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Examination of factors predicting secondary students' interest in tertiary STEM education

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ABSTRACT

Based on the Social Cognitive Career Theory (SCCT), the study aims to investigate factors that predict students' interest in pursuing science, technology, engineering, and mathematics (STEM) fields in tertiary education both in general and in relation to their gender and socio-economic background. The results of the analysis of survey responses of 2458 secondary public school students in the fifth-largest Israeli city indicate that STEM learning experience positively associates with students' interest in pursuing STEM fields in tertiary education as opposed to non-STEM fields. Moreover, studying advanced science courses at the secondary school level decreases (but does not eliminate) the gender gap and eliminates the effect of family background on students' interest in pursuing STEM fields in the future. Findings regarding outcome expectations and self-efficacy beliefs only partially support the SCCT model. Outcome expectations and self-efficacy beliefs positively correlate with students' entering tertiary education but did not differentiate between their interests in the fields of study.

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The Social Cognitive Career Theory; STEM education; gender gap; socio-economic gap; advanced secondary science studies; interest in STEM fields in tertiary education

1. Introduction

Over the last century the world has witnessed rapid scientific and technological growth coupled with unprecedented environmental challenges. In order to prosper in a sustainable way, the economies of developed countries require not only a scientifically literate population (OECD, 2013), but also a workforce of science, technology, engineering, and mathematics (STEM) professionals. This underscores the importance of engaging previously underrepresented segments of the population in STEM fields. Since STEM-related careers often offer higher financial payoffs, this will open doors to economic upward mobility and financial independence (Riegle-Crumb, King, Grodsky, & Muller, 2012).

Yet, recent empirical research findings indicate the lack of gender and socio-economic equality in STEM fields (Milner-Bolotin, 2014; Blickenstaff, 2005; Ivie & Tesfaye, 2012; OECD, 2006; Smith, 2011; Statistics Canada, 2006). It is expressed by the underrepresentation of women and students from the low socio-economic family backgrounds both in

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secondary science and tertiary STEM courses, as well as in STEM-related careers (OECD, 2006). Ignoring the underrepresentation of these groups in STEM fields, at the secondary and tertiary levels, has dire economic consequences for developed countries (Let's Talk Science, 2013). Moreover, failing to address this problem perpetuates gender and social inequality and social injustice (Fox, Sonnert, & Nikiforova, 2011).

This study is guided by the Social Cognitive Career Theory (SCCT) (Lent, Brown, & Hackett, 1996). The study aims to investigate factors that predict students' interest in pursuing STEM fields in tertiary education both in general and in relation to their gender and socio-economic background. Our focus on students' interest in pursuing STEM fields is based on ample research evidence that interest is an important factor in career goals and choice (Brown & Lent, 1996; Lent et al., 1996; Lent, Lopez, Lopez, & Sheu, 2008). In the current study, we used a widely accepted definition of *interest* as 'an attitude or feeling that a certain object or event makes a difference or is of concern to oneself; a striving to be fully aware of the character of an object' (English & English, 1958).

In the next section we present the literature review. It is followed by the brief overview of the Israeli educational system with the focus on STEM education. Then we describe the methodology of the study, data collection, and analysis. The paper proceeds with the summary and discussion of the relevant results and concludes with the discussion of the educational implications of these findings.

2. Literature review and theoretical framework

2.1. SCCT and students' interest in STEM fields

SCCT proposed by Lent, Brown, and Hackett more than two decades ago (1994) has its roots in Bandura's general Social Cognitive Theory (Bandura, 1986). SCCT emphasizes the interrelationship among individual, environmental, and behavioral variables that can predict one's interest and choice of career (Lent et al., 1996; Lent & Brown, 2006). SCCT relies on key factors such as self-efficacy (beliefs in one's ability to successfully perform particular behaviors), outcome expectations, interests, environmental supports and barriers, as well as choice actions (Brown & Lent, 1996; Lent, Brown, & Hackett, 2002; Lent, Sheu, Gloster, & Wilkins, 2010). According to SCCT's model of interest and choice, self-efficacy promotes favorable outcome expectations (beliefs about the successful consequences of given actions). Students tend to develop interests in academic subjects at which they possess strong self-efficacy and consequently positive outcome expectations. The model also takes into consideration the input variables (gender, race, socio-economic background) and learning experience (Lent et al., 2002).

SCCT offers an appropriate theoretical view to study the issue of interest in and choice of STEM careers and has been applied in a number of STEM-related studies (Byars-Winston, Estrada, Howard, Davis, & Zalapa, 2010; Lent et al., 2008; Wang, 2013). Scholars who applied SCCT theory for predicting students' interest in STEM education and students' choice of STEM careers also included objective factors in their models such as exposure to STEM disciplines in secondary schools, as well as students' STEM educational achievements (Trusty, 2002; Wang, 2013).

Our research utilizes SCCT in order to explore meaningful factors that predict Israeli students' interest in pursuing STEM fields in tertiary education in general and among gender and socio-economic groups.

2.2. Main factors predicting interest in STEM according to SCCT

Below we present the main variables according to SCCT which will be examined in our research model.

2.2.1. Input variables

Gender. There is ample research evidence that boys are more likely to express interest in STEM fields, while girls tend to be more interested in pursuing arts, education and language-related fields (Iskander, Gore, Furse, & Bergerson, 2013; Modi, Schoenberg, & Salmond, 2012; Su, Rounds, & Armstrong, 2009). This gender gap is most pronounced in engineering (Modi et al., 2012). Researchers believe that gender stereotypes can lower girls' aspirations for STEM careers (Bradley, 2000; Graves, 2014; Iskander et al., 2013). Moreover, girls' enrollment in STEM fields in secondary schools does not necessarily translate into their choosing one of these fields as a career path (Ayalon, 2006; Modi et al., 2012). Given competing opportunities and interests, even when the girls' interest in STEM is high, few of them consider STEM careers as their preferred career choice (Modi et al., 2012). It is also worth mentioning that women's reasons for choosing specific careers are often different from the reasons affecting men's career choices. Some researchers suggest that women are often influenced by different values that affect their career choice, such as they, place less emphasis on potential career earnings and more importance on jobs that allow them to nurture others (Zafar, 2013).

Family background. Students of the low socio-economic background which reflected in lower parental education and family income tend to express lower interest in STEM fields than the students from high socio-economic background. However, there is research evidence that suggests that controlling for the students' educational achievements decreases the socio-economic gap in students' interest to pursue STEM fields in tertiary education (Legewie & DiPrete, 2014).

However, according to Coleman (1988), students' decision to enroll in secondary STEM courses or to choose STEM majors at tertiary institutions are not only governed by expected economic returns, but also by the cultural norms and expectations. Brand and Xie (2010) contend that the extent to which rational considerations and sociological perspectives influence enrollment decisions depends on student's economic background. In their theory of negative selection, Brand and Xie (2010) argued that economically disadvantaged students who were among the least likely to enroll in college stand to gain the most from college graduation and therefore are more inclined to weigh the economic benefits of such decisions. On the other hand, students from economically advantaged families are more apt to make such decisions based on cultural norms and expectations. Assuming pursuing intended major is related to student's decision to enroll at tertiary institution, majoring in a STEM field for low income students is arguably more intentionally linked to economic justifications than it is for high-income students (Beattie, 2002). According to George-Jackson and

Lichtenberger (2012), it is reasonable and viable to apply the SCCT to investigate college students' aspirations. They found that economically disadvantaged students generally had more confidence in their STEM majors than their high-income counterparts (George-Jackson & Lichtenberger, 2012; Lichtenberger & George-Jackson, 2013).

