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Major Matters: Relationship between Academic Major and University Students' Environmental Literacy and Citizenship as Reflected in Their Voting Decisions and Environmental Activism

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Institutions of higher education (HE) are increasingly expected to rise to the challenge of preparing environmentally literate graduates, equipped to bring a sustainability perspective into their professional function. While considerable research has explored the relationship between HE and tendency for political participation in general, studies on a possible relationship between exposure to environmental content during studies and students' inclusion of environmental considerations in political participation, as a component of their environmental literacy and indicator of the level of their environmental literacy, are lacking. Therefore, this study investigated, in a large university, the relationship between students' disciplinary major and their environmental literacy and citizenship as reflected in their inclusion of the environment in decision-making as voters and in citizen-society activism. A questionnaire was administrated to students from departments that include environment-related courses ('exposed') and departments that do not explicitly include environmental content ('unexposed'). The questionnaire investigated exposure to environmental content, EL-dimensions (knowledge, dispositions, self-reported involvement in environmentally-responsible behaviours), voting characteristics. All these variables were found to be significantly related to academic major: 'Natural Resource and Environmental

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Management' and Geography majors acknowledged greater exposure to environmental topics and were more knowledgeable of these. These students, along with biology majors, reported being more active in responsible environmental behaviour (REB) and in environmental organizations. 'Exposed' students rated higher environmental issues as factors that influence their political decision-making, declared greater willingness to vote for environmentally-oriented parties and reported increased support for such parties in the 2006 and 2009 elections compared to 'unexposed' students. Results also indicate that despite these differences between the two groups, self-reported participation of 'exposed' students in REB and in civic society was lower than could be expected. Results indicate that two interplaying factors may underlie the relationship between academic major and students' environmentalism: a transformative influence of studies via the content, ideas and philosophies of the studied discipline, and pre-existing orientation of students which influences their choice of studies. These processes can be taken into consideration towards incorporating sustainability within different academic programs in a manner that will be effective in educating environmentally-responsible graduates and preparing them as influential environmental citizens and professionals in society.

Keywords: environmental literacy, higher education, academic major, political voting, responsible environmental behavior

INTRODUCTION

There is wide agreement that Earth's ecosystems cannot sustain current, let alone, increased levels of resource consumption and waste production (Millennium Ecosystem Assessment, 2005; OECD, 2012). These studies empirically illustrate how human health and well-being, economic vitality, social justice and national security depend on the healthy functioning of earth's ecosystems ('ecosystem services'). For example, in 2013, humanity exhausted nature's annual budget of ecological resources and services in less than eight months (Global Footprint Network, 2014).

Since the symptoms of environmental deterioration are manifested in the biophysical dimension, environmental problems are often considered 'scientific', although they are caused by social, economic and political factors that determine how people, as individuals and a society, exploit the environment (De-Shalit, 2004; Orr, 1992). Environmental issues are, therefore, located at the point where science and society meet. One conclusion of The Millennium Ecosystem Assessment (2005) and OECD Environmental Lookout for 2050 (OECD, 2012) is that to reverse ecosystem degradation, significant changes are required in policies, institutions and human practices. Although individuals are responsible for the environment, institutional, political and public policies are required to create a climate that promotes and enables environmental-social responsibility at the individual level.

Since the 1990s, environmental issues have permeated the Israeli political system (Blander, 2007b; Ishai, 1999). While political discourse still focuses mainly on national security, economy and society, the last two decades have witnessed an ongoing increase in the position environmental considerations hold in decision-making processes and public consciousness (Blander, 2007b). This is evident in all political spheres– citizen society, political parties, the Knesset (legislating institution) and government (national and municipal levels). It is reflected in the inclusion of environmental sections within the political platform of most parties, and establishment of new parties with environmentally-oriented political substrates (Blander, 2007b). Following Blander (2007b), important political arenas for promoting environmental issues (in Israel) are municipal parties and citizen society organizations: increased environmental awareness in the third sector has been a major factor influencing the infiltration of environmental issues within legislation.

Maintaining and strengthening the position of the environment within the political agenda largely depends on public support and increased political involvement of citizens. De-Shalit (2004) claims that in view of the political nature of environmental problems, the struggle for environmental improvement requires a public that is not only knowledgeable and aware of the environment, but is 'environmentally conscious'- understands that environmental issues are political by nature, and that addressing them requires political action of the public. The important role of citizens as a political means for addressing environmental problems, and the bottom-up nature of green politics (Blander, 2007b), make it all the more important that the public be capable of and inclined to political participation.

This requires an environmentally-literate citizenry (i.e. environmental citizenship). According to Roth (1992), the environmentally-literate individual has the knowledge, disposition, commitment and skills that both motivate and enable environmentally responsible action. Roth asserts that environmental literacy (EL) is not a binary characteristic, but a continuum from minimal ability to advanced skills, and the "*degree of EL is reflected in the breadth of human/environmental interaction to which that person brings to bear all the skills and knowledges that define operational EL*" (Roth, 1992, p. 19). According to Roth's categorization, individual or group political action reflects a more advanced level of EL. According to Dobson (2010), citizens' use of different political channels for promoting responsible environmental management is one demonstration of environmental citizenship (EC).

Agenda 21, The Talloires Declaration (1990) and other declarations emphasize the role of higher education (HE) in leading the changes required of society to realize the goals of sustainability. This responsibility stems from HE's function in preparing the majority of professionals (scientists, decision-makers, teachers, etc.) who will hold key positions, and in developing the creative and critical thinking required to cope with the challenges facing society. Because HE institutions will "*influence the direction we choose to take as a society*" (Filho, 2002, p. 9), they are expected to increase their commitment to preparing environmentally-literate graduates. Hence, incorporation of sustainability is increasingly being viewed by HE as a strategic goal– one that both improves the quality of education and enhances its relevance to society. Consequently, more institutions of HE are aiming to incorporate sustainability within curricula so that all graduates will be capable of and motivated to bring an environmental perspective into their future profession (Anderson et al., 2007; Filho, 2002; Goldman, Yavetz, & Pe'er, 2014; Shephard, Mann, Smith, & Deaker, 2009; Stewert, 2010).

Regarding the influence of exposure to environmental content in HE, some studies indicate that participation in environmentally-oriented courses (such as environmental studies, sustainable development (SD), environmental ethics and education) during academic studies lead to development of components of students' EL (Brody & Ryu, 2006; Hsu, 2004; McMillen, Wright, & Beazley, 2004; Smith-Sebasto, 1995; Teisl, Anderson, Noblet, Criner, & Rubin, 2011; Wongchantra & Nuangchalerm, 2011). Other studies support a relationship between students' EL and their academic major, with environment-affiliated majors (such as biology, zoology, environmental studies, outdoor recreation, tourism) demonstrating higher levels of environmental knowledge (Tikka, Kuitunen, & Tynys, 2000), more pro-environmental attitudes (Anderson et al., 2007; Ewert & Baker, 2001; Harraway, Broughton-Ansin, Deaker, Jowett, & Shephard, 2012; Hodgkinson & Innes, 2001) and a greater level of environmentally responsible behaviour (Fusco, Snider, & Luo, 2012; Tikka et al., 2000) in comparison to other majors.

