system, acquisition of defined knowledge is considered the foundation of the pedagogical process, and it enables methodical learning and clear evaluation of the learning products. An alternative basis, which is more appropriate for 21st century demands, is learning based on problem-solving and carrying out projects. This type of learning develops the student's creativity and enables him to acquire and practice 21st century skills. The student acquires knowledge and skills through experiential learning that is relevant to her and her unique individual world.

Critics of the traditional education system argue that frontal education methods and the demand that students take exams on defined material produces behavior that is no longer necessary in modern times. They say that traditional pedagogy encourages conformism and rigid thinking, and that relying on memorization leads to superficial learning, mainly because the learned material is considered irrelevant to real life and is forgotten quickly after the exam. Furthermore, these teaching methods are likely to damage the student's motivation to work hard in her studies. On the other hand, pedagogy that is based on projects and research encourages curiosity and favors experimentation in the field. It gives students the freedom to add their own value to the topics of study; encourages creativity and cooperation; and motivates the students to attain quality products in an experiential manner. The educational experience is internalized and its impression felt far beyond completion of the project (Krajcit and Blumenfeld, 2006).

Individualized pedagogy

Another significant disadvantage of traditional pedagogy is the standard teaching that it provides. It is based on uniform educational programs, and almost never relates to the individual characteristics, strengths and weaknesses of each student. This is a characteristic of the mass education system that was created during the Industrial Revolution and fit the needs of that historical period.

In the traditional education system, the students are sorted into classes primarily by age. Teaching hours are divided among students uniformly, and the same exams are used to test all students. Today, thanks to technological advances, it is easier to identify the unique characteristics of each student and to formulate a curriculum that is adapted to her or her individual talents and needs.

The research emphasizes that individually adapted pedagogy is particularly vital in education systems such as Israel's, which is highly heterogeneous. Israel's system is plagued by large gaps, and many students have difficulty handling the standard requirements (Tomlinson et al., 2003).

Conclusion

Examining the challenges and opportunities that are anticipated for the graduate of the education system in the 21st century reveals that the ability to make an exact prediction of future demands is increasingly complex and difficult. In truth, only one thing is clear: the social, economic and employment frameworks in which the graduate is expected to live are expected to change significantly, and we cannot predict them at a high level of certainty.

Therefore, researchers in the field of education repeatedly emphasize that the 21st century education system must transfer its emphasis from "industrialized" learning of specific knowledge to teaching skills that will enable the graduate to adapt herself to a changing, unknown environment. The content learned in school should be transformed from a pedagogical goal to a pedagogical tool – instead of being required to complete their studies with a body of defined knowledge, students will use the educational content for the purpose of learning and practicing skills.

This transition is particularly complex, and it requires students, teachers and principals – the entire system – to agree to change and to adapt themselves to these changes.

Chapter 2: Adapting the Israeli Education System to the 21st Century: Changes and Reforms

The need to adapt the education system to changing times has been a focus of public debate for many years. The functioning of the education system and the growing gap between what happens behind school walls and in the world outside seems to provoke constant dissatisfaction. Against this background, in the late 20th and early 21st centuries, a broad range of reforms were implemented in the Israeli education system. These reforms aimed, at least according to their own declarations, to teach students 21st century skills. Most of them emphasized methods of “deep” pedagogy that encourage high-level thinking.¹² Some aimed to introduce digital applications in schools. Others focused on improving the skills measured on international comparative tests. Still others worked to broaden autonomy and flexibility in schools. The survey below is based on the survey of Adam Nir et al. (2016).

Reform in Biology Teaching

Israel can be considered as groundbreaking in the implementation of what are defined today as “21st century skills” in pedagogy and evaluation methods. As early as the 1970s, a reform was introduced in biology education, and emphasis was placed on learning to conduct individual research. The main points of the reform were: change in teaching methods, professional development of biology teachers, and changes in the student evaluation methods. Two additions were made to the standard matriculation exam: a practical exam in the research laboratory and an individual research project on a biotope. The weight of these two additions was 40% of the final grade. These changes still stand today, and the evaluation methods in biology teaching are an important model for testing deep learning skills.

“Tomorrow 98” (1993-1998)

The Tomorrow 98 reform was based on the 1990 report of the National Committee for Science and Technology Education, headed by Prof. Haim Harari. The committee’s goal was to advance science and technology education in Israel in preparation for the 21st century. The reform focused on teaching math, technology, and sciences in junior high and high school. It aimed to improve research learning, acquisition of thinking skills, project-based learning, and the implementation of strategies for learning and evaluation in the education system. This reform had several main emphases:

1. An interdisciplinary approach to core topics; increasing the autonomy of teachers to teach several STEM subjects together.
2. Encouraging science and technology studies outside school and making these accessible to broad populations.

¹² According to Bloom’s taxonomy, the classification of tasks based on the level of thinking that they require: knowledge, understanding, implementation, analysis, synthesis, and evaluation. See Bloom et al., 1956.

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3. Integration of computers in teaching; funding the opening and upgrading of computer classrooms.
4. Teacher training and professional development; developing teacher communities as part of academic centers for teachers.

Evaluation studies found that this reform did not produce many results (Fortes, Muallem and Levi-Nachum, 2009; Klein, 2006). Implementation of the interdisciplinary pedagogical methods does not take place. The models for teach training are almost never implemented. The curriculum that were developed are used very infrequently. Despite the investment in physical infrastructure of schools and equipment, there is still a wide gap on this issue between Israel and other developed nations.¹³

Ben-Peretz Committee and “Matriculation 2000” (1994)

The committee headed by Prof. Miriam Ben-Peretz proposed changes in the structure of the matriculation exams and in the manner of evaluating students. The committee concluded that the matriculation exams place heavy pressure on teachers and students, and do not enable deep learning and development of creative, unique thinking. It thus recommended giving the schools greater autonomy in choosing the evaluation methods that are appropriate for the students and for “deep” learning. To do so, the committee recommended authorizing experimental schools to give students autonomous evaluation in a small number of subjects, instead of the matriculation exams in those subjects. Experts would be appointed to support these schools.

Following these recommendations, the experimental project “Matriculation 2000” was launched. The project functioned in twenty-two schools and in several subjects. An evaluation study indicated success (Dori, 2003): students who participated in the project handled unfamiliar content more successfully than the control group, in all the subjects that were examined.¹⁴

Despite the success of the project, it was not expanded to additional schools, and it was stopped due to political changes and budget constraints. Most of the recommendations that were formulated in the committee were included in Director-General Circular 20 of the Ministry of Education (below), but they were not implemented.

Director-General Circular 20 (1995)

After the Ben-Peretz Committee, the Ministry of Education established another committee headed by Prof. David Gordon, chairman of the Pedagogical Secretariat. The committee’s mandate was to implement the recommendations of four previous public committees – the Harari Committee, the Shenhar Committee, the Kremnitzer Committee, and the Ben-Peretz Committee. Based on these recommendations, the new committee would make a significant

¹³ For an international comparison of the scope of advanced pedagogical aids, see OECD, 2017a.

¹⁴ We note that schools that participated in the project were chosen based on proposal that they submitted, which demonstrates the high motivation of the pedagogical staff working there. Thus we do not know whether we can use this trial to draw conclusions about the efficacy of implementing the reform in schools that are required to do so.

change in the secondary education curriculum. The committee emphasized several aspects: changing the treatment of secondary education from separating middle school and high school to a six-year pedagogical continuum; changing and varying evaluation methods (Van-Leer, 2007); and inculcating 21st century skills (Nir et al., 2016). The committee's recommendations were never implemented.

The Reform in Teaching Reading (2000)

Following the findings on deficiencies in reading comprehension, particularly in weak socioeconomic groups, a committee was formed to examine methods for teaching reading in Israel. The committee recommended switching to teaching methods that promote deep comprehension of texts; changing evaluation methods; changing teacher training; granting differential resources to strengthen the weaker layers of society; and budgeting additional resources for the system (Ben Sasson-Furstenberg, 2001). A steering committee was established, and as a result, the reading teaching method was changed for first grade.

Dovrat Committee (2005)

Following the sense of crisis in the education system, and with the goal of reorganizing the entire system, in 2003 a task force was recruited that included senior professionals from several sectors, including high-tech and business. The committee's report was confirmed by the government in 2005. It recommended significant changes in the education system: in school infrastructures; in school evaluation (RAMA, the National Authority for Measurement and Evaluation in Education was founded); and in teachers' work and compensation (Bels, 2011). The committee aimed to apply the changes alongside increasing pedagogical autonomy of principals in their schools. However, the report did not relate to pedagogical changes, such as changes in teacher training methods, methodology of teaching, and learning and evaluation of students (Nir et al., 2016). Due to opposition from the teachers' unions, the report was not implemented, except for the establishment of RAMA. However, organizational reforms that took place in the years following publication were largely based on the report (Bels, 2011).

Horizon Pedagogical Policy (2006-2009)

From 2006-2009, the Ministry of Education decided to change the focus of the education system and emphasize the principles of learning instead of improving grades. Rote learning would be replaced by deep learning of material. This program, led by Prof. Anat Zohar, chairman of the Pedagogical Secretariat, aimed to promote teaching what was defined as "high-level thinking skills." Students would be active, while learning would be experiential and relevant. Students would develop deep understanding of the content and the ability to analyze it actively.

To implement the program, the Ministry defined a list of skills that contribute to developing high-level thinking. This list included:

- Distinguishing between essential and non-essential issues;
- Organizing and mapping information and knowledge;
- Searching for reasons for phenomena;
- Comparing phenomena and drawing conclusions from the comparison;

- Identifying different and opposing viewpoints;
- Finding proves, explanations, and justifications for arguments;
- Solving problems; using metaphors and analogies appropriately;
- Exposing the underlying assumptions of an argument;
- Choosing a topic to research and researching it up to the stage of disseminating the acquired knowledge;
- Using databases wisely and choosing relevant information to solve a problem;
- Identifying the reliability of information sources;
- Distinguishing between opinions and facts, assumptions, conjectures, and beliefs;
- Making balanced and justified decisions; and other skills (Zohar, 2013).

In practice, the reform was implemented on three planes. Changes were made in the curriculum to include that required independent thinking. Some twenty-five thousand teachers and teacher trainers received professional training. The national tests and matriculation exams were updated to test for deep learning. The Ministry of Education continued supporting this policy even after a new minister took office in 2010. The program's principles formed an important component of the reform called "Israel Moves Up a Grade: Transitioning to Meaningful Learning," which was launched in 2013. This program continues to be influential today (Nir, 2017).

Policy for Improving Achievements and the National Program for Adapting the Education System to the 21st Century (2009-2013)

In 2009, the Education Ministry launched two reforms. One aimed to improve achievements. Emphasis was placed on the students' achievements and on increasing the accountability of the pedagogical staff, mainly with relation to success on national tests ("Meitzav") and international tests (PISA and TIMSS). Changes were made in the curriculum and additional resources were budgeted for a limited number of core subjects. Rigid quantitative standards were determined for measuring the pedagogical processes.

The second reform attempted to adapt the education system to the 21st century. It focused on promoting communications technology processes in schools. As part of this reform, 21st century skills were defined.¹⁵ But in fact, the focus was on promoting technology-based learning, mainly equipping schools with technological equipment and establishing the required infrastructure. Accordingly, the pedagogical instructions addressed ways of teaching technological skills and the ability to function in a digital environment, and defined the necessary skills for students (Ministry of Education, 2012).

