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Science and Engineering Education as an Anchor in the Midst of a Changing World: The Case of Covid-19

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Abstract

The discourse on science and engineering education focuses on ways of preparing students, as future employees, and global citizens. While this discourse deals with the purposes and characteristics of engineering education, it tends to neglect the students' perspectives.

The purpose of this study was to provide insights into the perspectives of undergraduate science and engineering students with respect to six factors, during the Covid-19 pandemic: end-of-semester exams, financial situation, social life, extension of study duration, the future of the labor market, and how the world will look. A comprehensive questionnaire was distributed to all undergraduate students in a research science and engineering university in two consecutive academic years. Descriptive statistics and content analysis were applied.

Our findings show that science and engineering students were mostly concerned about their end-of-semester exams. Their social life was the only factor that changed between the two periods in terms of the percentage of students who were concerned with it. As for the other factors, the percentage of students who were concerned about them remained comparatively the same in both academic years. The findings highlight the confidence students had during the pandemic, and demonstrate the resilience of science and engineering, especially in times of volatility.

Keywords: higher education, engineering curriculum, undergraduate, student perception, COVID-19 pandemic, science and engineering undergraduate education

1. Introduction

The discourse on the future of higher education (HE), its purposes and characteristics, has a long history. "The Yale Report on the Course of Instruction", published in 1828, already dealt with the need to "accommodate the course of instruction to the rapid advance of the country, in population refinement, and opulence" (*Committee of the Corporation and the Academical Faculty, Reports on the Course of Instruction in Yale College*, 1828) . Over the past few decades, the world of HE has undergone significant transforming changes driven by forces such as globalization, knowledge-driven economy, labor market demands, and advanced information technologies that dramatically influence the different ways learning and research take place (Antony et al., 2017; Donnelly et al., 2013). Almost two centuries after The Yale Report was released, these and other challenges keep the discourse on the future and role of HE valid. A report by Selingo (Selingo, 2016), for example, focused on three main trends that shape HE in the USA : 1) changes in the student' profile as a result of demographic changes; 2) a flexible model of the role of faculty members; and 3) a change in learning processes including diverse HE models (e.g. online education and competency-based education). Several years earlier, Donnelly et al. (Donnelly et al., 2013) predicted an "avalanche" in HE and called to move from a traditional four-year program to a more flexible learning model that combines learning and working in a the business sector and industry. In addition, there is a growing movement that seeks an alternative to the traditional HE system, a kind of anti-college movement, that encourages young students to explore universal and philosophical questions, as opposed to focusing solely on practical skills (Worthen, 2019). We argue that although different HE disciplines may share similar challenges, it is important to investigate particular disciplines. Specifically, we suggest that in order to

understand a particular discipline, it is important to understand the perceptions of different stakeholders in that discipline. Thus, in this study we focused on the disciplines of science and engineering, and particularly investigated the students' perspective of their studies, as key stakeholders in HE (Graham, 2018; Köksal & Eğitman, 1998). To better understand the specific characteristics of science and engineering education, the study presented in this paper aims to present the perspective of science and engineering undergraduate students on factors that they are concerned with. The following research questions were derived from this research objective: 1) What were science and engineering students concerned with at the onset of the COVID-19 pandemic and one year later? 2) How do science and engineering students perceive the influence of the COVID-19 pandemic on their academic and professional development?

The main conclusions of this study are relevant to the future challenges of HE in general, and particularly for those of science and engineering HE, for the following reasons:

1) This study demonstrates that students' greatest concern remains their studies regardless of worldwide changes. Even during a global crisis that threatens to affect the course of their studies and future lives, they are most concerned with their exams, just as during routine periods. One explanation for this phenomenon is that science and engineering education provides students with great confidence regarding their future employment, especially in light of the COVID-19 pandemic which has demonstrated the importance of scientists and engineers in contributing to the challenges of the pandemic and to the post-pandemic era (Siegfried et al., 2020),

2) The change in the students' concern regarding their social life, from the second most concerning factor in the 2020-2021 academic year to the least concerning factor in the 2021-2022 academic year, may indicate that social interaction plays a highly significant role in the students' academic lives. In this sense, we argue that social interaction has also an academic role that can be associated with the fact that social interaction relates to collaborative learning and mutual support and feedback (García-Ros et al., 2018), and, accordingly, that the role of the physical campus should be revisited when teaching and learning return to campus (Hazzan, 2020).

