

## **Regenerating our place: Fostering a sense of place through rehabilitation and place-based education**

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### **Introduction**

*Sense of place* is a concept that describes the fundamental relationship between people and places. It has been noted by environmental researchers as a key component in understanding and encouraging environmental behaviour (Avriel-Avni et al. 2010; Scannell and Gifford 2010). It is based on the assumption that people's sense of place affects their desire to reside in a certain place and their attachment to it, which in turn encourages them to care about its environmental health and strengthens their commitment to protect it (Halpenny 2010; Ramkissoon et al. 2012). Though sense of place has gained increasing attention in the context of environmental education (Ardoin 2006; Kudryavtsev et al. 2012), few studies have addressed the relationship between sense of place and environmental education, and even less attention has been paid to documenting and explaining what children's sense of place is and how it might matter in educational contexts (Gruenwald 2003; McInerney et al. 2011).

One primary assumption in environmental education research is that to develop a strong sense of place, students should deepen their understanding of their surroundings through hands-on, outdoor learning. This calls for *place-based education* – an increasingly popular educational approach that has been suggested by researchers as an appropriate framework in which to develop students' sense of place and encourage them to embrace and promote sustainable living within their communities (Semken and Freeman 2008). The study presented here followed a group of young Bedouin students throughout a two-year, place-based education program that was conducted in their local environment, and seeks to understand that program's influence upon the students' sense of place.

One distinctive aspect of this particular place-based education program was that it was conducted in tandem with an extensive project designed to rehabilitate the highly contaminated environment in which these students live. The students in this study live in small, rural villages along the banks of the Hebron Stream in Israel's Negev Desert. The stream has become an environmental hazard – constantly contaminated with sewage runoff, with mounds of additional waste being dumped along its banks. This hazardous combination directly impacts the health and wellbeing of the Bedouin communities that live nearby. Because the Bedouin villages in the Negev have not been recognized by the state, they receive no municipal funds and suffer from a lack of basic infrastructure (e.g., water, sewage treatment, waste removal). The residents of these villages have been disposing of their waste themselves – by burning it or dumping it in the stream. Recently, however, these villages have begun a process of regularization, and a massive project for the reclamation of the Hebron Stream has begun.

The study presented here is part of a larger, three-pronged rehabilitation program that was instituted for the Hebron Stream area, which includes: a. the rehabilitation of the Hebron Stream near the Bedouin community; b. a new waste disposal program, including the establishment of waste treatment systems in the Bedouin community; and c. an environmental education program. The setting of our study sets it apart from most sense of place research because it offers us an opportunity to examine the sense of place of individuals who live in unsafe, contaminated environments, unlike previous studies, which have tended to focus on positive affective bonds to places (Kudryavtsev et al. 2012; Manzo 2005). Moreover,

the fact that the study and the intervention program coincided with the beginnings of this environment's reclamation provided the opportunity of seeing how the changes introduced by the reclamation project influenced the students' sense of place.

The primary research question posed by this study is: 'How is sense of place expressed by the students before versus after engaging in the place-based intervention program?' Understanding these students' sense of place can provide a more comprehensive and in-depth understanding of the relationship between people and their immediate environment when that environment is contaminated. Such information could serve to guide other place-based learning programs for students around the world who have limited access to healthy natural environments.

## **Literature Review**

*What does 'sense of place' mean and what other concepts does this term encompass?*

The concept *sense of place* can be broadly defined as the meaning and importance that individuals or groups ascribe to a given setting, based on their experience within it (Stedman 2003). In this context, the term *place* refers not just to a place's natural, environmental, *physical* elements, but also to its cultural and social characteristics (Ardoin 2006; Stedman 2003). As a result, *sense of place* reflects the complex web of lifestyles, meanings and relations that are associated with a particular place at a particular time by an individual or group of individuals (Garavito-Bermúdez and Lundholm 2017). This relationship between people and their place includes multiple factors – physical, biological, cultural, social, historical, psychological and political – all of which go into determining *sense of place* (Ardoin 2006; Lim and Barton 2006).

Despite this complexity, scholars have agreed on a combination of two complementary principal aspects of sense of place: *place attachment* and *place meaning* (Haywood 2014; Stedman 2003). Fundamentally, *place attachment* refers to the bonds between people and places and reflects how strongly people are attracted to places (Kudryavtsev et al. 2012). It is an umbrella concept that includes three additional terms: *place identity*, *dependence* and *affect* (Haywood 2014; Kudryavtsev, Stedman and Krasny 2012; Stedman 2003). *Place affect* is conceptualized as the emotional bonds and feelings that individuals share with settings in a particular place (Halpenny 2010; Ramkissoon, Weiler and Smith 2012). According to Low and Altman (1992), place attachment refers first and foremost to emotional attachment, since "affect, emotion and feeling are central to the concept" (pp. 4-5). *Place dependence* is conceptualized as a bond that individuals form with the physical characteristics of a place. It is a functional attachment, based specifically on the individual's physical connection to a particular place and reflecting the potential of a place to provide conditions that support an individual's needs, goals, or activities (Halpenny 2010; Raymond, Brown and Weber 2010). The greater an individual's level of dependence on a place, the less the individual desires to change that place for another (Scannell and Gifford, 2010). *Place identity* describes a deep connection between a place and an individual's personal identity. It refers to the mixture of feelings about specific physical settings and symbolic connections to place and helps individuals structure their experiences within various physical environments (Halpenny 2010; Haywood 2014; Raymond, Brown and Weber 2010). Relph (1976) relates this term to the notion of 'insiders' and 'outsiders', asserting that the more deeply individuals feel that they are 'insiders' (i.e., feel a sense of belonging to and deep identity with a place), the more that place is part of their sense of self.