2.2.2. Learning experience

Exposure to STEM during education in secondary school. Students who enroll into STEM programs in secondary schools are more interested in pursuing STEM at tertiary level (Sahin, Oren, Willson, Hubert, & Capraro, 2015; Tsui, 2007). Moreover, Wang (2013) found that the effect of students' exposure to mathematics and science courses is even stronger than that of mathematics achievement, which was once deemed the single best predictor of students' future entrance into STEM fields. Scholars also emphasize that after-school STEM program activities have become a means for students to better understand scientific concepts, processes, and procedures (McGee-Brown, Martin, Monsaas, & Stombler, 2003). Scholars report that engaging students with the extra-curricular activities in early years of their secondary education cultivates their STEM interest, thus encouraging them to consider STEM fields as a profession (Maltese & Tai, 2010; Tindall & Hamil, 2004). Therefore students with positive experiences in their early grades with science and the STEM subjects both at school or after-school are more likely to choose a STEM-related careers (Sahin, Ayar, & Adiguzel, 2014). Moreover, the results from this STEM engagement are especially important for girls, who even more than boys show positive changes in both perception of abilities and career interests (Prives, 2012; Weinberg, Pettibone, Thomas, Stephen, & Stein, 2007). The scholars also found positive correlation between the mathematics achievements in secondary school and interest in STEM in tertiary education (Wang, 2013).

2.2.3. Self-efficacy

Self-efficacy is described by Lent, Brown, and Larkin (1986) as beliefs about one's own personal capabilities. Many studies suggest that self-efficacy plays a pivotal role in informing career considerations, decisions, implementation (Betz, Borgen, & Harmon, 2006; Lent et al., 1996; Su et al., 2009) interests, goals, persistence, and performance (Bandura, 1986, 2002; Fouad & Smith, 1996; Lent et al., 1986).

2.2.4. Social support

Scholars report that support from friends and family, academic environment, including mentoring relationships, residential environments, related to more positive outcome expectations in the STEM field, serves as a protective factor in academically challenging environments and may serve as an important socializing agent in determining the choice of the field of study (Fisher & Stafford, 1999; Garmezy, 1991; Taylor & Lobel, 1989).

2.2.5. Outcome expectations

Positive future expectancies motivate individuals to look past proximate situations, particularly challenging ones, so that they can maintain focus on the attainment of long-term goals and desires. In other words, an outcome expectancy is a person's estimate that a certain behavior will produce a resulting outcome as a function of performing a behavior. For example, expecting to earn a graduate degree is positively associated with the choice of STEM tertiary enrollment (Wang, 2013).

2.3. Science courses in Israeli secondary schools

In Israel, the secondary school public education system is supervised by the Israeli Ministry of Education and the Educational Division of the relevant municipality. The municipality's Educational Division is akin to a North American School Board. In addition to the municipality's financial support of secondary schools, it has limited influence (through employment) on the school's pedagogical staff. For example, a principal of the secondary school is chosen both by the committee of the Ministry of Education and by the Educational Division of the municipality. Therefore, municipalities in Israel, similarly to School Boards in many western countries, have influence on the educational processes in public secondary schools and may enable a certain level of flexibility in the secondary curriculum.

The Israeli secondary school curriculum (grades 7–12) comprises required and elective courses that can be studied at different difficulty levels, expressed by the number of units of study ranging from 3 to 5 units (Ayalon & Yogev, 1997). For example, the lowest level (3 units of study) of mathematics is compulsory, while the higher levels (4 or 5 units) are optional. The higher levels of study are comparable to the Advanced Placement (AP) courses offered in North America. Sciences (such as biology, physics, chemistry, or computer science) are optional in Israeli secondary schools and are usually offered at the 5-unit level (Ayalon, 2003). These courses are considered difficult and demanding, and most schools are selective in enrolling students into these advanced courses. The advanced mathematics and sciences courses are more often taken by more capable students and by the students belonging to privileged social groups (Ayalon & Yogev, 1997).

In addition, tertiary institutions in Israel contribute significantly to the high status of mathematics by their policy of university admissions bonuses. Students are accepted to universities and colleges on the basis of a combination of their grades in the secondary school matriculation diploma and their score on the National Psychometric Test (akin to the SAT in the US). In calculating the applicant's combined score, universities add bonuses for each subject taken at an advanced level. Mathematics (like English) brings higher bonuses, as compared to other subjects (e.g. social studies). Therefore, the special status of mathematics at advanced level makes it relevant and useful for all students who wish to enroll in tertiary education. Consequently, a significant proportion of Israeli students take advanced mathematics courses.[1]

In order to shed light on the secondary public school students' interest in pursuing STEM fields at the tertiary level in Israel in the Jewish sector, we focused on the Israeli Jewish city of Ashdod in which the local municipality placed its priority on increasing secondary school student engagement in advanced science courses.

2.4. The case of Ashdod

Ashdod is the fifth-largest city in Israel. According to the Israel Central Bureau of Statistics, in 2013, Ashdod had a population of 240,400 and was an average Israeli city in the Jewish sector in terms of the socio-economic level of its population (Socio-Economic Cluster 5 on the scale from 1 to 10) (CBS, 2014).

In most Israeli public secondary schools, science courses are offered from grade 10. Only in very selective schools with a very low acceptance rate, these courses are offered from grade 7. At the beginning of this century, the Municipality of Ashdod decided to enhance the educational opportunities among its secondary students with respect to their prospects in the tertiary education and further employment. To achieve this goal, the students in Ashdod were encouraged to begin studying science fields, such as physics, from grade 7. As a result, an increasing number of schools have begun to join this project, and from 2004 each of 11 public schools in Ashdod began offering science courses from grade 7.

In 2011–2012 school year the Israeli Ministry of Education started to implement the new secondary curriculum program that focused on teaching science courses from grade 7. In 2012–2013 school year about 200 secondary schools (from about 1100 secondary schools in Israel) have joined this program. It should be noted that despite Ashdod's average socio-economic level, Ashdod was a pioneer in this initiative in Israel and in 2013 it was leading the country in the percent of public school students who begin studying sciences at advanced level in grade 7 ().

In the following section we describe the research goals for the current study.

3. Research questions

On the basis of the literature review and the unique context of Ashdod in the current study, the following research questions were formulated:

- What are the factors that predict secondary students' interest in pursuing STEM fields in tertiary education?
- Do the effects of these factors differ between the two genders?

To answer these questions we implemented the following research design and methodology. They will be discussed below.

4. Methodology

4.1. Data

For the analyses we used the survey data from the project 'Investigation of the Attitudes towards Higher Education among Grade 11–12 Students in Ashdod'. The project aimed at examining the barriers to tertiary education access among the Israeli secondary students. The first author of this paper was a principal investigator of the project. The data were collected in November–January (2012–2013) under the auspices of the Research Education Division of the Municipality of Ashdod. The study sample consisted of grade 11 and 12 students enrolled in 11 public schools in the city. The final sample included 2458 grade 11 and 12 students comprising 68% of the entire grade 11 and 12 students population in public schools in the city.