1.1 Literature Review

1.1.1 Main Issues in the Future of Engineering Education

The Fourth Industrial Revolution and the global knowledge economy have further accelerated the discussions about the need to reshape engineering HE (Ochoa-Duarte & Pena-Reyes, 2020; Pillay et al., 2019). The working assumption is that while rigorous technical and scientific knowledge is essential in engineering education, it is not sufficient (Brito et al., 2019). Indeed, studies suggest that engineering programs should focus on 21st century skills such as interpersonal skills, creativity, discovering, system thinking, and critical metacognitive thinking (Bentur et al., 2019; Crawley et al., 2018). Other studies emphasize essential skills such as the ability to integrate knowledge across disciplines (Brito et al., 2019; Grasso & Martinelli, 2010). In reality, while engineering solutions are considered to be the answer to many of the world's problems and challenges (Saleh, 2009; Wetmore, 2018), universities worldwide are reevaluating their science and engineering programs to adapt them to the new landscapes of industry (e.g., Industry 4.0), technology (e.g., data science and IoT), and education (e.g., new for-profit and non-profit competitors that offer both full degrees and short-term programs).

One of the flagship documents that envisioned the needed changes in engineering HE is *The Global State of the Art in Engineering Education* (Graham, 2018). This report highlights three anticipated trends: 1) a shift in the leading engineering programs from high income countries to emerging economies in Asia; 2) a shift towards more society-oriented curricula that emphasize the students' choice and multidisciplinary learning that includes global experiences outside the traditional engineering class; and 3) a shift towards integrated student-centered curricula across courses and years of study. The second trend is highly relevant to our study, which focuses on students' perceptions, and it echoes Donnelly et al.'s (2013) call to adopt a flexible learning model that combines learning and working, by embedding work-based learning that is relevant to the global challenges facing society.

1.1.2 The Impact of the COVID-19 Pandemic on Higher Education

The COVID-19 pandemic, which broke out in March 2019, added a significant dimension to the challenges facing HE, namely the need to deal with continuous uncertainty (Regehr & McCahan, 2020). **T**he growing number of discussions and predictions about the implications of the pandemic for HE cover a variety of aspects: the societal role of universities (Al-Maadeed & Marques, 2020; Blankenberger & Williams, 2020); the role of the physical campus (Garvey, 2021; Zhang et al., 2021); pedagogical effects as a result of the rapid move to online learning (Adnan & Anwar, 2020; Kumar & Pande, 2021); adoption of innovative pedagogical approaches, e.g.,

HyFlex and BlendFlex learning (Miller et al., 2021); enrollment decline and student dropout (Lederman, 2021); internationalization in HE in general (Johnson, 2021; Li & Eryong, 2021; Obadire et al., 2020), the impact of the pandemic on student exchange programs and student mobility (Redden, 2020); the impact of the pandemic on HE in developing countries (El Said, 2021); and the influence of the pandemic on scientific research as the focus in many research labs around the world, as well as resource allocation, shifted to COVID-19-related topics (Basken, 2020).

In addition to the above mentioned topics, studies have focused on the influence of the pandemic on the personal affairs of students, for example persistence in their degree (Lederman, 2021), their stress (Husky et al., 2020; Nakhostin-Ansari et al., 2020), concerns and uncertainty about the future and the "new normal" post COVID-19 (Åhag et al., 2020; States et al., 2021), and exam-related issues (Asgari et al., 2021; Bashitialshaaer et al., 2021; Gradišek & Polak, 2021). Initial evidence shows that the pandemic has had direct implications on the stress, anxiety, and depression experienced by students (Garcá-Espinosa et al., 2021; Yadav et al., 2021). For example, research on depression and anxiety among university students in nine countries during the COVID-19 pandemic revealed that different depression and anxiety rates are associated with different national settings (Ochnik et al., 2021). Another important issue that relates to the impact of COVID-19 on students is the economic aspect. Although during the pandemic many students faced job loss or a reduction in working hours and, as a result, had to deal with financial burden (States et al., 2021), studies also mentioned the increase in job opportunities in the fields of engineering (Åhag et al., 2020). While these and other studies focused on students' experiences and needs, they did not emphasis the students' experiences and perspectives regarding the challenges facing HE. In this study, we aimed to explore the students' perspectives with respect to their studies and beyond their studies, and regarding challenges facing HE.