In contrast to all of these terms, *place meaning* deals with the symbolic meanings that people ascribe to places (Kudryavtsev et al. 2012; Stedman 2003). It serves as the reason for place attachment and depends on the value characteristics that people ascribe to places (Kudryavtsev et al. 2012; Stedman 2003). As Manzo (2005) notes, “it is not simply the places themselves that are significant, but rather what can be called *experience-in-place* that creates meaning” (p. 74).

#### *Assessing sense of place: Ardoin’s Dimensions of Sense of Place model*

As we have shown above, *sense of place* is a complex concept, which has been employed in the context of a variety of academic disciplines, including psychology, anthropology, geography, sociology, architecture, political science, environmental studies and education (Ardoin 2006; Gruenewald 2003; Stedman 2003). However, as Ardoin (2006) points out, these varied and multidisciplinary components should not be viewed as entirely separate from one another, but as interrelated parts of a holistic whole. Based on this understanding, Ardoin proposed a multidimensional model of sense of place, which comprises four basic dimensions that make up sense of place and describes the relationship between them.

The first of these four dimensions is the biophysical dimension, which refers to the physical environment that provides the physical context (be it natural or human-made) within which sense of place occurs. As Ardoin points out, “without the physical environment, there could be no sense of place,” since it provides “the *stage*...for human/environment interactions” (pp. 114-5). Accordingly, this dimension *encompasses* the other three dimensions in the model, which always exist within and in relation to it (see Figure 1).

[Insert Figure 1]

The other three dimensions of the model are the psychological, sociocultural, and political-economic dimensions. The psychological dimension refers to the ways in which “humans ... experience places as individuals” (115). Ardoin notes that this dimension is addressed extensively in the literature, and that it encompasses a variety of other terms associated with sense of place, including *place identity* and *place attachment*. The sociocultural dimension refers to the aspects of sense of place that are most often addressed by disciplines like sociology and anthropology – namely how individuals’ sense of place is influenced by their social and cultural context (Ardoin 2006). It therefore focuses on symbolic and cultural elements such as how social norms and cultural beliefs and practices influence and are influenced by a community’s relationship with its environment (Ardoin, et al. 2012; Low and Altman 1992). Finally, the political-economic dimension refers to understanding that political and economic considerations can also significantly impact (and be impacted by) individuals’ and communities’ relationship with places, and that the very definition of a place is often shaped by “a shared, community-based understanding and image of place” (Ardoin 2006 p. 117). It also refers the importance of the fact that “places are not isolated entities,” but are in fact part of a larger web of political and economic influences, that tie them together with *other* places through “innumerable visible and invisible connections” (ibid).

#### *Connecting sense of place and place-based education*

The relevance of Ardoin’s holistic, multi-dimensional model extends beyond its usefulness in assessing sense of place. As she herself points out, “actively acknowledging the holistic nature of sense of place” can also greatly benefit “the field of environmental education” (2006, p. 121). Ardoin notes that many “place-based educational efforts” tend to focus exclusively on the biophysical dimension, but that “to

realistically and honestly assess, address, and explore sense of place, environmental education initiatives must recognize [its] multiplicity of meanings, sources, and expressions” (pp.120-1).

Place-based education is an educational approach that emerged from a perceived need to bring students closer to their local environments and the particular problems that affect them (Eijck 2010; Smith 2002; Sobel 2004). As such, it can be viewed as a countermovement, responding to dominant educational cultures that focus on global or abstract issues that bear no tangible relation to place (Eijck 2010). Emphasizing global issues is reflective of traditional science and environmental education programs’ goal of educating for global participation and generating a body of *universal* environmental knowledge that is independent of any and every place (Eijck 2010; Greenwood 2003). However, doing so risks neglecting the local experiences of individual students and eroding their sense of place.

