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Student Self-Reported Learning Outcomes of Field Trips: The pedagogical impact

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In this study, we used the classification and regression trees (CART) method to draw relationships between student self-reported learning outcomes in 26 field trips to natural environments and various characteristics of the field trip that include variables associated with preparation and pedagogy. We wished to examine the extent to which the preparation for the field trip, its connection to the school curriculum, and the pedagogies used, affect students' self-reported outcomes in three domains: cognitive, affective, and behavioral; and the extent the students' socioeconomic group and the guide's affiliation affect students' reported learning outcomes. Given that most of the field trips were guide-centered, the most important variable that affected the three domains of outcomes was the guide's storytelling. Other variables that showed relationships with self-reported outcomes were physical activity and making connections to everyday life—all of which we defined as pedagogical variables. We found no significant differences in student self-reported outcomes with respect to their socioeconomic group and the guide's organizational affiliation.

Keywords: *Field trips; Natural environments; CART; Learning outcomes*

Field trips to natural environments have been studied to a less extent than other out-of-school settings such as museums. In the last few years, we have conducted a large-scale study that encompasses many aspects related to these unique learning environments. In the outdoors, students can have direct experience with natural phenomena. Abstract ideas that are taught in school can be sensed by vision, touch, smell, and sound. Students can see and hear bubbles of methane gas which is released

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from the ground in an area that was a swamp in the past. One can throw a lighted match into the bubbling liquid and see it burns like a stove flame. The smell cannot be ignored, and all these sensory experiences can be the preamble for discussing the ecological consequences of the drainage project of what was once a unique wetland habitat. In a hike in the lime stone mountains of the Galilee, one can see an assortment of Karstic formations caused by the dissolution of the soluble lime stone. This includes sinkholes, reappearing springs, poljes, and stalactite caves. In school, students can drop hydrogen chloride on a lime stone, learn about the chemical reaction, and make the analogy. The teacher can show pictures or videos or let the students surf the web to find other examples for similar phenomena. However, seeing such a concentration of geological formations in a few hours' walk is more tangible and impressive even in comparison with a good demonstration in school. Two decades ago Orion (1993) and Orion and Hofstein (1994) pointed to a number of challenges related to learning in the outdoors and suggested a learning sequence that includes the classroom and the outdoors. Their and other scholars' studies from various out-of-school settings pointed to the importance of good preparation of the students (Anderson, Kisiel, & Storksdieck, 2006; Falk & Dierking, 2000) to the success of the field trip. A huge body of literature points to other variables that affect the field trip's learning outcomes such as active and hands-on learning, having opportunities for reflection, and developing one's identity, values, and beliefs (Bell, Lewenstein, Shouse, & Feder, 2009).

However, since field trips to natural environments, in general, are considered as enrichment to classroom teaching, and as their majority is facilitated by informal educators affiliated with environmental organizations rather than by teachers, typically, pedagogical concerns are only secondary to other considerations of schools, teachers, and guides. In a previous study, we have attempted to provide the field with coherent framework for designing and assessing field trips to natural environments (Morag & Tal, 2012). This Field Trips in Natural Environments (FiNE) framework addressed the main aspects of the field trip: planning and preparation, pedagogy, activity, and outcomes in two domains: the cognitive and the affective. In that study, we collected data on the features of the field trips from 22 field trips we observed and documented. In a follow-up study, we added 40 field trips to that sample (Tal, Lavie Alon, & Morag, 2014). We used a different approach to identify exemplary field trips based on our observations and student reported outcomes in interviews. Although these studies enabled us to point to good practices as well as poor ones, the data were limited to what the observers could capture and to a limited number of in-depth interviews.

In addition to careful analysis of the interviews and observations, we intended, as well, to examine the explanatory power of the main variables we pointed to in the FiNE framework. This article's contribution is by focusing on the relationship between the field trip characteristics and student self-reported outcomes. Our goal in this study was to analyze the field trip outcomes in terms of: knowledge acquisition, pro-environmental attitudes, and tendency or commitment to environmental action with respect to the preparation for the field trip, the connections to the school curriculum, and the pedagogy. In our previous study, we asserted that students' socioeconomic status (SES) and their prior outdoor education programs could affect their self-reported outcomes as well. Given the relatively limited opportunities students from low SES get to visit nature parks and enjoy leisure activities in the outdoors, we believed the difference between middle class schools and schools that serve lower SES population should be investigated. We addressed this issue as well as the issue of who guided the field trip.

The research questions that guided this study were:

(a) What components of the field trip best affect self-reported outcomes in three domains: cognitive, affective, and behavioral?
(b) To what extent do the students' SES affect the students' self-reported outcomes?
(c) To what extent do facilitators from different groups (organizations, teachers) affect the students' self-reported outcomes?

Our study followed up 26 field trips in natural environments of students in their 4th to 9th school year (age 9–14) from all across the country.