4.2. Procedure

In order to construct a research instrument for the project, we conducted 15 in-depth interviews: 11 of them involved academic councillors in public schools (a special position in Ashdod public schools funded by the city Municipality) whose goal is to support and encourage students in pursuing tertiary education; and 4 interviews involved the Secondary Education Division managers in the Municipality. The goals of these interviews were to ensure that the questionnaire addressed all of the important aspects relevant to the educational decision making by the Municipality, such as students' perceptions and attitudes toward tertiary education, the main barriers to pursuing higher education and ways to encourage students to continue their studies. On the basis of these interviews the draft version of the questionnaire was created which was later validated in the pilot study. The final version of the questionnaire for this project was generated using Qualtrics Research Suite (Qualtrics, 2014) and was administered online.

After the students were informed about the study and the consent was obtained, they were provided with a limited-time access to the survey link with a unique school and grade access code. In order to maintain the anonymity promised to the students, the database did not include their identifying information. As a result, 68% of Ashdod secondary public school students completed the questionnaire.

4.3. Questionnaire

The entire research questionnaire contained 68 items (see the entire Questionnaire translated into English in the Appendix). It included 25 items pertaining to student's attitudes towards and intentions about tertiary education; 19 items focused on student's academic achievement in general as well as in advanced science courses; 13 items collected information on student's enrollment in extra-curricular activities, such as private lessons, extra-curricular academic courses; and 10 items measured the socio-economic background variables. In the following section we discuss the study variables.

4.4. Variables

4.4.1. Dependent variable

Our dependent variable is the *student's interest in pursuing STEM fields in tertiary education* was measured by the following two items: (1) Are you interested to study in an academic institution? and (2) Disregarding your current educational achievements at school and your grade in the Psychometric exam (if you have taken it already), what is the field of study that you are interested to pursue in tertiary education? The fields, such as mathematics, computer, physical or biological sciences, statistics, agriculture, engineering, architecture, and medicine, were defined as STEM fields. On the basis of these two questions, the following three categories were constructed: 1—you are not interested to study at an academic institution; 2—you are interested to study a non-STEM field at an academic institution; 3—you are interested to study a STEM field at an academic institution. The third category was used as a comparison group. It is worth mentioning that by academic institution we meant a tertiary institution such as a university, a college, etc.

4.4.2. Independent variables

Input variables

Gender: A dichotomous variable coded 0 for boys and 1 for girls.

Mother's educational level was measured by the following question: What is your mother's educational level? 1—less than secondary, 2—secondary, 3—post-secondary, non-academic, 4—B.A., M.A. and Ph.D. Each of these variables was transformed into two dichotomous variables: post-secondary (non-academic) and academic (B.A., M.A. and Ph.D.) education. Those students who had mother with less than secondary and secondary education were the comparison group.

Father's educational level was measured by the following question: What is your father's educational level? 1—less than secondary, 2—secondary, 3—post-secondary, non-academic, 4—B.A., M.A. and Ph.D. Each of these variables was transformed into two dichotomous variables: post-secondary (non-academic) and academic (B.A, M.A. and Ph.D.) education. Those students who had father with less than secondary and secondary education were the comparison group.

The student's perception of the family economic background variable was defined by the following question: How do you estimate your family economic status: (1) low, (2) average-low, (3) average, (4) average-high, (5) high.

Learning experience Math grade was measured by the following two items: At what level do you study mathematics? (3 units is minimum, 4 units is the middle level, 5 units is maximum – AP level) and what is the last mark that you earned in math? ((1) below 59, (2) 60–69, (3) 70–79, (4) 80–89, (5) 90–100). The last variable was transformed into a continuous variable using the midpoint of each group and then we computed the math grade variable using the calculation of the Israeli Ministry of Education which integrates between unit and grade.

Enrollment in advanced secondary science courses was measured by the following questionnaire items: Do you study the following subjects at an advanced level (5 units): biology, chemistry, physics and computer sciences? The students who reported as studying at least one of these subjects at an advanced level were coded 1, the others were coded 0. Since in Israel studying mathematics at an advanced level indicates the student's achievement level rather than the STEM-related track (Ayalon, 2006), studying mathematics at an advanced level was not included as one of the advanced secondary STEM courses.

Extra-curricular activities. Students who participated in extra-curricular STEM activities (academic STEM-related courses at universities or at the military companies) were coded 1, others were coded 0.

Self-efficacy Self-efficacy was measured by the following item: If you were to study at tertiary institution, without any connection to your intention to pursue or not to pursue at tertiary education, do you think you would succeed at your studies? It was measured on the following scale: (1) I am confident (for sure) I would not be able to succeed at my studies; (2) I think I wouldn't be able to succeed at my studies; (3) I think I would be able to succeed at my studies; (4) I am confident (for sure) I would be able to succeed at my studies.

Table 1. Attitudes toward tertiary education, factor analysis findings.

	Factor loadings	Cronbach's alpha
Factor 1: *tertiary education as social value*		0.81
K-12 schools should devote lessons on the topic of tertiary education, tertiary study subjects, etc.	0.82	
It is important to support young people at early stages of their lives with guidance regarding their pursuing tertiary education.	0.81	
I would be proud to become a student at tertiary institution.	0.62	
It is important for me to succeed at studies at school so I can pursue tertiary education.	0.62	
Factor 2: *tertiary education as a mobility channel*		0.65
People with higher education credentials are more successful in life.	0.72	
Do you agree or disagree that people with a tertiary degree will be able to get more economically satisfying jobs than people without a tertiary degree?	0.70	
People with higher education credentials have higher social status in Israeli society.	0.60	
Factor 3: *perceived social support*		0.64
My teachers and my school administrators encourage me to pursue tertiary education.	0.81	
Most of my friends plan to pursue tertiary education.	0.78	
My parents (or at least one of them) encourage me to pursue tertiary education.	0.56	

Outcome expectations and social support Attitudes toward tertiary education. The questionnaire included 13 items on a Likert scale from 1 to 5, where 1—strongly disagree, 5—strongly agree. In order to examine whether general categories could be identified within the 13 items measuring attitudes toward tertiary education, a Principal Component Factor Analysis was performed with Varimax rotation. The factors obtained in the analysis with factor loadings for the items and reliability coefficients are presented in Table 1. From Table 1 it can be seen that three factors were found in the analysis. The first factor represents the content world of the academic education as a social value and explains 39% of the variance. The second factor represents the academic education as mobility channel and explains 10% of the variance. Those two factors can reflect *the outcome expectations.* The third factor represents *the perceived social support* for academic education and explains 8% of the variance. Three items received the similar scores in two or three factors and for this reason were not included in the further analysis.

In all the models, we included a control for a *grade level* (a dichotomous variable coded 1 for grade 12 and 0 for grade 11).

The description of the dependent and independent variables of the study is presented in Table 2.

5. Findings

In this section we offer a descriptive analysis of our findings. Then, in order to obtain a deeper understanding of the descriptive results, we apply the multinomial logistic regression for the student's interest in pursuing STEM fields in tertiary education.