Concerning the relationship between education and political participation, studies show that education influences the tendency for political participation via

various channels – voting, citizen society activity, protesting, etc. (Blander, 2007a; Hillygus, 2005; Verba, Schlozman, & Brady, 1995). Most empirical research cites education as the strongest predictor of political participation (Lijphart, 1997; Verba et al., 1995). While considerable research has explored the relationship between HE and the tendency for political participation in general, studies on a possible relationship between exposure to environmental content during academic studies and students' inclusion of environmental considerations in their political participation, as a component of their EL and indicator of the level of their EL, are lacking. Therefore, this study aimed to investigate if a relationship exists between exposure to environmental content during university studies and students' involvement in environmental organizations (i.e. civic activism) and inclination to include the environment in their decision-making as voters. Specifically, it addressed two research questions: 1) What is the relationship between the students' academic major and their EL-characteristics (environmental knowledge, dispositions and behaviour)? 2) Are students who are exposed to environmental content more inclined to vote for an environmentally-oriented political party and more active in environmental organizations (citizen society activity) than students who did not receive such exposure? The first research question aims to provide the context for the second research question. The study is based on the perspective that political participation (whether through voting or citizen activism) is a component of environmentally responsible behaviour (Dobson, 2010; Roth, 1992). Despite the acknowledged role of citizens in influencing environmental policy through their participation in political channels, such activities have not yet been addressed in studies exploring adults' EL. This study is a step in that direction.

THEORETICAL FRAMEWORK

Environmental literacy and environmental citizenship

Developing people's EL is a key towards achieving sustainability. This stems from the crucial role of environmental education in achieving the goals of sustainable development (UNESCO, 2014) and from the stated ultimate goal of environmental education as developing an environmentally literate citizenry (North American Association for Environmental Education, 2010). Hollweg et al. (2011) define an environmentally literate person as *"someone who, both individually and together with others, makes informed decisions concerning the environment; is willing to act on these decisions to improve the well-being of other individuals, societies, and the global environment; and participates in civic life*" (p. 2-3). Roth defined EL as "*the capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain, restore, or improve the health of those systems*" (p. 8). According to both definitions, an individual's EL is the outcome of a number of interplaying components which can be grouped into cognitive, affective and behavioural domains (Hollweg et al., 2011; Roth, 1992). The cognitive domain refers to: a) the knowledge of ecological concepts and processes that are foundational for comprehending human impact on natural systems, environmental issues that derive from these interactions, and environmental action strategies; and b) the skills for analysing environmental problems and for using environmental action strategies. It is significant that socio-political knowledge is recognized alongside ecological knowledge, and that citizenship skills are recognized alongside higher order thinking skills, as foundational to the cognitive domain (Hollweg et al., 2011; McKeown-Ice & Dedinger, 2000). The affective domain refers to dispositions toward the environment. According to Hollweg et al. (2011), dispositions are important determinants of environmental behaviour through their influence on the individual's willingness to recognize and choose among value perspectives, and on

their motivation to act upon environmental issues. Behaviour is the ultimate expression of EL – an individual's EL should be reflected in his/her behaviour concerning the environment. As Roth (1992) claims: "*Environmental literacy must likewise be defined in terms of observable behaviours … A person who is environmentally aware is not necessarily environmentally literate; nor is a person who possesses a broad environmental understanding*…" (p. 17, 27). In other words, in the context of EL, knowledge, dispositions and competencies enable and are expressed as behaviours (Hollweg et al., 2011; Roth, 1992). Thus, developing EL is equivalent to developing responsible environmental behaviour (REB). Behaviour is, therefore, a significant variable to measure when evaluating peoples' EL.

EL is developmental - it is a continuum of capacities that can be developed through expansion of knowledge, clarification and strengthening of dispositions and refinement of competencies. These will be reflected in more sophisticated and effective behaviour (Hollweg et al., 2011; Roth, 1992), thus advancement to higher levels of EL should be reflected in behaviour. According to Roth (1992), individual or group 'political action' reflects a more advanced level of EL.

Another concept that has permeated sustainability discourse is environmental citizenship (EC). In view of the active involvement required of citizens in realizing sustainable development goals and promoting a society that places sustainability on its agenda, developing EC has been identified as a goal of environmental education (Bell, 2005; Berkowitz, Ford, & Brewer, 2005; Hawthorne & Alabaster, 1999). Researchers claim that EC is a distinct form of citizenship with specific characteristics (Bell, 2005; Dobson, 2010). Dobson (2010) provides the following definition: "*Pro-environmental behaviour, in public and in private, driven by a belief in fairness of the distribution of environmental goods, in participation, and in the co-creation of sustainability policy. It is about the active participation of citizens in moving towards sustainability*." (p. 6). The UN Environment Programme views EC as a reiteration of a known fact: preservation of the environment is an obligation entrusted upon all individuals and governments by virtue of the inherent relationship between people and nature and between citizens and their governments. Both interpretations emphasize the component of responsible environmental behaviour and the individual responsibility of citizens towards sustainability in their private as well as professional function. According to Dobson (2010), citizens' use of different political channels for promoting responsible environmental management is one demonstration of environmental citizenship (EC).

The distinction between EL and EC is blurred: the model of EC provided by Hawthorne and Alabaster (1999) includes EL as one of EC's components. According to Berkowitz et al. (2005), developing EC "*involves empowering people to have the knowledge, skills, and attitudes needed to identify their values and goals with respect to the environment and to act accordingly, based on the best knowledge of choices and consequences*" (p. 228). Based on the integration of knowledge, attitudes, skills and behaviour, the Berkowitz et al. definition of EC parallels the Roth definition of EL. Furthermore, policy and educational documents state development of EC or EL as the central goal of environmental education (Hollweg et al., 2011). The authors, therefore, view these two terms as corresponding in this study.

METHODOLOGY

Participants

The study was conducted in a major University. The first task was to map the University's academic programs according to their explicit inclusion of environmental content. This was conducted in two stages: first, the university

catalogue was reviewed to identify departments that include the term 'environment' in their title, overview of curricular aims or content. Two departments emerged: Geography and Environmental Studies (GES) (Bachelor and Graduate degrees) and Department for Natural Resources and Environmental Management (NREM) (Graduate degrees). In the second stage, the online syllabi of all courses taught at the University were also reviewed to detect courses that explicitly include environmental content. Two additional departments emerged: Biology and Science Education, and Land-of-Israel Studies. Based on the syllabi of these four departments, one or two courses with environment-affiliated content were selected for administering the questionnaire. These students constitute the 'exposed' group (125 students). The 'unexposed' sample (138 students) was comprised of students from four departments (Communications, Business Management, Law, and Special Education) that do not, explicitly, include environment-affiliated content, based on the above mapping of the University's programs. One course from each department was chosen for conducting the questionnaire after verifying the absence of environment-affiliated content in the syllabi. Participants were in their last semester of Bachelor's degree (58.6%) or 2nd year of Masters studies (41.4%). This explains the mean age of the students which was 31.3±8.2 years. Table 1 summarizes distribution of participants' background and demographic data.