Theoretical Underpinning

Field trips are a good thing to have. The international research literature in many fields such as science, environmental, and geographical education points to the many merits of field trips. They allow students to experience different learning environments such as science museums, zoos, nature centers, and art museums that expand their education beyond the curriculum and help them become science- and environment-literate and well-informed citizens. Field trips provide enrichment in various areas and break the daily school routine. They allow students to develop their social skills, their motoric skills and enhance motivation to learn and develop individually. There is much evidence related to student learning, when field trips are properly arranged and executed. Students learn new things, though not necessarily in the way school-based structured learning is perceived (Ballantyne & Packer, 2009; Dillon et al., 2006; Orion & Hofstein, 1994). They often remember field trips many years after their occurrence and can point to things they remember or how the field trips affected their personal development (Falk & Dierking, 1997). Field trips to museums and science centers allow hands-on experiences and free choice learning. Out-of-school environments enable students interact socially, and some of these interactions, if properly designed can promote various types of learning (i.e. conceptual, social, etc.) and skill development (Falk & Dierking, 2000; Tal et al., 2014). Research on learning outcomes, which is relevant to our study, comes from two main research fields—out-of-school learning and environmental education. It is widely acknowledged that cognitive outcomes are only part of the possible learning outcomes of museum visits (Falk & Dierking, 2000; Schauble et al., 2002). For example, in their study of multiple learning outcomes of museum visits, Bamberger and Tal (2008) pointed to cognitive as well as non-cognitive outcomes. Content-related outcomes included acquisition of new knowledge and making connection to prior knowledge; and the non-cognitive ones included social interactions related to learning, interest and motivation. They found that in the content domain, the main outcomes were the concrete experiences the exhibits allow, and prior connection and everyday knowledge of what was experienced in the museum. In the social domain, social interactions among students and with the guide were widely reported by students, and finally, the outcomes of personal relevance and willingness to visit the museum again were widely reported in the affective domain. In environmental education, that often takes place in out-of-school settings too; Mintz and Tal (2014) offered extensive literature reviewing learning outcomes, and pointed to 11 learning outcomes that included gaining knowledge, developing thinking skills, changing attitudes in several domains, motivation in some areas, and the emotional effect, too. Brody (2005) pointed to sensory experiences, deep thinking, and developing a range of feelings including beliefs, values, and attitudes, and Rickinson et al. (2004, p. 6), who reviewed studies on outdoor learning around the world, indicated:

> There is substantial research evidence to suggest that outdoor adventure programs can impact positively on young people's attitudes, beliefs and self-perceptions—examples of outcomes include independence, confidence, self-esteem, locus of control, self-efficacy, personal effectiveness and coping strategies, interpersonal and social skills—such as social effectiveness, communication skills, group cohesion, and teamwork.

The research literature points to shortcomings of field trips as well and to challenges that quite often undermine their effectiveness. Field trips are expensive. Schools need to pay for transportation, entrance fee, and professional guides. Teachers are concerned with student safety. They do not feel capable to take them to 'unknown' or 'less-known' settings (Dillon et al., 2006). Teachers and schools prefer to use professional guides rather than teaching themselves, which quite often makes them passive or they change their role to 'caretakers' or 'discipline keepers' (Lavie Alon & Tal, 2015; Tal & Morag, 2013). The accumulated literature on the advantages and limitations of field trips provides us with many examples to draw upon, but the majority of this bulk of literature comes from specific sites, such as a single museum, zoo, or an exhibit, and focuses on a small number of participants. Only few studies followed up a number of field trips in one site or several sites and even fewer studies followed a large number of field trips and aimed to draw conclusions based on quantitative data (Tal et al., 2014). One exception is the accumulated work of Roy Ballantyne and Jan Packer from Australia, who elaborate on our understanding of field trips to natural environments by drawing on large databases obtained by studying a range of field trips and looking at students' views, students' learning, and pedagogical approaches (Ballantyne & Packer, 2002, 2006, 2009). In this study, we continue this line of research in another part of the world. Aiming to address the small amount of explanatory studies in the field, we followed up a relatively large number of field trips (26) to natural environments, and collected data from 566 participants.

The FiNE framework we developed, based on the research literature and on our own findings, points to variables that affect the field trip design and enactment. It is built in several layers, each including a few variables. The main categories are: preparation and planning, pedagogy, activity, and outcomes (Morag & Tal, 2012). The sociocultural theory (Jakobsson & Davidsson, 2012) and the contextual model of learning in museums (Falk & Dierking, 2000) have influenced us in developing the framework, as well as the bulk of research carried out in various out-of-school settings. For example, work published on (1) the importance of good preparation (Bell et al., 2009; Jarvis & Pell, 2005); (2) teacher–guide collaboration (Bitgood, 1989; Tal & Steiner, 2006); (3) the connection between the field trip and the school curriculum (Bamberger & Tal, 2008; Dillon et al., 2006); (4) connection to everyday life (Brody, 2005); (5) active and free choice learning (Ballantyne & Packer, 2009; Bell et al., 2009); (6) physical activity (Brody, 2005; Rickinson et al., 2004); and student outcomes (Ballantyne & Packer, 2006, 2009). Field trips have multiple outcomes in the cognitive, affective, and social domains: students learn things or understand them differently that in traditional classroom environments, they interact with each other, they enjoy, experience anxiety, and even discomforts, and they often change their attitudes toward science, natural history, or toward the environment in general. They change or develop beliefs and new behavior (Ash & Wells, 2006; Bamberger & Tal, 2008; Bogner, 1998, 1999; Falk & Dierking, 2000; Knapp & Barrie, 2001). Based on our previous study of exemplary field trips, we modified FiNE so the activity layer is now part of the pedagogy, and a third outcome—behavior—was added. Table 1 presents the modified list of variables.

Although we applied this framework on analyzing 60 field trips (Morag & Tal, 2012; Tal et al., 2014), the main limitation was the small sample of students from whom we documented learning outcomes through interviews. In this study, we looked at how we can use the framework in a large-scale study with a diverse student population, as detailed in a following section.