Though place-based education is a relatively recent term in environmental education, it draws upon and shares qualities with a variety of other educational approaches, including community-oriented schooling, ecological education and bioregional education. Place-based learning takes place outside the school walls, in the students’ local environment, and is therefore strongly based in the *outdoor learning paradigm*. As such, it must take place in an environment that is authentic (Braund and Reiss 2006), and provide opportunities for hands-on learning (Lavie-Alon and Tal 2015). Quay and Seaman (2013) associated outdoor learning with John Dewey’s theory of experiential learning. According to this theory, learning is experience-based, and therefore learning about nature cannot be achieved without actual experiences with real phenomena in a specific environment. Dewey emphasized the cognitive aspect of experiences in nature, citing activities such as scientific observation, and the gathering and analysis of data. Smiths (2013) noted that, “place-based education could well provide a way for overcoming the division between the classroom and community Dewey identified over a century ago,” adding that in such cases, “students, communities, and the environment could all be the beneficiaries” (p. 220).

Ardoin’s multi-dimensional vision of place-based education also associates it strongly with *education for sustainability*, which emphasizes a multi-disciplinary learning experience designed to promote the values of environmental sustainability within the local context of a place and community (McInerney, Smyth, and Down 2011). This approach perceives the environment as more than its physical components, arguing that the historical, cultural, political, economic and emotional contexts must be accounted for as well (Gruenewald, 2003). Furthermore, the learning experience is designed not just to provide learners with knowledge, but to develop a sense of responsibility and encourage them to become involved in the goal of achieving local ecological and cultural sustainability (Woodhouse and Knapp, 2000).

Place-based education speaks to these central elements in environmental education by giving students the chance to do *real life*, outdoor work, addressing and investigating issues of local concern that are situated within their own local landscapes, environments and communities, or even advocating on behalf of local needs (Smith 2002). By employing programs based on real-world learning experiences, it gives the students the opportunity to leave the classroom to discover their local environment in an active, *hands-on* learning experience that is authentic, realistic, and relevant to their daily lives (Eijck 2010; Smith and Sobel 2010). In addition to improving students’ academic achievement, place-based education also aims to strengthen students’ ties to their local community, and to increase their attachment to and appreciation for their natural environment (Sobel 2004).

Engagement with the community is an important concern of place-based environmental education, since such education aims to promote students' understanding of the interdependence between their own life and behavior and the health and prosperity of their communities (Hashimoto-Martell et al. 2011; Howley et al. 2011). Gruenewald (2003), for instance, emphasized that place-based education can help students achieve "engagement and understanding through multidisciplinary, experiential, and intergenerational learning that is not only relevant but potentially contributes to the well-being of community life" (p.7). This approach seeks to equip students with transferable knowledge and skills that will enable them to make contributions to and assume responsibility for the health of their communities (Howley et al. 2011; Tal and Abramovtich 2013).

In recent years, the implementation of place-based education programs as a framework has increased. However, research on the feelings and connections that people develop toward the places where they are born and raised, and the function that these places fulfil in their lives, has been neglected. Most empirical, place-based education research has focused on scientific approaches that have helped students acquire scientific knowledge and skills, and a scientific understanding of the local ecosystem (e.g. Brkich 2014; Endreny 2010; Keynan et al. 2014). In contrast, few studies of place-based education have addressed the question of how these programs have affected their participants' sense of place.

This lack of attention is inconsistent with the claims of researchers, who have suggested that one of the primary contributions of place-based education is revealing the human-place relationship and promoting the conservation and restoration of the local natural environment (Hung 2017). Semken and Freeman (2008), for example, argue that the scientific outcomes of place-based education programs are important, but do not indicate how deeply students have engaged with their physical and cultural environments. If one of the goals of place-based education is promoting local ecological and cultural sustainability, then strengthening the sense of place of individuals and communities must be one of place-based education's primary goals (Ardoin 2006; Gruenewald 2003; Kudryavtsev et al. 2012; Semken and Freeman 2008).

## **Context**

### *The Bedouins and their relationship with place*

The Bedouins of the Negev Desert are an indigenous people, a sub-group within the Arab minority in the State of Israel. While the Bedouins who live in the Negev are Muslims, they are a distinct sub-culture, owing to their close ties to the desert landscape and the lifestyle that evolved there before the formation of the State of Israel in 1948. According to Abu-Saad (2008), for many indigenous peoples connection to land is suffused with social, economic and spiritual meaning, and is therefore central to their culture and their day-to-day lives. The Bedouin economy has, for most of their history, been based on the herding of sheep and camels, with some additional reliance on traditional seasonal agriculture (Abu-Rabia 1994). Like other indigenous communities around the world (Holt 2006), the Bedouins lived at low population densities with limited technology, relying directly on local natural resources for survival and using these resources in a sustainable manner. Their traditional lifestyle was clearly molded to suit the specific requirements and characteristics of their environment, reflecting the community's awareness of the importance of their place in providing pasture and drinking water for both people and livestock (Abu-Rabia et al. 2008).