Some asserted that increasing the pressure to meet the demands of the curriculum and improve the measurable achievements harms teachers' efforts to teach material in-depth and encourages superficial learning (Zohar, 2011; Nir et al., 2016). Others stated that these reforms do not encourage instilling skills related to deep learning, partly due to the absence of practical

¹⁵ The definition was based on a survey of skills as part of the P21 – Partnership for the 21st Century project.

instructions for how to teach the defined skills. Despite the criticism of the reform, grades on the PISA exam began to improve significantly.

The Transition to Self-Management (2010 till today)

In the 1970s, the Education Ministry began processes for reducing centralization in the education system and transferring authority from the ministry to schools. Since 1996, the ministry has permitted elementary schools to manage themselves independently. But in 2004, the transfer of new schools to this type of management was ceased (schools that had already received managerial autonomy kept their authorities). In 2010, a decision was made to return to independent management. The ministry decided that the program would begin as a pilot, and in 2011 a supervisory body was established for schools under independent management. In 2014, the program was expanded to almost all the formal elementary schools. A RAMA evaluation study supported implementation of the program (Wininger, 2017).

The program acted to increase the schools' pedagogical, organizational, and budgetary autonomy, and emphasized the accountability of the pedagogical staff. Advancement of the program was based on evidence from educational systems whose students succeed on international tests and that adapt themselves optimally to current needs. These systems were found to be characterized by decentralization and a high level of autonomy of local level entities that act within the school and on behalf of the regional authorities (Ministry of Education, 2012).

Evaluation of the program revealed that pedagogical staffs tended to express positive attitudes toward the approach that enabled autonomy, but it was not found that it made any pedagogical contribution (RAMA, 2013). Another study examined the functioning of schools that had participated in the program since its beginning, and it produced similar results. Many staffs reported initiatives, but pedagogical results were not observed, and the educational methods almost always relied on frontal teaching (Nir, 2017).

"Israel Moves Up a Grade: Transitioning to Meaningful Learning" (2013)

The declared purpose of the reform was to encourage deep, relevant learning in which students would find significance, and to encourage students to take initiative in their studies as well as socially (Ministry of Education, 2013).

Practically, aside from the directive given to pedagogical staff to encourage Meaningful Learning, the main thrust of the changes addressed methods of evaluation and encouraging social involvement. Several external national Meitzav exams were converted to internal exams within schools. The number of external matriculation exams was reduced, and matriculation exams in the tenth grade were canceled. Further, internal school evaluation methods were expanded and diversified, and the decision was made that 30% of the student's final grade would be based on an internal evaluation such as a research project or task. It was determined that high school students would have a social responsibility obligation for three years. Finally, an attempt was made to define characteristics of meaningful learning in the social-ethical field (Nir, 2017).

5X2 Initiative (2013 till today)

Following a gradual decline and resulting lack of students sitting for the five-unit matriculation exam in mathematics, in 2013 an initiative was launched to increase the rate of outstanding students in math, science, and technology. The initiative was based on cooperation between the Ministry of Education and several entities, including philanthropic funds and industrial companies.

Unlike most of the other reforms, this one did not involve any real change in pedagogical or learning methods. The education system determined which subjects were necessary for the current needs of industry and defined clear targets and measurables for the short term. This initiative seems to have met its goals, and within five years the number of students completing the five-unit matriculation exam in math more than doubled.

Above we have focused on pedagogical reforms, but in the past few decades structural reforms were also implemented. Some examples are programs titled “Giving Choice to Parents” (1994), “Differential Standard” (2003), “New Horizon” (2008), “Courage to Change” (2011-2012) (for more detail, see Nir, 2017).

Year	Title of Reform	Goal	Long-Term Effects
1970s	Reform in Biology Teaching	Encouraged teaching and learning through research. Integrated skills of scientific thinking, critical thinking, and problem solving.	The reform was implemented in the education system. One expression was the biotope project.
1993-1998	Tomorrow 98	Adapted scientific-technological education to the 21 st century. Emphasized teaching high-level thinking skills (thinking strategies, project-based learning, etc.); equipping schools with modern pedagogical tools.	Evaluation of the reforms ten years later showed little evidence of results.
1994	Ben-Peretz Committee and Matriculation 2000	Change in the matriculation exam format so they would promote high-level thinking. Created a basis for internal exams in schools.	The reform was implemented in 22 schools as a pilot. Evaluation of its implementation showed that the pilot succeeded, but the reform was not continued and not expanded across the entire system.
1995	Director-General Circular 20	Based on the recommendations of four professional committees that aimed to preserve the	The recommendations were never implemented.

		<p>six-year pedagogical continuum in secondary studies. Aimed to adapt the exams and pedagogy to teach 21st century skills.</p>	
2000	Reform in Teaching Reading	<p>Designed to improve reading comprehension. Emphasized deep comprehension of written text.</p>	<p>The steering committee implemented some of the reforms. The reaching teaching program for first grade was changed.</p>
2003	Dovrat Committee	<p>Task force of experts from several fields tried to reorganize the entire education system. Attempted to increase autonomy of schools and improve technological infrastructure.</p>	<p>The reform was not implemented, except for establishing the National Authority for Measurement and Evaluation (RAMA). Some of its components were implemented later.</p>
2006-2009	“Pedagogical Horizon” Policy	<p>The curriculum’s emphasis was switched from improving grades to deep, active learning.</p>	<p>Several education ministers adopted the reform’s principles, but the pedagogical changes in schools have not been significant.</p>
2009-2013	The National Program for Adapting the Education System to the 21 st Century	<p>The program focused on promoting digitalization processes in schools and in establishing infrastructure for digital learning methods. A policy of improving achievements was decided, and emphasis was placed on success in comparative exams.</p>	<p>The program was criticized for harming previous reforms that emphasized deep learning. In addition, the process of digitalization of schools and transfer to online learning has not been completed. Still, following the reform an improvement was noted in grades on international exams.</p>
2010	Transfer to Self-Management	<p>Autonomy was increased for elementary schools. One of the goals of this process was to encourage adaptation of the pedagogy in schools to the contemporary needs of the students.</p>	<p>Although school staffs expressed a positive attitude toward the program, it did not lead to pedagogical changes.</p>
2013	Israel Moves Up a Grade –	<p>Encouraged process of Meaningful Learning.</p>	<p>Changes began in evaluation methods. It</p>

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	Transitioning to Meaningful Learning	Emphasized changes in teaching methods and encouraged social involvement.	was decided that 30% of the grade would be based on internal evaluation, but the reform has not caused important pedagogical changes.
2013-today	5X2 Initiative	Increasing the rate of outstanding students in math and sciences.	From 2012-2018, the number of students who completed 5 units of mathematics was more than doubled.

Summary

The survey shows that throughout the past twenty-five years, the Israeli Ministry of Education and the education system has been very concerned with the issue of adapting schools to changing times. The motivation to change the system has been strong, and each new minister of education has aspired to implement a revolutionary reform that would surpass everything that was done previously. Most of the reforms shared the view that in order to teach the student 21st century skills, we must replace traditional teaching methods with innovative pedagogy.

Chapter 3: The Level of Adaptation of the Israeli Education System to 21st Century Demands – Description and International Comparison

Those who wish to evaluate education systems, whether in Israel or in general, and their level of adaptation to 21st century demands, face the fundamental challenge of how to evaluate them and how to compare their efficacy, particularly in teaching the skills appropriate for the current age.¹⁶ In this chapter, we will present measures that can indicate the level of adaptation of the Israeli education system to contemporary changes, based on international comparisons.

We will examine the state of the education system from four perspectives: the achievements of Israeli students on international tests; the teaching methods used – rote learning as opposed to deep learning; the level of inclusion of technology in the education system; subjective attitudes of parents and students to the education system.

Comparative international tests

Standard tests are an accepted method for evaluation of education systems and their results. For many decades, international organizations have conducted comparisons of education systems based on achievements in tests.¹⁷ One of the parameters that testers have tried to measure is deep thinking, considered one of the 21st century skills.¹⁸ Tests have been regularly adapted to the results of current studies of the skills that required in today's job market and anticipated to be necessary in the future (see, for example, Gordon et al., 2002, p. 21).

PISA test

The test with the greatest impact is the PISA test, which was developed by the OECD. This test has been conducted once every three years since 2000. It evaluates the academic level of fifteen-year-olds in three areas: reading, math, and science, as well as an additional area that varies for each round. The 2015 test, for example, evaluated collaborative problem-solving, a 21st century skill. The test is updated regularly. In the 2015 version, some of the tasks in reading, math, and science were performed in a digital environment.¹⁹

¹⁶ In this context, Rittel and Webber defined “malicious problems” of school functioning as problems that are difficult to define. They do not have easily identifiable solutions, and the proposed solutions are difficult to evaluate methodically. In addition, there is no clear causal connection between the problem and its solutions (Rittel and Webber, 1973).

¹⁷ For example, over the years the International Association for the Evaluation of Educational Achievement (IEA) has written several comparative tests, some of which were conducted in Israel. The first tests were the FIMS (1960s) and SIMS (1980s), which tested math skills. Today the association conducts the TIMSS test in math and science, and the PIRLS in reading (see the association website).

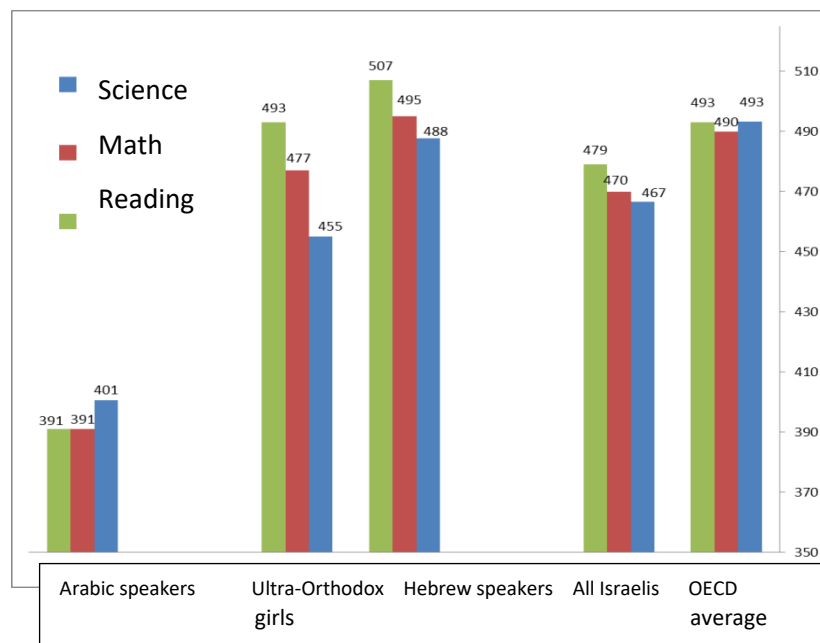
¹⁸ The tests do not focus on memorization and repetition but rather on abilities of analysis, synthesis, and evaluation.

¹⁹ For more detail, see the OECD website.

Israel has participated in the PISA tests since 2002. Over the years, the grades of Israeli students have improved, but they are still low in comparison to the average for OECD countries.²⁰ In the 2015 test, Israel was ranked twenty-eighth out of thirty-five in reading (grade 479; the average grade in the OECD was 493), thirtieth in math (470; OECD average was 490), and thirtieth in science (467; the average OECD grade was 493). The percentage of students who achieved low grades in all three subjects was particularly high: 20.2%, compared to an OECD average of 13%.

Israeli students' lack of success is particularly noticeable among students in lower socio-economic groups. There are large gaps between the various ethnic and religious communities in Israeli society as well as between socio-economic groups. For example, there is a large gap between Hebrew-speaking and Arabic-speaking tested students, and ultra-Orthodox boys are not tested at all (see data in Figure 1). The gap between the highest-scoring and lowest-scoring students is the largest of the OECD countries. The rate of outstanding performers among Israeli students is also low compared to most of the developed countries (RAMA, 2017a).