Method

We collected data from 26 field trips. Professional guides, employed by two environmental organizations, facilitated 17 field trips, and school teachers guided the other

Table 1. The FiNE framework (modified)

Layer		Component
Planning	1	Classroom preparation
	2	Teacher–organization coordination
	3	Connection to curriculum
Pedagogy	1	Using the environment
	2	Making connections to the curriculum
	3	Making connections to everyday life
	4	Collaboration between the teacher and guide
	5	Encouraging social interactions
	6	Enhancing physical activity
	7	Active learning
Outcomes	1	Cognitive: knowledge and understanding
	2	Affective: feelings, attitudes and beliefs
	3	Behavioral: pro-environmental

nine. In an unpublished survey that we conducted for the Chief Scientist of the Ministry of Education, we found that most one-day field trips in Israel are provided to students of the upper elementary and the junior high school classes. Therefore, in this study, we focused on students in their 4th–9th year in school. All the field trips took place in the outdoors, in nature parks and nature reserves in the central and northern parts of the country.

Participating Students

We selected the participating schools to represent different SES groups in Israel: urban schools, developing towns, suburban communities, and countryside schools (mainly kibbutzim). In Israel, urban schools can be excellent schools or mediocre, depending on many factors which do not necessarily correlate with the SES of the students' families. The strongest population can be found in urban schools as well as more underprivileged population. However, in our study, the schools represented in this category are of middle class population. Developing towns are characterized as more diverse in terms of students' ethnicity, with many immigrants from all over the world and lower SES. These schools have a bigger proportion of first and second generation immigrants, and students from unprivileged families. Suburban communities are more homogeneous and affluent, and countryside schools are usually smaller and characterized by having more access to outdoor education. Some of their students come from farming communities. Table 2 presents the participating school groups, their class level, and the field trips' guides.

Guides and Teachers

In Israel, the vast majority of field trips are guided by professional guides. In the elementary school (years 1–6), only a very small minority of field trips are guided by schoolteachers, usually a specific teacher who has a background in outdoor education. High schools and junior high schools employ special teachers who teach the subject 'Field, Nation, Society' (FNS). The goals of FNS are: (a) to lead the educational processes to learn about the Land of Israel, and to reinforce the students' national values; (b) to allow experiential learning in and out of school, to enhance democratic values and participative citizenry, and to encourage self-realization and social involvement and commitment; (c) to encourage and allow all students to take part in outdoor education and to enhance the students' place-based commitment (The Ministry of

Table 2. Group distribution by type of school, school year, and guide

	Urban	Suburban	Developing towns	Countryside
Environmental organization 1	4,5,5,6		6,8,6	7
Environmental organization 2	6,6	4,5	5,6	5,6,4
School teachers	8,7	8,4,5,6	8,9,8	

Education, downloaded in May 2014).[1] These teachers are specially trained in outdoor education and they guide their students in all the field trips to the outdoors.

The guides were affiliated with two major environmental organizations in Israel—the Society for the Protection of Nature in Israel (SPNI) and the Jewish National Fund (JNF). They were trained to interpret the natural environment, they were familiar with environmental issues and policies, and their training includes also the pedagogy of teaching in nature. Some of the guides were young adults (ages 18–20) who do the job as part of their military service[2] or as volunteers for a year before the service. Other guides are professionals, employed by the two organizations.

Data Collection

In our larger study, we collected data by student questionnaires and by interviewing 20 teachers, 16 guides, and 92 students following the field trips which we documented. In this article, we report mainly on the questionnaire analysis and we add interview data to illustrate and demonstrate this analysis. In other studies related to this project we analyzed mainly the qualitative data (Lavie Alon & Tal, 2015; Tal et al., 2014).

The questionnaire we used in the study was initially developed based on the *Science Outdoor Learning Environment Inventory* (SOLEI; Orion, Hofstein, Tamir, & Giddings, 1997), which was originally developed for high school students. SOLEI included the following scales: (a) interaction with the environment; (b) integration of the outdoor event with school learning; (c) student cohesiveness; (d) teacher support; (e) open-endedness of the learning activities; (f) preparation and organization; and (g) available learning materials. Since we studied mainly upper elementary students, we cut off the original number of items (55) and the number of scales, and used a four-point scale instead of five. The main difference between the studies of Orion et al. and this one was the role of the teacher. While Orion et al. studied schoolteachers who offer a continuum between school and outdoor learning, in our study, most of the field trips were led by guides, who maintained limited coordination with the teachers prior to the field trip. Following factor exploratory analysis, four factors were obtained, which were in line with both SOLEI and the FiNE framework: (a) preparation and connection to learning in school (scales b, f of SOLEI); (b) pedagogy (scales a, e of SOLEI); (c) guide's personality (scale d of SOLEI); and (d) learning outcomes, which were not present in SOLEI but suggested in the FiNE framework. Three of the items were omitted due to low weight, and the revised survey included 34 items covering the following characteristics of the field trip: preparation in school, communication and collaboration between the guide and the schoolteacher, connection to the school curriculum; pedagogy: guide's explanations and stories, guide's use of the environment, demonstrations, active learning, physical activity, connecting to everyday life; and the following outcomes: learning new things or enhanced learning, enjoyment of the outdoor experience, developing positive attitudes toward the environment, and environmental action intentions following the field trip. Altogether 25 items are associated with the independent variables—the field trip's characteristics, and 9 items with the dependent variables—three outcome domains: cognitive, affective, and behavioral (that we added to the modified FiNE framework). The four-point, Likert-type scale questionnaire was administered to all the students following each field trip. They were requested to write only their school name, their town/village name, and their school year. Altogether, we collected 566 student surveys. Semi-structured interviews took place in school a few days after the field trips by the researcher who observed the field trip. They were recorded and transcribed.