Table 1. Distribution of background and demographic data of participants

	Research groups		**Sample size**	
Variable	**Group**	**Academic department**	**N**	**% of sample**
Exposure to environmental content in academic program	"Exposed"		125	47.5
		Geography and Environmental Studies	39	
		Natural Resources and Environmental Management	36	
		Biology and Science Education	42	
		Land-of-Israel Studies	8	
	"Unexposed"		138	52.5
		Business Management	51	
		Law	40	
		Communications	24	
		Special Education	24	
Gender	Male		129	49
	Female		134	51
Ethnic Background	Jewish		224	85.2
	Non-Jewish (mostly Arab)		36	13.7
	Missing		3	1.1
Religiousness	Secular		196	74.5
	Traditional		57	21.7
	Religious		10	3.8
Mother's education	High school or less		111	42.2
	Post-secondary vocational		44	16.7
	Academic		107	40.7
Economic status	Low to middle class		28	10.7
	Middle		125	47.5
	Middle to upper class		111	42.1

Instrument

Since this study aimed to explore the relationship between students' exposure to environmental content and their EL and voting characteristics, it was necessary to construct a questionnaire that addresses all aspects. The 'Environmental Literacy and Voting' questionnaire consisted of five sections:

Exposure (self-reported) and knowledge of environmental topics - This section assessed the extent of exposure to 11 environmental topics, as perceived and reported by the students, using a Likert-type scale with five possibilities (from 1-not exposed to 5-very highly exposed). This inventory included subjects that address classical focus of environmental science (i.e. environmental problems, their causes, impacts and solutions), and concepts more affiliated with broader sustainability discourse (i.e. environmental organizations, politics and policies, justice and ethics). Content validity of the exposure section was evaluated by five environmental science experts from different universities. This inventory had a Cronbach's alpha reliability of 0.96. Factor analysis confirmed that all items measured the same variable.

To gauge environmental knowledge, the students were asked to provide written examples for nine of the items.

Students were also asked to rank, in order of contribution, 7 sources of influence on their environmental knowledge (university, television, radio, journals/periodicals, daily newspaper, internet, friends and family).

Environmental dispositions- This study used the New Ecological Paradigm (NEP)-scale (Dunlap, Van Liere, Mertig, & Jones, 2000) to assess students' dispositions toward issues of human-nature interrelationships. The reliability and validity of this widely used tool is well established, and it continues to be used internationally in the investigation of the beliefs, values, attitudes and concerns of HE students with respect to nature and human relationships with nature (Anderson et al., 2007; Erdoğan, 2009; Goldman, Ben Zvi Assaraf, & Shemesh, 2014; Harraway et al., 2012; Hodgkinson & Innes, 2001; Lang, 2011; Ogunbode, 2013; Rideout, Hushen, McGinty, Perkins, & Tate, 2005; Schultz, Shriver, Tabanico, Khazian, & Khazian, 2004; Shephard, Mann, Smith, & Deaker, 2009; Shephard et al., 2014).

The NEP-scale includes 15 statements gauging views on five hypothesized facets of an ecological worldview: *reality of limits-to-growth*, *anti-anthropocentrism*, *fragility of nature's balance*, *rejection of exemptionalism* and *likelihood of eco-crisis* (Dunlap et al., 2000). Items are rated on a five-point Likert-type scale (from 1-Strongly agree to 5-Strongly disagree). Odd-numbered items are phrased so that agreement reflects a pro-ecological stance; even-numbered items are phrased so that agreement reflects an anthropocentric position.

While evidence supports the overall validity of the NEP-scale, there is inconsistency in the number of dimensions obtained through factor analysis and less consensus whether it measures a single construct or is multidimensional. Hence Dunlap et al. (2000) encourage researchers to factor analyze the set of NEP-items in each individual study and break these into multiple variables depending on the results of this factor analysis. Factor analysis of the NEP-scale results of this study yielded four factors with alpha coefficient values lower than that obtained when all items were loaded on the first un-rotated factor. Thus the scale was treated as uni-dimensional with an acceptable internal consistency of α=0.69 (Dunlap et al., 2000).

Self-reported environmental behaviour - This section was based on the questionnaire developed and validated for the assessment of student teachers' self-reported environmental behaviour, which identified environmental behaviour categories that reflect increasing levels of environmental commitment (Goldman, Yavetz, & Pe'er, 2006). The students were asked to state to what extent they conduct

12 environment-related activities using a Likert-type scale with five responses (from 1-never to 5-almost always). This section had an internal reliability of α=0.78. Factor analysis revealed 4 categories as presented in Table 2.

Table 2. Environmental behaviour categories that resulted from factor analysis

Behavioural category	Number of items	Example item	Cronbach α values
Environmental activism	4	Active in environmental organization	0.8
Responsible use of resources	3	Bring recyclables to local collection points	0.65
Take interest in environment in the media	2	Read articles on the environment in newspaper/ magazines	0.52
Resource conserving actions with personal financial benefit	3	Conserve water at home	0.40

Voting characteristics – This section investigated students' political participation and voting characteristics in national and municipal elections. It was based on the 2003 voting questionnaire in Arian and Shamir (2004) to which additional questions were added according to the research questions of the current study. Fourteen questions assessed: students' political tendency, support for or involvement in an environmental organization and in a political party, issues that influence their voting decisions, factors related to political party that influence their choice of party (national and municipal level), name of party they voted for in the two last elections (2006, 2009) and would vote for if elections were currently held (2011). Two additional questions specifically explored the influence of exposure to environmental topics during studies on the students' willingness to vote for a 'green' party in national and municipal elections. Questions constructed specifically for this study were evaluated independently by three political science experts for content validity, and the questions included are the outcome of complete agreement among these experts.

Demographic and background data– Students' gender, age, degree of studies, major, ethnic background (Jewish, Non-Jewish), religiousness (Secular, Traditional, Religious), country of birth, mother's level of education, socio-economic status (below middle class, middle class, above middle class). Participation in the questionnaire was anonymous.

The content-validated draft was administered as a pilot to 28 students (14 'exposed' students and 14 'unexposed' students; 18 male and 10 female). The final questionnaire was constructed according to results of the pilot study and administered towards the end of the spring semester.

Data analysis

Statistics were conducted with SPSS-14. For statistical purposes, the scores for pro-ecological statements of the NEP-section were reversed so that high scores (4-5) indicate pro-ecological orientation.

