Strategic Plan for Undergraduate Studies:

VISION, STRATEGIC PLAN, IMPLEMENTATION AND INTEGRATION

June 2022

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Summary

In recent years, the environment in which the Technion operates has transformed at an accelerated rate in almost every possible aspect: scientific, technological, economic, and social. The COVID-19 crisis has accelerated many of these processes of change. As a result, the need arose to re-examine Technion's mode and nature of undergraduate education. To meet this objective, in March 2021, the Dean of Undergraduate Studies initiated the establishment of the Steering Committee for Innovation and Entrepreneurship in Undergraduate Studies, the purpose of which was to update the Technion's undergraduate studies mission statement in accordance with its vision for the Technion graduate in the 21st century, and to develop a strategic plan accordingly.

The steering committee specified an overall framework that addressed:

- Multidisciplinary and inter-faculty programs
- Teaching methodologies for core subjects and content courses
- Reconceptualizing the instruction of core courses at the Technion
- Internationalisation at home
- Integration of advanced degree students in the teaching and supervision of undergraduate students
- Cooperation with industry
- Educational management and encouragement mechanisms at the Technion
- Reconceptualizing core courses
- Social engagement and experience
- New frameworks for engineering and science studies
- Selection and admission of undergraduate applicants and marketing strategies

Reciprocal relationships exist between different fields. Such relationships lead to the development of synergies and consequently a formulation of a plan of action, whose main goal is to provide an education that will foster the profile of the Technion graduate in accordance with Technion's updated vision for its graduates, and which will emphasize several key expectations:

> *"...to have the ability to make decisions and steer the ship while understanding the complexity, the ability to consider conflicting values while understanding the broader socio-cultural-economic context and while upholding one's integrity, professionalism and sense of commitment to the community and society. They must be able to initiate, create, and lead processes and be agents of change in their environments. Moreover, we view this type of education as a part of Technion's social responsibility and public mission;"*

This plan incorporates evolutionary steps with more radical moves and processes and presents measures that can be readily implemented and integrated with long-term measures.

Background

The current document presents the main recommendations of the Strategic Plan for Undergraduate Studies that has been formulated at the Technion, as well as the initial steps for implementation and integration. The plan is based on principles and proposals for procedures, which have been formulated as a result of discussions within the Steering Committee for Innovation and Entrepreneurship in Undergraduate Studies and its working groups, which are presented in the committee's report[1]. The committee and its working groups were comprised of approximately 80 members, including representatives of the Technion management, academic faculty and administration members, as well as, students and industry personnel outside of the Technion.

The driving forces for the plan are the processes and revolutions of the current era – scientific, technological, social and economic – which necessitate a re-examination of the profile of the graduate and the educational role of the faculty member, alongside an adoption of a new perspective regarding the structure of the curriculum and incorporation of innovative pedagogical approaches. Further, an evaluation of current instructional methods indicates that they are far from optimal and include elements that are not adequately effective and tailored for achieving the goals of the education, especially when considering the nature and culture of the current generation of young men and women. There is thus room for significant improvement.

1 Innovation and Entrepreneurship in Undergraduate Studies, Part A: The Strategic Plan, August 2021, in Hebrew

The first part of the current report addresses the principles of the plan and the goals for undergraduate studies at the Technion, as derived from the Technion's vision for the profile image of its graduates. The second part of the report reviews the principles of implementation and integration for achieving these goals.

Part A: **Principles**

1. Vision for the Profile of the Graduate (from Technion's strategic plan) (2021-2031)

Quote from the Technion's document[2]:

> *"We believe that our graduates will encounter significant junctions in their professional lives when they will need to make decisions, and it is at those times that they will need to uncover their professional leadership skills – to have the ability to make decisions and steer the ship while understanding the complexity, the ability to consider conflicting values while understanding the broader socio-cultural-economic context and while upholding one's integrity, professionalism and sense of commitment to the community and society. They must be able to initiate, create, and lead processes and be agents of change in their environments. Moreover, we view this type of education as a part of Technion's social responsibility and public mission;"*

2 From a working draft of the Technion, as of May 2021; changes may be made.

In light of the above, the new plan for Undergraduate Studies will promote training of undergraduates that goes beyond scientific-engineering knowledge to additionally incorporate leadership education. This type of training will include:

- Expanding students' horizons by having them educated in select topics in the humanities, social sciences, and ethics.
- Imparting essential skills and competencies, including critical thinking, creativity, entrepreneurship, complex problem-solving, teamwork, internationalization, and communication.
- Instilling an awareness of entrepreneurship, as well as promoting social and environmental engagement as a way of life.

2. Undergraduate Studies Mission Statement

Impart knowledge and provide education and training to the next generation to foster leaders in engineering-science for innovation and entrepreneurship (business/social-entrepreneurship and organizational-intrapreneurship), while instilling and integrating values of excellence, innovation, social engagement, and inclusion of the other, for the advancement of the State of Israel and humanity.

3. Skills and Competencies of Technion Graduates

- Technion graduates will be engineers/scientists/architects/physicians/thoughtful and creative educators, who possess multidisciplinary analytical abilities, self-learning abilities as well as experience in research and development, and who have been exposed to a culture of design and entrepreneurship.
- The graduates will have scientific, cognitive, social, and interpersonal skills that will enable them to adapt to a changing world, and to advance within it, while they engage in professional activities, including activities in planning/design, production, entrepreneurship, development, medicine, and educational and academic research; such skills and competencies will enable them to be leaders in these fields.
- Graduates will possess an understanding of the socio-cultural-economic context in which they operate and the values consistent with it, as well as an ability to formulate a worldview for themselves and to consider complexities and value-based questions.
- The Technion will instill additional unique values in its graduates, which will derive from their exposure to cutting-edge research and technological advancements, through their interactions with prominent researchers and their direct involvement in research being conducted within Technion laboratories, research that is at the forefront of science and technology.

4. The Central Components of Undergraduate Education at the Technion

The plan includes three complementary components, which are derived from three main categories:

- What: Education for leadership in a changing world – expanding learning outcomes.