Data Analysis

In this study, we used the classification and regression trees (CART) method to draw relationships between variables, and only afterwards we added multiple regression analysis. The reasons for using the CART method were: (a) the rather big number of items (explanatory variables) in the survey, and the large number of surveys; and (b) insufficient models that examine the relationships between field trip characteristics and students' self-reported outcomes. The CART method is used extensively in data mining in general, and its use in educational research is growing, to enhance the understanding of learning processes by focusing on identifying, extracting, and evaluating variables related to the learning process of students (Yadav & Pal, 2012). Data mining is an umbrella term that describes a number of sophisticated computer-intensive, statistical, non-parametric procedures designed to identify unknown patterns and relationships in large databases. Descriptive data mining models are used to describe patterns in existing data, and are generally used to identify and describe meaningful subgroups (McGrew, Moen, & Thurlow, 2010). Developed from database management systems technology and conventional statistics, data mining goes beyond retrieving, analyzing, and representing information in databases; it focuses particularly on uncovering hidden patterns in large data sets. Today, data mining involves not only database and statistics, but also machine learning, information science, and visualization. It is being applied in sciences (e.g. bioinformatics), business, internet security, and many other fields. Data mining performs two functions: one is to identify regularities among data records (e.g. concept cluster, concept comparison, and discrimination), and another is to find relationships between variables in data that will predict unknown or future values of the variables (Liu & Ruiz, 2008).

CART provides distinct advantages over traditional parametric multivariate statistical procedures when employed in an exploratory study using a large database. Regression assumes that there are linear relationships between the independent and dependent variables. Linear model is less suitable when there are a lot of variables so it is best to use CART which assumes a normal distribution of the explanatory variable and helps reduce the number of explanatory factors. Decision trees, also called rule induction techniques, are fairly easy to explain, since the notions of trees, leaves, and splits are generally understood. Inductive reasoning refers to estimation of a sample while the population is known. Decision trees use splits to conduct modeling and produce rule sets (Luan, 2002), and in this regard, Xin (2005), who used the CART method in analyzing math achievement growth in school-age students, explains how CART performs binary splitting of groups successively, based on a statistical criterion. In our research the statistical criterion is the explanatory variable of the learning outcomes: preparation and connection to learning in school, teacher involvement, pedagogy, etc. The process includes splitting groups of students each time into two groups called child nodes, which are more homogeneous. Each node is again split through the same procedure (nodes that descend child nodes are called parent nodes). As the process continues, students are classified into smaller and smaller nodes. With this method, we identified for each type of outcome the statements (and combinations of statements) that explain it. In the second stage, we used classical analysis of variance (ANOVA) for assessing the significance of the relationships. In principle, the method divides the entire population into groups according to the highest rank the group is assigned to each variable. For example, the analysis of behavioral outcome brought up two explaining variables and three groups of students (nodes). A group of 217 students gave the highest average score ($Y = 2.28$) to the guide's stories (V21) and things they could understand from what they learned in school (V7). The second group of 142 students gave the same variables a bit lower average score ($Y = 2$), and the third group of 212 students gave a low average score ($Y = 1.8$) to the guide's stories (V21). The more the final branches are, the less the agreement between participants is and vice versa (as seen, for example, in Figures 1 and 2).

Following Xin and others cited in detail in his work, we assumed that those complex interactive effects among variables are often difficult to pinpoint. Although CART is not commonly used in educational research, it provides opportunities to address

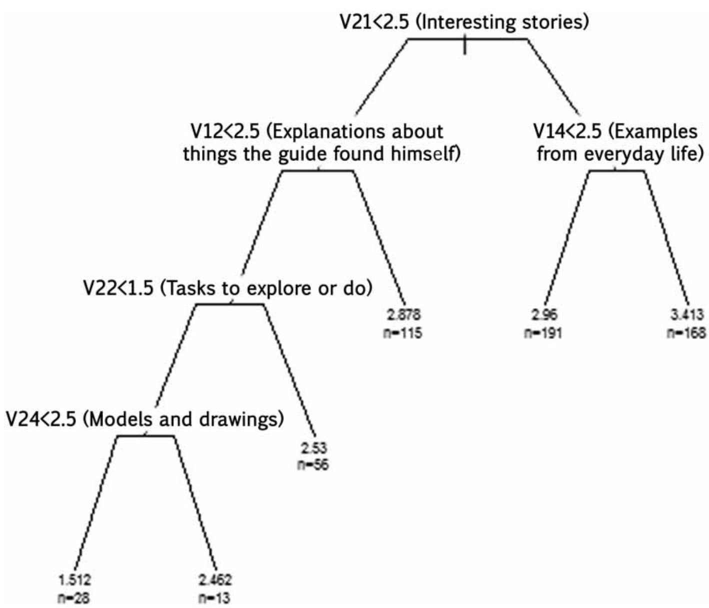

Figure 1. CART diagram showing the most significant cognitive outcomes

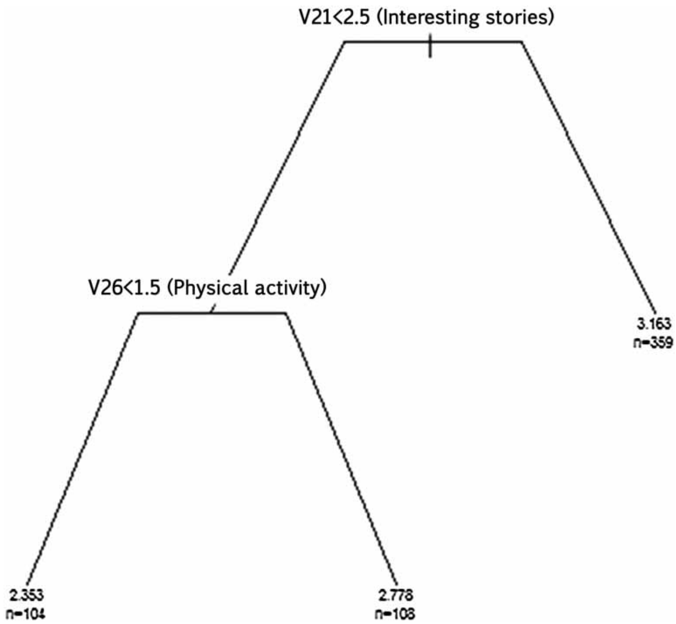

Figure 2. CART diagram for showing the most significant affective outcomes

many research questions and mainly in complex learning environments with this quite recent technique.