Like other indigenous populations, however, Bedouin society has, over the past several decades, been undergoing a relatively rapid process of urbanization and modernization. In the Bedouins' case, this was brought about by their close proximity to other, sedentary, populations with vastly different lifestyles, and further expedited by the sharp decrease in land left available for the Bedouins' use, as areas they had been accustomed to live on were reallocated by the state for other uses. As a result, approximately 50% of the Negev Bedouins now live in state-recognized townships, while 34% live in unrecognized villages or *shantytowns*, and the remaining 17% live in recently recognized villages.

Unrecognized villages do not receive municipal funding and suffer from a lack of infrastructure. Moreover, any domestic structures that are formally classified as *illegal* are under ongoing risk of being torn down, so they tend to be temporary, composed of light substances such as fabric, tin or wood. Whatever their legal status, all of the Bedouin localities are ranked lowest in socio-economic indices in Israel at large, and they remain the most underdeveloped in all areas of life, including education, infrastructure, industry and commerce (Rudnitzky and Ras 2012).

One of the basic municipal services unrecognized villages lack is the organized collection and disposal of trash. As a result, the residents must dispose of their waste themselves. Studies of settlements with similar waste-disposal issues have shown that the lack of the means and knowledge for proper disposal, together with the combined inaction of the government and the community in addressing this lack, can lead to environmental and health problems like foul smells, the agglomeration and reproduction of harmful insects and bacteria, and the outbreak of infectious diseases (Ismail et al. 2017). The method of waste disposal currently employed in the unrecognized and recently recognized Bedouin villages involves: backyard burning of household waste; dumping of household and agricultural wastes in unregulated dumps in and around the settlements; storage of bulky waste such as asbestos in backyards; and dumping of waste in streams and streambeds (Meallem et al. 2010; Authors, 2014). It is worth noting that practices like incineration or leaving waste to biodegrade worked reasonably well in the days when Bedouin communities were smaller, nomadic, and generated waste that was almost entirely organic. Today, however, the waste generated by the village that is the focus of this study is an amalgam of miscellaneous packaging materials, diapers, aerosol containers, paper and cardboard, glass, rope, barrels, buckets, tires etc., which poses significant environmental risks (Meallem 2006).

#### *Research participants and setting*

The study was conducted with a sample of 107 Bedouin indigenous students (60 girls and 47 boys) who live in Um Batin – a Bedouin village in Israel's Negev Desert. The village is located on the banks of the Hebron Stream. The students were therefore familiar with Hebron Stream and its surroundings, since the stream crosses/passes the village where they live. The study followed the students over a two-year period, which began when they were in the fifth grade and concluded when they finished sixth grade. The students were in five different classrooms in two schools. The Hebron Stream intervention unit was originally attended by 154 students, but only those who were present in all stages of the intervention program were ultimately included in the study.

Hebron stream is part of the drainage basin for the Hebron and Habsor streams. The basin houses mostly urban settlements and a few rural ones. The stream is contaminated with runoff from urban and industrial waste – sewage from Palestinian towns and Jewish settlements in the area, and from the sawmills and

quarries that run along its banks. The riverbed is rich with vegetation that is fertilized by the sewage and littered with mounds of solid waste. The sewage water, combined with the contamination from additional waste dumped on the banks by local residents, has turned the stream into a real environmental threat, with a direct impact on health and wellbeing the people who live nearby (Shikma-Bsor Drainage Authority website).

#### *The intervention program*

The rehabilitation program instituted for the Hebron Stream area was three-pronged. It included (a) the rehabilitation of the Hebron Stream near the Bedouin community, (b) a new waste disposal program, including the establishment of waste treatment systems in the Bedouin community, and (c) a place-based environmental education program. It was carried out in cooperation with municipal and national organizations: the Ministry of the Environment, the Society for the Protection of Nature (SPN), the Shikma-Besor Drainage Authority, and the Al-Kasom Regional Council.

The place-based Hebron Stream study unit was designed to be long-term, spanning 36 hours of teaching per year, over two years. Its purpose was to help the students develop an in-depth understanding of authentic environmental phenomena in the stream's surroundings, while encouraging a deeper sense of place regarding the stream. It took place during school hours and consisted of a combination of indoor and outdoor learning. The program was built around four field trips per year – some in the students' village environment, some around Hebron Stream, and some at other streams that are located on nature reserves with healthy ecological systems (see Table 1). It was developed in cooperation with the National Society for the Protection of Nature (SPN), a non-governmental organization (NGO). The sessions were taught by instructors from SPN, and their contents were designed to reflect topics from the Ministry of Education's recommended topics for the fifth and sixth grades.