- How: Transitioning from teaching to education – improving and revising learning and instructional strategies.
- Who: Recruitment and selection of candidates based on aspects that are consistent with the unique characteristics of the Technion.

Each of these components include distinct domains, as specified below:

Component I: Education for Leadership in a Changing World: Expanding Learning Outcomes

Skills and values

Imparting skills and values; incorporating applicable pedagogy into content courses, and incorporating research, industry and social experiences within content courses. In addition, extracurricular activities are offered.

Insights were gathered on the following topics, and action steps were formulated accordingly:

Faculty Initiatives

- Appointment of a faculty leadership team
- Active and continuous learning
- Syllabus template
- Internationalisation at home
- Industry experience
- Research experience
- Social engagement

Administration/Undergraduate Studies Initiatives

- Expansion of teaching staff: industry experts
- Expansion of teaching staff: Graduate advanced degree students
- Expansion of teaching staff: researchers and research engineers at the Technion and the Technion R&D Foundation
- Encouragement of faculty members: recognizing educational achievements promotions and accolades
- Encouragement at the faculty level – teaching experts
- Encouragement at the Technion level – competitive calls for proposals for innovative education processes
- Development and integration of new evaluation methods
- Offering guidance and sharing insights and lessons learned from successes and failures

System and interdisciplinarity

Within the various academic programs, students can participate in multidisciplinary projects that will enable them to gain knowledge across disciplines, as well as multidisciplinary and system thinking skills. In addition, students will take courses in other faculties to deepen their familiarity of other fields of study and to gain additional knowledge.

Insights were gathered on the following topics, and action steps were formulated accordingly:

Joint Faculty - Administration/ Undergraduate Studies Initiatives

- Multidisciplinary, inter-faculty clusters (Technion+)
- Multidisciplinary project

Administration/Undergraduate Studies Initiatives

- Humanities and social sciences cluster (Technion+)
- Social experiences
- Multidisciplinary academic center

Expanding the breadth of core subjects

An emphasis is placed on providing students with a strong foundation in core subjects, which will enable them in the future, as Technion graduates, to independently and continuously learn and remain up-to-date throughout their professional lives. This will provide them with the ability to cope with the challenges of the 21st century that are characterized by rapid changes and innovations in the fields of science and technology. This includes expanding the breadth of core subjects, both in the exact sciences (such as life sciences, digital sciences) and in the humanities and social sciences (within the framework of strengthening the connections between science-technology-society-economics)

Component II: Transitioning from Teaching to Education: Improving Learning and Instructional Strategies

Promoting pedagogies of active and continuous learning throughout the semester and integrating them into content courses

An emphasis is placed on the role of the instructor, in regard to advising and mentoring, while also emphasizing the professional strengths of the academic staff which result from involvement in research, connections with industry, and international activity.

Component III: Identifying, recruiting and selecting candidates, as well as marketing the programs to them: In accordance with the unique aspects of the Technion

Identifying and recruiting candidates in accordance with the unique expected profile of the Technion graduates

This framework underscores the uniqueness of the Technion as an institution and the uniqueness of the profile of the Technion graduate, by incorporating these strengths and messages into a marketing strategy geared toward potential candidates, including promotion that takes place through Technion's relationships with schools.

screening of candidates

Additional selection tools that will help to identify and recruit candidates, in accordance with their potential to grow

into the desired profile of a Technion graduate.

Tools that have been integrated:

- Entry exam in mathematics: To encourage candidates to arrive well-prepared to start the academic year at the Technion
- Admission on the basis of the student's final grade point average and interview/resume
- Admission on the basis of a shortened admission route when applying from the external studies program

Part B: **Implementation and Integration**

5. Cultural Changes

In order to achieve the long-term goals, the implementation of the strategic plan will involve a reconceptualization of the entire curriculum, based on cultivating the desired profile of a Technion graduate in general and with regard to various disciplines in particular. Each faculty supports a reconceptualization of the overall curriculum. As such, Technion's Undergraduate Studies considers several tiers, including the core overall academic program as well as particular disciplinary studies, and an expansion of multidisciplinary programs and experiences. An example of an outline for reconceptualizing the curriculum at the faculty level is shown in Figure 1.

Figure 1: Example of an outline for developing a general curriculum, with consideration to the period of time after receiving one's undergraduate degree

Outline for Education and Training Program at the Technion – Bachelor's Degree Studies

Faculty of Civil and Environmental Engineering

	Bachelor's degree		First Year	Second Year	Third Year	Fourth Year	Development throughout one's career post-graduation	Lifelong Learning
The Disciplinary Academic Core		Academic Training	Engineering Science – Mechanical Engineering, Strength Theory Mathematics – Calculus, Algebra, Differential Equation Science – Physics, Chemistry Computer Science/Data – Introduction to Computers, Graphic, Graphical Engineering Information	Engineering Science – Statistics, Fluid Mechanics, Materials, Transportation, Concrete Structures, Biology, Geology, Economics, Mapping and Measurement Science – Physical Chemistry, Physics, Computer Science/ Data, Statistics, Numerical Methods	Specialization Tracks: General Civil Engineering Management and Construction Engineering Water Engineering Transportation Engineering Structural Engineering Foundation Engineering Environmental Engineering Mapping and Measurement Engineering			Graduate degrees, continuing education
Extending Multidisciplinary Studies and Research in the Academic Infrastructure		Development of Systemic and Multidisciplinary Thinking Abilities	Transversal core courses in the Social Sciences and Humanities; Core courses in new topics, for example: Life Sciences, Data Science	Multidisciplinary Learning Cluster	Multidisciplinary Project; Learning Cluster consisting of a group of faculties	Multidisciplinary Project		Multidisciplinary graduate degrees; continuing education
		Exposure to Research			"Ladder" ("Sulamot") Program	"Ladder" ("Sulamot") Program; Research Cluster, as an initial step towards a graduate degree program		
Enrichment and Practical Experience		Exposure to Entrepreneurship and Experience in Industry		Employment fair; secondary specialization in entrepreneurship; Experience in Industry Model, as integrated into one's studies; workshops to learn about diverse entrepreneurship topics; program centered around establishing entrepreneurial ventures: "BizTEC"; internships in industry programs; Israelis and Internationals; participation in accelerator activities at the Technion (Drive), entrepreneurship workshops within the EVP program of the Consortium of European Technological Universities (EuroTech); individualized advising for students in the Mentoring Program of the Technion Alumni Organization (TENGIVING); development of a program to expose students to workplaces with the assistance of Technion alumni				Track focused on advancing Technion alumni's ideas within the Technion Accelerator Program (Drive)
		Global Exposure			Student exchange; joint programs with Technion's branches in New York and in China and individual courses within these programs; experiences within Technion's branches in New York and in China; joint programs with the Consortium of European Technological Universities (EuroTech); joint programs with partner universities; Engineers Without Borders			Participation in lectures and webinars in collaboration with the Technion Alumni Organization and International Friends Associations; graduate degrees in collaboration with Technion's branches in New York and China