5.1. Descriptive analysis

We start with a description of the students' characteristics in our sample. As we can see from Table 2, the proportion of girls in the sample was slightly higher than boys (52% vs. 48% respectively). About 80% of the students defined their family economic

Table 2. Descriptive statistics (*N* = 2458).

Variables	
% of girls	51.7%
% of 12th grade students	48.3%
% of students who had at least one parent with the academic degree	40.0%
Mother's educational level	
Secondary	55.3%
Post-secondary (non-academic)	11.8%
Academic degree	31.4%
Missing	1.5%
Father's educational level	
Secondary	60.0%
Post-secondary (non-academic)	10.3%
Academic degree	27.1%
Missing	1.6%
The student's perception of the family economic background	
Low	3.5%
Average-low	8.1%
Average	37.1%
Average-high	33.8%
High	10.0%
Missing	7.4%
% of students enrolled in at least one advanced science course at schools	44.7%
Mean of mathematics grade	69.3
(SD)	(21.1)
% of students enrolled in extra-curricular STEM activities	34.6%
The student's perception of self-efficacy	
Low	1.3%
Average-low	4.7%
Average-high	60.9%
High	33.1%
Student's interest in pursuing STEM fields in tertiary education	1.3%
Is not interested to study in tertiary education	20.6%
Is interested to study non-STEM fields in tertiary education	56.7%
Is interested to study STEM fields in tertiary education	22.7%

background as an average and higher, and about 40% of them had at least one parent holding an academic degree (34.1% mothers hold an academic degree and 27.1% fathers hold an academic degree). About 35% of students reported that they were enrolled in extra-curricular STEM activities. Moreover, the proportion of students who were enrolled in advanced secondary science courses at school was about 45%, while the Israeli average was less than 30% (CBS, 2014). This can be explained by the educational reform implemented by the Municipality of Ashdod mentioned earlier. In addition, about 23% of students reported their interest in pursuing STEM fields in tertiary education.

5.2. Multivariate analysis

In the first step of our multivariate analysis the logistic regression, predicting students' interest to study at academic institutions vs. being not interested to study at academic institutions was applied (see Appendix, Table 4). This regression enables to investigate the variables associating with entering into higher education. In the second step in order to distinguish between the fields of study a multinomial regression analysis[2] was conducted, where student's interest in pursuing STEM fields was the dependent variable (see Table 3). The third category 'is interested to study STEM fields in academic

Table 3. Multinomial logistic regression analysis for student's interest: comparison group is 'is interested to study STEM fields'.

	Is interested to study non-STEM fields in academic institutions				Is not interested to study at academic institutions			
	Model 1		Model 2		Model 1		Model 2	
	B	Exp (*B*)	*B*	Exp (*B*)	*B*	Exp (*B*)	*B*	Exp (*B*)
Intercept	0.96		0.73		10.48**		10.38**	
Gender (girl = 1)	1.73**	5.62	2.26**	9.54	0.95**	2.58	1.35**	3.84
Grade	−0.06	0.94	−0.07	0.93	0.13	1.14	0.13	1.14
Father's non-academic education	0.24	1.27	0.24	1.28	0.44	1.55	0.44	1.55
Father's academic education	0.13	1.13	0.14	1.15	−0.57*	0.57	−0.57*	0.57
Mother's non-academic education	0.08	1.08	0.08	1.08	−0.66*	0.52	−0.67*	0.51
Mother's academic education	0.27	1.31	0.26	1.29	−0.18	0.83	−0.20	0.82
Perceived SES	0.18	1.20	0.18*	1.20	0.09	1.10	0.09	1.10
Mathematics grade	−0.01**	0.99	−0.01**	0.99	−0.02**	0.99	−0.01**	0.99
Advanced secondary science courses	−1.25**	0.29	−1.00**	0.37	−1.81**	0.16	−1.77**	0.17
STEM extra-curricular activities	−0.27**	0.76	−0.26*	0.77	−0.58**	0.56	−0.58**	0.56
Academic education as social value	−0.04	0.96	−0.02	0.98	−1.40**	0.25	−1.40**	0.25
Academic education as mobility channel	−0.07	0.93	−0.08	0.93	−0.13	0.88	−0.13	0.88
Perceived social support	0.07	1.07	0.07	1.07	−0.45**	0.64	−0.45**	0.64
Self-efficacy	0.02	1.02	0.02	1.02	−0.41*	0.67	−0.41**	0.67
Advanced secondary science courses* gender			**−0.78***	**0.46**			−0.36	0.70
Nagelkerke	0.44		0.45		0.44		0.45	

Note: The most interesting and relevant result for the current study is indicated in bold.
*$p < .05$.
**$p < .01$.

institutions' serves as a comparison group. The negative coefficient in the model indicates the increase of the log odds in favor of STEM fields, whereas the positive coefficient indicates the decrease of the log odds.

In line with the research questions, we ran two regression models. To answer our first question (What are the factors that predict secondary students' interest in pursuing STEM

Table 4. Logistic regression analysis for student's interest to study at academic institutions vs. being not interested to study at academic institutions.

	Model 1		Model 2	
	B	Exp(*B*)	*B*	Exp(*B*)
Intercept	−9.27**		−9.28**	0.00
Gender (girl = 1)	0.40**	1.49	0.55**	1.74
Grade	−0.17	0.84	−0.18	0.83
Father's non-academic education	−0.26	0.77	−0.26	0.77
Father's academic education	0.64**	1.90	0.66**	1.93
Mother's non-academic education	0.72**	2.06	0.74**	2.09
Mother's academic education	0.37*	1.45	0.38	1.47
Perceived SES	0.05	1.05	0.04	1.04
Mathematics grade	0.01*	1.01	0.01*	1.01
Advanced secondary science courses	0.96**	2.62	1.22**	3.39
STEM extra-curricular activities	0.38*	1.47	0.40	1.49
Academic education as social value	1.37**	3.92	1.39**	4.01
Academic education as mobility channel	0.07	1.08	0.07	1.07
Perceived social support	0.50**	1.65	0.50**	1.65
Self-efficacy	0.42**	1.53	0.42**	1.52
Advanced secondary science courses* gender			−0.64*	0.53
Nagelkerke	0.43		0.44	

*$p < .05$.
**$p < .01$.

fields in tertiary education?), we ran Model 1 which examines the main effects of our independent variables on the secondary students' interest in pursuing STEM fields in tertiary education. To answer our second research question (Do the effects of the predictors differ between the two genders?), we add the interaction effects between gender and the rest independent variables. Model 2 presents only the significant interactions.

In Table 3 we present the results of the multinomial logistic regression. First, we show the comparison between the students *who are not interested to study non-STEM fields in academic institution*s and those who *are interested to study STEM fields in academic institutions*. This is a comparison between two groups of students who are interested in pursuing tertiary education. Then, we draw a comparison between the students who are not interested in pursuing tertiary education (to study in any academic institution) and those who are interested to study STEM fields in academic institutions.

'Is interested to study non-STEM fields in academic institutions' vs. 'Is interested to study STEM fields in academic institutions'

It is important to emphasize that this is a comparison between two groups of students who are interested in pursuing tertiary education: the students who are interested to study STEM fields and those who are interested to study non-STEM fields (Table 3). The multinomial regression analysis reveals the striking effect of gender on the student interest in STEM fields in tertiary education (see Table 3, Model 1). The odds for girls to express interest in non-STEM fields versus an interest in STEM fields are more than 5 times ($B = 1.73$, $\exp(B) = 5.62$, $p < .01$) higher compared to boys. However, the parental education effect (both mother's and father's) on student's interest in a specific (STEM vs. non-STEM) field of study in tertiary education is insignificant.