To assess students' environmental knowledge, the examples provided by the students in the environmental exposure section were coded. Incorrect examples or provision no example were scored 0; correct examples were scored 1; correct examples of more advanced level were scored 2. For each student a knowledge score

was calculated by summing the scores. Since the participants provided no more than one example for each item, and none of the students provided advanced examples, the maximum score students could accumulate was 9. For validity, coding of the examples was conducted independently by the four researchers; the outcomes were compared and discussed until agreement was reached regarding correctness and level of examples and this code was used for calculating the knowledge score.

Analytical statistics included: T-test to examine for differences in EL variables between 'exposed' and 'unexposed' groups and between gender; One-way analysis-of-variance to examine for differences in EL among students from different departments, Tukey's post hoc test to identify the source of difference and Eta-square was calculated to measure the strength of the main effect; Pearson correlations to examine relationships among EL variables; Chi squared for independency to examine differences in the tendency to vote for 'green' parties between groups ('exposed'/'unexposed', gender); Spearman correlations to determine the relationship between extent of exposure to environmental content and tendency to vote for a 'green' party.

RESULTS

Exposure to environmental topics

Students in programs that include environmental courses acknowledged significantly greater exposure to all environmental topics evaluated (Table 3). In these departments, topics that received the highest exposure (moderate to considerable, scores>3) are the classical focuses of interest in environmental science (problems, their causes, impacts and solutions), while more advanced themes (new remediation technologies) and those affiliated with sustainability discourse (environmental organizations, politics and policies, justice, and ethics) received low exposure (scores<3). 'Unexposed' students confirmed minimal exposure to all topics explored (scores<2).

Table 3. Comparison of the extent of exposure to environmental topics between 'exposed' (N=125) and 'unexposed' (N=138) students, as reported by the students.

Environmental topic	**Mean ± SD**		**t value**	**P value**
	Exposed	**Unexposed**		
Environmental problems	3.73±1.29	2.08±1.17	10.78	.010
Causes of environmental problems	3.62±1.35	1.98±1.16	10.51	.010
Sustainability or sustainable development	3.42±1.54	1.35±.70	13.76	.000
Human impact of environmental problems	3.33±1.27	1.90±1.08	9.73	.005
Solutions for environmental problems	3.32±1.37	1.75±.96	10.67	.000
Environmental laws and regulations	3.14±1.45	1.85±1.12	7.94	.000
Organizations that cope with environmental problems	2.83±1.40	1.85±.92	6.66	.000
Technologies that lessen environmental problems	2.62±1.32	1.38±.64	9.50	.000
Environmental politics and policy	2.60±1.38	1.50±.80	7.80	.000
Environmental justice	2.54±1.35	1.63±.95	6.30	.000
Environmental ethics	2.42±1.23	1.70±.97	5.26	.000
Total mean	**3.05±1.11**	**1.72±.71**	**11.38**	**.000**

Of seven sources of influence on environmental knowledge, 'exposed' students ranked university education highest (5.43±2.20) and radio lowest (2.47±1.39), whereas 'unexposed' students ranked university education lowest (3.07±1.95) and television highest (5.38±1.68).

Together, the minimal exposure to environmental content reported by 'unexposed' students, along with their low rating of the university as a source of influence, indicate that if environmental perspectives are brought up in class lectures and discussions, such exposure is not consciously acknowledged by those students studying in non-environment-related departments. These results also indicate that if environmental activity is conducted on campus independent of studies, as an extracurricular source for raising awareness and involvement (for example, 'Green Campus' initiatives), this has no influence on students that study in non-environment-related departments.

The total mean for environmental exposure items was compared among students according to their department (Figure 1). The extent of exposure to environmental content was significantly and strongly related to the students' academic program ($F_{(7,253)}$=45.99, p<.001, η^2=.56). Tukey's post hoc test created three groups: (a) the greatest exposure (moderate to considerable) occurred in the departments 'Natural Resources and Environmental Management' and 'Geography and Environmental Studies'; (b) Land-of-Israel Studies, Biology and Law students acknowledged low exposure (<3); (c) the lowest exposure (minor to none) occurred in the Communications, Business Management and Special Education programs (Fig 1).

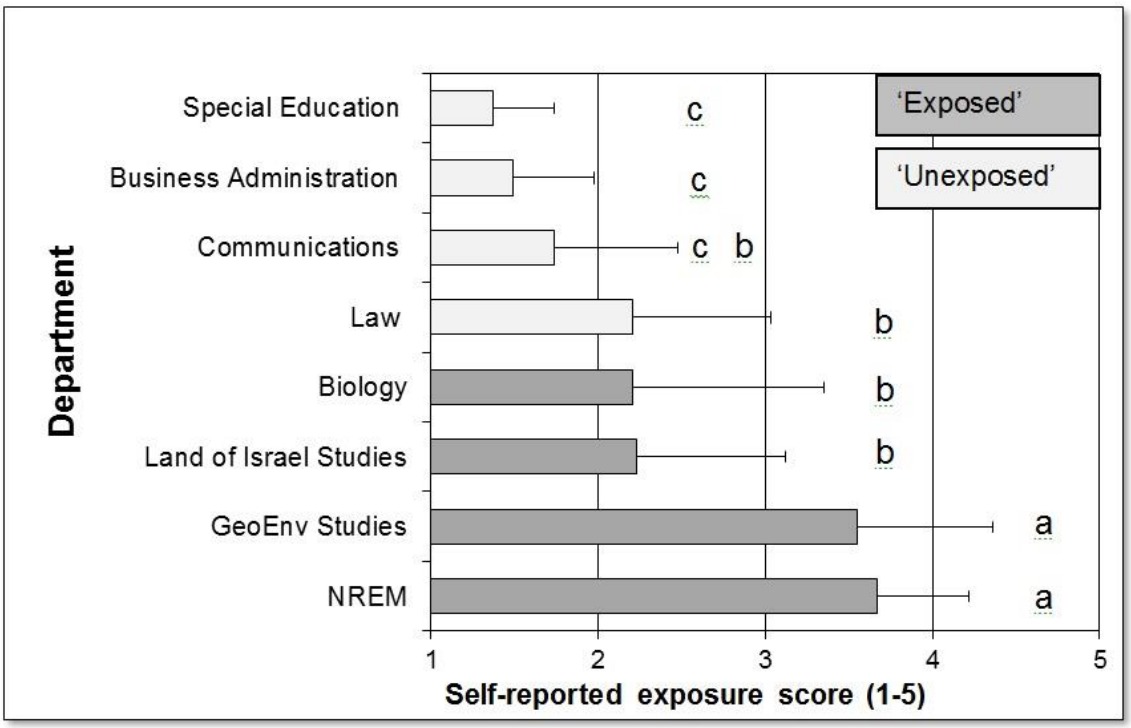

Figure 1. Extent of self-reported exposure (total mean for exposure inventory) to environmental topics according to academic program. Groups a, b and c are the result of Tukey's post hoc test.