[ Insert Table 1 ]

Each of the eight field trips was preceded and followed by additional, in-class activities. This structure was based on Orion's model (1993) for outdoor learning. One goal of these activities was identifying students' preconceptions, because students' outdoor learning experience is influenced by their previous knowledge (Lavie-Alon and Tal 2015). Orion's model also emphasizes pre-activity preparation, which introduces the students to all of the environment's components, minimizing the uncertainty and strangeness of the new environment. Cognitively, preparation familiarizes students with the new skills and basic concepts required for field work. Psychologically, it addresses the gap between students' expectations of the field activity and what the activity actually is. Geographically, introducing the students to the physical environment in advance makes the later learning activity more efficient because students enter the activity familiar with the area in which they will work (Orion 1993). Each field trip in our program was therefore preceded by two hours of preparation, in which students discussed their experiences and emotions regarding the village and the stream, were introduced to basic concepts (stream, tributary, creek etc.), played card games such as "gifts from the stream," watched film clips about the impact of waste on water pollution and on animal life, and more. Each field trip was also followed by two hours of in-class knowledge integration activities. In these, the students reported the results of their observations from the field trip, defined socio-environmental problems present in the field

trip, conducted comparisons between a “healthy stream” and a “sick stream,” examined photos taken from the field trip and arranged them according to the interaction between the stream and the vegetation, animals and the people, and more.

At the end of each school year, the students participated in a series of additional “summarizing and looking ahead” activities. These included constructing a model that describes the students’ vision of a future stream, learning about various solutions for managing and preserving water resources, and multiple activities designed to encourage the students to take responsibility and develop their sense of competence as agents of change.

## **Methodology**

### *Research approach and data collection*

This study employed an ethnographic research approach, which focused on exploring the ‘lived experiences’ of the students in the program and helped to provide a more comprehensive and in-depth picture of their sense of place. This approach places a strong emphasis on using detailed observations and interviews to explore the nature of a particular social phenomenon, providing rich, holistic insights into people’s views and actions, and the nature (i.e., the sights, sounds) of the location they inhabit (Reeves, Kuper and Hodges 2008). Ethnographical research can make significant contributions to environmental and sustainability education research, helping to characterize various aspects of relevant cultural, social and economic contexts (Sutoris 2019).

Data were gathered from 2014 to 2017 in order to obtain a comprehensive picture of the students’ sense of place both before and after their learning experiences. The study employed two primary research tools: drawings and semi-structured, in-depth interviews.

Student drawings: Using drawings is a well-established methodology for examining how students make sense of a given space and identifying meanings in students’ lifeworlds (Alerby 2000; Avriel-Avni et al. 2010). Drawings allow students the freedom to express their knowledge without limitations of language (Alerby 2000). In this study, the drawings were deployed in two stages – before and after the completion of the intervention program. The 107 students were asked to make two drawings at each stage, describing (a) *my village* and (b) *the stream in my environment*.

Semi-structured interviews: The interviews were conducted only after the students had completed their drawings, in order to gather additional information that the drawings did not provide. Using drawings alone to elicit understanding can have limitations, since what the students produce is partly limited by their drawing ability. Incorporating an interview thus allows additional ideas to be gathered.

Each student was interviewed on two occasions – before and after the completion of the Hebron Stream study unit. The pre-interview described how the students experience the Hebron Stream area, how they perceive the stream itself, the practices involved in their experiences of the area, and the perceptions and intentions that underlie these practices. Each interview lasted 40-50 minutes, and included questions that were divided between two topics – some to do with the village (e.g. “What places in your village do you like/dislike? What changes would you make to it?”), and others addressing the Hebron Stream specifically (e.g. “Describe the stream to me. What do you feel towards it?”).

The post-interview was conducted two years later. It was designed as a reflective activity, in which the students addressed any changes that their perceptions had undergone following the study unit, focusing on how they now perceived the stream and the importance of changing its condition. Each student was presented with the pictures they had drawn – first the pre- and post-pictures of the village, and then the pre- and post-pictures of the stream. The students were then asked: “What are the differences between the two pictures you drew?”, “What changes have occurred in the village/stream?”, “What do you think about these changes?” and “How do you feel about the stream/village?”

### *Data analysis*

The method of analysis chosen for this study was a hybrid approach of qualitative methods of thematic analysis. It incorporated both the data-driven inductive approach (Braun and Clarke 2006) and Ardoin’s Dimensions of Sense of Place model, which served as a theoretical anchor to characterize students’ sense of place. The analysis was conducted in three stages: inductive analysis, comparison between pre- and post-data, and theory-driven thematic analysis.

**Stage 1** – Inductive analysis: This stage included open coding and axial coding (Corbin and Strauss 2008). The authors conducted several rounds of discussion about the data from the drawings and interviews, until a consensus was reached about their interpretation and division into themes. Analysis began with thematic inductive analysis by open coding, in which every drawing and interview was analyzed separately by the authors, so as not to impose the categories of one interview/episode on another. In the analysis process of the students’ drawings, we analyzed a total of 428 drawings (four per student). The basic premise for visual content analysis was: (a) identify visual elements; (b) count their frequencies; (c) analyze those frequencies (see Figure 2).