		Social Engagement			"Perach"; programs conducted with the Technion Student Association community, Programs within the Technion Social Hub		
		Personal Development Training	Self-learning training within content courses	Self-learning training within content courses	Self-learning training within content courses; workshops for preparing and delivering presentations	Workshops for writing resumes; workshops for job searching; workshops for time management	Graduate degrees, lifelong learning programs, support from the alumni organizations; participation in different events of the Technion Alumni Association, as applicable (for example, the "Lady-Tech" conference, alumni webinars and lectures)

With the understanding that the curriculum must combine both the acquisition of knowledge and the development of skills and competencies, a long-term transition from teaching to education is critical.

The driving force behind such processes arises from the field – the faculties and faculty members, with the Technion's administration serving as an entity that guides, supports, and enables the changes. This process creates a solid basis for a dialogue between the administration, faculties, faculty members, students, etc.

Upon approval of the plan by the Technion administration, an additional step was taken to promote the integration of the principles of the new plan, which the Dean of Undergraduate Studies led in numerous meetings with deans, faculty councils, and students. In addition to these activities, faculty members were surveyed regarding the proposed changes. Approximately one-third of the faculty members (about 200 individuals) responded to the surveys. There was considerable involvement among the students as well. Dozens of students participated in the meetings initiated by the Dean of Undergraduate Studies; these meetings were conducted in good spirits and arose from a genuine desire among the students to have an impact on and improve their own experiences and those of future students at the Technion.

Actions implemented by deans and faculty members:

- Changing teaching methods and exam formats.
- Re-evaluating Technion's core courses – scope and depth, as well as modifying the curriculum for the future.
- Establishing collaborations across faculties, for example offering dual degrees and joint study clusters.
- Evaluation of resources required to transition to small-group instruction, with ongoing guidance and assessments.
- Providing solutions for the challenges that accompany teaching in the English language.
- Developing joint activities with industry – courses, practical experiences, and visits.

Students' main insights, in response to activities conducted in the field:

- The need to increase the number of study spaces, arising from an understanding that joint learning is preferred when compared to the difficulties experienced when learning alone via Zoom.
- Use of recorded lessons as an aid to support learning.
- Enjoyment and benefits gained from courses that implemented new methods of teaching.
- Desire to participate in a student exchange program, alongside remarks about the difficulties associated

with the academic calendar and exemptions.

- Striving for fairness in regard to grades, questions about the "factor" (grade adjustments, grading on a curve), establishing the average grade in the faculty in advance, etc.
- Desire to have a monthly calendar that includes all the activities of all the different entities on campus (Dean of Students, Technion Student Association, Entrepreneurship, Alumni Organization, etc.).
- Increasing activities for meeting others and cultivating "team spirit".
- Increasing activities that foster interactions between different groups of the population to help them to get to know each other, for example Arabs and Jews who meet on campus for the first time.
- Opportunities for gaining work experience for credit while also taking courses in the final semesters, especially in faculties in which students do not start working during their degree studies.
- Some students enjoy dividing their time between Technion and their homes – the proposed division of days is two days at the Technion and the remainder at home. Arriving to the Technion when there are activities on Wednesday afternoons – sports classes or laboratory activities. This division of students' time on and off campus saves time/money on transportation, and/or money on renting an apartment in the area.
- A recommendation to develop a project-based course taught during the first year in the program, which will demonstrate to students how they can apply the content taught during the first year in the future, and thus help them to make connections between core courses and the work world, as well as to enhance their motivation during their studies.

6. Curricula: Knowledge and Skills

The realization of the profile of the graduate, in accordance with Technion's vision and the faculty's vision, necessitates a transition from a framework in which the main emphasis is on imparting knowledge to a framework that additionally imparts skills and competencies as to enable graduates to realize their potential throughout their professional lives. This transition requires various steps to be taken within an overall framework, as shown in Figure 1, such that each step stands on its own but operates in harmony with the others, in order to ultimately provide a comprehensive curriculum.

Meetings were held with deans and faculty members to determine the set of priorities as well as to discuss how to integrate the imparting of skills and competencies in content courses. This is essential for two purposes: the first is to find a way to promote skills and competencies that does not come at the expense of imparting knowledge, and the second is to develop effective ways to tailor education geared towards the development of skills and competencies in a way that recognizes that teaching them in conjunction with content is much more meaningful than in a context that is separate from content.

The surveys that were conducted made it possible to set priorities in regard to skill importance (Figure 2) and to map which skills can be imparted within the context of content courses (Figure 3). This mapping forms the foundation for the steps involved in developing pedagogies that integrate the provision of skills into the structure of content courses, as well as the professional support measures needed to do this.