In addition, the perceived socio-economic background was insignificant in the entering in tertiary education (see Appendix, Table 4), while significant in differentiation between the fields of study (see Table 3): the higher the student's perception of their family's economic background, the lower their interest to study STEM fields in an academic institution ($B = 0.18$, $\exp(B) = 1.20$, $p < .05$).

The learning variables (mathematics grade, the enrollment in advanced secondary STEM courses and extra-curricular STEM activities) negatively associated with the student's odds to be interested non-STEM fields vs. to be interested in STEM fields ($B = -0.01$, $\exp(B) = 0.99$, $p < .01$; $B = -1.25$, $\exp(B) = 0.29$, $p < .01$; $B = -0.27$, $\exp(B) = 0.76$, $p < .01$; respectively). In other words, students with positive experiences with science and the STEM subjects both at school and after-school are more likely to be interested in STEM fields.

The effects of outcome expectation variables and self-efficacy beliefs were insignificant. Hence, the perceived social support, the perception of academic education as social value and as a mobility channel and the self-efficacy beliefs did not differentiate between interests in fields of study.

In Model 2 (Table 3) we present the significant interaction effect between gender and the enrollment in secondary science courses. Other interactions with gender were insignificant. Studying advanced secondary STEM courses has a higher effect on the interest in pursuing STEM fields among girls than among boys ($B = -0.78$, $\exp(B) = 0.46$, $p < .01$).

'Is not interested to study in academic institutions' vs. 'Is interested to study STEM fields in academic institutions'

As seen from Model 1 (Table 3), the odds for girls to be not interested to study in an academic institution versus to be interested to study STEM fields at an academic institution are higher than for boys ($B = 0.95$, $\exp(B) = 2.58$, $p < .01$). In other words, boys are more likely than girls, to be interested to study STEM fields in tertiary education, than to be not interested to study at any academic institution. As one would expect, the academic parental education (mother's and father's education level) positively correlated with the odds of being interested in pursuing STEM fields in tertiary education vs. to be not interested to study at academic institution. Students' perception of the family economic background does not have a significant effect on these odds.

Similar to the previous comparison, our findings show that the learning variables (mathematics grade, the enrollment in advanced secondary STEM courses and extra-curricular STEM activities) negatively associated with the student's odds to be not interested to study at academic institutions vs. to be interested in STEM fields ($B = -0.02$, $\exp(B) = 0.99$, $p < .01$; $B = -1.81$, $\exp(B) = 0.16$, $p < .01$; $B = -0.58$, $\exp(B) = 0.56$, $p < .01$; respectively). Consequently, students with positive learning experiences with science and the STEM subjects both at school and after-school were more likely to be interested in STEM fields.

In contrast to the previous comparison (non-STEM fields vs. STEM fields), the effects of self-efficacy beliefs, the perceived social support and the perception of academic education as social value were significant ($B = -0.41$, $\exp(B) = 0.67$, $p < .01$; $B = -0.45$, $\exp(B) = 0.64$, $p < .01$; $B = -1.40$, $\exp(B) = 0.25$, $p < .01$; respectively). Accordingly, high self-efficacy beliefs and high outcome expectations negatively correlated with the odds of not being interested to study at academic institutions. These findings are in line with the logistic regression results (comparison between students' interest to study at academic institutions and being not interested to study at academic institutions) that high self-efficacy beliefs and high outcome expectations positively correlate with the odds of being interested to study at academic institutions (see Appendix, Table 4). It should be noted that in both regressions the effect of academic education as mobility channel was insignificant (see Appendix, Tables 4 and 3, Model 1).

In addition, all interaction effects (including the interaction between gender and enrollment in advanced secondary STEM courses) were insignificant.

6. Discussion and conclusions

The results discussed above shed light on a very important societal issue—encouraging students of both genders and from all socio-economic level to engage in STEM fields. As a result of recent technological developments in the last half a century, the need for the STEM-related occupations has increased significantly. In this context, encouraging students to pursue these fields at tertiary institutions became one of the important national goals in developed countries in general and in Israel in particular (Senor & Singer, 2009). Based on the SCCT our study examined the factors which associated with students' interest in pursuing to study STEM fields in tertiary education.

Our findings about input variables only partially support this theory. In line with the research literature was found that the boys are more interested in pursuing STEM fields in tertiary education than girls. However, we found that the parental education differentiates only in interest to study in tertiary education and not in choosing a field of study, whereas according to the literature there is a positive association between parental education and student's interest in STEM fields. One of the possible explanations is that parental influence on children decision to acquire higher education, and less on their field of study. The decision about the choice of study field is made by the students themselves, while the parents' influence mainly focuses on their children earning higher education. The alternative explanation is the fact that our data do not differentiate between STEM versus non-STEM parental education. Investigation of the impact of parents' field of education may be for a focus of a follow-up study.

The perceived socio-economic background was insignificant in the entering in tertiary education, while significant in differentiation between the fields of study. Those from lower socio-economic background were more likely to be interested in STEM fields, compared to those from higher socio-economic background. These findings support the findings of George-Jackson and Lichtenberger (2012) and Lichtenberger and George-Jackson (2013) who reported that economically disadvantaged students generally had more confidence in their STEM majors than their high-income counterparts. One of the possible explanations is the fact that on average that the wages in STEM-oriented occupations are higher than in non-STEM ones, therefore, students from low socio-economic background are more likely to choose STEM fields due to the instrumental reasons.

Findings regarding the learning experience go in line with the research literature based on the SCCT. Math achievements, extra-curricular STEM activities and the enrollment in science courses at advanced level at secondary schools were positively correlated with student's interest in pursuing STEM fields. It should be noted, whereas mathematics achievements and extra-curricular STEM activities have the similar effect among both genders, studying advanced secondary science courses effects more the interest in STEM fields among girls than among boys. However, since the gender effect is the dominant one, studying science courses at advanced level at school decreases the gender gap, but does not eliminate it. These findings emphasize the importance of studying advanced secondary science courses at secondary schools.

Findings regarding outcome expectations and self-efficacy beliefs only partially support the SCCT model. According to the study, outcome expectations and self-efficacy beliefs did not differentiate between interests in fields of study. This is possibly a result of the general formulation of items (about tertiary education in general) and not oriented STEM fields. In addition, the findings show that the self-efficacy beliefs, the perceived social support and the perception of academic education as social value were positively associated with being interesting to study at academic institutions, whereas the effect of academic education as mobility channel was insignificant. We can speculate that among 16–18 years old students the two significant variables reflect the short-term vision (here and now) whereas the academic education as mobility channel is the sign of more distant future.

To summarize our findings, studying science courses at advanced level at secondary schools and participation in after-school activities positively correlated with the level of interest among students in pursuing STEM fields in tertiary education versus non-STEM education. Moreover, studying science courses at advanced level at secondary schools decreases the gender gap and eliminates the impact of family background on students' interest in pursuing STEM fields in the future. These results have noteworthy educational implications: in order to attract more students from various socio-economic and family backgrounds into STEM-related tertiary education, it is crucial to encourage them to study advanced secondary science courses at the low secondary school (from grade 7).