2. Method

2.1 Research Methodology

In this research we applied a mixed method that combines quantitative research methods and tools with qualitative research methods (Creswell et al., 2006). We used a quantitative method to describe the scope of reference to predefined factors, as an expression of student perceptions. We also used qualitative methods to deepen our understanding of students' perceptions by analyzing texts according to the predefined factors (Hsieh & Shannon, 2005).

2.2 Research Environment

The research took place during two consecutives winter semesters – the 2020-2021 Winter Semester (October 2020 – March 2021), and the 2021-2022 Winter semester (October 2021-March 2022) – at the Technion – Israel Institute of Technology. The Technion is a science and engineering research university in Israel. It is the major provider of scientists and engineers to the Israeli industry, and its graduates have played a significant role in the growth of Israeli technology (Senor & Singer, 2011). About ten thousand undergraduate students are enrolled in the Technion's science and engineering faculties. In addition, the Department of Humanities and Arts provides elective courses in social sciences and liberal arts.

2.3 Participants

The research participants were Technion undergraduate students in all four years of study (Table 1).

Table 1. Distribution of participants by year of study: Number and percentage of total students in each cohort

Academic year	Freshmen	Sophomores	Juniors	Seniors	Total
2020-2021	873	397	369	294	1933
	45%	21%	19%	15%	100%
2021-2022	339	274	254	174	1041
	33%	26%	24%	17%	100%

2.4 Data Collection Tools

Each year, during the fifth week of the winter semester, a comprehensive questionnaire, named "the 5th week survey", is sent to all Technion undergraduate students. The purpose of the questionnaire is to learn about the students' perspectives with regards to their studies and experiences at the Technion, and based on these perspectives, to take relevant actions. The questionnaire includes both closed and open questions about the students' experiences at the Technion, learning habits, and suggestions on how to improve their study and personal experiences at the Technion.

In the 2020-2021 academic year, a new set of questions related to the COVID-19 pandemic was added to the questionnaire. The purpose of these questions was to learn about concerns students had during this unusual time and to address those issues as part of the Technion's proactive approach to coping with the implications of the pandemic, in general, and with the need to transition to online learning, in particular.

The realization that the data collection that took place at the onset of the COVID-19 pandemic may affect students' conceptions of its impact, both locally and globally, guided us to include the same set of questions in the 5th week survey distributed in following academic year (2021/2022). This enabled us to validate students' perceptions as well as the consistency of our findings.

Specifically, in the 5th week survey of these two consecutive academic years, the students were asked to rank their concerns with respect to the following factors: 1) end-of-semester exams; 2) their financial situation; 3) their social life; 4) the extension of the study duration; 5) the future of the labor market; and 6) what will the world look like in the future. The students were asked to indicate whether they were (a) not concerned, (b) occasionally concerned, or (c) concerned about each of the six factors listed above.

2.5 Data Analysis

The data analysis is based on descriptive statistics and content analysis methods. Descriptive analysis was used to analyze demographic data and closed ended questions. Top-down content analysis (Hsieh & Shannon, 2005), based on the predefined factors, was used to analyze the open questions.

3. Results

In what follows, we discuss students' answers to the set of questions on their concern about the six factors listed above, in the 2020-2021 and 2021-2022 academic years. Figure 1a presents the six factors in the decreasing order of student concern, as expressed in the 2020-2021 survey, presented as the percentage of students who indicated they were "concerned". As can be seen, in the 2020-2021, the two highest and two lowest factors are related to the students' personal affairs, while the two middle factors are related to society as a whole.