Figure 2: Ranking of skills according to their level of importance for educating scientists and engineers, a survey of faculty members at the Technion (195 respondents; % of respondents who rated the topic as important or very important)

Thinking:

Complex problem solving

Critical thinking

Creative thinking

Design thinking

Systemic and interdisciplinary

thinking

Personal and Interpersonal:

Self-learning

Teamwork skills

Communication

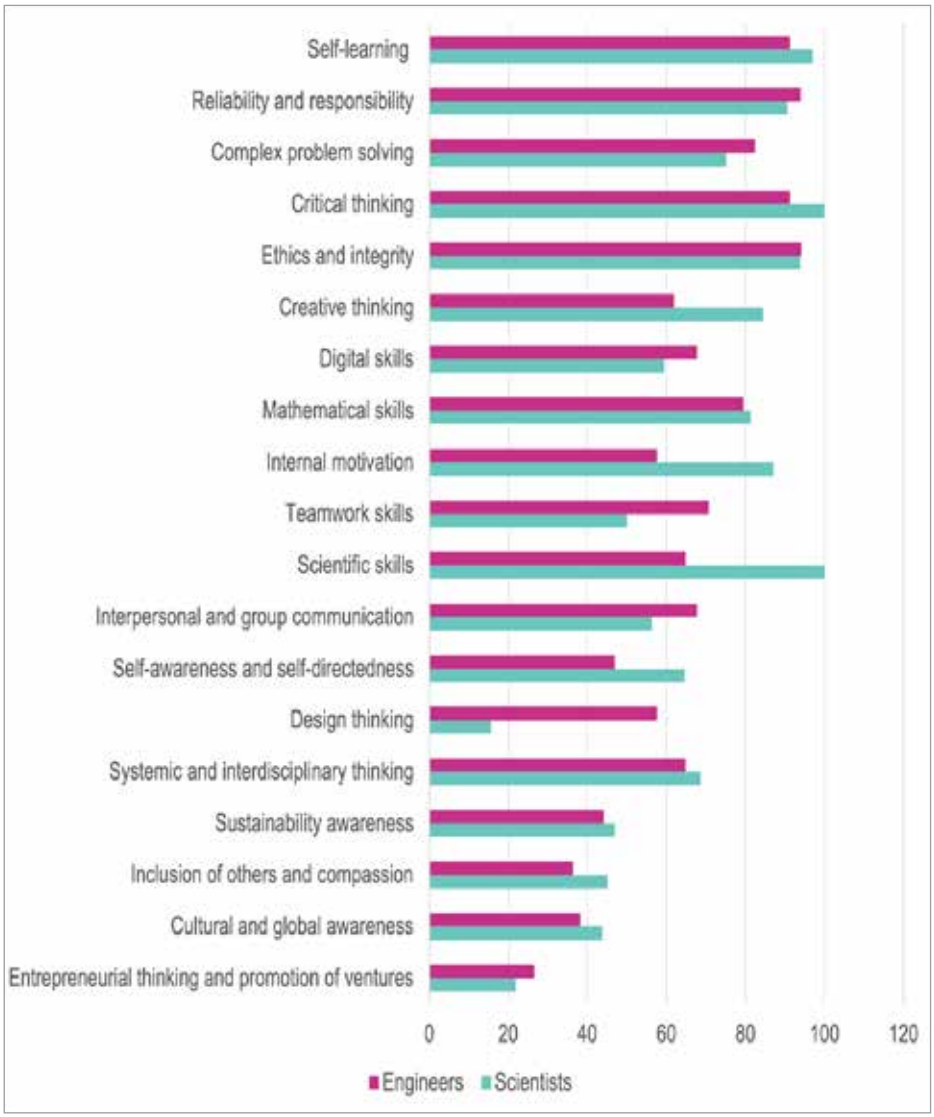
Values:

Reliability and responsibility

Ethics and integrity

Internal motivation

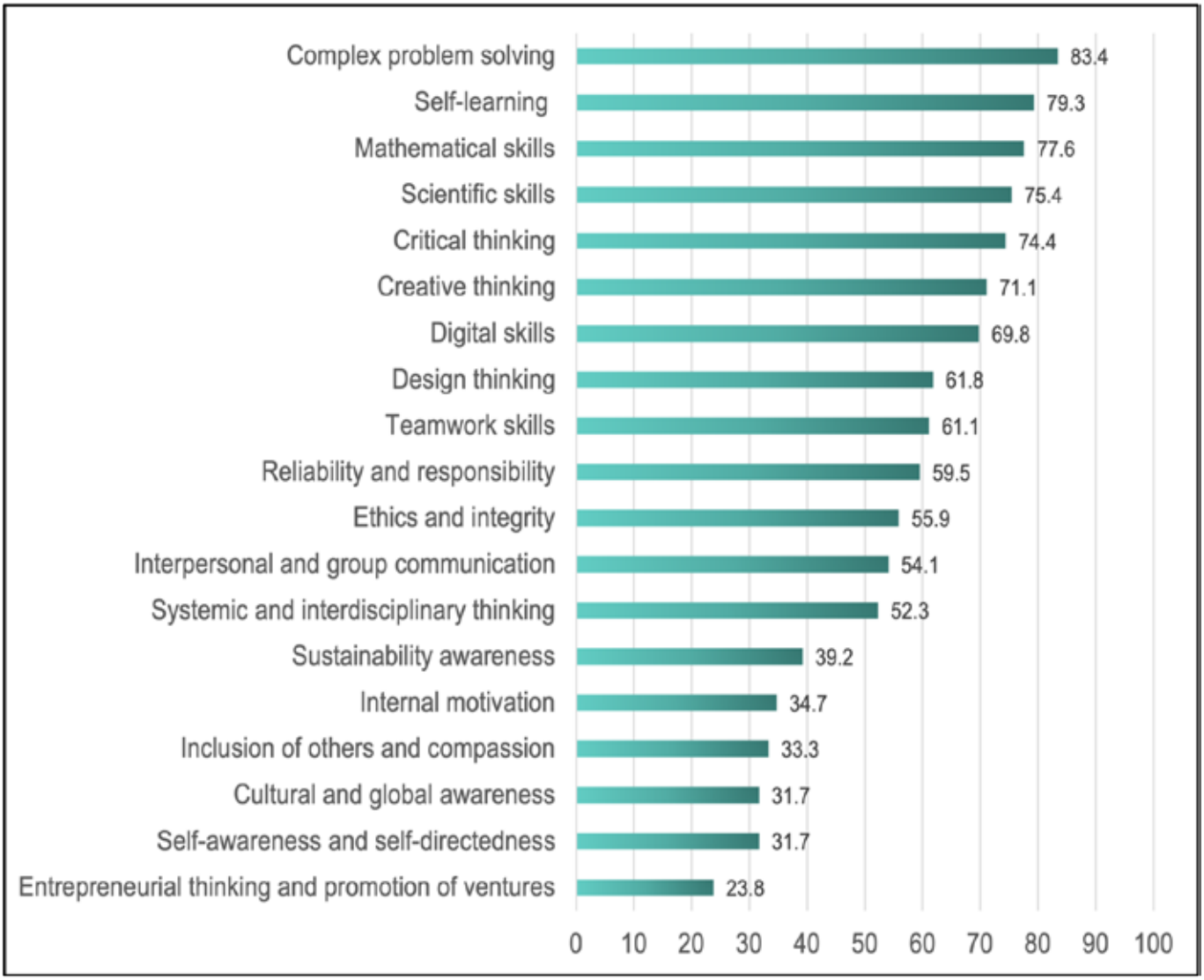
Self-awareness and self-directedness



Essential skills

(in descending order)

Figure 3: Skills and competencies that can be fostered in content courses, a survey of faculty members at the Technion (195 respondents; % of respondents who noted the topic as possible to be built into the content course)



7. Core Courses

The necessary changes to the curricula require a reevaluation of the core courses, an expansion of the content and a change in teaching methods.

In this framework, processes with two features are promoted: (i) integration of pedagogy to impart skills within content courses, (ii) clusters to expand core subjects that are not part of the faculties' required subjects.

The first step is to integrate the teaching of skills into the pedagogy, starting with core courses in mathematics, led by the Faculty of Mathematics.

The second step, to enable the expansion of the field of digital literacy, is advanced via the establishment of a cluster for digital literacy which combines general Technion core subjects and faculty subjects that emphasize discipline-based content related to digital engineering. A group of courses is currently being developed, which will consist of four courses that total approximately 10 credits:

- Python
- Algorithmic basics
- Data collection and analysis (big data) and AI applications
- Simulation-driven design
- An experiential-integrative course/lab for summarizing knowledge derived from a project

8. Interdisciplinary

A learning clusters model was developed, each cluster totaling about 10 credits, which can be integrated into existing degree programs. About half of the credits can count towards the elective subject requirement of the degree program and half towards subjects that are not part of the degree requirements.

In this regard, different types of inter-faculty learning clusters were specified:

- Multidisciplinary learning
- Multidisciplinary professional/industry experience
- Multidisciplinary research experience
- Multidisciplinary initiatives
- Social and environmental engagement/sustainability
- Communications, social sciences and humanities cluster
- International and multicultural cluster

To advance these steps, a meeting with the heads of Technion's interdisciplinary institutes and projects was conducted in order to mobilize their support and to initiate programs in this format. This step was promoted as a result of the perspective regarding the overall importance of the topic and the added value for the multidisciplinary institutes and projects themselves, in order to encourage undergraduate students to continue for advanced studies to obtain graduate degrees in the multidisciplinary frameworks of the Technion. This activity, in combination with activities conducted at the faculty level, are reflected in steps taken to establish several learning clusters on multidisciplinary topics:

Human Health

- Public health
- Entrepreneurship for biomedicine

Sustainability, Environment and Infrastructure

- Sustainability
- Urban environment
- Transportation

Advanced Manufacturing – Industry 4.0

- Advanced manufacturing in industry
- Advanced design and manufacturing in construction

Society, Humanities and Education

- Society and technology
- Social engagement
- Evaluation in learning and education
- Mathematical, scientific, and engineering education
- Digital learning design

Multidisciplinary Technology

- Nanotechnology

9. Internationality at Home

Instilling the ability to operate in a multicultural and international environment is an important component in the profile of the graduate, especially in a world that is rapidly becoming a "global village". In the past, international exposure was primarily based on participation in student exchange programs; in other words, international exposure occurred when students studied abroad for a limited period of time. Travel restrictions during the COVID-19 pandemic accelerated the promotion of new mechanisms that do not require travel abroad, and they fall under the category of "internationality at home". These mechanisms are especially important for Israeli students because, even during typical times, they have difficulty traveling abroad for a period of a few weeks or months.

Therefore, alongside traditional models, new mechanisms are now being promoted that are aided by modern communication technologies to enable students to participate in international activities without being physically present. The Technion is a partner in the Consortium of European Technological Universities (EuroTech), in which joint curricula are developed. Another mechanism that is being developed is based on interactions between students at the Technion campus in Haifa and students studying at the Technion's branches in China (TGIT) and New York (the Jacobs Institute; joint institute between the Technion and Cornell University).

In order to promote these processes, a new policy stating that students must take at least two courses in English during their degree studies was enacted. These courses may form an infrastructure that supports the participation of international students, as the courses will promote interactions with students from abroad via exercises, projects, joint seminars, and more.

In order to encourage these activities, Undergraduate Studies at the Technion advanced several measures:

- Provide an English translation for all e-mails from the Undergraduate Studies Secretariat.
- Provide an English translation for all major documents and guidelines on the Undergraduate Studies website.
- Grant scholarships to undergraduate students traveling abroad to participate in student exchange programs.
- Request faculties to encourage students to study abroad for a semester.

10. Practical Experience

Students can gain experience in industry and in research and can participate in social activities within the context of varied organizations, including the Center for Innovation, the Center for Global Engineering, the Social Hub, and the Ladders ("Sulamot") Program for research experience. Most of the activities conducted in these frameworks are on a volunteer basis and are not part of the curriculum. Experiences that are part of the curriculum take place within the framework of the academic program via an industry project; this opportunity is available in several faculties.