After obtaining a smaller number of more influential variables, we moved forward to execute a linear mixed model procedure, using 12 out of the 26 initial independent variables from the questionnaire. We treated the trip as a random effect, and by this, we added an explanatory analysis to the CART exploratory one, hoping to find few common highly impacting variables.

The interviews were content-analyzed by the first author, based on the analysis rubric we developed in a previous study (Morag & Tal, 2012). In our previous study, we established the analysis categories based on the research literature on field trips. A team of researchers then was trained and established good agreement on the classification. The authors were part of that team. Responses were classified in this study, again, according to the different characteristics of the field trips as identified in the FiNE framework and according to its different learning outcomes. For example, we classified the responses to the question 'What do you think of the guide teaching?' according to the questionnaire items; the response 'she did activities and games that are suitable for us' was classified as the student referring to learning activity. The response 'he was serious, authoritative, less nice than the other guide' was identified as referring to the guide's personality, etc. The two authors achieved nearly 95% agreement on the classification, and remaining responses were not included. As indicated earlier, in this study, we used the data from students' interviews mainly to illustrate the quantitative analysis and to give the reader better sense of the context.

Findings

Cognitive Outcomes

As indicated, the questionnaire measured the field trip components as viewed by the students, and the outcomes they reported. The CART procedure yielded six categories with respect to the cognitive outcomes for which the highest value for the learning outcome (3.41 out of 4) was reported by 168 subjects, who ranked high (3 or 4) the first two explanatory variables (V21: the guide's interesting stories, V14; connecting to everyday life). The lowest significant score for cognitive outcomes ($Y = 1.51$) was given by 28 students, who ranked these two explanatory variables low (1 or 2) (see left part of Figure 1). In the other four categories, the students ranked low one of the variables, and the other one high. To understand this range, we later ran the regression we report on in another section. Two other variables that appeared as contributing to this middle group were V12: the guide discovered interesting things and told us about them; and V22: getting tasks to explore and do. These middle groups' cognitive outcomes value ranged between 2.46 and 2.95. They were all significantly different ($p = 0.05$) from the lowest and highest values, but we found no significant difference between them.

The regression we ran showed few variables with significant impact on the student self-reported outcomes, most of them emerged already in the CART analysis. In the cognitive domain, these were how the field trip enabled better understanding of things learned in school (Q7), the guide's explanations on his and of the students' discoveries (Q11, Q12), giving examples from everyday life (Q14), the guide's interesting stories, and exploration tasks (Q22).

By using both the CART procedure and the linear mixed model procedure, we found a strong and significant relationship between the extent to which the students believed connections to everyday life were made during the field trip and how they perceived the field trip pedagogy, and the cognitive and the affective outcomes of the field trip. We did not find a significant relationship between those reported outcomes and: (a) how the students perceived the preparation to the field trip, (b) connection made to the school curriculum, and (c) the teacher's involvement.

Figure 1 shows that the two main explanatory variables according to the CART procedure were (a) the stories that the guide told (V21) and the guide's use of examples from everyday life (V14) (both on the right-hand side). Other explanatory variables were the guide's use of the environment (V12), exploration tasks given throughout the field trip (V22), and the guide's demonstrations (V24). All these are pedagogical variables.

Two illustrations from the interviews support the importance of storytelling:

> Explanation during the field trips was very good. Through stories, it was made more interesting. They did not talk too much. They allowed us to ask questions and also tell our stories about things that happened to us. (Student, 6th grade)

> You can also explain and give information, but not too much, maybe incorporate stories—personal stories … . It's clear to me that when you add the human and personal angle, it is more interesting. (Teacher)

Affective Outcomes

In the affective domain (see Figure 2), we found that 359 respondents who thought the guide had interesting stories (V21), ranked the affective outcomes high (3.16 out of 4). In the middle range of the affective outcomes rank (2.78), there were 108 students who did not acknowledge the guide's interesting stories, but pointed to physical activity and challenges (V26). The following quotes are congruent with this pattern:

> Working in the forest, with our own hands, is not only fun to do. You feel you're contributing to your country. (Student, 8th grade)

> (The most fun was) when we were in the old cemetery, like near the tower and we climbed there and had this (fun) climb downhill. (Student, 6th grade)

> I loved the slippery rocks, the climb up and the challenge in "Little Switzerland". (Student, 4th grade)

The 104 students who did not agree with either having physical activity or listening to interesting stories ranked this group of outcomes low (2.35). The three groups significantly differed from each other ($p < 0.05$), as can be seen in Figure 3. With respect to students' views, there was no impact on (a) making connections to everyday life, (b) connection to the curriculum, or (c) preparation for the field trip.

Looking at Table 3, one can see that similarly to the CART procedure, it is worth pointing to additional contribution of the physical experiences and challenges. Here again, the regression we conducted supports the exploratory analysis of CART.