Figure 1b presents the picture that emerged one year later (in the 2021-2022 academic year), a year and a half after the outbreak of the Covid-19 pandemic. As can be seen, while the most concerning factor in both years was "End-of-semester exams", the order of the other factors changed. In the 2021-2022 academic year, the two highest factors, after the "End-of-semester exams" factor, are related to the future of the world, and the lowest factor is the one that one year earlier was the second highest factor – social life. In other words, as soon as the campus reopened, social life, which was a concern one year earlier due to the pandemic, became the least concerning factor of all six. This observation will be further elaborated on in the continuation of the paper.

In what follows, we review the students' concerns about each of the six factors.

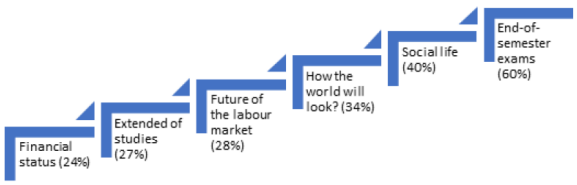

Figure 1a. Percentages of students concerned with respect each of the six factors – 2020-2021 academic year

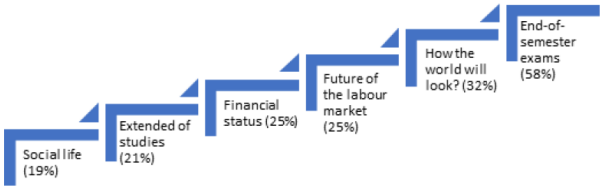

Figure 1b. Percentages of students concerned with each of the six factors – 2021-2022 academic year

3.1 End-of-semester Exams

The only factor that clearly concerned all students in both years was the "End-of-semester exams". The majority of students (60% and 58% in the 2020-2021 and 2021-2022 academic years, respectively) declared that they are concerned about the semester final exams (see Table 2a and 2b). This trend reflects the situation across all years of study and all faculties. Furthermore, we see that the same cohorts of students expressed almost the same levels of concern in the two consecutive years: freshmen who became sophomores, sophomores who became juniors, and juniors who became seniors.

Table 2a. Students' concerns regarding the end-of-semester exams (2020-2021 academic year)

	Freshmen	Sophomores	Juniors	Seniors	Total
Concerned	63%	60%	57%	51%	60%
Occasionally concerned	30%	27%	27%	30%	29%
Not concerned	7%	13%	16%	19%	11%
Total	100%	100%	100%	100%	100%

Table 2b. Students' concerns regarding end-of-semester exams (2021-2022 academic year)

	Freshmen	Sophomores	Juniors	Seniors	Total
Concerned	53%	64%	60%	57%	58%
Occasionally concerned	39%	29%	32%	33%	34%
Not concerned	8%	7%	8%	10%	8%
Total	100%	100%	100%	100%	100%

Freshmen in both academic years explained that their greatest concern was their preparedness for the exams:

> *"*I feel there is a lot of pressure and a lot of things to do……The stress is from not being prepared for the exams because my studying during the semester was not at its best. (Freshman, Industrial and Management Engineering, female, 2020-2021 academic year)
>
> "If you think ahead about the exam period and the fact that the material will become more difficult, then it is stressful and frustrating to feel not proficient and to not 100% understand the learning material." (Freshman, Civil and Environmental Engineering, male, 2020-2021 academic year)
>
> "The Technion is a competitive and stressful place. As a student in her first semester, the feeling is always that "the worst is yet to come" and that many of the friends around you are also stressed. There is a load (as expected), and we need to handle it. The exams are stressful, the level they will require, and the consequences of not passing them adequately." (Freshman, Biotechnology and Food Engineering, female, 2021-2022 academic year)

One explanation of why students were mostly concerned with the end-of-semester exams is the level of stress they felt during their studies. Sixty eight percent (68%) of the students in the 2020-2021 academic year and 64% in the 2021-2022 academic year defined their stress level as being above 7 on a 1-10 scale. The students attributed their stress to the high academic level, the heavy homework load, the large amount of learning materials, as well as the fast pace of teaching and online classes:

> "Assignment load and things to submit. There is no time to deepen the understanding of the material." (Freshman, Electrical and Computer Engineering, female, 2020-2021 academic year)
>
> "There is an endless amount of material..." (Freshman, Computer Science, male, 2020-2021 academic year)
>
> "I feel that I don't have enough time to "digest" the learning material during class time because of the fast teaching pace…" (Freshman, Industrial and Management Engineering, female, 2020-2021 academic year)
>
> "The level is high, and you must stay in the learning cycle. You have to attend the lectures, the tutorials, do homework and practice more on your own. That's why the Technion is challenging." (Freshman, Mechanical Engineering, male, 2021-2022 academic year)

The fact that the students' greatest concern was the end-of-semester exams, regardless of the COVID-19 pandemic, as seen in both academic years, may also be related to the development of stress in rigorous engineering education (Jensen & Cross, 2018; Jensen & Cross, 2021).

3.2 Social Life

The second most concerning factor in the 2020-2021 academic year was social life (see Table 3a), with which 40% of the students were concerned. Students' concern about their social life can be explained by the fact that the pandemic constraints in the 2020-2021 academic year led not only to the closure of the campus and to a transition to online learning, but also to the closure of the public learning spaces located in most of the Technion's faculty buildings. Indeed, public learning spaces play an important role in the social interaction of students. For example, 38% of the students reported that they used to study in the learning spaces 3-4 times a week and 28% said that they used to study in the learning spaces once or twice a week. Indeed, closing of the

learning spaces was mentioned as one of the main consequences of the pandemic:

> "Cool space. Too bad that during the Corona there is nothing like it" (Junior, Mechanical Engineering, female, 2020-2021 academic year)

> "I study mainly in the "Tesla" learning space, which is a more collaborative space. Its main disadvantage is that the learning space is a bit noisy, but the benefits of getting help from friends and collaborative learning with friends, overcome the disadvantage" (Junior, Electrical and Computer Engineering, male/female, 2021-2022 academic year)

> The students referred to the learning spaces as places to make new friends. When asked where they meet new friends, freshmen referred to social contact in classrooms, on the campus in general, in learning spaces, and during social activities:

> "Roommates in dormitories, orientation day, learning spaces, lectures, and parties on campus". (Freshman, Mechanical Engineering, male, 2021-2022 academic year).

> "On orientation day, during the first days at a faculty event, and in classes" (Freshman, Biotechnology and Food Engineering, female, 2021-2022 academic year).

Furthermore, students explained the advantages and contribution of the learning spaces not only to their social life, but also to their learning:

> "Distance learning leads to isolation of the student from the faculty, it [distance learning] lacks the support one can get from other students and the use of the facilities that the faculty offers" (Freshman, Architecture and Town Planning, male, 2020-2021 academic year)

> "It is very nice there, it is fun to work in groups, there is a lot of mutual assistance" (Junior, Bio-Medicine Engineering, female, 2020-2021 academic year)

> "There is a good learning atmosphere, and it is also an important social area…" (Junior, Computer Science, male, 2020-2021 academic year)

> However, one year after the outbreak of the pandemic, during the 2021-2022 academic year, the campus reopened, and the concern students exhibited regarding their social life changed completely: Social life now became the factor that least concerned the students. Nineteen percent (19%) of the students in the 2021-2022 academic year were concerned about their social life, compared with 40% in the previous academic year (see Table 3b).

Table 3a. Students' concerns regarding social life (2020-2021 academic year)

	Freshmen	Sophomores	Juniors	Seniors	Total
Concerned	41%	44%	38%	36%	40%
Occasionally concerned	39%	36%	39%	39%	39%
Not concerned	20%	20%	23%	25%	21%
Total	100%	100%	100%	100%	100%

Table 3b. Students' concerns regarding social life (2021-2022 academic year)

	Freshmen	Sophomores	Juniors	Seniors	Total
Concerned	14%	24%	20%	19%	19%
Occasionally concerned	39%	40%	40%	39%	39%
Not concerned	47%	36%	40%	42%	42%
Total	100%	100%	100%	100%	100%

While the COVID-19 pandemic proved the importance of online learning in times of crisis (Dhawan, 2020), the findings on the factor of social life in general, and with reference to the unique learning spaces in particular, reflect the important role of the physical campus in students' lives (Garvey, 2021; Zhang et al., 2021).