Environmental literacy characteristics

Knowledge - The examples students provided for items in the exposure section reflect their knowledge of these topics and were therefore used as a measure of their knowledge: Correct examples indicate more knowledge, incorrect examples or

providing no example indicates less or no knowledge of the respective topic. The percentage of correct examples provided by 'exposed' students for all environmental topics was significantly higher than that of 'unexposed' students (Table 4). It is noteworthy that the decrease in correct examples parallels the decrease in degree of exposure shown in Table 3. These results indicate the relevance of exposure to environmental content within the framework of studies to the students' knowledge.

Table 4. Comparison of the percent of correct examples provided for each environmental topic between 'exposed' and 'unexposed' students.

Topic	**% of correct examples**	
	Exposed (N)	**Unexposed (N)**
Environmental problems	54.4 (68)	12.5 (17)
Causes of environmental problems	43.2 (54)	5.9 (8)
Solutions for environmental problems	35.2 (44)	5.9 (8)
Organizations that handle environmental problems	31.2 (39)	8.1 (11)
Environmental laws and regulations	25.6 (32)	2.2 (3)
Technologies that reduce environmental problems	20.8 (26)	0.7 (1)
Environmental politics and policy	10.4 (13)	0.7 (1)
Environmental justice	8.8 (11)	1.5 (2)
Environmental ethics	4.8 (6)	0.7 (1)

Mean environmental knowledge scores calculated for students from different departments are presented in Figure 2. Results indicate that the knowledge measure was significantly related to the students' academic program ($F_{(7,253)}$=16.12, p<.001, η^2=.31). Tukey's post hoc test showed that 'Natural Resources and Environmental Management' and 'Geography and Environmental Studies' majors scored higher than Biology, Law, Communications, Business management and Special Education majors (see grouping in Figure 2).

Dispositions - Mean scores for the NEP-items were calculated according to academic programs. The relatively high scores demonstrated by all the students (>3.5) indicate that the majority of students expressed pro-environmental dispositions and ecologically supportive worldviews. The most ecologically supportive attitudes were demonstrated by biology students (3.87) while the least supportive were demonstrated by Law students (3.54). The difference between these two groups is the source for the significant relationship found between dispositions and department ($F_{(7,253)}$= 2.70, p<.05, η^2=.07).

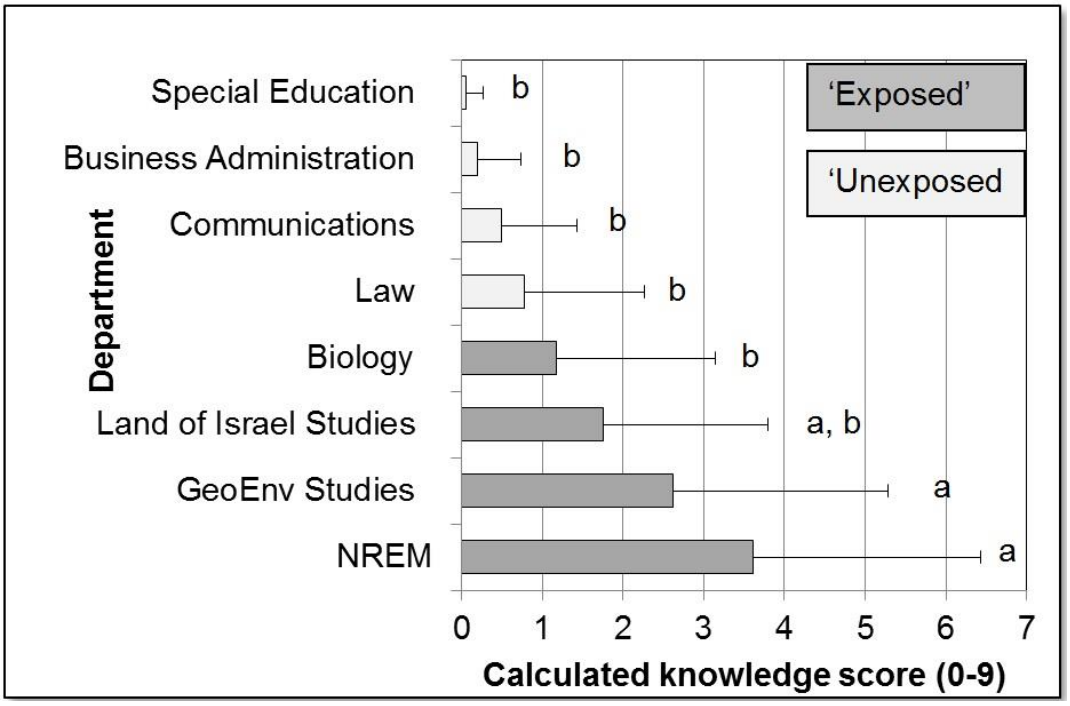

Figure 2. Mean calculated knowledge score (maximum value can be 9) for environmental topics according to department of major. Groups a and b are the result of Tukey's post hoc test.

Table 5. Comparison of the mean activity level scores for each environmental behaviour category between 'exposed' and 'unexposed' students.

Environmental behaviour category	Mean ± SD		t value	P value
	Exposed	Unexposed		
Resource conserving actions with personal financial benefit	4.50±.68	4.24±.67	3.11	.814ns
Support of responsible use of resources	3.77±.79	2.97±.91	7.56	.032
Take interest in environment in the media	3.60±.87	2.75±.82	8.13	.97ns
Environmental activism	1.83±.83	1.27±.43	6.86	.000

Self-reported environmentally responsible behaviour - Table 5 compares the mean activity-level scores for each behaviour category between 'exposed' and 'unexposed' students. The category conducted most frequently (often to almost always) was *resource-conserving actions with personal financial benefit*, whereas *environmental activism* was conducted least frequently (seldom to never). 'Exposed' students reported, as could be expected, significantly greater involvement in the behavioural categories *support of responsible use of resources* and *environmental activism* as compared to their 'unexposed' counterparts. These are behavioural categories which require some environmental commitment. As could also be expected, the two groups did not differ in their involvement in *resource-conserving actions with personal financial benefit*- behaviours for which the motivation may be financial and not environmental. The groups also did not differ in the behavioural category *take interest in the environment in the media*.

Comparison of total means for the behaviour inventory according to academic program (Figure 3) indicates a significant relationship between department and involvement in pro-environmental behaviour ($F_{(7,252)}$=18.53, p<.001, η^2=.34). Tukey's post hoc indicates that students in the departments 'Natural Resource and Environmental Management', 'Geography and Environmental Studies' and Biology reported significantly greater involvement than students in the departments Business Management, Law, Communications and Special Education. Students in Special Education reported significantly less involvement in pro-environmental behaviour than those in Land-of-Israel- Studies and Business Management (see grouping in Figure 3).