To expand upon students' involvement in various types of experiences, a number of new avenues and an expansion of existing ones have been proposed, with the aim of encouraging the faculties to include them in their curriculum. A description of these experiences is presented in the following sections.

10.1 Gaining Familiarity with Industry/Experience in Industry

The steps taken to provide students with practical experience in industry include establishing programs for students to take tours during the summer months in order to gain familiarity with technologies and innovations across a variety of industries. In addition, a new course was established on industry-academia relations.

Another intended step is to discover creative ways to leverage the potential of the current and unique situation in Israel, in which a significant proportion of students, primarily third- and fourth-year students, work in industry.

All models share several academic and professional principles:

- Employed students will be assigned a mentor from industry who will guide them at work, as well as an academic advisor from the relevant academic unit.

- Prior to beginning their employment, the students, industry mentors and academic advisors will formulate a professional work plan.
- Students' activities in the workplace will be monitored.
- Student summary reports will be submitted and presented, and will be the basis for evaluating the training that they receive.

The different models are characterized by unique operating principles:

The first model, the "blended model", is based on current procedures, however it needs to be upgraded to ensure that the activities in the industry have professional added value. The model suggested represents an approach that does not fundamentally change the overall framework. In other words, students work during their studies, and the activities they conduct in industry correspond with their faculty and include academic supervision.

Other models represent a new approach, in which there is a separation between employment in industry and one's studies: intensive work during vacations/school breaks or during a leave of absence for a semester. In this framework, procedures to enable students to receive the financial support that they need have been formulated and suggested, as well as procedures that will enable industrial companies to reach students whom it is in their interest to cultivate their abilities, as they represent the next generation's leaders of their companies. These models are built in such a way that the quality of education that students receive does not suffer as a result of their employment in industry, rather industry experience provides an added value for everyone, including the Technion. In addition, the proposed course of action enables a stronger connection between the Technion and industry, as students' work experience is supervised so that they gain added value from their experience in industry, in parallel to and in combination with their academic studies.

10.2 Research Experience: Ladders ("Sulamot") Model

The goal of the "Ladders Program" is to expose undergraduate students to research conducted at the Technion in order to transition students away from passive learning and towards active learning, and away from being receivers of content and knowledge and towards being creators of deliverables in the context of a research team. These activities will foster students' learning in all matters related to acquiring skills, relevant capabilities and practical experiences to prepare them for entering the job market in the future.

Another added value, which is no less important, is the interaction between students from different faculties, which leads to the creation of multidisciplinary work teams, something that is incredibly valuable and necessary in today's changing world of work.

10.3 Experience in Teaching and Advising: An Integration into Teaching Model

Experience in teaching and advising can provide an added value for students in all matters related to improving and acquiring communication skills of various forms, qualities that are important when managing workgroups in industry and in training for an academic career. In this framework, students will also receive basic academic

training to advance the quality of their teaching and advising abilities.

The elements proposed for this track are:

- During students' third and fourth years, they will be integrated into teaching, both as laboratory instructors and teaching assistants in courses that they have taken in the past.
- Students on this track will not be employed in industry during the course of their studies and will only work as instructors and advisors at the Technion during their studies.
- Payment for teaching will be in accordance with the accepted rates for teaching staff and will be paid as wages. In addition, and depending on the resources available, a scholarship will be provided to students during their studies.
- During the summer, in between the second and third years of study, students will undergo additional training in the Center for the Promotion of Learning and Teaching in preparation for their integration into the teaching staff.
- Upon completion of their work, students will be awarded a certificate attesting to their training at the Center for the Promotion of Learning and Teaching. This experience and certificate will hold value in

industry for engineers and scientists who will be expected to lead and guide teams, as well as for those pursuing academic careers.

10.4 Social Engagement

Social engagement primarily takes place within the context of the Center for Global Engineering and the Social Hub. Participation in the cluster that integrates social engagement with one's studies is largely voluntary, although there are are some options that of courses with credits which may count towards the degree.

The social cluster develops several academic courses (for example: ethics and social engagement, courses in the fields of humanities and social sciences, etc.), in conjunction with faculty projects that incorporate a salient social component.

11. Innovation in Teaching and its Integration

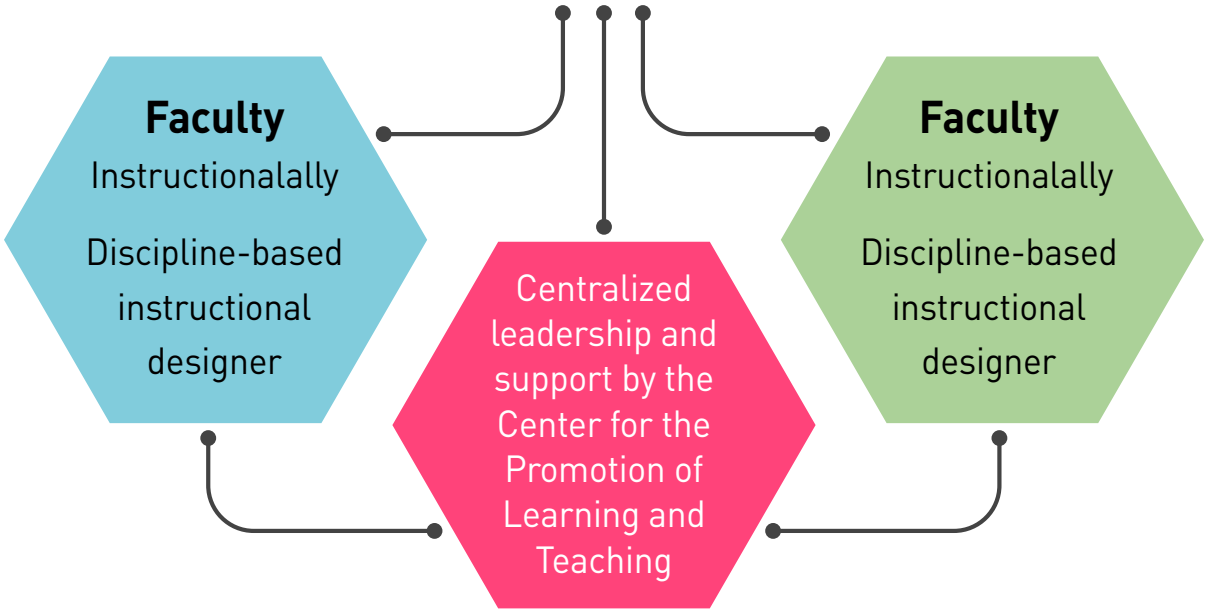
The Technion takes steps to promote innovation in teaching methodologies and pedagogies, and to provide direct professional support to faculties and faculty members for activities conducted in the field. In support of these goals, the vision of the Center for the Promotion of Learning and Teaching was upgraded and redefined:

"The Center designs the education and training provided at the Technion in such a way that supports processes of knowledge attainment and skill development, which are required for graduates to be leaders of the 21st century."

Based on this vision, the Center for Teaching promotes innovation, plans instructional activities, and provides management and guidance. To achieve these goals, new mechanisms and procedures have been formulated, including:

- Support at the faculty level: discipline-based instructional designers
- Support at the course level: holding competitions during the semester in accordance with specified criteria
- Improvement of mechanisms for evaluating teaching and learning
    - Promoting innovation in teaching in the academic unit
    - Instructional design
    - Training lecturers
    - Assessment of outcomes
    - Announcements
- A coordinator and advisor for faculty instruction and education
    - Identifying and prioritizing needs
    - Specifying goals and metrics
    - Providing guidance and support
- Guiding research in accordance with a unique model, Figure 4

Figure 4: Model for Guiding Research and Innovation in Teaching and Pedagogy in Academic Units



A particular emphasis is given to the construction and integration of five new models of action, as described below:

Model of Support Provided by Disciplinary-Based Science Education Specialists

In order to help academic units adapt their courses to existing needs and opportunities, knowledge is required both in the particular field and in techno-pedagogy. A proven mode of action in the world is the Science Education Specialists model. These specialists are faculty members who possess an in-depth disciplinary background and experience, as well as a commitment to teaching and who operate in accordance with the following principles:

- Each teaching specialist will be assigned to one academic unit.
- The courses and academic units to which a teaching specialist is assigned will be based on calls for proposals (one at the faculty level, one at the course level), and in accordance with goals, needs, and support required.
- In addition to their affiliation with the faculty, teaching specialists will receive professional guidance from the Faculty of Education in Science and Technology and from the Center for the Promotion of Learning and Teaching.

- The goals of these specialists are to improve courses; improve teaching quality and practices; promote an organizational culture of excellence, innovation, and entrepreneurship in education; and to build an information infrastructure over time. The work done in regard to courses will occur in such a way that supports the transfer of knowledge between and within faculties.
- Specialists will: (1) assist faculty members in analyzing course content; (2) mentor and providing feedback to faculty members; (3) guide faculty members in educational research and evaluating the quality of teaching and learning, with the goal of identifying principles for successful implementation at the Technion; and (4) make announcements in the relevant arenas and promote faculty discourse.

Model for Providing Direct Support to Faculty Members

- In conjunction with the support provided by education specialists, faculty members will receive help from teaching assistants for developing course materials.
- Common upgrades: advancements of the 21st century (modeling, programming, working with tools, teamwork); implementation of alternative evaluation methods; uploading content online and utilizing lectures for active learning.
- Course instructors receive support in the development process (consulting + employment units + evaluation). This upgrade takes up to two years, after which the operating costs will return to their current steady state.

Model for Improving Individual Courses

- Creation of an orderly and defined process for working with lecturers who are interested in improving their courses, separate from the support provided by the faculty.
- Competitive call for proposals model with two deadlines: before the spring semester, before the winter semester.
- In order to receive support, four main elements must be specified:
    - Goals for the change – What needs improvement?
    - Means of making the change – What will it look like?
    - Evaluation – How will we learn what works and what needs improvement?
    - Budget

Evaluation Model

Formulation of evaluation mechanisms for courses, with the following objectives:

- To better identify the quality of learning across different programs at the Technion.
- To identify characteristics of successful teaching and to replicate and scale up, particularly in an era of frequent changes to the teaching format.
- To evaluate the Center's model of support.

Examples of evaluation materials include templates to conduct mid-course surveys, interviews with lecturers and students, surveys of students in regard to course characteristics, and mining digital learning data from various systems.

12. New Admission Routes

New admission routes have been developed, with the understanding that additional admissions criteria can be considered in addition to the commonly-utilized ones – matriculation exam scores and psychometric scores – in order to provide opportunities for candidates who have the potential to succeed but who, for various reasons, do not meet the usual requirements:

- Admission on the basis of a shortened admission route when applying from the external studies unit program: integrating into the Technion's regular program in the spring semester program (formal admission to the Technion) after completing and succeeding in a semester in the external studies.
- Entry exam in mathematics as a substitute for the psychometric exam.
- Admission interview for applicants whose grade point average is close to the required threshold.

These steps are only initial steps, and they are the result of the idea that there is a need for pluralism in the admissions policy. Other steps that are being promoted regard preparing candidates through various training avenues, the first of which is a mathematics camp.

13. Follow-Up and Research

- All activities performed within the framework of Undergraduate Studies at the Technion are monitored and evaluated on an ongoing basis:
    - Follow-up assessments are conducted after implementation.
    - Assistance is provided in response to challenges that arise during implementation: intervention and referrals for collaboration.
    - Ongoing meetings within academic units with deans and vice deans for the purpose of providing support and assistance with conveying ideas.
- The Statistics Unit continuously monitors students' performance, including various aspects of their performance, as well as the stages that lead up a student dropping out of the program or to a student's demonstration of excellence in the program, in order to improve upon the mechanisms of selecting and supporting students.