3.3 How will the World Look?

While the two factors discussed above, "end-of-semester exams" and "social life", are related directly to the students' studies, the third most concerning factor in the 2020-2021 academic year – "How the world will look" – refers to an issue that is beyond the students' studies. In the 2021-2022 academic year, this factor was the second most concerning factor, yet in both academic years, the percentage of concerned students remained

32%-34%. The following quotes, in which students describe the role of scientists and engineers as a driving force for global social and economy development, may explain the students' relatively low concern level:

> "[The role of scientists and engineers is] finding solutions to exciting problems" (Junior, Bio-Medical Engineering, male, 2021-2022 academic year)
>
> "[Scientists and engineers] lead the world's progress through an understanding of the universe and the development of society" (Senior, Computer Science, male, 2021-2022 academic year)
>
> "[The role of scientists and engineers is) to build a better world" (Senior, Electrical & Computer Engineering, male, 2021-2022 academic year)
>
> "[The role of scientists and engineers is) to build the future" (Junior, Aerospace Engineering, female, 2021-2022 academic year)

In addition to the above, the next factor we discuss, "the future of the labor market", may also explain why the students are not concerned by the future of the world at large.

Table 4a. Students' concerns about how the world will look in the future (2020-2021 academic year)

	Freshmen	Sophomores	Juniors	Seniors	Total
Concerned	31%	35%	40%	37%	34%
Occasionally concerned	38%	41%	39%	38%	39%
Not concerned	31%	24%	21%	25%	27%
Total	100%	100%	100%	100%	100%

Table 4b. Students' concerns about how the world will look in the future (2021-2022 academic year)

	Freshmen	Sophomores	Juniors	Seniors	Total
Concerned	31%	31%	34%	33%	32%
Occasionally concerned	37%	44%	35%	39%	39%
Not concerned	32%	25%	31%	28%	29%
Total	100%	100%	100%	100%	100%

3.4 Future of the Labor Market

Another factor that relates to issues beyond the students' studies is "the future of the labor market". We found, to our surprise, that the students were less concerned about "the future of the labor market" than they were about the factor "how the world will look" (See Table 5a and 5b).

Table 5a. Students' concerns regarding the future of the labor market (2020-2021 academic year)

	Freshmen	Sophomores	Juniors	Seniors	Total
Concerned	18%	31%	41%	40%	28%
Occasionally concerned	32%	34%	27%	28%	31%
Not concerned	50%	35%	32%	32%	41%
Total	100%	100%	100%	100%	100%

Table 5b. Students' concerns regarding the future of the labor market (2021-2022 academic year)

	Freshmen	Sophomore	Junior	Seniors	Total
Concerned	12%	27%	32%	37%	25%
Occasionally concerned	36%	40%	38%	36%	38%
Not concerned	52%	33%	30%	27%	37%
Total	100%	100%	100%	100%	100%

While the majority of the students were not concerned by this factor per se, when they were asked to suggest additional topics they would like to study as part of their degree, they mentioned two main topics that are connected to their future employment: the world of employment and industry, and humanities and social sciences, which they felt may be useful for them in their future employment, as the following quotes illustrate.

a) Content related to the world of employment and industry:

> "More practical content that is relevant to the employment world, more lecturers from the outside [from the industry], or lecturers from the inside [from the university] who have real experience with programing

languages and working experience" (Senior, Industrial and Management Engineering, female, 2020-2021 academic year)

"Study programs in cooperation with the industry, dealing with cutting-edge technologies that are used and developed today." (Senior, Industrial and Management Engineering, female, 2020-2021 academic year)

"Content that is more related to the real world. To best of my knowledge there is a significant gap between the studies in academia and the industry" (Sophomore, Computer Science, male, 2021-2022 academic year)

"More substantial preparation for the "daily life" of those who will engage in engineering work…as well as exposing us to the variety of occupations and roles in the industry" (Junior, Electrical and Computer Engineering, male, 2021-2022 academic year)

b) Subjects related to the field of humanities and social sciences:

"Not academic content, but humanities-related professions (the current variety is not enough). Equality, human rights" (Junior, Computer Science, female, 2020-2021 academic year)