In addition, it might be reasonable to suggest that in order to eliminate the gender gap, the society's perception about the participation of women in STEM-related careers must change, but this requires further study.

7. Limitations and suggestions for future study

The limitations of our study stem from the limitations of our database. It was important to include into analysis the participation of the students in STEM studies in the early stage of secondary education (from grade 7). Unfortunately, this question was not included in the Questionnaire. In addition, items regarding outcome expectations and self-efficacy beliefs were not STEM-oriented and were formulated concerning tertiary education.

The reported research was conducted in an Israeli city, where a local municipality encouraged secondary students to enroll in advanced science courses. It would be recommended to conduct a similar research in other Israeli cities with different education policies in order to compare the impact of gender, parental education and enrollment in secondary science. This is especially important in light of the implementation of the new educational program of teaching science disciplines from grade 7 of the Israeli Ministry of Education in about 20% of the Israeli secondary schools. Expanding the study internationally would provide additional data and deeper insights on the issue. It would be especially valuable to conduct longitudinal research, to enable a follow-up study, measuring secondary school students' intentions and their actual achievements both at tertiary level and future careers.

Notes

1. In 2012, in Jewish sector about 34% of students studied Math at advanced level (4 or 5 units):18% of students studied Math 5 units and 16%—4 units (CBS 2014).
2. For the analysis of data that involve a categorical response variable, a multinomial logistic regression is used to model nominal outcomes, in which the log odds of the outcomes are modeled as a linear combination of the predictor variables. This model provides a convenient closed form for the underlying choice probabilities without any requirement of multivariate integration (Cox, 1988; Hausman & McFadden, 1984).

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

Ayalon, H. (2003). Women and men go to university: Mathematical background and gender differences in choice of field in higher education. *Sex Roles*, *48*(5/6), 277–290.

Ayalon, H. (2006). Nonhierarchical curriculum differentiation and inequality in achievement: A different story or more of the same? *Teachers College Record*, *108*(6), 1186–1213.

Ayalon, H., & Yogev, A. (1997). Students, schools, and enrollment to science and humanity courses in Israeli secondary education. *Educational Evaluation and Policy Analysis*, *19*, 339–353.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (2002). Social cognitive theory in cultural context. *Applied Psychology: An International Review*, *51*(2), 269–290.

Beattie, I. R. (2002). Are all "adolescent econometricians" created equal? Racial, class, and gender differences in college enrollment. *Sociology of Education*, *75*(1), 19–43.

Betz, N. E., Borgen, F. H., & Harmon, L. W. (2006). Vocational confidence and personality in the prediction of occupational group membership. *Journal of Career Assessment*, *14*(1), 36–55.

Blickenstaff, J. C. (2005). Women and science careers: Leaky pipeline or gender filter? *Gender and Education*, *17*(4), 369–386. doi:10.1080/09540250500145072

Bradley, K. (2000). The incorporation of women into higher education: Paradoxical outcomes? *Sociology of Education*, *73*(1), 1–18.

Brand, J. E., & Xie, Y. (2010). Who benefits most from college? Evidence for negative selection in heterogeneous economic returns to higher education. *American Sociological Review*, *75*(2), 273–302.

Brown, S. D., & Lent, R. W. (1996). A social cognitive framework for career choice counseling. *The Career Development Quarterly*, *44*(4), 354–366. doi:10.1002/j.2161-0045.1996.tb00451.x

Byars-Winston, A., Estrada, Y., Howard, C., Davis, D., & Zalapa, J. (2010). Influence of social cognitive and ethnic variables on academic goals of underrepresented students in science and engineering: A multiple-groups analysis. *Journal of Counseling Psychology*, *57*(2), 205–218.

CBS. (2014). Statistical abstract of Israel (Vol. 65). Retrieved from http://www.cbs.gov.il/reader/shnaton/shnatonh_new.htm?CYear=2014&Vol=65&CSubject=30

Coleman, J. S. (1988). Social capital in the creation of human capital. *American Journal of Sociology*, *94*, S95–S120.

Cox, C. (1988). Multinomial regression models based on continuation ratios. *Statistics in Medicine*, *7*(3), 435–441. doi:10.1002/sim.4780070309

English, H., & English, A. C. (1958). *A comprehensive dictionary of psy- chological and psychoanalytic terms*. New York: David McKay.

Fisher, T. A., & Stafford, M. E. (1999). Reliability and validity of the career influence inventory: A pilot study. *Journal of Career Assessment*, *7*(2), 187–202.

Fouad, N. A., & Smith, P. L. (1996). A test of a social cognitive model for middle school students: Math and science. *Journal of Counseling Psychology*, *43*(3), 338–346.

Fox, M. F., Sonnert, G., & Nikiforova, I. (2011). Programs for undergraduate women in science and engineering: Issues, problems, and solutions. *Gender & Society*, *25*, 589–615.

Garmezy, N. (1991). Resilience and vulnerability to adverse developmental outcomes associated with poverty. *American Behavioral Scientist*, *34*(4), 416–430.

George-Jackson, C. E., & Lichtenberger, E. J. (2012). *College confidence: How sure high school students are of their future majors*. Illinois Education Research Council. Policy Research: IERC 2012–2. Retrieved from: http://ierc.education/wp-content/uploads/2014/10/EJL_2012_ACT_College-Confidence_final.pdf.

Graves, O. (2014). Indicators for the number of females choosing STEM majors. *Senior Honors Projects*. Paper 34.

Hausman, J., & McFadden, D. (1984). Specification tests for the multinomial logit model. *Econometrica: Journal of the Econometric Society*, *52*(5), 1219–1240.

Iskander, E. T., Gore, P. A., Furse, C., & Bergerson, A. (2013). Gender differences in expressed interests in engineering-related fields ACT 30-year data analysis identified trends and suggested avenues to reverse trends. *Journal of Career Assessment*, *21*(4), 599–613. doi:10.1177/1069072712475290

Ivie, R., & Tesfaye, C. L. (2012). Women in physics: A tale of limits. *Physics Today*, *65*(2), 47–50.

Legewie, J., & DiPrete, T. A. (2014). The high school environment and the gender gap in science and engineering. *Sociology of Education*, *87*(October), 259–280.

Lent, R. W., & Brown, S. D. (2006). On conceptualizing and assessing social cognitive constructs in career research: A measurement guide. *Journal of Career Assessment*, *14*(1), 12–35.

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifyingsocial cognitive theory of career and academic interest, choice,and performance [Monograph]. *Journal of Vocational Behavior*, *45*, 79–122.

Lent, R. W., Brown, S. D., & Hackett, G. (1996). Career develop-ment from a social cognitive perspective. In D. Brown, L. Brooks, & Associates (Eds.), *Career choice and development* (3rd ed., pp. 373–421). San Francisco: Jossey-Bass.

Lent, R. W., Brown, S. D., & Hackett, G. (2002). Social cognitive career theory. *Career Choice and Development*, *4*, 255–311.

Lent, R. W., Brown, S. D., & Larkin, K. C. (1986). Self-efficacy in the prediction of academic performance and perceived career options. *Journal of Counseling Psychology*, *33*(3), 265–269.