Table 1: PISA Grades in Israel – Total Population, Arabs, and Ultra-Orthodox (2015)



²⁰ In all three fields, the results in Israel have improved appreciably over the years. In reading, the average grade rose from 452 in 2002 to 474 in 2009 and 479 in 2015. In science, the average grade rose from 454 in 2006 to 455 in 2009 and 470 in 2012. In 2015, the average grade stabilized at 467. In math, in which Israel first participated in 2006, the average grade rose from 442 to 447 in 2009, to 466 in 2012 and 470 in 2015. Such an improvement is rare in OECD countries. In most other countries, grades have declined (even though the grades on the first tests were much higher than grades in Israel).

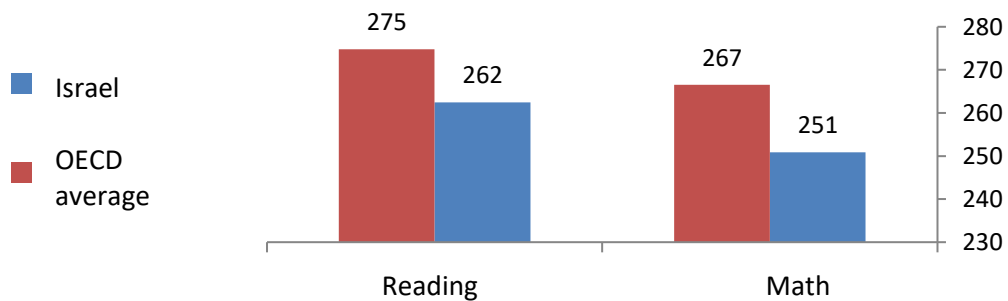
Source: Authors' analysis of data from the Ministry of Education (RAMA, 2017a).

PIAAC test of adult skills

Another test that can demonstrate the products of the education system is PIAAC test for evaluating skills of adults. This test is also conducted by the OECD, and it examines the skills of the working-age population (16-65) and its level of adaptation to the needs of the labor market. The test is conducted in thirty-three countries, and Israel participated in 2014-2015. It examines achievements in three areas: reading, math, and problem-solving in a technology-rich environment. It emphasizes skills that are considered necessary in the 21st century, primarily non-repetitive skills (Marcolin, Miroudot, and Squicciarini, 2016) and use of digital tools (Grundke et al., 2017).

We may learn about the readiness of adults for the needs of the labor market by analyzing the achievements of students who are still in school and young adults after they have completed their studies in the education system.²¹ Analyzing the achievements of Israeli youth ages sixteen to twenty-four gives a grave picture of the education system's accomplishments. In reading, Israel is ranked twenty-eighth out of the thirty-three OECD nations that participated (Israel's grade was 262; the average OECD grade was 275), while in math, Israel was twenty-ninth out of thirty-three (251; average 266) (see Figure 2). In these two fields, the grade distribution shows that Israel has a particularly large population that has failed to acquire basic skills: 22% of the Israelis tested were classified in the first reading level or lower (out of five levels, below first level means less than basic level), as compared to an average of 14% among OECD nations; 30% of the Israelis tested were classified at the first level in math or lower (out of five levels), as compared to an OECD average of 19%.²²

Table 2: Grades on PIAAC Test in Reading and Math, Ages 16-24 (2016)



Source: Israel Democracy Institute analysis of data from OECD, Education GPS.

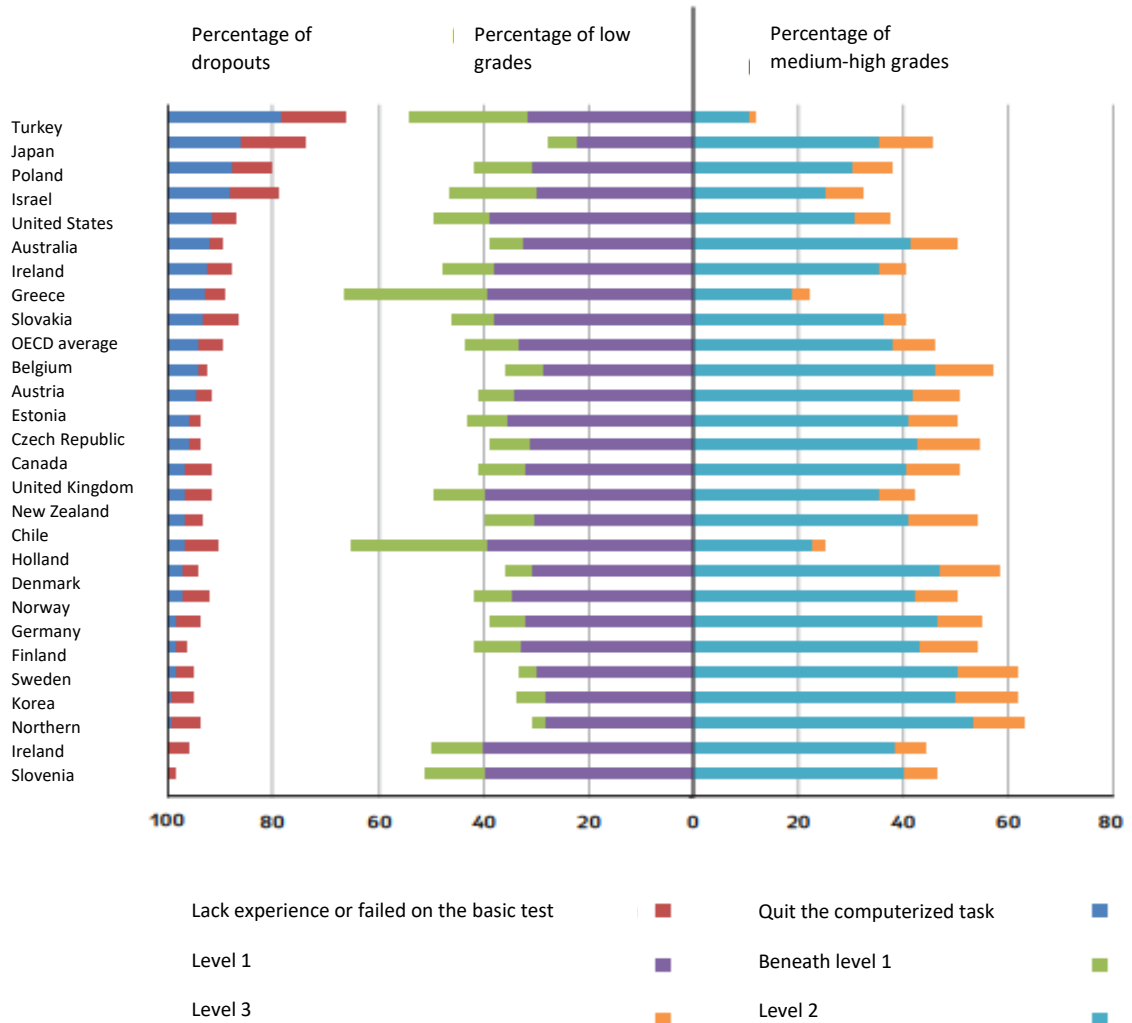
No comparison was published of the average grades among young adults in the third field examined – problem solving in a technology-rich environment. But comparison of the

²¹ Israeli young adults are unlike most young adults in developed nations because Israel has a mandatory draft law, and military service can influence skill levels. We could not analyze this issue here, but it is important for future research.

²² The PIAAC test also reveals significant gaps between Jewish and Arab populations, which are already recognizable at school age (see Portnoy, 2016).

distribution of levels between Israel and the other countries shows that this field also requires improvement. In each country, the grades in this field were distributed between those who did not manage to complete the test (did not attempt it or quit in the middle), individuals classified under the lowest level (under 1), those classified at the lowest level (1), middle level (2), and highest level (3). Of Israeli young adults, 20% were unable to perform the test in the digital interface, as opposed to the OECD average of 10%; 17% were classified as under level 1, compared to the OECD average of 10%; 30% were classified as level 1, compared to the 33% OECD average; 26% were classified as level 2, compared to the 39% OECD average; and 7% were classified as level 3, compared to the OECD average of 8%. In other words, only 33% of the tested individuals in Israel had the skills considered necessary for problem-solving in a digital environment (level 2 and 3), as compared to the 46% average in the OECD nations (see Figure 3).

Table 3: PIAAC Test of Problem-Solving in a Technology-Rich Environment, Distribution of Levels for Ages 16-24, and International Comparison



Source: Israel Democracy Institute analysis of data from OECD, Education GPS.

International comparison of learning skills taught in the education system: memorization-based learning vs. analysis-based learning

OECD researchers examine the teaching methods reported in various countries and the tools they use to address pedagogical challenges. The need to handle new and unfamiliar problems using flexible problem-solving strategies has become particularly important in the 21st century. The 2012 PISA test examined math problem-solving strategies and identified the strategies the students used and the scope of their use (OECD, 2016):

- **Traditional strategies based on memorization.** Problem solving that mainly relies on knowledge of similar problems and repetition of actions that led to a solution in the past.
- **Strategies based on analyzing problem components (elaboration strategies).** Problem solving that relies on training in a variety of strategies and identification of the most appropriate strategy for each task. This requires methodical and dynamic analysis of the problem's components, and attempting to solve new, unfamiliar problems.

The study showed that traditional strategies were more efficient in problem-solving at the low or medium level, while elaboration strategies were more efficient in solving high-level problems. It also found that students who were able to adapt the solution strategy to the problem type were more successful than students who tended to use one specific strategy.

Regarding the Israeli students, analyzing the test shows that they tend to rely on traditional memorization strategies instead of strategies for analyzing problem components. Therefore, the probability that an Israeli student will use a memorization strategy to solve a question on the PISA test is twice as high as the probability that he will use an elaboration strategy – a particularly high rate in relation to most of the countries that participated in the PISA test (Figures 4 and 5). We also find that Israeli students who rely on memorization strategies achieve much lower results on the PISA test than Israeli students who rely on more advanced problem-solving strategies. Thus the chance of solving a high-level math problem was almost four times higher among students who used elaboration strategies, as opposed to students who relied on memorization strategies (*ibid.*).