"Sociology studies in the context of transportation engineering" (Junior, Civil and Environmental Engineering, male, 2020-2021 academic year)

"The ethical impacts of engineers' work" (Freshman, Electrical and Computer Engineering, male, 2021-2022 academic year)

It is evident from these quotes that the students are oriented towards future employment, not only in the context of engineering profession aspects, but also in a wider context that refers to subjects related to the humanities and social sciences. The orientation of students to future employment corresponds with their responses to the question "Suppose you are asked to explain in one sentence why it is worth studying at the Technion. What sentence would you choose?".

Many of the answers given were related to employment advantages:

"It is easier to find a job." (Freshman, Computer Science, female, 2020-2021 academic year)

"It is more valued later on, in the labor market." (Junior, Electrical and Computer Engineering, female, 2020-2021 academic year)

"The Technion provides a body of knowledge and excellent practice for any possible situation that may occur in the industry" (Junior, Electrical and Computer Engineering, female, 2020-2021 academic year).

"Lots of options in the employment market" (Freshman, Chemical Engineering, female, 2021-2022 academic year)

The orientation of students toward the employment world is also expressed by the fact that a large proportion of students work, from as early as their sophomore year, up to 20 weekly hours in high-tech companies in jobs that are related to their field of study (Hazzan & Levontin, 2018). The students' orientation towards future employment may be unique to science and engineering fields, as demonstrated during the COVID-19 pandemic by the resilience of these fields in the global workplace (*Coursera Skills Reports | Top Trending Skills in 2021*, n.d.). Moreover, according to the literature, students indicated that the COVID-19 pandemic enhanced employment opportunities in the field of science and engineering (Åhag et al., 2020).

3.5 Extension of the Study Duration

The students, it seems, were not overly concerned about the extension of the duration of their studies in the 2020-2021 academic year, as seen in Table 6a, and were even less concerned about this factor in the academic year of 2021-2022, as seen in Table 6b. Similar to many universities around the world, the Technion rapidly switched to online learning (Adnan & Anwar, 2020; Kumar & Pande, 2021) in the 2020-2021 academic year and to hybrid learning in the 2021-2022 academic year. In addition, the final exams took place as scheduled before the COVID-19 pandemic, so students had no reason to be concerned about the duration of their studies.

Table 6a. Students' concerns regarding the extension of the study duration (2020-2021 academic year)

	Freshmen	Sophomores	Juniors	Seniors	Total
Concerned	24%	28%	27%	33%	27%
Occasionally concerned	30%	30%	27%	20%	28%
Not concerned	46%	42%	46%	47%	45%
Total	100%	100%	100%	100%	100%

Table 6b. Students' concerns regarding the extension of the study duration (2021-2022 academic year)

	Freshmen	Sophomores	Juniors	Seniors	Total
Concerned	15%	21%	25%	29%	21%
Occasionally concerned	33%	35%	35%	30%	34%
Not concerned	52%	44%	40%	41%	45%
Total	100%	100%	100%	100%	100%

3.6 Financial Situation

The factor students were the least concerned about in the 2020-2021 academic year is their financial situation (See Table 7a). While in the 2021-2022 academic year, this was the fourth most concerning factor, the actual level of concern remained similar (except among the freshmen who became sophomores), as reflected by the percentages of the different levels of concern (See Table 7b).

Table 7a. Students' concerns regarding their financial situation (2020-2021 academic year)

	Freshmen	Sophomores	Juniors	Seniors	Total
Concerned	19%	28%	28%	30%	24%
Occasionally concerned	28%	33%	32%	24%	29%
Not concerned	53%	39%	40%	46%	47%
Total	100%	100%	100%	100%	100%

Table 7b. Students' concerns regarding their financial situation (2021-2022 academic year)

	Freshmen	Sophomores	Juniors	Seniors	Total
Concerned	18%	28%	29%	28%	25%
Occasionally concerned	35%	32%	35%	34%	34%
Not concerned	47%	40%	36%	38%	41%
Total	100%	100%	100%	100%	100%

As mentioned above, in many undergraduate students in Israel work in parallel to their studies (see Table 8a and Table 8b). Since work at high-tech companies continued during the pandemic, the effect of the pandemic on the economic status of the students who work in parallel to their studies was minor.