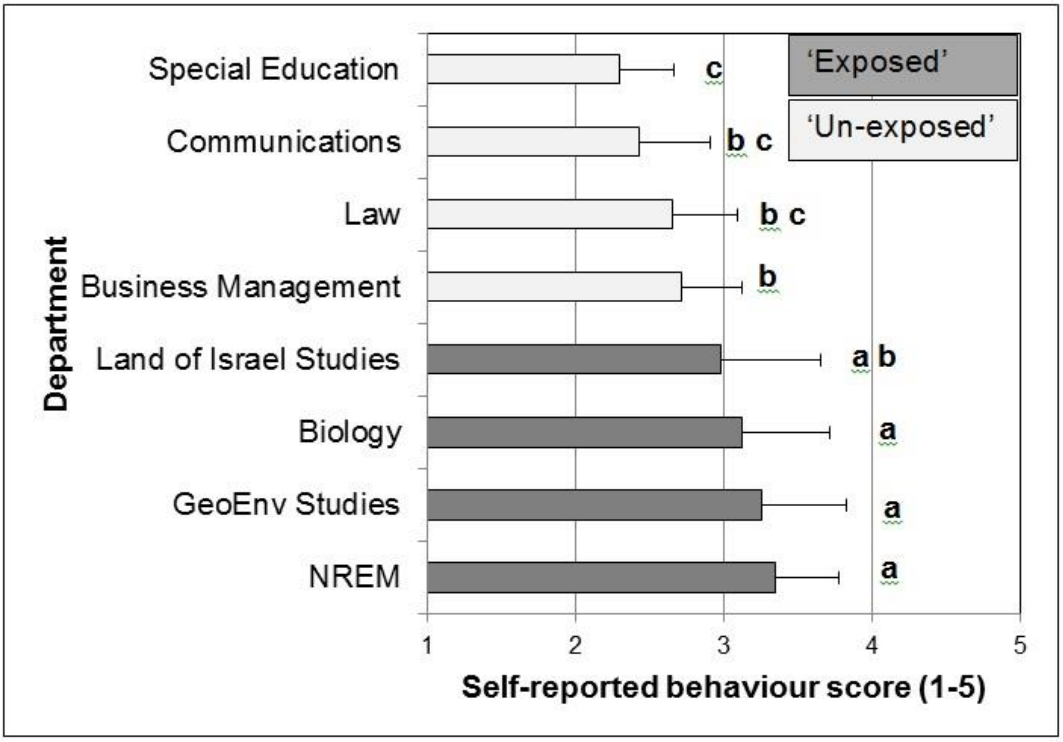

Figure 3. Comparison of total means for behaviour inventory among students according to their academic program. Groups a, b and c are the result of Tukey's post hoc test.

The students were also asked if they support, are members of, or have an active role in environmental organizations. A significant difference was found in the distribution of responses between 'exposed' and 'unexposed' students (X^2 =22.8, p<.001): 70.4% of the 'unexposed' students stated that they do not support and are not members of such organizations, 26% support but are not members, and only 3.6% are members. In comparison, 44% of the 'exposed' students stated that they do not support and are not members in environmental organizations, while 43.2% support them, 8% are members, and 4.8% are members with active roles.

Correlations among EL variables - Significant correlations (p<.01) were found among the extent of exposure, environmental dispositions and all categories of pro-environmental behaviour. Relatively high correlations (Pearson correlation values >.3) were found between the extent of exposure and the behavioural categories *Take interest in environment in the media* (.421, p<.01), *Environmental activism* (.344, p<.01), and *Responsible use of resources* (.315, p<.01).

Voting characteristics

When students were asked to rank seven issues (addressing aspects such as: economy, social policy, state and religion, peace, corruption, environment) that influence their decision-making in political voting, 'exposed' students ranked environmental issues as the second most influential after social policy, while 'unexposed' students ranked environmental issues the lowest.

The majority of students (89% of the sample) in both groups stated preference for a large or medium size party with a broad political platform which includes an environmental agenda as opposed to a small party with an environmentally-focused platform ('green' party). Nonetheless, results presented in Table 6 show that students who are exposed to environmental content during their studies state that as a result of such exposure they are significantly more inclined to vote for a 'green' party in both national (X^2=24.6, p<.001, *V*=.31) and municipal elections (X^2=13.08, p<.01, *V*=.23). This is supported by the significant correlations found between exposure to environmental content during studies and the students' willingness to vote for a 'green' party in national (Spearman correlation value .33, p<.01) and municipal elections (Spearman correlation value .29, p< .01).

Table 6. Comparison, between 'exposed' and 'unexposed' students, of the distribution (%) of their predisposition to vote for a green party in national elections (a) and municipal elections (b) consequent upon their exposure to environmental content during studies.

		% of responses	
	Possible choice	**Exposed students**	**Unexposed students**
a) To what extent, as a result of exposure to environmental topics during your studies, will you consider voting for a "green" party in national elections?	High extent	22.6	7.4
	Certain extent	43.5	30.9
	Limited extent	15.3	30.1
	Not at all	18.5	31.6
b) To what extent, as a result of exposure to environmental topics during your studies, will you consider voting for a green "party" in municipal elections?	High extent	25.8	12.9
	Certain extent	40.3	31.8
	Limited extent	18.5	31.1
	Not at all	15.3	24.2

In addition to exploring the relationship between academic exposure to environmental content and willingness to vote for 'green' parties, the students' (self-reported) voting choices in the last two elections (2006, 2009) and their hypothetical votes if elections were conducted at the time of the study (2011) were also investigated. Table 7 compares the percentage of votes given by both groups to the two 'green' parties. Although not statistically significant, the increasing trend of supporting 'green' parties is more pronounced in 'exposed' students than in their 'unexposed' counterparts.

Table 7. The percentage of votes given by 'exposed' and 'unexposed' students to the two "green" parties in the 2006 and 2009 elections, and their hypothetical votes if elections were held in 2011.

		% of votes		
Name of party		**2006 elections**	**2009 elections**	**Hypothetical 2011 elections**
The Greens	Exposed group	1.6	2.4	4
	Unexposed group	.7	1.5	2.2
The Green Movement	Exposed group	.8	12	17.6
	Unexposed group	0	0	0

No differences were detected between men and women in their environmental behaviour, environmental attitudes or predisposition to vote for a 'green' party. The tendency to support such parties was also found not related to economic status.

DISCUSSION

Students' environmental literacy characteristics

This study aimed to explore if students' environmental literacy and citizenship are related to their exposure to environmental content in HE, and whether 'exposed' students are more inclined to include environmental considerations in their political participation.