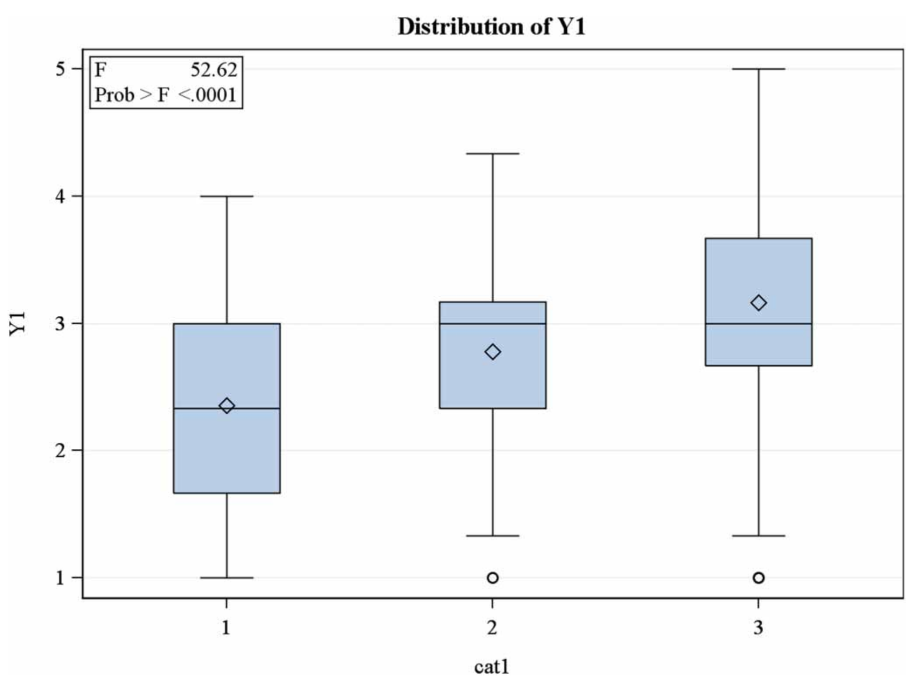

Figure 3. Distribution of the groups of respondents to the affective outcome

Table 3. The linear mixed model procedure

		Cognitive outcomes			Affective outcomes			Behavioral outcomes		
Effect		Estimate	SE	Pr > |*t*|	Estimate	SE	Pr > |*t*|	Estimate	SE	Pr > |*t*|
Intercep		2.3896	0.06176	<.0001	2.1204	0.09842	<.0001	2.0079	0.1098	<.0001
Q3	Preparation in class	0.1237	0.04944	**0.0127**	−0.06973	0.07257	0.3371	−0.01802	0.08531	0.8328
Q4	Teacher involvement	−0.03353	0.04637	0.4699	0.1199	0.06766	0.0770	0.08109	0.07961	0.3090
Q6	Connection to school	0.06131	0.05323	0.2501	0.08638	0.07850	0.2717	0.009080	0.09196	0.9214
Q7	Understanding things learned in school	0.1001	0.04992	**0.0455**	0.1828	0.07185	**0.0113**	0.1871	0.08506	**0.0283**
Q11	Explanations about things the students found	0.1096	0.04822	**0.0235**	0.1273	0.06867	0.0644	0.2752	0.08158	**0.0008**
Q12	Explanations about things the guide found himself	0.2605	0.04785	**<.0001**	0.1606	0.06865	**0.0197**	0.1134	0.08140	0.1642
Q14	Examples from everyday life	0.1288	0.04653	**0.0059**	0.1614	0.06669	**0.0159**	0.1433	0.07926	0.0713
Q15	Learning activity: individual or small group tasks	0.05074	0.05005	0.3112	0.1804	0.07296	**0.0137**	0.07745	0.08597	0.3681
Q21	Interesting stories	0.1893	0.04785	**<.0001**	0.3379	0.06836	**<.0001**	0.2044	0.08118	**0.0121**
Q22	Tasks to explore or do	0.09621	0.04687	**0.0407**	−0.05526	0.06819	0.4181	−0.04629	0.08021	0.5642
Q25	Games in groups or pairs	0.09290	0.05044	0.0662	0.04817	0.07362	0.5133	0.09571	0.08657	0.2695
Q26	Physical activity	0.03192	0.04700	0.4974	0.1363	0.06860	0.0475	0.05017	0.08103	0.5361

Behavioral Outcomes

In the behavioral domain, we found that the variables that had the most significant impact on changing the students' approach to the environment and making them want to change their environmental behavior, were (again) the guide's stories (V21) and things they could understand (about the environment) from what they learned in school. The next excerpts from interviews shed light on this. In the interview, the student addressed the ways the field trip affected her attitudes, and she acknowledged how the field trip changed her opinion on whether to build a shopping center or protect an old Eucalyptus tree. She responded:

> Like all people, I thought a shopping center would be great, but then (during the field trip) I understood it has to be protected.