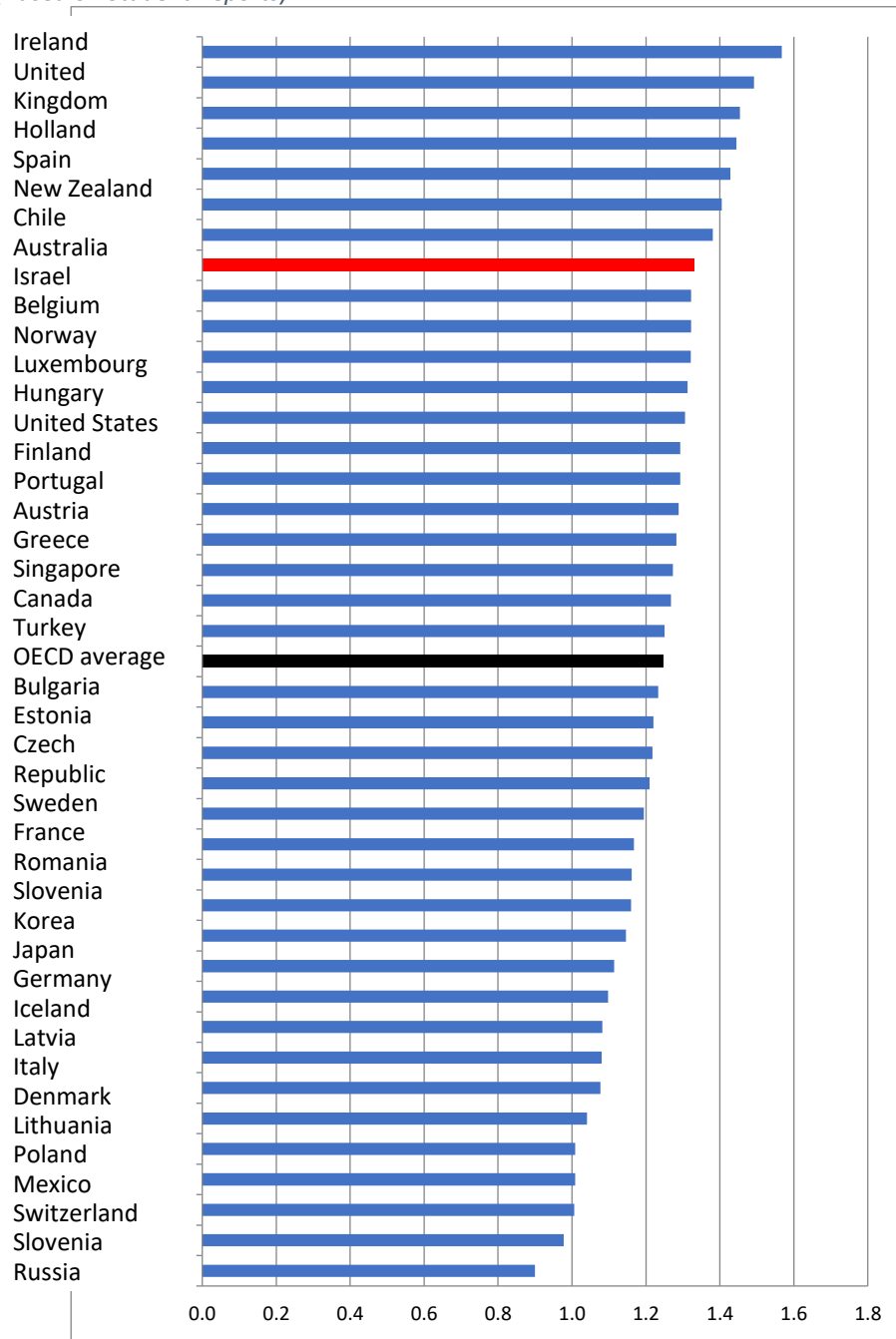
These findings conflict with the way Israeli teachers view themselves. In questionnaires completed by teachers in Israel, they reported that they preferred advanced learning methods: 95% of Israeli teachers agreed, for example, with the statement that their role as teacher was to enable independent research; 88% agreed that students learn best on their own; 91% agreed that processes of deep thinking and understanding were more important than completing all the study material (RAMA, 2015). Accordingly, teachers and students reported that broad use was made of individually adapted pedagogic methods aimed to teach high-level thinking skills.²³

It seems, therefore, that Israeli teachers and students are aware of the great importance of acquiring flexible thinking skills, but this has no practical expression. There is a broad gap between the subjective views that the teachers report, and the teaching practices they implement, which are traditional. Accordingly, it seems that Israeli students have trouble solving problems requiring unique thinking and deep understanding, and therefore their results on the international tests are low.

²³ Reports were examined on use of several teaching methods (teacher-directed teaching, student-directed teaching, formative evaluation teaching, and active use of cognitive abilities). The rate of teachers and students who reported that they use each of these methods met the OECD average and sometimes even surpassed it (OECD, 2016).

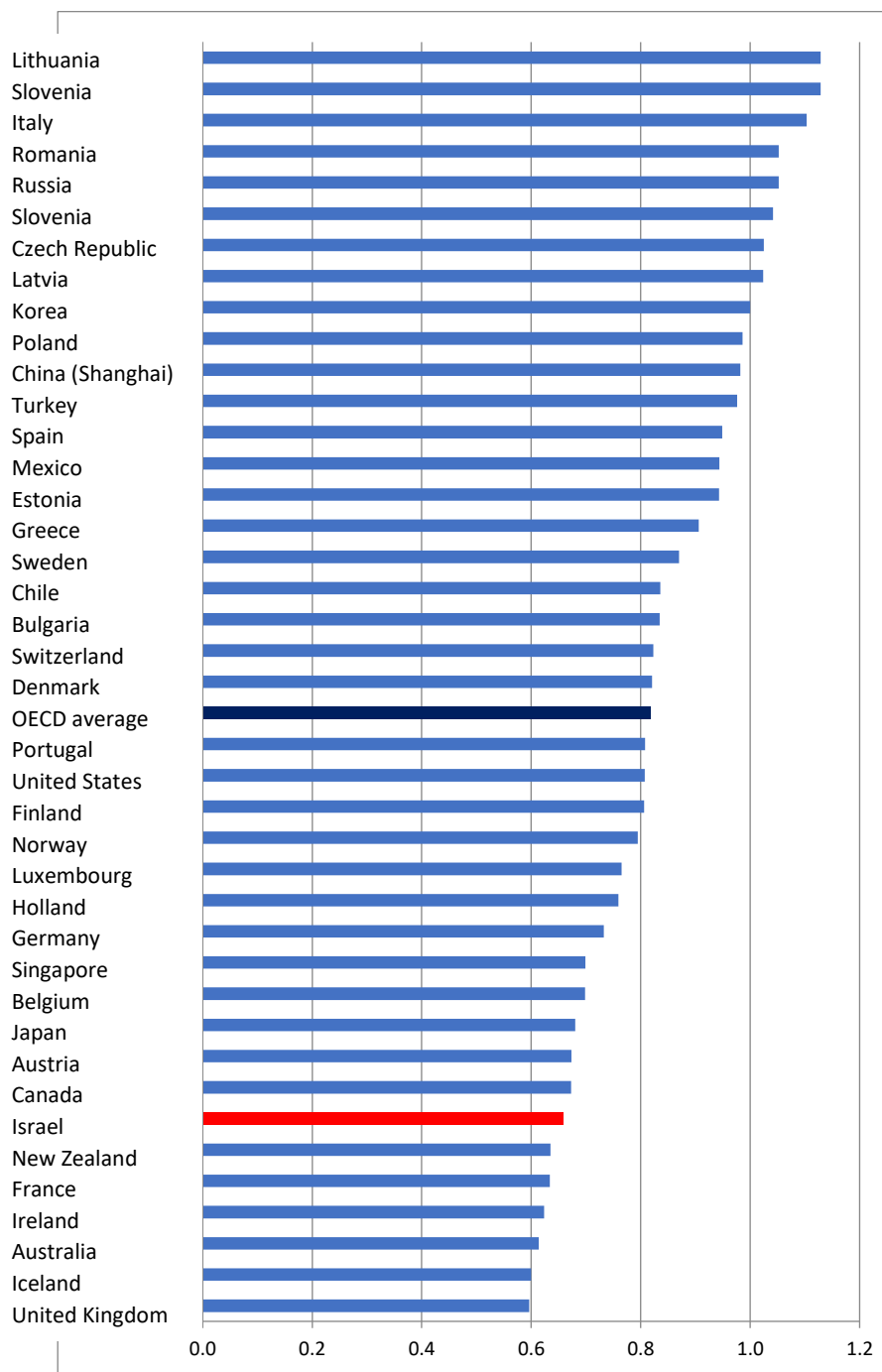
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Table 4: Rate of Use of Memorization-Based Strategies in the Math Portion of the 2012 PISA Test
(Based on Student Reports)



Source: Israel Democracy Institute analysis of data from OECD, Education GPS.

Table 5: Rate of Use of Strategies Based on Analyzing Problem Components in the Math Portion of the 2012 PISA Test (Based on Students' Reports)



Source: Israel Democracy Institute analysis of data from OECD, Education GPS.

The national Meitzav survey of school climate also gives an indication regarding teaching methods and learning in schools. Teacher and student reports in the survey reveal use of

advanced pedagogical methods, such as tasks that integrate research, independent learning strategies, and personally adapted learning. The reports show relatively broad use of advanced strategies at young age levels (mainly in elementary school), but as the age level rises, use of such strategies declines. We note that these reports do not supply a complete picture of what happens in classrooms, they do not indicate the scope of use of each teaching method.²⁴ Further, the reliability of these personal reports is doubtful (RAMA, 2017b).

From interviews we held with researchers in the field, and based on the many years of experience of the head of the present study, we find that most of the teaching in Israel is based on frontal presentation. Furthermore, Adam Nir supports this conclusion in his book (Nir, 2017). Nir examined five elementary schools that participated in the independent management reform,²⁵ and found a significant gap between the pedagogical methods that the teachers reported they prefer and the manner of classroom teaching in practice. In conversations held in the teachers' resource room, many teachers asserted that they prefer to adapt the teaching methods to the students' learning methods. But classroom observations revealed that the teaching in all schools was almost always based only on traditional frontal instruction. We also found that teachers who attempted to adapt their teaching methods to the needs of individual students came up against barriers, and quickly stopped trying.

Use of technology in the education system

Many of the reforms that have attempted to adapt the education system to the 21st century have focused on implementing pedagogical technologies and establishing infrastructure for computerization of classrooms.

An evaluative study that checked the implementation of the national program for adapting the education system to the 21st century based on teachers' reports offers evidence that this program broadened the use of digital media and improved technological literacy among teachers (RAMA, 2015). Still, apparently the digital skills that were checked did not meet accepted global standards. The skills checked were very basic: use of a word processor, email, presentations, etc. According to student reports on the Meitzav tests, in most of the junior high and high school classes, computers were not used at all.²⁶ In schools that were checked in Nir's study, no attempt was made to integrate digital tools in lessons, even though often such tools could have given preferable solutions (Nir, 2017).²⁷ We recall that the findings of the PIAAC test reveal that broad populations in Israel still have a basic technological disadvantage – over 20%

²⁴ In most of the reports, teachers and students were asked whether they used a certain technique or tool, but the report did not indicate frequency of use – whether use was frequent or single.

²⁵ We may reasonably assume that in these schools, the teaching methods used are more advanced than those practiced in most schools. This is because the advanced methods are more frequently used in elementary schools (based on the findings of the Meitzav tests), and also because these schools participating on their own initiative in the pilot for reform in independent management. In other words, the pedagogic staff of these schools had special motivation to promote advanced pedagogy.

²⁶ At elementary school age, 57% of students report some use of computers in Meitzav test subjects, as opposed to 38% at junior high age and 29% at high school age.

²⁷ Despite the clear advantages of educational software, all the schools wrote tasks on paper, by handouts given to students or students copying into notebooks.

of Israeli young adults did not succeed in performing tasks that were presented in digital format, and of the other individuals tests, 47% were classified at the low level according to OECD standards.

For purposes of comparison, a comprehensive study conducted in the United States on the use of digital tools found that 67% of teachers showed their students online educational films on a weekly basis; 65% used pedagogical software or digital applications; 56% used websites for research every week; and 52% strengthened certain skills using digital games (Deloitte, 2016).