The open coding was designed to create preliminary categories based on the information arising from the students’ drawings and interviews. All pre- and post-data were analyzed separately, and a preliminary list of ideas arising from the data was constructed. In the axial coding, the preliminary codes were reexamined to find relationships between them and develop subcategories.

**Stage 2** – Pre-/post-data comparison: At this stage, we compared the categories from the pre-intervention data to those from the post-intervention data of the drawings and the interviews. This comparison yielded various points of difference and similarity between the themes that arose in the data collected before the intervention and those that were collected after it.

**Stage 3** – Theory-driven thematic analysis: At the third stage, connections were drawn between our data and the research literature. Specifically, we used the *Dimensions of Sense of Place* model proposed by Ardoin (2006), as a means of further organizing and interpreting our data and the categories produced by the inductive analysis (see Tables 2 and 3). As we worked to draw connections between the interview data and the sense of place dimensions in Ardoin’s model, we found that much of our data did not fall clearly within only one dimension. The following quotation, for example, reflects a place where the political-economic and the sociocultural dimensions overlap: “Where should they put the garbage, near the houses?! Where can they go with the garbage? That’s why they throw it in the stream.” This quotation reflects the impact of the village’s lack of infrastructure on its population’s social norms, thus blurring the boundaries between economic/political factors and social/cultural ones. The data analysis was

validated by five experts in the field (the authors and two PhD students), who reviewed the stages of analysis and the categories until agreement was reached.

[Insert Figure 2]

## Results

This section begins with an overview of the results from the students' drawings (Table 2) and interviews (Table 3). The data from these two tables are then discussed in more detail according to seven major categories, derived from the four dimensions in Ardoin's model and the relationships between them (see Figure 1). The first category addresses the biophysical dimension, which provides the physical context for sense of place and encompasses the other three dimensions, which all exist *within it*. Specifically, it describes changes in how the students portrayed the biophysical environment of the Hebron Stream area. The next three categories represent how each of the model's *internal* dimensions were expressed by the students, and how the students' expressions of each dimension differed (or not) before and after the intervention program. Finally, the last three categories represent students' expressions in which each of the three *internal* dimensions overlapped with one another. The results below are presented according to these categories, including both a qualitative analysis of the students' interviews, and a quantitative distribution analysis of each category's relative frequency in the students' drawings.

[Insert Table 2]

[Insert Table 3]

### *The Hebron Stream – the biophysical dimension*

Analysis of the students' drawings and interviews showed significant differences in their pre- and post-intervention representations of Hebron Stream. First, we found that, following the program, the stream was more likely to be portrayed as part of the students' sense of place: after the program, 62% of the students drew the stream as part of their village, compared to just 27% ( $\chi^2(1) = 25.92$ ,  $p < 0.001$ ) who drew it there before (see Table 2). This increased representation of the stream as part of their home was accompanied by a marked transition from descriptions of the stream as an aesthetic and environmental blight to descriptions of its potential aesthetic and environmental value.

Analysis of the drawings (Table 2), for instance, shows that only 17% of the students drew waste in the stream and on its banks after the intervention program, vs 78% ( $\chi^2(1) = 79.22$ ,  $p < 0.001$ ) who did so before it. This change was also expressed in the students' interviews (Table 3). In their pre-interviews, 92% of the students described the stream as an ugly place filled with waste that spoils the landscape. As one student said: "The stream is not good. The state of it disfigures the view of the area." Other students referred to the stream as "a disgusting view," or offered more detailed descriptions such as, "there's garbage in the streambed, an old mattress, cans, old diapers, dead animals, bottles, bags." Furthermore, 67% of the students dismissed the stream's importance as a natural resource, and even described it as harmful to the environment. Some spoke generally, making statements like "the stream is not important. It's not pretty and not clean," or "the stream has no value. It's just garbage." Others noted specific problems, like "animals drinking from [the stream], eating bags ... and dying, and then [people] throwing them in the stream."

In contrast to these pre-intervention descriptions, after the learning process, many of the students (78%) referred to the stream as a natural resource and an essential part of the ecosystem. For example, one student explained, “The stream is very important. It collects rainwater and runs it to a different stream or the sea. Without the stream there would be floods. Animals drink out of it and there are plants to which it gives water. And there are plants in the water that the turtle and the ducks eat. Around the stream there are plants that I didn’t know before, like saltbush, cattail, soft rush, thorn tree. I also got to know the eagle and the hyrax and the ibex ... All these animals near the stream ... it is very important.” Though 22% of the pre-interviews also included references to the stream’s role as an environmental resource, there was a marked difference in the content of these references. Before the intervention, the students noted that they had seen animals living near the stream, going into the water and drinking from it. For instance, one student stated: “There are dogs that wade in the water and get dirty, there are dogs drinking water, cats and dogs, near the stream there are hills on which the birds stand.” However, as the first quote above exemplifies, after the intervention, the students presented much more specific descriptions of the various elements provided by the stream as a natural resource, such as: providing water, food and a habitat for various indigenous animals and plants, and collecting and channeling water to prevent floods.