Researcher:	Why?
Student:	Because we can learn from history; we need to protect nature.
Researcher:	Is it because of the field trip? Why?
Student:	Because of all her (the guide's) stories about plants and trees. (Student, 6th grade)

As shown in Figure 4, the CART procedure has yielded three categories. The highest rank of 2.28 (out of 4) was given by 217 students, who ranked the above two variables high. The lowest rank (1.8) was given by 212 students, who ranked the guide's stories (V21) low. It is worth noting, however, that even the highest score in the behavioral domain is relatively low in comparison with the two other outcomes. One variable that

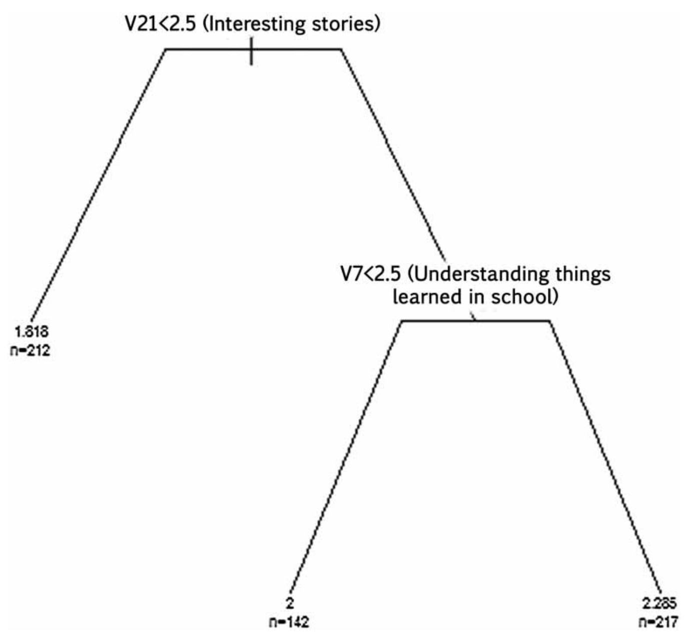

Figure 4. CART diagram showing the most significant behavior outcomes

the linear mixed model procedure put forward in the behavioral domain and was not identified by the CART procedure is the guide's explanations about student discoveries.

Looking at the main categories of the questionnaire (Appendix), which are planning (the preparation for the field trip, teacher involvement, and connection to the curriculum) and pedagogy (connection to everyday life, activity, guide's function, etc.), one can see that the category that had a significant impact on student self-reported outcomes in the three domains is pedagogy. Within this category, the variables that had the most impact are: the guide telling interesting stories, which appeared as the strongest variable in all domains; physical activity; demonstrations; giving examples from everyday life; and the guide's use of the environment and exploration tasks given throughout the field trip. One additional variable that appeared only in the behavioral domain in the CART analysis, but was found significant in the multiple regression, in all domains was that the field trip clarifies things learned in class (Q7).

As indicated, in addition to the CART analysis, we conducted a mixed-model regression as well, using 12 variables that we identified in the CART analysis as more influential. Table 3 presents these variables. The bolded ones are the most significant.

Impacts of SES Background and the Affiliation of the Guides

In a previous study (Morag & Tal, 2012), we asserted that the students' SES and the environmental organization that the guides were affiliated with, could be related to student self-reported outcomes. Consequently, in this study we consistently sampled the field trips so they represent the different groups. Using the mixed procedure ANCOVA, we found no significant differences between the student self-reported outcomes in the three domains with respect to their SES groups that included four groups representing urban, suburban, countryside, and developing town schools. F-values for the three dependent variables (cognitive, affective, and behavioral outcomes) were $F = .88$, $p = .46$; $F = .05$, $p = 0.98$; $F = .18$, $p = .91$, respectively. We found no significant difference in student outcomes with respect to the three groups of guides (SPNI, JNF, schoolteachers). F-values for the three dependent variables were: $F = .09$, $p = .92$; $F = .19$, $p = .83$; $F = .75$, $p = .48$, respectively.