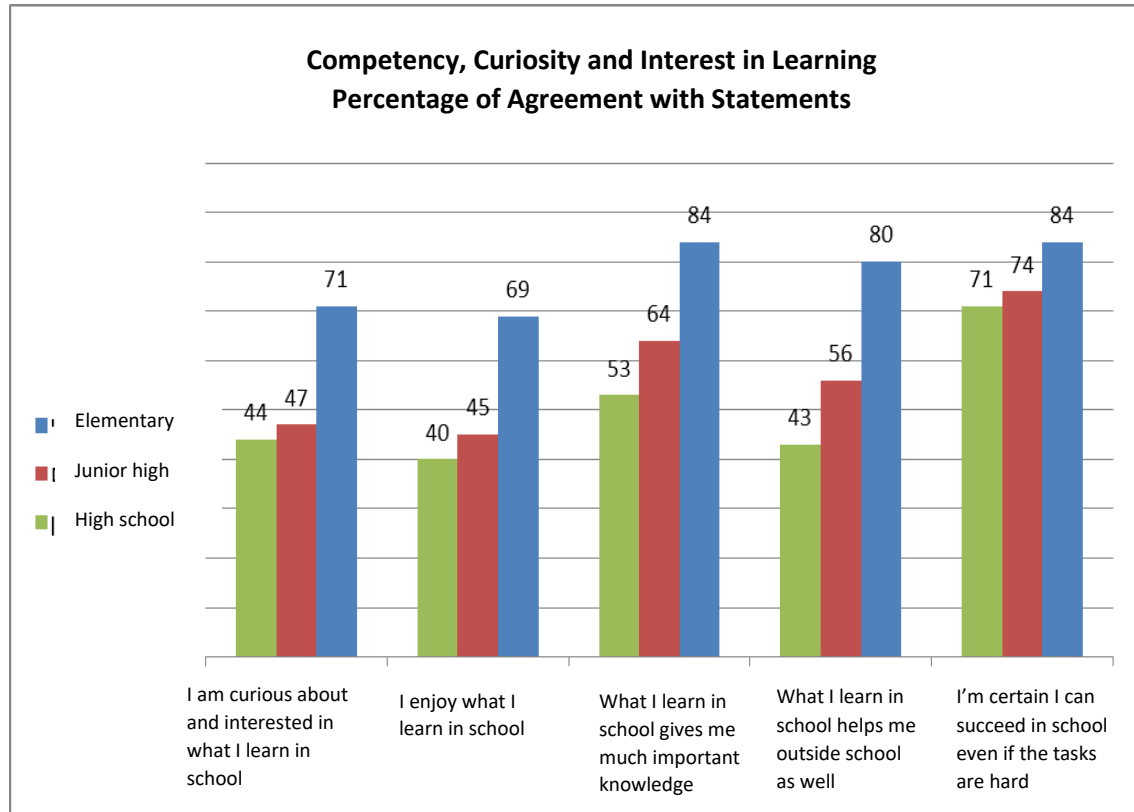
Public attitudes toward the education system

Another measure that can indicate the quality of the education system and its adaptation to the changes taking place outside the school gates is the country's citizens satisfaction with the system. A series of comparative surveys conducted by Gallup World Poll examined public attitudes in several countries regarding the quality of the government services they receive. Two questions addressed the education system.²⁸ The first question involved the education system in general, and the respondents were asked: "In the city or region where you live, are you satisfied or dissatisfied with the education system or school?" In Israel, 63% indicated that they were satisfied with the education system, and Israel was ranked 54 out of 149 countries (and 19th out of 34 OECD countries). The second question checked to what extent the respondents thought that the education system supported maximizing the students' potential: "Do most of the children have the opportunity to learn and grow every day, or not?" In Israel, 74% answered positively, and Israel was ranked 61 out of 149 countries (26th out of 34 OECD countries).

Another view is student attitudes toward the school's level of relevance. Several questions on the Meitzav test checked the students' level of satisfaction. 43% of high school students agreed with the statement, "What I learn in school helps me outside school as well"; 53% of high school students agreed with the statement, "What I learn in school gives me much important knowledge"; 40% agreed with the statement, "I enjoy what I learn in school"; 44% agreed with the statement "I am curious about and interested about what I learn in school"; and 56% agreed with the statement, "School gives me tools that will help me integrate in the world of employment in the future" (RAMA, 2017b).

²⁸ Data from the surveys was published as part of the Legatum Prosperity Index, which includes indicators for comparing the level of prosperity of 149 countries. Comparison was conducted among education systems based on educational achievement, level of equality according to various divisions, quality of higher education, quality of professional education, and adult attitudes toward the education system (for more details, see the Index website).

Figure 6: Rate of Students who Agree with Statements Related to Capability, Curiosity, and Interest in Learning, as Reported on the Meitzav Test



Note: In elementary schools, the test was given in fifth and sixth grades; in junior high, in seventh, eighth, and ninth grades; in high school, in tenth and eleventh grades.

Source: Israel Democracy Institute analysis of data from Israeli Education office, the Meitzav test, 2017.

The international comparison reveals that the general public's is reasonably satisfied with the education system, and among adults, it was not far from the OECD average. However, attitudes toward the education system's contribution to children's development were relatively less positive. Apparently, as students grow older, they think the education system is less relevant to life outside school.²⁹

Summary

The reforms attempted by applying 21st century teaching and learning methods have not succeeded at the anticipated level, and the pedagogy that is actually used is still mainly traditional. Why have the reforms implemented in the past twenty-five years not led to the

²⁹ The scope of these surveys seems limited, and possibly, the findings reveal the level of students' willingness to satisfy the system and to give positive answers. This finding may explain the relatively positive attitudes of young children as opposed to adults. Due to the deficiencies in attitude surveys (and of other indicators related to the education system), they are only one of the indices tested to check the level of adaptation of the education system.

anticipated change? In the next chapter, we will try to identify the main barriers that prevent adaptation of the education system to 21st century needs.

Box 1: Achievements in tests of work productivity and future growth path

A range of studies have examined the relationship between grades on the comparative tests conducted among students and changes that have taken place in various countries. In this box, we will present major studies that have connected success on tests and economic growth and work productivity.

Achievement on PISA test and growth path

In a broad literature survey, Eric Hanushek and Ludger Woessmann (2008) presented many findings related to the relationship between the cognitive abilities examined on the PISA test and the economic growth of countries. They showed that improvement by one standard deviation in achievements on math and science tests correlated with an increase of about 2% in the annual long-term growth rate.

The strong connection between test achievements and growth mainly stemmed from differences in the size of the population with particularly low achievement. Therefore, they conducted a follow-up study in several countries, in which they examined the rate of students who did not show competency in “universal basic skills”ⁱ and the anticipated effect of the lack of these skills. The effect was defined as the anticipated change in the growth path if all the students demonstrated competency in the basic skills (Hanushek and Woessmann, 2015). The study found that in Israel, the rate of students who did not acquire basic skills is very high – 33%, as compared to the OECD average of 21%. According to the proposed model, if all Israeli students in the education system acquired basic skills, the annual growth rate would rise about 0.5% per year – among OECD nations, this would be the third-largest potential improvement based on the acquisition of basic skills.ⁱⁱ

Achievements on PIAAC test and work productivity

Hanushek et al. also measured the relationship between the skills checked in the PIAAC test and productivity in the labor market. They found a statistical relationship between the tested skills and the salaries of workers in various countries. They found that the achievements on the PIAAC test explained 42% of the differences in work productivity. There is a clear connection between the skills tested on the PIAAC test and work productivity and salaries, and they provide the best representation of the economic variable called “human capital” (Hanushek et al., 2015).

Low labor productivity is considered a central factor in Israel’s failure to meet the level of standard of living and productivity accepted in developed nations.ⁱⁱⁱ Studies show that the gap mainly stems from economic sectors that have a particularly low level of productivity, as opposed to advanced economic sectors, in which productivity is high, even when compared to the world’s leading countries (Regev and Brand, 2015). Many characterize the Israeli economy as divided in two – one part is based on the advanced and innovative high-tech sector, with workers whose skills are among the highest in the world; another part is based on noncompetitive sectors in which the workers’ productivity is especially low compared to workers in the developed nations (Gabbai, 2009; Kendall, 2017). A Bank of Israel analysis has shown that the best explanation for gaps in work productivity among sectors in Israel as

compared to gaps in the developed nations is workers' skills as expressed in achievements on the PIAAC test. The analysis reveals that the gaps in skills are characteristic of young workers at the beginning of their professional career. In other words, apparently the education system is responsible for the gaps, at least partially (Zur, 2016).

According to Hanushek, an improvement of one standard deviation in math skills among Israeli workers correlates with an increase of 29% in salary, as opposed to a 20% average in the countries that participated in the PIAAC test. From this analysis, we may conclude that the effect of workers' skills on productivity in Israel is the third largest of the 33 countries studied (Hanushek, 2017).

We find, therefore, that Israel suffers from gaps in the basic core skills of various populations, and these gaps are expressed in the PISA and PIAAC tests. The findings point to the challenge that the education system faces: to provide the entire population with the basic skills needed to integrate into the 21st century work force. To date, it has had difficulty meeting this challenge. But the studies show that Israel has unique potential for growth, and this potential can be fulfilled if we are able to teach these basic skills to all population sectors.

I According to their method, basic skills are achieving at least level 1 in language skills, math, and science, as defined on the PISA test. Level 1 is reading and understanding a simple text and familiarity with basic science and math principles.

II The data for Israel was presented by Hanushek in his lecture on "Education Quality and Economic Development," at the "Workers' Skills in Israel" conference sponsored by the Bank of Israel research division and the Central Bureau of Statistics, June 11, 2017.

III Studies have shown that productivity per worker in Israel is 14% lower than productivity in the developed nations, and productivity per work hour is 24% lower (Zur, 2016).

Box 2: Criticism of reliance on international tests for evaluating the education system

Considering the extensive research on the relationship between results of international tests and economic product, many countries, including Israel, have defined improvement on test results as a major goal of the education system. But this trend has led to criticism, both of the nature of the tests and of how they are used.

1. The causal relationship between test results and economic growth is uncertain.

It is very difficult to measure variables that influence growth patterns on the international level, because there are many differences among countries, some significant, even if sometimes they are hidden. The assumption that improvement on international tests will lead to improvement in growth is based on an unsophisticated comparison between countries and on economic models designed to simplify the complex reality, and therefore we must consider it of limited reliability (Blass, 2016). When this applies to the PIAAC test, it is easier to demonstrate causality, but here as well, its direction is unclear. Possibly, when workers in innovative industries demonstrate high skills, this is not because the education system has provided human capital that is utilized in the employment framework. Rather, it is because innovative companies demand that their workers use high skills that are acquired and improve on the job.^a

2. The tests do not properly measure the skills required in the 21st century.

Although much thought and resources have been invested by test writers to ensure that the tests will measure 21st century skills, it is doubtful whether the tests succeed in meeting this goal. A large portion of the 21st century skills are not standard and are expressed in unique ways by different people and in different cultures. For example, it is doubtful whether standard tests can measure creativity, critical thinking, or the ability to cooperate (Labaree, 2014).

Comparison of developed countries that participated in the test revealed that cultures that encourage accepting authority and obedience are particularly successful on these tests. On the other hand, the achievements of countries characterized by innovation and refusal to accept authority are relatively low. For many years, students from East Asian countries have attained the highest grades in the world on comparative tests, while Israeli and US students receive relatively low grades. But on skills related to innovation, graduates of the Israeli and US education systems are more successful than their Asian cohorts (World Economic Forum, 2017).^β

3. Relying on standard tests is harmful

Pedagogy that is individually adapted to students based on their private strengths, weaknesses, and needs is more appropriate for meeting the challenges of the 21st century, as opposed to pedagogy that attempts to produce a standard, uniform graduate.

According to Ami Wilensky,^γ beginning in the 1970s, a trend began around the world that emphasized standardized tests, and schools focused on giving students the skills examined in these comparative tests. Today, education systems in leading countries such as Finland and Singapore are moving the emphasis from success on standardized tests to deep learning of material that is not necessarily tested on international tests.

Further, it has been argued that the major emphasis on standardized tests transforms them from a tool designed to evaluate the education system into a goal in and of itself. Some countries are willing to invest significant resources in preparing students for tests, even when this has negative pedagogical consequences. Further, findings show that certain education systems manipulate the results to raise their grades (Blass, 2016).