These changes in the students’ descriptions are reflective of specific information they acquired in the intervention program, a prominent part of which included visits to ‘healthy’ environments similar to their own. As Table 1 shows, the intervention program included three field trips per year to streams and springs on nature reserves, which were designed to help the students develop an awareness of streams and of nature as clean, inspiring places. These field trips also included exercises in scientific observation, in which the students approached the banks of the stream, identifying different types of plants, and conducted observations to identify animals and note signs of their presence (e.g. tracks, droppings). The plants and animals that were encountered in these observations not only featured in descriptions like the one cited above, but also in about a third of the students’ post-pictures (see, e.g., Figure 3).

Images like the one presented in Figure 3 reflect the interesting finding that about 33% of the students’ post-intervention descriptions of the stream (in both pictures and interviews) were *not* based directly on the contaminated stream near their own home. Instead, they seem to have been inspired by the streams they were shown in the intervention program. These pictures and interviews describe the stream as a nice, clean, aesthetically pleasing place, full of the plants and animals they had observed on their field trips to the nature reserves. One student explained, “the stream is prettier when it’s clean ... we’ll look at the birds and the flowers around it.” This student’s remark reflects those of others in that it does not strictly describe the stream as it *is*, but rather looks ahead to how it *could* be.

[Insert Figure 3]

#### *The sociocultural dimension*

The sociocultural dimension refers to the students’ sense of belonging and connectedness to a social group (e.g. friends or family), the emotional connections forged within that group, and how these relate to the physical environment. Bedouin society is collectivist, divided into a series of tribes defined by ties of blood kinship. Many of the pre-interviews (83%) reflected the students’ sense of belonging and attachment to the family and friends with whom they spend time in their tribe, also showing that the students’ circle of friends is made up of family members. The interviews showed that social ties are

described by the students as a central factor in their sense of attachment to the place in which they live (e.g., “I like the village because I play with my cousins”).

This connection between the students’ social experience and their experience of their biophysical environment was evident in multiple references from the pre-interviews, which were collected under the category “positive social experiences near home” (84%). In these references, the students’ descriptions of their physical environment are closely interwoven with their descriptions of the activities that take place in that environment – activities that are almost invariably social rather than solitary. For example, “I play with my cousins. There’s a large piece of land near the house and we play football and tag, we talk, we ride donkeys and we race, we hunt pigeons and raise and feed them. We also dig in the ground to see the insects and dig up worms. Sometimes we play marbles, ride bikes, sometimes we plow so that plants will grow.”

Inductive analysis of the students’ interviews divided the students’ perceptions of the relationship between the stream and the community into several aspects. The first of these was their awareness that the stream could be detrimental to their community’s health. Over half of the students’ interviews before the program (66%) expressed various negative health concerns, including diseases and the presence of pests (e.g. mosquitoes) that are drawn to and feed on the garbage around the stream. For example, “the stream is not good. It harms people. There’s lots of mosquitoes that bite and it itches” and “there are children that go in the stream and play in the filth ... it’s not healthy because the filth brings germs and diseases.” The students also noted that the smell rising from the stream is an irritant to those living nearby. As one student explained, “You can’t look at it; it smells bad, lots of filth and the way it looks makes people uncomfortable.”

The second aspect reflected their awareness of the stream as a source of danger. Some students recounted injuries from contact with waste items such as broken glass: “people dump garbage, furniture, glass; kids see the glass sheets and break them and get hurt.” Others described the stream as a treacherous path and expressed a fear of falling: “when I walk by the stream, the way is narrow and I’m afraid of falling in,” “there are rats and snakes there. Once I fell near the stream. There was a wedding and our house was on the other side. I went home to get something and I slipped on a stone and I was hurt in many places.” Finally, the students also noted the dangers of flooding, when the pipes that form a makeshift bridge over the stream become clogged with waste: “the stream widens in the rain and its scary and people fall in,” “in the winter the bridge breaks, the garbage gathers around it [and blocks the water flow] and people drown in it. The water is dirty, it rises when it rains and get nearer to the houses.”

The third aspect reflected the students’ awareness of the stream’s neglect as a social norm – a regular part of their community’s routine. In the pre-interviews, 81% of the students referenced the fact that their community routinely dumps waste in and around the stream, citing a variety of possible reasons for this behavior. These included: “they throw trash in the stream so their house will stay clean,” “they throw trash here because it’s close by, they burn trash near it,” “it’s already dirty, so it doesn’t matter if they dump more,” “people throw trash in the stream because they don’t have anywhere else here to throw their trash.” This theme of habitual neglect was also present in 30% of the post-intervention interviews, in statements like “they don’t care about the stream. They still throw garbage there, because they see others doing it and they follow their example.”