Appendix A

Composition of the Steering Committee for Innovation and Entrepreneurship in Undergraduate Studies

Founder of the Committee: Prof. Hossam Haick, Dean of Undergraduate Studies

Chairperson of the Committee: Prof. Emeritus Arnon Bentur

Committee Members:

Prof. Oded Rabinovitch, Senior Executive Vice President

Prof. Alon Wolf – Vice President of External Relations and Resource Development

Prof. Ayelet Fishman – Dean of Students

Prof. Reuven Katz – Center for Entrepreneurship and Innovation at the Technion (t-hub)

Prof. Avinoam Kolodny – Faculty of Electrical and Computer Engineering

Prof. Oren Cohen – Faculty of Physics

Associate Prof. Shachar Kvatinsky – Faculty of Electrical Engineering

Dr. Liat Moaz – Consultant to the President of the Technion for Strategic Planning

Dr. Shuli Schwartz – Director of the Technion's "DRIVE" Accelerator

Dr. Aviv Censor – Faculty of Mathematics

Ms. Linoy Nagar Shaul – Chairperson of the Technion Student Association (until 2020)

Mr. Ido Biran – Chairperson of the Technion Student Association (since 2020)

Ms. Efrat Nativ-Ronen – Academic Secretary and Head of the Registration and Admissions Center

Mr. Hovav Gazit – Chief Engineer of the Computer Graphics Laboratory - Electrical Engineering

Heads of the Workgroups

Prof. Reuven Katz, Multidisciplinary and Inter-Faculty Programs, Working Group B-1/B-2

Prof. Doron Shilo, Teaching Methodologies in Core Subjects and Content Courses, Working Group B-3

Prof. Havazelet Bianco-Peled, Reconceptualizing Core Courses at the Technion, Working Group B-9

Ms. Ronit Lis-Hacohen, Internationalisation at Home, Working Group B-4

Prof. Yehuda Pinchover, Integration of Continuing Education Students and Students who are Being Supervised, Working Group B-5

Prof. Avinoam Kolodny, Cooperation with Industry, Working Group B-6/B-7

Associate Prof. Ido Roll, Management and Encouragement Mechanisms at the Technion, Working Group B-8

Associate Prof. Mark Telesnik and Dr. Ruth Margalit, Social Engagement, Working Group B-10

Prof. Arnon Bentur, New Frameworks for Engineering and Science Studies, Working Group C-1

Ms. Efrat Nativ-Ronen, Selection and Admission, Working Group C-2

Appendix B

Working Groups: Working Group Members and Activities of the Working Groups

B-1: "Benchmark" for activities conducted within small unique projects/programs

B-2: "Benchmark" and special recognition of inter-faculty programs

B-3: Reconceptualizing the way in which students learn core subjects and content courses

B-4: Internationalisation at home

B-5: Integration between advanced degree students and excelling students acting as teaching assistanat and guides

B-6: Integration of industry experts into instruction and guidance activities

B-7: Cooperation with industry to provide practical experience

B-8: Education management and encouragement mechanisms

B-9: Reconceptualizing core courses at the Technion

B-10: Social engagement

C-1: New frameworks for engineering and science studies

C-2: Criteria for the selection and admission of candidates and the process of recruiting and identifying candidates

C-3: Lifelong learning

B-1, B-2	**B-3**	**B-4**	**B-5**	**B-6, B-7**	**B-8**	**B-9**	**B-10**	**C-1**	**C-2**
Reuben Katz	Doron Shilo	Ronit Lis-Hacohen	Yehuda Pinchover	Avinoam Kolodny	Ido Roll	Havazelet Bianco-Peled	Mark Telesnik Ruth Margalit	Arnon Bentur	Efrat Nativ-Ronen
Doron Shilo	Miri Barak	Liat Maoz	Oded Rabinovitch	Avi Ostfeld	Eitan Nave	Arnon Bentur	Oded Rabinovitch	Yehuda Pinchover	Liat Maoz
Hovav Gazit	Avinoam Kolodny	Doron Shilo	Hossam Haick	Arnon Bentur	Avinoam Kolodny	Oded Rabinovitch	Arnon Bentur	Liat Maoz	Avinoam Kolodny
Gabriel Poshumenski	Abigail Barzilai	Ayelet Fishman	Oren Cohen	Hovav Gazit	Hossam Haick	Yaakov Ben Haim	Tali Tal	Shachar Kvatinsky	Arnon Bentur
Esti Holtz-Meyron	Yachin Cohen	Arnon Bentur	Dan Givoli	Yaron Har-Shai	Abigail Barzilai	Ohad Nachtomy	Daniel Orenstein	Hossam Haick	Oded Rabinovitch
Jackie Schiller	Sima Yaron	Oded Rabinovitch	Havazelet Bianco-Peled	Marina Vaxman (Intel)	Naama Geva-Zatorsky	Esti Segal	Meirav Aharon	Oded Rabinovitch	Moshe Horowitz
	Tal Basfani	Shuli Schwartz	David Diskin	Hossam Haick	Oded Rabinovitch	Eran Friedler	Ohad Nachtomy	Yossi Steinberg	Gitti Frey
	Aviv Censor	Uri Tzabari		Oren Cohen		Adi Mayer-Wolf		Esti Segal	Adi Mayer-Wolf
	Dani Levin	Sima Yaron		Reuben Katz		Benny Kimelfeld		Zeev Gross	Nir Shilo
				Noah Mor		Hagai Peretz		Sarah Lev	Ido Roll
				Sheffer Meltzer (Rafael)		Amir Landesberg		Dan Givoli	Dganit Danino
				Shachar Kvatinsky		David Diskin			Jack Haddad
				Koby Rubinstein					Yohay Carmel
				Matan Raz					Noam Soker
				Shuli Schwartz					
				Shai Shen-Orr					

Note: The names of the heads of the groups are displayed in bold on the first row of the table.

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