Results point to a relationship between students' academic major and their EL characteristics: students who majored in environment-affiliated departments displayed a higher level of EL compared to other students. This is reflected, as could be expected, in their knowledge of environmental topics (see Figure 2), but more importantly in their involvement in environmentally responsible behaviour (see Figure 3). These results correspond to other studies which have found that majors in environment-related fields demonstrated a greater level of environmental knowledge and were more active in pro-environmental behaviour as compared to students majoring in other fields such as engineering, statistics or business administration which are technologically or economically-oriented (Arnocky & Stroink, 2011; Fusco et al,. 2012; Lang, 2011; Shephard et al., 2014; Tikka et al., 2000; Yavetz, Pe'er, & Goldman, 2011).

A question raised in the literature addresses factors that lead to these differences: do the differences in EL between environment-related majors and other majors reflect a transformative influence of education (i.e. mediating effect of studies) or do they reflect the students' predisposition, which leads them to choose environment-related studies? Providing an answer to this question is pertinent to designing HE programs effective in educating environmentally-responsible graduates. Results obtained by Ewert and Baker (2001) led them to suggest that education and academic major can play mediating roles in the development of an individual's set of beliefs and attitudes toward the environment: The main ideas of their major, embodied in the content, discourse, reading material and assignments the students are exposed to during their studies, transmit a worldview. Conversely, Sherburn and Devlin (2004) claim that students choose their major and courses based on their prior interests and beliefs. The results obtained in this study point to

the contribution of both mechanisms, and suggest that the mediating effect of studies is significant. This is clarified in the following.

Several of the results support the influence of studies on the students' EL characteristics, in the university in which the study was conducted:

(a) The significant relationship between students' major and extent of their self-reported exposure to environmental content, with the highest exposure occurring in the 'Natural Resources and Environmental Management' and 'Geography and Environmental Studies' departments, and limited to no exposure occurring in Communication, Business Management and Special Education departments (see Figure 1).

(b) The positive relationship between the knowledge level of students in different departments (see Figure 2) and extent of their exposure to environmental content (see Figure 1), in particular, points to the relevance of exposure to environmental content within the framework of studies to the students' acquisition of knowledge in this domain. Furthermore, the decrease in correct examples provided for the different environmental topics (see Table 4) parallels the decrease in degree of exposure to these topics (see Table 3). These results further support the relevance of exposure to environmental content within the framework of studies to the students' knowledge.

(c) The high rating students from environment-related departments reported for the contribution of academic studies to their environmental knowledge as compared to the limited contribution acknowledged by other students.

(d) The high correlations found between academic exposure to environmental content and students' involvement in actions that reflect environmentally responsible behaviour, especially those reflecting greater environmental commitment (Goldman et al., 2006).

Together, these findings support the relevance of exposure to environmental content within the framework of courses to components of the students' EL; i.e., studies are a mediating factor in these students' environmentalism. However, the results do not rule out that prior interests (i.e. environmental orientation) may have led these students to choose these particular programs and may also influence their tendency for pro-environmental action.

The departments in which students' displayed the highest level of environmental knowledge and reported the greatest extent of involvement in activities that reflect environmentally responsible behaviour are 'Natural Resources and Environmental Management' and 'Geography and Environmental Studies'. The 'Natural Resources and Environmental Management' program addresses aspects of environmental management, and the participants testified to their high exposure to environmental topics. Nevertheless, the mean knowledge score indicates their ability to provide examples for less than a half of the environmental subjects investigated. Likewise, these students were not as involved in environmentally responsible behaviour as might be expected. One explanation for the modest involvement in pro-environmental behaviour is that most of the students in this program (MA degree) are working parents in addition to their studies; circumstances that may limit their availability for more extensive involvement in environmental activism. This may comprise a "situational factor" (Hines, Hungerford, & Tomera, 1986/7) or "external factor" (Kollymus & Agyeman, 2002) as a barrier to pro-environmental behaviour. Nonetheless, greater commitment to pro-environmental behaviour could be expected from students in a graduate program on environmental management, raising questions as to the incorporation of environmental participation requirements and opportunities as integral components of the academic program, which could contribute to more involved graduates.

Geography is one of the main disciplines that traditionally incorporate environmental content, addressing the physical and social-cultural-economic-

political aspects of environmental issues (Ballantyne, 1999; Reinfried & Hertig, 2013; Van Petegem, Blieck, & Van Ongevalle, 2007). In a survey conducted in a large British university, which investigated curricular areas in which the students were exposed to sustainable development (SD) and sustainability, 63% of the students reported geography. Interestingly, less than 8% reported environmental science (Kagawa, 2007). Results of the present study also indicate that in the university in which it was conducted, geography is a major area that deals with environmental content, including SD and sustainability. However, these students' knowledge level and involvement in pro-environmental behaviour were lower than could be expected in view of the extent of exposure to environmental content they attested to, thus raising questions regarding the educational approach.

The EL characteristics of biology majors are especially intriguing, and provide insight regarding the way the environmental perspective is (not) incorporated into science studies. Biology majors exhibited the most environmentally supportive dispositions, and their extent of involvement in environmentally responsible behaviour was similar to that of 'Natural Resources and Environmental Management' and 'Geography and Environmental Studies' majors (see Figure 3). These results are in line with other studies which have found that biology/natural science majors, compared to students in other fields, are characterized by more pro-environmental beliefs, concern and attitudes, (Anderson et al., 2007; Ewert & Baker, 2001; Harraway et al., 2012; Hodgkinson & Innes, 2001; Shephard et al., 2013; Tikka et al., 2000), and greater involvement in pro-environmental behaviour (Fusco et al., 2012; Goldman et al., 2014; Tikka et al., 2001). Regarding the mediating influence of studies versus students' predisposition, these results of the biology majors support the pro-environmental tendency which characterizes students who elect biology studies and the importance of the students' pre-existing environmental orientation to their choice of academic focus (Anderson et al., 2007).

On the other hand, these students report that they received limited exposure to environmental subjects within their academic studies (see Figure 1), and their knowledge of these subjects was low (see Figure 2). The limited exposure and environmental knowledge of these students raise questions regarding the approach to addressing the topic of 'environment' in science education, which is recognized as one of the major subjects in which environmental content and education can be incorporated (Dillon, 2002; Gough, 2013; Van Petegem et al., 2007). Environmental issues are not purely scientific, but multi-dimensional and situated at the science-society interphase. These issues cannot be understood or addressed by disconnecting problems in the ecological-environmental domain from the social, economic and political dimensions that shape human use of nature, and thus influence human-environment interactions (McKeown-Ice & Dedinger, 2000; UNESCO, 2002). Educational programs that limit their focus to concepts and processes in the natural sciences are insufficient in developing students' ability to analyze and comprehend the complexity of the environmental-social-moral issues of life. McKeown-Ice and Dedinger (2000) claim that it is mistakenly assumed that "*once the science of an environmental issue is understood the students can simply apply their knowledge of today's society and create a reasonable solution*" (p. 37). They argue that such an approach is mistaken because it assumes that the students can identify and relate relevant principles from the social sciences acquired from previous learning. Along this line, David Orr, in his discussion on the challenges for educating a society that embraces sustainable values and life-styles, critiques the disconnect existing in HE between study of nature and study of humans, and the tendency of such institutions to isolate ecology within the departments of biology, as a subject separate from social sciences, humanities or the professions (Orr, 1992). Biology students' environmental knowledge, found in the present study, reflects these issues raised in the literature and conclusions reached by researchers that