So what do the international tests show about the Israeli education system?

Israel's results on international tests are lower than the results of most developed nations. It seems that these results may be connected to the lack of job skills required in the 21st century, and also to the low job productivity among broad populations in Israel. Still, it is unclear to what extent these tests are truly able to test 21st century skills. In the first PISA test, for example, Israeli students were less successful than students of all developed nations, and the rate of outstanding Israeli students was half the OECD rate. But in hindsight, the pessimism that this caused was unjustified. A significant portion of that year's graduates joined innovative industry, no less than their cohorts in other countries who achieved outstanding scores on the PISA tests (OECD, 2017b).^δ

It seems, then, that it is difficult to draw conclusions about the strong population from the comparative tests. On the other hand, the tests do give an important indication of the status of the weaker populations, and the basic tools that the education system imparts. The findings raise fear that the Israeli education system does not provide basic skills to the weak populations and lower deciles, and they are unable to make up the difference on their own or

with family support. This deficiency can explain some of the gaps in Israeli society. It harms the ability of these populations to integrate into the 21st economy and society, and harms the economy's productivity and growth potential.

^α In this context, Zur has demonstrated inter-sectorial gaps in worker productivity among young workers in their first years of work. This finding strengthens the assumption that the level of skills influences joining one sector or another. High skills encourage workers to apply for jobs in advanced sectors, and thus it is reasonable to assume that teaching high skills in the education system before entering the job market represents a dominant explanation for the high productivity in advanced sectors (Zur, 2016).

^β This point indicates the problematic nature of comparative tests with regards to valid, reliable measurement of skills, mainly among the strong populations. The elites in Israel and the US demonstrate particularly high skills in innovative industries, but this excellence is not expressed in the comparative tests conducted in school. On the other hand, the comparative tests succeed in providing a valid and reliable indication of the deficiencies that characterize populations that do not excel.

^γ This material was presented by Ami Wilensky in a lecture titled "The Background for the Rise of the Third Wave of the Education Reform" at the Israel Democracy Institute on February 20, 2018.

^δ Researchers identify several factors behind the success of Israeli innovation. The education system is not one of them (Senor and Singer, 2009).

Chapter 4: Barriers that Prevent the Adaptation of the Israeli Education System to 21st Century Needs

Below we will present the major barriers that we think must be faced to adapt the education system to 21st century needs and to implement innovative pedagogy in classrooms, schools, and the entire education system. We have identified two general types of barriers: barriers based on the nature of 21st century skills and the difficulty of adapting the system and its employees to teaching that fit changes over time and systemic barriers resulting from the characteristics of the education system and the diversity of the Israeli population that impede introducing significant reforms.

1. Evaluation methods do not test 21st century skills

Evaluation forms behavior; systems and people both adapt themselves to the way they are measured and to the demands that are made of them (Drucker, 1974). To implement change in the education system and its functioning, we must clearly define 21st century skills and adapt the exam and testing system to this definition. Several global initiatives³⁰ have invested significant resources in creating tasks that test the level of competency in 21st century skills and how schools affect development of these skills.³¹

Education researchers emphasize the potential inherent in integrating formative and summative types of evaluation. Formative evaluation is done during the learning process, through the direction of the pedagogical staff (for example, in carrying out a project); summative evaluation is carried out after completion of the learning process. These two types of evaluation are intended to test the skills required in the 21st century (Bloom, 1971).³²

Although recently, attempts have been made in Israel to adapt the matriculation exams to 21st century skills,³³ but most of the tests still check skills that were needed in the past. Changing methods of evaluation must be promoted by the Ministry of Education and also by the higher education system. Adapting the admissions requirements to university so that they will reflect 21st century skills is expected to influence the entire education system and create incentive to develop these skills in schools. As examples, adapting the university entrance requirements can be expressed in placing greater weight on projects carried out in school; using alternative filtering methods such as digital courses; and changing the structure of the psychometric exam.

³⁰ See, for example, the Assessment and Teaching of 21st Century Skills (ATCS 21) project.

³¹ As opposed to the research field that attempts to methodically define 21st century skills, we note that several researchers have cast doubt on the validity of tests that attempt to measure soft skills, such as life skills and deep thinking skills (National Research Council, 2012; Duckworth and Yeager, 2015).

³² In this context, the proposal was raised to change report card grades so that each grade would be presented as a matrix that evaluates the skills relevant for learning (Asher, 2016).

³³ The “Transition to Meaningful Learning” reform determined that 30% of the students’ final grade on the matriculation exams would be based on internal evaluation. The reform in the history matriculation exams decided that in 2021, the exam would be open book in all schools. Ministry of Education directors are attempting to expand this process to other fields of knowledge.

2. Trend toward standardization and excess focus on tests

An education system that focuses on teaching general skills and that tries to be relevant to life outside school must adapt itself to the individual characteristics of the students as well as to the characteristics of the communities in which they live. In other words, a skill-oriented education system must act in a decentralized manner and decrease the weight of uniform standards. However, the approach common in many education systems around the world actually encourages standardization.

This trend began in the US as a result of dissatisfaction from the functioning of its education system. Beginning in the 1980s, reforms have been carried out in the US that attempt to define clear educational standards and to instill competitive mechanisms in schools that will enable them to meet the standards defined. This approach involves a proliferation of national exams, encouraging competition among schools, and increasing pressure by the public in cases in which the ranking of their local schools is unsatisfactory (Hargreaves and Shirley, 2009).

Standardization has spread in many countries around the world. In Israel as well, the education system began to conduct comparative tests, and achievement on these has become a main goal of the pedagogical staff.³⁴ In Israel, the tendency toward standardized tests is particularly prominent, as the number of required subjects in Israel is very high compared to other countries, and in all of these the student must take an external matriculation exam (Van Leer, 2007). The result – learning in high school focuses on success in the matriculation exams.

Educational researchers emphasize that this approach leads to “institutionalized” learning and impedes deep learning processes (Zohar, 2013). Over the years, committees have recommended reducing the number of external matriculation exams in the required subjects and the number of test booklets in each subject and to convert these into internal exams. But in actuality, the number of exams has not been reduced, and the changes have only increased the requirements and harmed the ability to conduct deep learning processes (Van Leer, 2007).

Of course, we are not arguing for the complete annulment of tests. Most of the world’s leading education systems have a small number of external summary tests in the core subjects (Schleicher and Shewbridge, 2004), and in Israel as well, it is important to hold such tests. But we must address the disadvantages of the comparative tests and not make them a goal in and of themselves.³⁵ The number of standardized external tests in the Israeli education system is exaggerated and the feedback and evaluation methods do not offer enough variation. This prevents the implementation of innovative pedagogy in the education system.

3. School principals and teachers lack adequate knowledge of 21st century skills

Teachers have always occupied a central place in the educational process. McKinsey & Co. conducted a study of characteristics of education systems that succeeded in improving and that

³⁴ This trend gained traction in 2002, when the PISA and Meitzav tests began to be conducted. In some of the reforms

³⁵ See Chapter 3 – critique of the basis for using international tests to evaluate educational systems.

became the world's best. Their main conclusion was that the quality of the education system cannot exceed the quality of its teachers (Barber and Mourshed, 2007).

This understanding is particularly important in the education system required for the 21st century, which emphasizes teaching and improving students' skills, and not defined content that the students must acquire. The pedagogic team must be able to adapt itself to changes in teaching and learning methods. The challenge is even greater with regards to software and internet applications, as the younger generation was born into a digital environment, while teachers are considered "immigrants" in the technological world (Prensky, 2001).

Examining teachers' skills in Israel reveals a particularly problematic situation. On the PIAAC test, Israeli teachers' skills were found to be lower, both compared to teachers in other countries and compared to the general population in Israel (Hanushek, Piopiunik, and Wiederhold, 2014; Ritov and Kerill, 2016).³⁶

The low quality of human resources in the teaching profession in Israel may be ascribed to two main factors:

- A. Lack of strict filtering of candidates for the teaching profession.
- B. Lack of incentives to join the teaching profession.

The basic factor found to be significant to the success of the education system is recruiting the best candidates for teaching (Barber and Mourshed, 2007). Studies show that in the leading education systems, the salary is relatively stable throughout the work year. Beginning teachers are offered relatively high salaries, which encourages talented candidates to enter the system (ibid.). In Israel, salary rises sharply based on experience, and so teaching salaries are particularly low just at the point when they choose the career path (the Chief Economist of Israel, 2017). Low salaries are one of the main factors for teachers leaving the profession, particularly teachers with a high level of human capital (Arbiv-Elyashiv and Zimmerman, 2013).

4. Teacher training institutions are not adapting themselves

International experience shows that teacher training has a powerful influence on the quality of the education system (Barber and Mourshed, 2007). In Israel, the training may be classified into two types:

³⁶ The average grade of Israeli teachers in the quantitative field on the PIAAC test in 2012 was 270, compared to an average of 292 among OECD nations (third from the bottom). The average grade in the verbal field was 281, compared to an average of 295 among OECD nations (fourth from the bottom). In comparison to the general population, the grades of Israeli teachers were in the 57th percentile in the quantitative field and 62nd percentile in the verbal percentile, as compared to the 68th percentile in the quantitative field and 71st percentile in the verbal field on average among the OECD nations. (In other words: in Israel the average grade for teachers in the quantitative field was higher than the average grade of 57% of the population, while in OECD the teachers' average grade was higher than the average grade of 68% of the population. For detail of this data and international comparison, see Appendix 2 below.)

- Training teaching candidates (preservice) – Teacher training institutions are aware of the need to promote innovative pedagogy, but colleges and education departments at universities are still teaching traditional methods.³⁷
- Teacher in-service programs – In Israel, the system of in-service programs is designed to ensure continuous improvement in teaching methods throughout the professional life of the teachers. But it seems that the system itself must change to adapt itself to changing pedagogical demands. For example, evaluations of the productivity of in-service programs show deficiencies both in the final exams of the participating teachers and follow-up of implementation of knowledge and skills they acquired in school in-service programs (Schleicher, 2018).

5. Over-centralization in the education system

In the 1970s, the decentralized model began to spread throughout education systems in the developed world: pedagogic and managerial authorities were granted to entities on the local or school level. This model was found to be vital for adapting the school's operation to needs arising from the field, and to increase the motivation and accountability of functionaries in the field. The model was found to be more appropriate for education systems that aimed to teach students general skills instead of giving them defined, standard knowledge (Wolensky and Friedman, 2003). Yet studies have shown that the influence of decentralization is not identical in all types of education systems, and expanding autonomy strengthens systems with a highly qualified pedagogic staff. On the other hand, in education systems where cooperation between teachers and management is deficient and appropriate evaluation mechanisms are lacking, transferring authority to local functionaries can actually do damage (Ministry of Education, 2016; Asher, 2017).

The centralized model was deeply rooted for many years in Israel. During the early years of the state, the education system aimed to achieve a wide range of goals and did not only focus on providing education that fit the needs and desires of each student. One goal was to use the education system to create a melting pot. Children who immigrated to Israel from many countries received a uniform, non-sectorial education that aimed to create a unified Israeli society (Berger, 2014). Influenced by global trends, beginning in the 1970s several attempts were made in Israel to decentralize the system, but most were unsuccessful. Often, the failure was due to objections by the supervisory system, which feared the loss of authority and power.