Discussion

Our findings indicate that many of the variables which we assumed important for a good field trip, such as good classroom preparation, carefully crafted learning activities, and connection to the school curriculum, were not acknowledged by the students as contributing to their learning, attitudes toward the environment, and their environmental behavior. The most outstanding variable that emerged by using the CART analysis was the guide's stories. This variable was significant as well in the ANOVA analysis. When the guides told interesting stories, students acknowledged high outcomes in all three domains. Other important factors in the cognitive domain were: drawing connection to everyday life, the guide's use of the environment, student exploration tasks, and demonstrations. In the affective domain, another factor the students acknowledged was the physical activity and challenge, and in the behavior domain, except for the guide's stories, one factor appeared—'The field trip helped me understand things we learned in school'(V7). Preparation in class was found significant in the ANOVA, but only to cognitive learning. All the other variables acknowledged by the students were from the pedagogy category. In their comprehensive research of learning in natural environments, Ballantyne and Packer (2009, p. 259) found that 'the most engaging, effective, and enduring learning experiences in the context of learning in natural environments, occur through experience-based, rather than teacher-directed strategies.' The authors add that these strategies have the greatest merit in promoting learning for sustainability that encompasses changes in knowledge, attitudes, and behavior. They suggest a fifth productive category (to four suggested earlier by the Queensland Education Authorities). The four categories were intellectual quality, supportive classroom environment, acknowledging differences, and connectedness, and the fifth they suggested is experience-based learning that consists of (a) learning by doing—active exploration and investigation; (b) being in the environment and learning to appreciate the natural environment; (c) connection to real life issues; (d) having sensory engagement; and (e) encouraging investigation of local issues. Ballantyne & Packer point to experience-based learning in contrast to teacher-directed methods as most important in natural environments. In a way, our findings contradict theirs, because the variable that had the greatest impact was—the guide's stories. One way we can look at this difference is by acknowledging that in our study, active exploration of the environment and student-centered pedagogies were less prevalent. Given what we already observed earlier (Morag & Tal, 2012), we can suggest that in a pedagogical context in which guide-directed activities are more prevalent, storytelling has a unique power. The special power of storytelling was recently discussed by Zhai and Dillon (2014), who stressed that stories are believed to be the primary means by which we make sense of things in our everyday thinking and living, and that a substantial body of evidence shows that the use of stories is effective in improving the teaching and learning of science. Zhai and Dillon, who studied guided visits to a botanical garden, found that guides employed storytelling to explain about plants and their unique features. In the stories, they incorporated historical, cultural, and botanical information in an appealing way that strongly engaged the students. Similarly, in our study, in which we identified mainly guide-centered learning environment, stories allowed drawing on the students' imagination, the intersection between the familiar and the unknown, and an advanced method for science communication. Another argument in support of the power of stories comes from our own work. One example which we documented was a story of a girl who fell off a cliff (Tal et al., 2014). The story, told by a teacher while hiking near a memorial dedicated to that girl, was echoed by all the interviewees from that field trip. Another story, which had a great impact on students' questions, discussions, and memories, was of a huge forest fire that, not only burned much of Mt. Carmel's natural vegetation, but caused the death of 40 prison officers who were caught in the fire on their way to evacuate a prison and protect the prisoners. Although the guide provided much information on habitat loss, the students' excitement was more evident while referring to the human tragedy. This is consistent with Chawla (1998, 1999), who highlighted the impact of feelings and significant life experiences on environmental sensitivity. Although storytelling was more acknowledged by students, they clearly highlighted in their responses other important pedagogical features of the field trips. It is clear that the sensomotoric experience was valued in the affective domain, that self-exploration and guide demonstrations were of importance in the cognitive domain, and in the behavioral domain, we found a single association between ideas discussed in class and the field trip's contribution to clarifying those ideas. We began this study with a long list of variables representing pre-field trip activity in schools, pedagogies used in the field, and variables related to the guide's personality. Based on the literature and our own experience, we also believed strongly that the schoolteacher who accompanies the students has a major role in the field trip. It appears that in the context of one-day field trips the most effective factors were pedagogical—meaning the way/s the guides facilitated the field trip. When they told interesting stories, encouraged explorations, demonstrated and enhanced the physical experience, students rated their learning, attitudes, and behavioral change higher. These results support our previous study (Tal et al., 2014) that points to pedagogy as central to meaningful outdoor education. In that qualitative study, we highlighted exemplary field trips as ones in which the guides and teachers collaborated, enacted hands-on activities, encouraged discussions, and made connections to the curriculum and to everyday life. The question of why the teacher's contribution (V4, V5) was not a factor that determined the students' self- reported outcomes bothered us, since in earlier work (Lavie Alon & Tal, 2015; Tal et al., 2014) we claim otherwise. We assume that the greater resolution of the previous studies that (a) focused only on five case studies; and (b) focused only on guide–teacher relationships, enabled the isolation of one variable—the teacher function—which yielded a different picture than this large-scale study of many variable yields. Nevertheless, the large sample we studied here represents a diverse picture of field trips on the one hand, but reinforces the same point we made previously: good outdoor education pedagogies probably yield higher learning outcomes—at least as viewed by the students.

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Notes

1. http://cms.education.gov.il/EducationCMS/UNITS/Noar/Templates/RegularText.aspx?NRMODE=Published&NRNODEGUID=%7b425E5292-406E-4126-86C1-EE17A6B7FA0C

%7d&NRORIGINALURL=%2fEducationCMS%2fUnits%2fNoar%2fTechumeiHaminhal%2fShelach%2fMiAnachnu%2ehtm&NRCACHEHINT=NoModifyGuest#chazon

2. The Israeli military, as part of its social contribution, assign soldiers to education roles, especially for teaching of underprivileged youth and for providing out-of-school education through environmental organizations.

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Appendix. Student Survey (four-point scale: highly agree, agree, do not agree, do not agree at all)

Category	Question (Q)	Variable
Planning		
Preparation for the field trip	1	In class, the teacher presented the field trip program
	2	In class, we learned the field trip's topics
	3	In class, we did activity related to the field trip topics
Teacher involvement	4	Our teacher took part in the activities during the field trip
	5	Our teacher took part in guiding during the field trip
Connection to school	6	The topics we learned in the field trip are connected to what we learn in school
	7	The field trip helped me understand things we learned in school
	8	In the field trip, we learned topics that we do not learn in school
Pedagogy		
Discussing goals	9	At the beginning of the field trip, the guide/teacher talked about/presented the field trip plan
Using the environment	11	The guide told us about things we found ourselves
	12	The guide discovered interesting things and told us about them
Connections to everyday life	13	The guide asked us about our everyday life
	14	The guide gave examples from everyday life
Learning activity	15	In the field trip, we had individual or small group tasks
Guide's personality and language	16	The guide was patient and nice to everyone
	17	The guide treated everyone equally
	18	The guide's language was clear
Learning activity	19	The guide talked too much
	20	The guide told about himself/herself
	21	The guide told interesting stories
	22	In the field trip, we got tasks to explore or do
	23	In the field trip, we played games on the field trip's topic/s
	24	The guide showed models and drawings
	25	In the field trip, we played games in groups or pairs
Physical activity	26	In the field trip, we had to crawl, jump or sneak through cool passages
Outcomes		
Affective	27	In the field trip, I met some difficulties and overcame them
	34	I enjoyed being in nature
	35	I enjoyed walking the nature trails
Cognitive	28	In the field trip, I learned new things
	29	In the field trip, I learned about the environment, plants and animals
	30	In the field trip, I learned why it is important to take care of nature and the environment
Attitudes and behavior	31	Following the field trip, I changed the way I think about the environment
	32	I think I will better take care of the environment after the field trip
	33	I intend to act to keep our environment