The norm according to which students combine work and studyies, which is commonly exhibited in Israel in general, and in science and engineering HE in particular, is not unique to the COVID-19 period.

Table 8a. Percentage of research participants who work (2020-2021 academic year)

Freshmen	Sophomores	Juniors	Seniors
11%	24%	42%	60%

Table 8b. Percentage of research participants who work (2021-2022 academic year)

Freshmen	Sophomores	Juniors	Seniors
11%	24%	42%	60%

4. Discussion

This paper presents findings from a survey that was distributed to Technion undergraduates in the 5th week of the winter semester of two consecutive academic years - 2020-2021 and 2021-2022. We present findings from two surveys: the first was distributed at onset of the COVID-19 pandemic, and the second, one year later. While the course of studies continued by switching to online hybrid learning in the 2020-2021 academic year, we were interested in learning about the influence of the pandemic on the perceptions of the Technion undergraduate students about their studies and the future of the world. Accordingly, the answer to our first research question, what are science and engineering undergraduate students concerned with during the COVID-19 pandemic?, is that in times of a global pandemic, science and engineering students are still concerned mostly with factors that are directly related to their studies and that affect them on the individual level (i.e., end-of-semester exams and their social life). Once the threat of the pandemic on their personal life diminished due to the return to routine campus life, the students' main concern was with a factor related directly to their studies, namely

end-of-semester exams.

One of the main insights of the current study is that the return to hybrid studies, combining studies in the physical campus with online learning, provided a secure infrastructure (Garvey, 2021; Zhang et al., 2021), that enabled the students to focus their concern mainly on their studies in general, and on their exams in particular.

We also highlighted the unique context of Israeli science and engineering students, who often combine study and work (Hazzan & Levontin, 2018). Unlike the literature, which describes students' job loss and, as a consequence, an increased financial burden (Hawley et al., 2021), the pandemic had little influence on the Israeli students' employment situation. As our data indicates, the students were not concerned about their future employment in general, and specifically they were not worried about the future of the labor market and their economic status. Therefore, the answer to our second research question ("From the perspective of science and engineering undergraduate students, how will the COVID-19 pandemic influence their academic and professional development?), is, therefore, that according to the students' perceptions, the COVID-19 pandemic had little effect on their academic and professional development.

To conclude, in this paper, we presented an analysis of the factors that concern undergraduate students at a science and engineering research university. The findings highlight the unique status of science and engineering students regarding two main aspects:

1. Their status as students – The period of being a student is bounded by time and certain criteria of entrance and exit this status and it is considered as transitory phase towards employability in one's field of studies (Field & Morgan-Klein, 2010). Our findings reveal, however, that the case of Israeli science and engineering students is different. The student status is not characterized by clear cut boundaries between the phase of being a student and that of being an employee. Israeli science and engineering students have strong employability orientations and the transition to employability very often happens during and in parallel to their undergraduate studies.
2. The resilience of science and engineering students - The status of science and engineering students as described above is also characterized by its strength. Our findings indicate that, from the perspective of science and engineering students, they were not affected by the extremely unusual times of the COVID-19 pandemic.

Following the understanding that the status of Israeli science and engineering students is apparently unique, we argue that the disciplines of science and engineering give undergraduate students confidence in their future as professionals and they are, therefore, resilient also in extreme times. Thus, we suggest that the discourse on the future of higher education should rely on the strong foundation of these disciplines as exhibited by the students' perceptions, with science and engineering education acting as an anchor in their professional life, both as undergraduate students and as practitioners after graduation in science and engineering professions.

5. Limitations

This study has several limitations. The first is the duration of the study, which may not represent the long-term effect of unexpected circumstances such as the COVID-19 global pandemic, for which a longitudinal study may provide more solid insights. A second limitation stems from the need to explore the research problem as close in time as possible to the occurrence of the COVID-19 pandemic. As a result, we did not have sufficient time to deepen our insights by using interviews to better understand the students' perceptions.

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