Lent, R. W., Lopez, A. M., Lopez, F. G., & Sheu, H.-B. (2008). Social cognitive career theory and the prediction of interests and choice goals in the computing disciplines. *Journal of Vocational Behavior*, *73*(1), 52–62.

Lent, R. W., Sheu, H.-B., Gloster, C. S., & Wilkins, G. (2010). Longitudinal test of the social cognitive model of choice in engineering students at historically black universities. *Journal of Vocational Behavior*, *76*(3), 387–394.

Let's Talk Science. (2013). *Spotlight on science learning: The high cost of dropping science and math*. Toronto, ON: Author.

Lichtenberger, E., & George-Jackson, C. E. (2013). Predicting high school students' interest in majoring in a STEM field: Insight into high school students' postsecondary plans. *Journal of Career and Technical Education*, *28*(1), 19–38.

Maltese, A. V., & Tai, R. H. (2010). Eyeballs in the fridge: sources of early interest in science. *International Journal of Science Education*, *32*(5), 669–685.

McGee-Brown, M., Martin, C., Monsaas, J., & Stombler, M. (2003). *What scientists do: Science Olympiad enhancing science inquiry through student collaboration, problem solving, and creativity*. Paper presented at the annual National Science Teachers Association meeting, Philadelphia, PA.

Milner-Bolotin, M. (2014). Promoting research-based physics teacher education in Canada: Building bridges between theory and practice. *Physics in Canada*, *70*(2), 99–101.

Modi, K., Schoenberg, J., & Salmond, K. (2012). *Generation STEM: What girls say about science, technology, engineering, and math*. A Report from the Girl Scout Research Institute. New York, NY: Girl Scouts of the USA.

OECD. (2006). *Women in scientific careers: Unleashing the Potential*. OECD. Retrieved from http://www.oecd.org/science/sci-tech/womeninscientificcareersunleashingthepotential.htm
OECD. (2013), *OECD skills Outlook 2013: First results from the survey of adult skills.* OECD Publishing. Retrieved from http://dx.doi.org/10.1787/9789264204256-en.
Prives, L. (2012). Scouting out STEM: Girl scouts moved by careers program [pipelining: Attractive programs for women]. *IEEE Women in Engineering Magazine*, *6*(6), 26–28.
Qualtrics. (2014). *Qualtrics research suite*. Provo, UT. Retrieved from http://www.qualtrics.com/
Riegle-Crumb, C., King, B., Grodsky, E., & Muller, C. (2012). The more things change, the more they stay the same? Prior achievement fails to explain gender inequality in entry into STEM college majors over time. *American Educational Research Journal*. doi:10.3102/0002831211435229
Sahin, A., Ayar, M. C., & Adiguzel, T. (2014). STEM related after-school program activities and associated outcomes on student learning. *Educational Sciences: Theory and Practice*, *14*(1), 309–322.
Sahin, A., Oren, M., Willson, V., Hubert, T., & Capraro, R. M. (2015). Longitudinal analysis of TSTEM academies: How do Texas inclusive STEM academies (T-STEM) perform in Mathematics, Science, and Reading? *International Online Journal of Educational Sciences*, *7*(4), 11–21.
Senor, D., & Singer, S. (2009). *Start-up nation: The story of Israel's economic miracle*. Twelve. New York: Hachette Book Group.
Smith, E. (2011). Women into science and engineering? Gendered participation in higher education STEM subjects. *British Educational Research Journal*, *37*(6), 993–1014. doi:10.1080/01411926.2010.515019
Statistics Canada. (2006). *Women in Canada: A gender-based statistical report*. (p. 311). Ottawa, ON: Statistics Canada.
Su, R., Rounds, J., & Armstrong, P. I. (2009). Men and things, women and people: A meta-analysis of sex differences in interests. *Psychological Bulletin*, *135*(6), 859–884.
Taylor, S. E., & Lobel, M. (1989). Social comparison activity under threat: Downward evaluation and upward contacts. *Psychological Review*, *96*(4), 569–575.
Tindall, T., & Hamil, B. (2004). Gender disparity in science education: The causes, consequences, and solutions. *Education*, *125*(2), 282–296.
Trusty, J. (2002). Effects of high school course-taking and other variables on choice of science and mathematics college majors. *Journal of Counseling and Development*, *80*(4), 464–474.
Tsui, L. (2007). Effective strategies to increase diversity in STEM fields: A review of the research literature. *The Journal of Negro Education*, *76*(4), 555–581.
Wang, X. (2013). Why students choose STEM majors: Motivation, highschool learning, and post-secondary context of support. *American Educational Research Journal*, *50*, 1081–1121. http://dx.doi.org/10.3102/0002831213488622
Weinberg, J. B., Pettibone, J. C., Thomas, S. L., Stephen, M. L., & Stein, C. (2007). *The impact of robot projects on girls' attitudes toward science and engineering*. Paper presented at the Workshop on Research in Robots for Education.
Zafar, B. (2013). College major choice and the gender gap. *Journal of Human Resources*, *48*(3), 545–595.

Appendix

Attitudes about Academic Education—Follow-up Questionnaire

Dear student:

Please find an attached questionnaire about academic education. By an academic education we mean higher education at an academic institution such as a university or a college (that grant a Bachelor, a Master's or a Ph.D. degrees). In Israel this level of education if commonly referred to as 'higher education'.

In this questionnaire, you are asked to mark the most relevant answer that reflects your views and opinions. There are no wrong or right answers. The questionnaire is anonymous.

Students' attitudes about higher education

1. How important in your view it is to pursue higher (post-secondary) education?

1	2	3	4	5
Very important	Somewhat important	So—so (in the middle)	Not very important	Not important at all

3. Do you agree or disagree that people with a higher education (post-secondary) degree will be able to get more economically satisfying jobs than people a higher education degree?

1	2	3	4	5
Strongly disagree	Disagree	Somewhat agree	Agree	Strongly agree

3. Disregarding you school grades and your mark on the Psychrometric exam (if you have one), are you planning to pursue higher (post-secondary) education?

1	2	3	4	5
Not for sure	Probably not	Maybe yes, maybe no	Maybe	Yes, for sure

4. Explain your answer (it is not important what was your answer):

____

Survey questions based on the responses to the previous questions:
For the respondents who said that they would not be pursuing higher (post-secondary) education:

5. Why are you hesitating to pursue higher (post-secondary) education? (You are welcome to mark more than one response)
   1. I am not interested
   2. For economic (financial) reasons
   3. My secondary school graduation certificate isn't sufficient for me to pursue higher (post-secondary) education
   4. I do not believe that I can succeed in higher (post-secondary) education
   5. My family is against higher (post-secondary) education (they do not encourage it)
   6. It is waste of my time
   7. I am planning to engage in my family business that doesn't require higher (post-secondary) education.
   8. Other: ____________________________________

For the respondents who said that they would be pursuing higher (post-secondary) education:

6. Disregarding you school grades and your mark on the Psychrometric exam (if you have one), what is the area of study you would be interested to study in higher education?
   1. Humanities (such as languages, literature, art education, etc.)
   2. Social studies (such as sociology, political studies, economics, psychology, etc.)
   3. Business and management sciences
   4. Law
   5. Medicine
   6. Medical support professional education (such as nursing)
   7. Natural science and mathematics (such as, mathematics, statistics, computer science, physical sciences, biological sciences, etc.
   8. Agriculture
   9. Engineering
   10. Architecture
   11. Other: ____________________