In recent years, several initiatives were implemented to increase autonomy in the education system, including the Meaningful Learning reform and the Transition to Self-Management reform (see Chapter 2). But promoting these reforms is also a centralized project, and it relies on the assumption that they are appropriate for everyone to the same extent. We also note that the reforms aim for partial autonomy only. The reform for transition to self-management is implemented only in elementary schools. This reform applies only to a few fields

³⁷ In a conversation for the purpose of this study, Dr. Nir Michaeli, rector of Oranim College, noted the difficulty of offering incentives for lecturers in teacher training institutions to change the content and structure of their courses.

and supplemental initiatives, which are initiatives that are added to the regular curriculum. The Ministry of Education is still responsible foremost pedagogical matters. Budgeting autonomy also applies mainly to supplemental budgets. The local entities lack authority in management of the regular personnel, which accounts for most of the school budget (Wininger, 2017).

6. The Ministry of Education suffers from excess complexity

In general, large organizations, and especially public systems, have difficulty promoting organizational activities that involve closing, reducing, or unifying their divisions. Furthermore, separate units tend to develop at different rates, and so it is difficult to synchronize them and create a uniform, shared agenda (March and Olson, 1983). This problem also characterizes the Israeli Education Ministry. Over the years, the Ministry has established new units whose mission is to promote the required changes, but these units acted in parallel to units that had existed previously. For this reason, the Ministry has a number of units that are working on adapting the education system to contemporary changes:³⁸

- The Pedagogical Secretariat
- The Pedagogical Administration
- Computerization, Technology, and Information Systems Administration
- The Chief Scientist of the Ministry of Education
- Senior Branch for Planning and Strategy
- RAMA – The National Authority for Measurement and Evaluation in Education
- Assistant Director of Human Capital Management
- Assistant Director of Human Resources in Teaching
- Teaching Employees Administration
- Deputy Director Avney Rosha Institute for training school principals

We are not asserting that there is no room for decentralization in the structure of the Education Ministry, but rather that in order to implement effective reform, the work of all these units must be synchronized.

Another example of the difficulty caused by the decentralized functioning of the Education Ministry is the work of the national subject supervisors, who coordinate specific subjects (such as math, English, electricity and electronics) under the framework of the Pedagogical Secretariat. The State Comptroller's report for 2009 found several deficiencies caused by lack of synchronization among these national subject supervisors, and among the supervisors and other Education Ministry pedagogical units. It was found that despite overlap of subject material in some subjects, there is almost no opportunity for cooperation in teaching different subjects, and the connection between the subject supervisors and supervisors of other units in the Ministry is deficient. In addition, although there are several entities and professionals whose purpose is to provide the subject supervisors with a professional envelope, they do not have a clear, unique address for obtaining support on daily problems (State

³⁸ In all, there are fifty entities operating under the Director of the Education Ministry that work on the ministry's daily management.

Comptroller, 2009). Individuals connected to the Ministry even specified to us that some subject supervisors have delayed or prevented reforms in subjects and testing methods, even though these reforms received broad support from entities entrusted with determining strategic policy in the Education Ministry.

The difficulty of advancing policy in this complex system was also discussed in the State Comptroller's 2018 report, which examined implementation of the Meaningful Learning reform. The report noted that implementation of the reform was deficient due to insufficient cooperation among the Ministry of Education units. For example, due to lack of coordination among the pedagogical secretariats and the Division of Elementary Education in the Pedagogical Administration, most of the elementary school curricula were not updated to fit the principles of Meaningful Learning.

We also find that outside the Ministry's national offices, various entities act that influence the implementation of education policy. These include Ministry units that act on the local and sectorial level, teachers' organizations, parents' and students' organizations, research bodies that act with universities and teacher training institutions, educational networks, and non-profit organizations.

7. Frequent political changes impede achievement of long-term goals

As we have described above, since 1994, ten reforms were conducted that attempted to create change in teaching and learning. Most of these reforms were promoted by the education ministers who launched them, and they were identified with them. Since that date, ten ministers of education have governed in the State of Israel. Mostly, each new minister pushed the budget and ministerial attention from his predecessor's reform to his own, and even cancelled the previous one (Alfarassi, 2015). Of course, such functioning leads to incomplete reforms, as the ministers want to implement their reform as quickly as possible and place their stamp in a way that prevents their successors from cancelling it.

Aside from harming implementation of reforms, the frequent turnover of ministers also provokes instability in the Ministry's policy. The turnover of ministers is often accompanied by changes in professional personnel, in policy, and in budget allocation (State Comptroller, 2009). For comparative purposes, in the Finnish education system, which is considered a model of an education system focused on effective pedagogical reform, only one reform has been conducted. It began in the 1980s and came to fruition over many years (Sahlberg, 2009).

8. Difficulty adapting structural reforms to a heterogenous population

Israel is an immigrant country, and its population is very heterogenous. Different groups have a wide range of characteristics and needs, and each group requires its own approach and separate resources. The State Comptroller's report on implementing the Meaningful Learning reform stated that one of the barriers to maximum implementation was the lack of data infrastructure for classifying schools based on the reform's level of adaptation to them (State Comptroller, 2018).

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For example, the advantaged group has a strong foundation of knowledge and skills, and the education system can mainly contribute enrichment to this group. On the other hand, weak groups have significant deficiencies in education, and they require methodical, deep support. Students from these communities are not able to carry out basic tasks in a digital environment, and they need a reform that will focus first on providing basic technological skills, and only then on providing high level skills. We also note that there are major gaps between the level of teaching staff in schools in well-off communities and the level of schools in weak areas and populations (Ritov and Kerill, 2016). This also applies to budget. The large gaps among groups seem to justify practice of affirmative action so that the entire population will acquire basic skills in the framework of the education system.

Chapter 5 – Insights and Recommendations

The barriers that prevent adaptation of the Israeli education system to the 21st century are numerous and complex, and in order to address them, thorough research is needed, along with a methodical, long-term action plan. In this chapter, we will recommend several preliminary steps that can be implemented in the short term.

Formulating tested, methodical processes to define evaluation of 21st century skills and to create indicators to be tested

The transition from an education system that emphasizes learning defined content to a skills-directed system poses a significant challenge due to the declarative ambiguity of the skills in behavioral terms and how to assess them. As we have described above, a substantial majority of teachers in Israel share the desire to lead change in pedagogy and to make it deeper. But they have been unsuccessful in putting this policy into effect.

For this reason, we must first define the skills that the system aims to instill and strengthen, and determine how to measure them. Many entities worldwide are occupied with this challenge, and several international projects are investing extensive resources in it.³⁹ Thus our first step must be to create basic definitions of the desired skills, according to the following stages:

1. A clear and exact description must be formulated for each skill that schools wish to teach the students in the 21st century, based on the current literature. We must verify that entities in the field (teachers and managers) know the characteristics of each skill, and in what ways they may be taught.
2. A clear gauge must be created for each of the skills: examinations, feedback of students and teachers, formative evaluation and summative evaluation. We must enlarge the ratio of internal evaluation and reduce the ratio of external evaluation, in accordance with the policy of expanding pedagogical autonomy in schools.
3. A forum must be established to examine methods of examination and evaluation in institutions of higher education. This forum will include representatives from the education system, the military, industry, civilian society, and the higher education system. It will adapt the exam system to the needs of the individual, society, and the economy.
4. The skills defined in the gauge and increasing the desired results will serve as a basis for formulating curricula and methods of teaching, learning, and testing. We suggest that at

³⁹ The organizations Partnership for 21st Century Skills (P21) and Assessment and Teaching of 21st Century Skills (ATC21S) have invested significant resources in creating tests and indicators for 21st century skills, and their work can be used as a basis for their development and implementation in the Israeli education system.

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the preliminary stage, several skills be tested that are considered to be required in the 21st century, based on agreement between the Education Ministry and institutions of higher education and the Council for Higher Education. Gradually, all skills will be tested. In other words, we must create a model for methodical, continuous update of the education system. Box 1 offers a model that enables the education system to adapt itself to the current changes.

Box 3: Preliminary proposal for a methodical model for updating the curriculum in the Israeli education system

We relate here to the entire curriculum, which includes: the syllabus – content, skills, approaches (values), and skills to be imparted to the student; the teaching and learning methods; equipment required for learning and experimentation in laboratories and workshops, and the physical learning environment; and methods of testing, evaluation, and feedback.

In Israel, barring exceptional cases, the curriculum is developed and updated by academic subject committees headed by the subject supervisor in the Ministry of Education.

The timing and frequency of the subject committees' work, the makeup of the committees, sources of data on which they rely, manner of work and their output are mostly random. They largely depend on the personality of the subject supervisor and the chairman of the subject committee and its members, or the ad hoc decision of the minister, the director, the chairman of the Pedagogic Secretariat, and similar entities.

We suggest formulating a methodical model for updating the curriculum. This model will be based on the multiannual study carried out by Prof. Shlomo Wachs and coordinated by the main author of this paper (Wachs et al., 1988), at the Samuel Neaman Institute for National Policy Research of the Technion: "Formulating Policy for Technological Education in Israel: A Methodical Approach to Implementing an Up-To-Date Technological Curriculum." The model is called Systemic Curriculum Alignment and Watch (SCAW), addresses the timing of updating a curriculum in a specific subject based on its half-life – the period in which half the skills change (knowledge, skills, and approaches) – according to the actual demands of graduates of the program. We know, for example, that the half-life of applicative learning subjects (such as professional courses related to the graduate's professional employment) is shorter than the half-life of basic technology subjects (such as the theory of electricity and materials strength). In turn, the half- life of these subjects is half that of basic science subjects (such as physics and chemistry). Thus we recognize that the frequency and timing of development and updating curricula must fit the characteristics of each individual subject.

At the current time, we recommend updating the curricula an average of every five years. In the fifth year, all elements of the curriculum will be rewritten (as detailed above), and the teachers will be trained to implement it in schools.

The process of updating the curriculum will include the following stages:

- Stage A – collecting information on what is required from a graduate in the field. A representative sample of workers and employers will be asked to complete questionnaires; in-depth interviews will be conducted with a certain number of respondents to clarify the findings; information will be collected from researchers, academics in the field, education professionals, and individuals with training in the discipline, through a literature survey and sample interviews; the findings will be analyzed statistically and for content. Based on these, preliminary insights and conclusions will be formulated. This stage should take 3-4 months.
- Stage B – establishing committees of experts and organizing their work. Each committee will be comprised of about fifteen individuals – academics, researchers, people working in the discipline, educators, people with training in ethics and philosophy, and public representatives, as required. The expert committee will operate for 3-4 months, in about five cycles, and decisions will be made according to the Delphi method.
- Stage C – a small professional team of 3-5 experts in developing curricula in the relevant discipline will formulate a curriculum over 3-4 months.
- We note that the SCAW model is required mainly for the “what” – meaning what skills should be taught through the curriculum. We propose that the output of the expanded model also address the “how,” meaning the methods of teaching and learning, and the “where,” the learning environment and use of equipment and materials. Methods of testing and evaluation must also be addressed.

We believe in a holistic view. A methodical method is required that will relate to all components of the curriculum and enable appropriate professional development of teachers and its effective implementation in schools in the Israeli education system.

Improving the quality of teaching staff and school administration

First and foremost, the nature of the education system is dependent on the quality of its teachers. Those interested in promoting reform in the education system must first ensure that the teachers and administrators are able to implement it. Of course, in the long term a system of incentives must be created that will attract excellent candidates to the teaching profession. It is particularly important to improve the salaries of teachers at the beginning of their career (see barrier 2, above).