ecology studies (study of ecological systems of the natural environment) are not synonymous with environmental education or education for SD, which involve multidimensional study of the environment (Goldman et al., 2014; McKeown-Ice & Dedinger, 2000; Yavetz, Goldman, & Pe'er, 2014). The practical implication of the findings is that providing a multidimensional perspective of the environment (without compromising the scientific component) to biology majors, who bring into their studies a pro-environmental orientation and tendency for involvement in pro-environmental behaviour, will enable academic education to realize the full environmental potential of these students and prepare them as influential environmental citizens and professionals in society.

Voting characteristics and involvement in civic society

The second research question dealt with the relationship between academic major and political participation, specifically the inclusion of environmental considerations in decision-making as voters and involvement in environmental organizations. Students in environment-related departments rated environmental issues higher as factors that influence their choice of political-party, declared greater willingness to vote for environmentally-oriented parties and reported increased support for such parties in the 2006 and 2009 elections compared to their unexposed counterparts. These students were also more active in environmental organizations, i.e. they are more involved in environmental activism via the political channel of citizen society. Roth (1992) classifies political action as behaviour that characterizes an individual who has advanced from the *nominal* level of EL to the more developed *functional* level. Based on Roth's framework, the significantly greater inclusion of environmental concerns in electoral decision-making demonstrated by students who were exposed to environmental content during their academic studies, and their greater involvement in environmental organizations, indicate the higher level of EL attained by these students compared to their unexposed counterparts. Dobson (2010) refers to use of the political arena as a means for promoting sustainable management as conduct that typifies environmental citizenship (EC). Based on Dobson's framework, findings of this study indicate that environment-related majors display greater EC. Based on both frames for analysis, findings point to a relation between students' academic major and their environmentalism. The higher level of their environmental literacy and citizenship will, hopefully, influence the capacity and inclination of these graduates to incorporate a sustainability perspective in their conduct as citizens, professionals and political participants (whether this is limited to voting or includes more extensive political participation).

Environmental issues are political by nature - "*the symptoms of environmental deterioration are in the domain of natural sciences, but the causes lie in the realm of the social sciences and humanities*" (Orr, 1992, p. 146). Therefore, a political response is required of citizens, be it negotiation, protest or other political action (De-Shalit, 2004). While the theoretical literature addresses political action as one category of environmentally responsible behaviour (Dobson, 2010; Roth, 1992), and despite acknowledgement of the important role of citizens in influencing environmental policy through their participation in political channels, empirical studies that have investigated the environmental behaviour of different target populations or the influence of educational interventions on behaviour, have not addressed political participation as a component of pro-environmental behaviour. This study is a step in that direction.

Despite the differences in voting choices between environment-affiliated majors and other students, findings also indicate a gap between the declarative support of environment-affiliated students for the environment and their practice: although

these students rated environmental issues second among factors that influence their vote, and although 60% of them stated that as a result of exposure to environmental content during studies they would consider voting for a 'green' party, the percentage of votes for such parties was low (see Table 7). These results, along with their preference for a large party that incorporates an environmental agenda in a broad political platform (as opposed to small party with narrow environmental platform), mirror the current local political discourse in which environmental issues are still marginal compared to economy, society and security (Blander, 2004b; OECD, 2013).

Another political means for promoting responsible environmental management is citizen society (Blander, 2007b). In this aspect, also, findings highlight that despite the greater declarative support and involvement of environment-affiliated majors in environmental organizations as compared to other students, their participation in practice is low and below expectation. Limited involvement may be related to occupational and/or family obligations which characterize most of the HE students in Israel. These are "situational factors" which may play as constraints to more pro-environmental behaviour (Kollymus & Agyeman, 2002). Future study of the same participants may provide indication of the long-term effects of university studies on their participation in promoting sustainability as citizens and professionals.

Clearly, this research has limitations. One of them is the method for gauging students' environmental knowledge. In this study, environmental knowledge was assessed by short answer method (Stiggens, Arter, Chappuis, & Chappuis, 2004): participants were asked to provide written examples for environmental topics. This can be critiqued as limited for assessing higher cognitive levels of knowledge such as conceptual, procedural or skills. It is necessary to keep in mind the aim of the knowledge assessment in this study, which was to assess the range of content knowledge among students who study in diverse disciplines. It is generally agreed that selected response or short answer options (retrieving and recalling relevant knowledge) are good at assessing the mastery of discrete elements of knowledge (Stiggens et al., 2004), which was the aim of this study. Of these two options, the researchers opted for the open response (short answer) method, based on its open approach and the assumption that respondents with limited knowledge will provide no example or very basic examples, while those with more knowledge will provide more diverse and advanced examples. Thus, the open response approach was perceived more sensitive in gauging differences among the different majors.

Another limitation is that the study addressed students at one time point - during their last semester of studies. Future research aimed at elucidating the influence of college major on attributes of students' environmental literacy would benefit from comparison of students between early stages and later stages of their studies.

Implications of the study

Findings of this study support that towards the end of university studies, environment-affiliated majors display greater environmentalism than students in non-environment-affiliated programs. Results also indicate that two interplaying factors may underlie this relationship: (a) a trans-missive influence of studies via the content, major ideas and philosophies of the studied discipline, and (b) the predisposition and orientation of the students, which influence their choice of studies. Appropriate planning that takes into consideration these processes can contribute to incorporating sustainability into environment-oriented academic programs in a manner that will be effective in impacting the environmental literacy and citizenship of environmentally-oriented students and laying the foundations towards realizing their "environmental potential" in society. Toward this end, further research conducted in a longitudinal paired pre-test - post-test design on a

larger sample of students would provide more insight into the changes occurring in the students majoring in different programs throughout their university years.

In view of the expectation that HE rises to the challenge of preparing *all* graduates equipped to bring a sustainability perspective into their professional function (The Talloires Declaration, 1990), findings also point to the necessity to incorporate an environmental perspective within non-environment-related programs.

An extracurricular means for exposing and involving students in sustainability issues is the environmental activity conducted on campus within the 'Green Campus' framework. The university in which the study was conducted is nationally certified as a 'Green Campus' and conducts diverse environmental activities on campus (http://yarok.haifa.ac.il/index.php/welcome). The EL-characteristics of students studying programs in non-environment related departments indicate that in this university, the potential of this channel, as one component of the academic experience which can influence the students' environmentalism, has yet to be realized.

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