7. At what academic institution would you are intrested to study?
   1. Ben-Gurion University of the Negev in Beersheba
   2. The Hebrew University of Jerusalem
   3. Tel-Aviv University
   4. University Bar-Ilan
   5. University of Haifa
   6. Weizmann Institute of Science
   7. Technion
   8. The Open University
   9. Sami Shamoon College of Engineering
   10. Ashqelon College
   11. Sapir College
   12. Achva Academic College
   13. The Business College at Rishon-Lezion
   14. Peres College in Rehovot
   15. Other ____________________

8. When are you planning to undertake your post-secondary studies?
   1. Immediately after secondary school graduation
   2. Immediately after finishing the army service
9. If you were to study at a post-secondary institution, without any connection to your interest to pursue or not to pursue a post-secondary education, do you think you would succeed at your studies?
   1. I am confident (for sure) I would not be able to succeed at my studies
   2. I think I wouldn’t be able to succeed at my studies
   3. I think I would be able to succeed at my studies
   4. I am confident (for sure) I would be able to succeed at my studies

Please express the level of agreement or disagreement with the following statements:

	Strongly agree	Agree	Somewhat agree	Disagree	Strongly disagree
10. Everybody who can (is capable) should pursue tertiary education					
11. It is important to acquire tertiary education					
12. K-12 schools should devote lessons on the topic of tertiary education, academic study subjects, etc.					
13. It is important for me to succeed at studies at school so I can pursue tertiary education					
14. I would be proud to become a student at a academic institution					
15. People with higher education credential are more successful in life					
16. People with higher education credential have higher social status in Israeli society					
17. It is important to support young people at early stages of their lives with guidance regarding their pursuing tertiary education.					
18. My parents (or at least one of them) encourage me to pursue tertiary education					
19. My teachers and my school administrators encourage me to pursue tertiary education					
20. Most of my friends plans to pursue tertiary education					
21. My decision to pursue tertiary education depends on my ability to finance it					

22. In case you decide to pursue tertiary education, will your family support you financially during your studies?
    1. Yes
    2. No
    3. I am not sure

23. In case you decide to pursue tertiary education, will you be required to support financially your family during your studies?
    1. Yes
    2. No
    3. I am not sure

24. Amongst your close circle of friends and family, who in your view are most likely to influence your decision to pursue or not to pursue tertiary education?
    1. My parents
    2. My siblings
    3. School principal and teachers
    4. My guide in youth motion (i.e. Boy scouts)
    5. Friends
    6. Academic counselor
    7. Other: ____________________

25. Do you know any people (in your close surroundings—family and friends) who hold an academic degree (do not count teachers and administration in your school)?

1. Yes 2. No

Students' knowledge about higher education:

26. Have you ever visited an academic institution?
    1. Yes 2. No

27. If yes, what academic institution have you visited (you can mark more than one answer)
    1. Ben-Gurion University of the Negev in Beersheba
    2. The Hebrew University of Jerusalem
    3. Tel-Aviv University
    4. University Bar-Ilan
    5. University of Haifa
    6. Weizmann Institute of Science
    7. Technion
    8. The Open University
    9. Sami Shamoon College of Engineering
    10. Ashqelon College
    11. Sapir College
    12. Achva Academic College
    13. The Business College at Rishon-Lezion
    14. Peres College in Rehovot
    15. Other ____

28. Have you done a Psychometric Exam already?
    1. Yes 2. No

29. Have you had a meeting with your school academic counselor already?
    1. Yes in person
    2. Yes in a group
    3. Yes, both in person and in a group
    4. Haven't met a school academic counselor

About Academic Guidance Center for Youth in Ashdod (Mirkas Kivunim)

30. Have you heard of the Academic Guidance Center in Ashdod?
    1. Yes 2. No
31. In recent years, a number of activities dedicated to exposure of youth to tertiary education took place. Please mark the activities you took part in from the list below (the list included names of extra-curricular activities)
32. Out of the list of activities, please mark the activity that was the most meaningful and influential activity for you in the process of making a decision about tertiary education:
33. Was the participation in these activities useful for you? For example, did it contribute to your knowledge about tertiary education, opened your eyes to the topics that you were not aware of? Please explain.

____

34. What were some additional topics that you would have liked to hear about but were missing from the activities mentioned above?

____

Personal Information about the Student:

35. What is your gender? 1. Boy 2. Girl

36. Where are you currently studying?
37. What is your grade level? 1. 11 2. 12

38. How many parallel classes do you have at your grade level in your school? _______
39. What school subjects do you study at the advanced placement level (5 units) (mark all that applies)?
    1. English
    2. Biology
    3. History
    4. Chemistry
    5. Economics
    6. Social sciences
    7. Computers
    8. Mathematics
    9. Literature
    10. Physics
    11. Communications
    12. Other: ____

At what level do you study the following subjects (3 units is min, 5 units is maximum—advanced placement level)?

	3units	4units	5units	Do not study
40. Mathematics				
41. English				
42. Physics				
43. Biology				
44. Chemistry				

What is the mark that you earned in these subjects?

	Below 59	60–69	70–79	80–89	90–100
45. Mathematics					
46. English					
47. Physics					
48. Biology					
49. Chemistry					

50. Do you think you will be able to earn a complete Maturation Certification (Teudat Bagrut)?
    1. I am sure I will
    2. I think I will
    3. I am not sure if I will earn it or not
    4. I think I will not
    5. I am sure I will not
51. Are you a member of the youth organization? 1. Yes 2. No
52. Are you going to serve in the Israeli Defence Forces (Army)? 1. Yes 2. No
53. If not, will your be serving at Israeli National Service? 1. Yes 2. No

Do you take private lessons in the following subjects?

	Yes, once a week	Yes, twice a week	No
54. Mathematics	1	2	3
55. English	1	2	3
56. Physics	1	2	3

Do you participate in after-school programs?

	Yes	No
57. A program that includes physical activity (athletic focus)	1	2
58. A program for preparation to the ZAHAL (the Israeli Army)	1	2

Student's Background Information:

59. What is your father's highest level of education?
    1. Less than secondary education
    2. Secondary education (12 years of school)
    3. Post-secondary non-academic education
    4. Academic education (Bachelor degree or higher)
60. What is your mother's highest level of education?
    1. Less than secondary education
    2. Secondary education (12 years of school)
    3. Post-secondary non-academic education
    4. Academic education (Bachelor degree or higher)

What is the country of birth of?

	Israel	Former USSR (including Georgia)	France	Ethiopia	Other
61. You	1	2	3	4	5
62. Your father	1	2	3	4	5
63. Your mother	1	2	3	4	5

64. If you were not born in Israel: When did you emigrate to Israel (write a full year of immigration—four digits) ______________________

65. Do you have older siblings? 1. Yes 2. No

66. If yes, do any of your siblings study at a post-secondary institution? 1. Yes 2. No
67. In your opinion, what is the economic situation of your family?
    1. Low
    2. Average-low
    3. Average
    4. Average-high
    5. High
    6. Do not know

68. Do you live in Ashdod? 1. Yes 2. No

Thank you for your participation!