But there are some actions that can be taken immediately to improve teachers’ level of qualification and adapt it to 21st century demands:

1. Plan and implement reform in the entities responsible for preservice and in-service training programs.

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- a. Verify that the principles of adapting pedagogy to the 21st century are implemented in teacher training institutions. During training, new teachers must experience for themselves the content and the methods of teaching and learning they will be required to implement in the classroom.
 - b. Follow-up of the efficacy of classroom teaching must be conducted with regards to the content, skills, and approaches learned in the training courses.
2. Formation of teacher communities should be encouraged, for mutual support in implementing innovation in schools. Use of technological tools should be tested for performing mutual learning processes among teachers – for example, filming classes and analyzing them.
 3. An environment should be created that supports teacher communities and individual teachers who are trying to promote unique pedagogy on the organizational level, through monetary resources and physical conditions. In other words, effective incentives must be supplied that will enable the practical creation of pedagogical autonomy in schools.
 4. Hard incentives must be created for installing advanced educational technology in schools, based on clear standards. We must find ways to handle teachers who avoid adopting such technology.

Creating a framework for determining long-term policy and cooperation for implementing the reform

To create reform, a mechanism is required that will ensure that all entities within the system work toward the same goals and be synchronized.⁴⁰ For this purpose, we must create a platform for cooperation or act for change in the structure of the Ministry of Education and other entities that influence the education system (such as teacher training institutions and municipal departments related to education), so that their manner of operation will fit the strategic goals of the reform.

For this purpose, we join those calling for establishment of a National Education Council that will be responsible for formulating policy, determining strategy and long-term goals in the field, and perform follow-up of the implementation of these tasks.

For the work of the National Education Council to be effective, several conditions are required:

1. Broad representation must be given to all entities and sectors related to education. One of the main barriers to reforms in the education field is the lack of consensus surrounding them and the objection of entities that thwart them. For this reason, it is vital that the National

⁴⁰ Andreus Schleicher, head of the education division at the OECD, showed in his book that in some countries, many reforms in the field of education were not implemented because consensus was not achieved among all stakeholders in the reforms. See Schleicher, 2018.

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Education Council be composed of a wide range of entities from various sectors that will work together to promote the goals of the education system, so that the proposed reforms will be made out of general agreement, or at least the participation of all entities relevant to their planning and implementation.

2. Subcommittees must be established for the different sectors. As noted above, the Israeli education system is very heterogeneous, and the needs and priorities of the various sectors regarding certain subjects are significantly different. Thus within the structure of the National Education Council, it is desirable to establish subcommittees for the various populations in Israel, to lead policies that are adapted to the needs of the entire population.

3. Ensure the council has a long-term budget. Many reforms that were initiated in Israel were not cancelled when the education minister was replaced. In most cases, the ministry's budget was transferred to achieve new goals identified with the new minister. For this reason, it is vital that the council act in cooperation with the budgeting entities to create a long-term budgetary and organizational structure, while establishing clear rules for budgeting during the time the reform is carried out.

Box 4: Two possible frameworks for work of the National Education Council

Various countries have different models for the work of their National Education Council. We may classify these models according to the scope of authority that the council has for action. In Finland and US states, councils have broad authority for action. In many other countries, the council's authority is advisory only (Weisblai, 2013).

Option A: Council based on the unification of several units in the Education Ministry (Finnish model)

As of today, several entities operate within the Education Ministry whose role is to determine long-term pedagogical policy: to estimate and evaluate educational products, to instill technology, among other goals. We believe that promoting consistent, long-term policy requires cooperative work of relevant entities within the Education Ministry. Furthermore, due to the advantages of size and variety of viewpoints, activity of personnel from various entities for forming long-term strategy is more efficient than separate activity of each entity.

In our assessment, establishing a National Education Council based on the merger of units that are already operating with the Education Ministry into one influential body that will work with the minister will create a strong foundation for leading long-term pedagogical policy. Furthermore, establishing a body based on existing frameworks will be a better use of public funds and prevent redundancy.

The manner of operation of such a council can rely on the model of the Finnish National Agency for Education, which was established in 1991 and merged two existing bodies. The committee has significant authority in areas such as development and planning, disseminating information, and disseminating educational content.

Option B: National advisory council (based on the model of Israel's National Economic Council and the National Security Council)

If major changes in the structure of the Education Ministry are not possible, we will support the proposal to establish a National Education Council based on the models of other national councils operating in Israel.

Such a council will be responsible for examining trends in the education system and identifying those that have the potential to achieve the education system's goals. It will act to reduce the frequency of change due to political turnover, perform follow-up on the implementation of Ministry policy, and verify that the policy does not harm the goals of education and supports vital long-term processes within the education system.

We recommend that this council act on behalf of the Education Ministry of the Prime Minister's Office. Members should include representatives of government ministries that have the power to promote or delay performance of reforms (Ministry of Finance, Ministry of Labor and Social Affairs, Ministry of Defense, etc.).⁴¹ The committee should also include experts; education researchers; educators; experts on ethics and philosophy; representatives of teachers' organizations, parents, and students; representatives of education networks; business people; and public officials.

[Differential budgeting that accounts for all educational frameworks to reduce social gaps](#)

The skills of the 21st century are general skills that are acquired and developed in various frameworks, not only the formal institution of school. Therefore, their development will be more effective if the system invests thought and resources to improving all the educational frameworks that the child encounters, and in making quality frameworks accessible to all children in Israel. An overall budgetary vision should be encouraged to avoid a situation in which various entities budget different sections of the general education system.

The gaps in Israel are very high, and therefore progressive budgeting should be used – the budget of weak populations must be compared to the budget of all entities that invest in education of the high socio-economic strata, both in formal and informal education (such as Ministry of Education, other government ministries, the local authority, parents, and non-profit organizations).⁴²

⁴¹ Education experts discussed the characteristics of such a council at a meeting held at the Taub Center for Social Policy Studies in Israel, on February 11, 2018.

⁴² Mandel-Levi and Artzi (2016) show that there are extensive gaps between local authorities with regards to investment in informal frameworks. In government decision 922, December 30, 2015, the Knesset decided that the informal education budget for the Arab sector would be no smaller than the budget for the Jewish sector. But significant gaps remain among the sectors, and comparison of them requires a great investment of resources in addition to facing other barriers (for more on this, see Haddad Haj Yehiye, 2018).

Testing the level of adaptation of the Ministry's reforms to the population's heterogeneous characteristics

The Ministry of Education tends to introduce reforms in a uniform manner, while the population of Israel is very heterogeneous. Reforms are not always appropriate for all sectors of the population. One example of a reform that we think should have been implemented in a differential manner is the transition to independent management, now being carried out in almost all schools. Research shows that different levels of autonomy are appropriate for different education systems. Thus an approach that aims to enable a certain level of autonomy for all schools is not optimal. In our opinion, the preferred approach adapts the level of autonomy to the characteristics of the school. By default, each school should be given maximum autonomy. At the same time, mechanisms for monitoring should be set in place for schools that are not prepared for successful independent management. These schools should be provided with professional support.⁴³

⁴³ The default should be granting autonomy to the school, and the Education Ministry should become involved only if there are indications of failures in self-management.

Conclusion

The changes taking place in the world at the beginning of the 21st century influence a wide range of fields and require acclimation and adaptation across all systems of government and society. But the need to adapt the education system to the needs of the present in the future seems particularly acute, as this system is responsible for establishing the foundations of the state's human and social capital.

In the long term, an outdated, cumbersome education system that has difficulty adapting to the current changes will harm the nation's flourishing, as its graduates will struggle to integrate into the world beyond the school gates. Furthermore, if it is not able to adapt itself to change, it is likely to become superfluous, and over time, parents and students will cease to value it and even to participate in the formal education system.

For many years, the system's leaders have tried to implement change in it and to adapt the pedagogy to contemporary needs. But it seems that a long road still lies ahead before the system will meet the expectations held of it.

Creating processes and mechanisms for methodical, long-term adaptation of the education system requires facing complex challenges. We hope that mapping the barriers to change in the system and the insights and recommendations offered in this study will aid the education system in facing these challenges and adapting to the needs of the 21st century.

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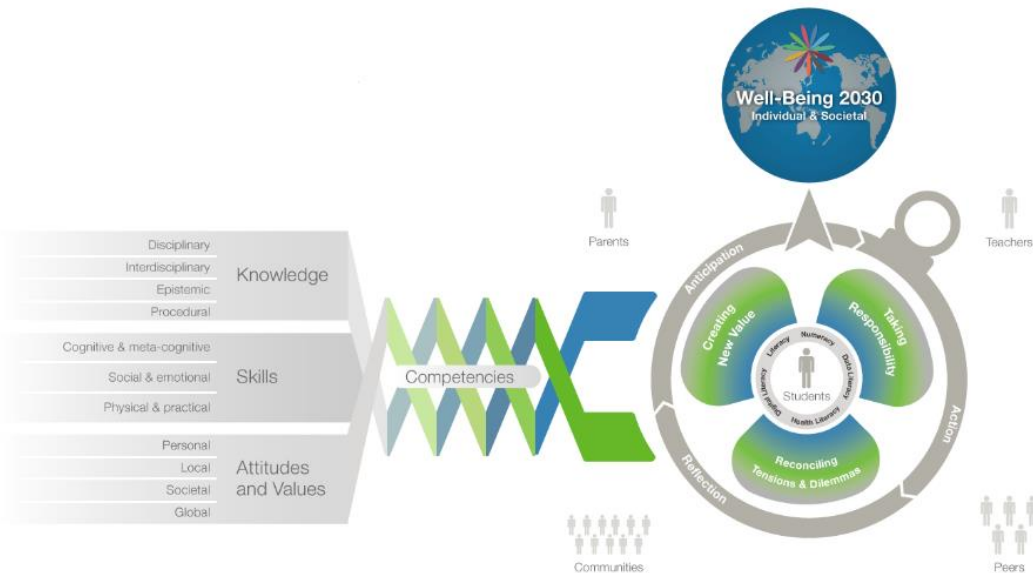
Appendices

Appendix 1: 21st Century Competencies: Knowledge, Skills, and Values

The study of 21st century competencies usually addresses three areas that form each competency and require adaptation to the needs of the 21st century:

1. Knowledge – including knowledge of specific subjects, inter-disciplinary knowledge, epistemic knowledge, understanding of the limits of the knowledge and its validity, procedural knowledge.
2. Skills – including cognitive and meta-cognitive skills, social and emotional skills, practical skills.
3. Attitudes and values – including personal values and local, social, and global norms.

Studies assert that to teach 21st century skills, each of these aspects must be emphasized and the changes taking place in them must be examined. Instilling these skills requires adaptation of the entire ecological system that envelops the student, including the school, teaching staff, parents, friends, and communities to which the child belongs (for details, see Griffin and Care, 2014; OECD, 2018).



Appendix 2: Teacher Grades on the PIAAC Test

Country	Math	Reading	*Percentile in Math	**Percentile in Reading
Finland	317	322	73	74
Japan	311	319	70	67
Belgium	308	303	68	71
Germany	308	301	72	74
Sweden	306	307	62	65
Czech Republic	305	300	73	77
Holland	304	308	63	67
Singapore	303	300	72	76
France	302	296	80	77
Norway	302	304	65	68
Australia	300	312	71	75
Austria	300	292	69	70
New Zealand	297	310	64	71
Denmark	295	288	56	60
Ireland	295	300	75	74
Slovakia	294	290	66	60
Slovenia	293	288	70	69
Average	292	295	68	71
Canada	292	307	67	72
United Kingdom	289	299	65	67
South Korea	287	296	72	74
Estonia	285	294	60	69
Lithuania	285	282	66	64
United States	284	301	70	71
Spain	283	290	75	80
Greece	282	286	74	75
Poland	277	293	64	73
Italy	273	279	67	73
Russia	273	283	53	54
Israel	270	281	57	62
Turkey	264	261	80	78
Chile	262	263	81	79

* Percentile in math: the percentage of the population that received a lower grade in math than the average teacher

* Percentile in reading: the percentage of the population that received a lower grade in reading than the average teacher

Source: Hanushek, Piopiunik, and Wiederhold, 2014