In the fourth aspect, the students describe the stream as a place of recreation. Interestingly, though both the pre- and post-interviews included references to this aspect, the content of these references changed significantly after the intervention program. The pre-intervention references describe the students' current recreational activities in the contaminated stream. For example: "We cross the stream and play 'who is the hero who doesn't fall.' We put stones in and try to cross on them, or put a board across and walk on it. When a kid stands in the middle of the board, sometimes we shake it so he'll fall"; "I have fun by the stream. We make boats out of Styrofoam from when people buy a fridge, the white stuff in the box."

In contrast, the post-intervention interviews reference the types of recreational activity that the students experienced on their field trips to the clean environments of the nature reserves. For example, "There's a calm in the stream, we sit and play near it ... it's a place of peace"; "If the stream was clean and there were flowers and grasses near it, a person could come by the stream ... enjoy the view and the sound of the birds and the sight of the animals around him"; "a person could swim, play and drink from the stream, and the stream would add beauty to nature, take the person out of their depression or despair and let the person see the animals and the plants." Quotations like these indicate a rise in the students' awareness of the stream's potential contribution to their own wellbeing – as a source of beauty, recreation and relaxation.

One of the knowledge integration activities included in the learning process was *gifts from the stream*. The goal of this activity was to help the students understand the importance of the stream as a resource for humanity. The instructor read the students a story about a generous stream and a little boy who lived nearby and used its water – drinking, swimming, playing, but also having a picnic on the banks and leaving a can of soda and leftovers behind. When the boy grows up, he builds a fish farm and draws water from the stream to fill it; he builds a large plant and its outflow runs into the stream. After the story, the instructor gave the students slips of paper and asked them to sort them into "gifts from the stream to humans" and "gifts from humans to the stream." The "gifts from the stream" column included things like water for drinking, bathing and irrigation, a nice place to spend time in nature, the flora and fauna that are sustained by it, energy from the flow of its water, and safety from floods due to its collection of runoff from the rains. "Gifts from humans," on the other hand, included things like air and water pollution from nearby construction, trash dumped along its banks, and fires started nearby.

The interview analysis showed that at the end of the learning process, 64% of the students described the stream as a place that contributes to the community's subsistence and wellbeing. For example, "We can use the stream ... if someone is thirsty and passes by he can drink, live near it to swim, water the animals and the family. We can use it in hard times ... when there's no water in the house use water from the stream. Children could play, swim in it." This was also reflected in post-intervention drawings like the one below, where the student drew the stream right in the middle of the village, with domesticated animals all around it, as well as the interactions between the community and the stream (see Figure 4).

[Insert Figure 4]

Another aspect of the community's relationship to the place that became predominant only in the post-intervention interviews is the portrayal of the stream as a place that should be habitually **protected** by the community. One student said, for instance, "It was normal for me that we dump garbage in the stream. [...] From the project I understood that the stream is important and if it's dirty that harms us ... we have

to protect the stream.” Another said, “We’ll clean up the stream. I didn’t think of it before, we need to look after the stream, and not burn. They will bring us trash bins. I didn’t think that we were polluting the environment.” While quotes like these cite the harmful contribution of humans as their incentive for changing their social norms, others cited the promotion of the stream’s potential positive contribution to both humans and animals: “The stream helped us, we drank from it, and we need to protect it because we need it ... It does us good, and if we keep polluting it we won’t be able to drink from it.”

#### *The political-economic dimension*

The political-economic dimension refers to the relationship between the physical environment and political-economic concerns, and to how this relationship impacts sense of place. The village in which the students live suffers from a severe lack of infrastructure, since it has only recently been recognized as a formal settlement by the state of Israel. This problem significantly impacts the students’ lives, and is visible in their drawings. For example, only 34% of the students drew public buildings like shops, schools, medical facilities or mosques, while 64% of them drew transport infrastructure within the village – mostly in the form of unpaved dirt roads. In this sense, the students’ drawings are reflective of conditions in their village – the village roads are mostly dirt, and there is only one paved road, leading only as far as the school. This lack of infrastructure was explicitly addressed in the interviews as well, in statements such as “In our village there are no paved roads, lots of garbage and filth, no playground, no park,” “I don’t like that our village is dirty. There’s lots of sand and dust. In other villages there’s no sand and they’re prettier.”

One of the primary goals of the intervention program at the village level was the regulation of the garbage removal services, the renovation of the bridge, and the reclamation of the stream. The data show that, following the intervention program, the students showed greater awareness of the relationship between the political-economic situation (i.e. the lack of infrastructure), and the biophysical situation. After the intervention, 31% of the students’ drawings reflected the introduction of organized trash bins to the village, vs only 6% ( $\chi^2(1) = 22.85, p < 0.001$ ) who drew trash bins before the intervention (see Figure 5). This perceptual change was also expressed in 58% the students’ interviews, in statements like: “Now it’s cleaner and there’s trash bins near the houses ... the garbage was everywhere in the stream and on the road, and today the bins have helped and it’s cleaner. It’s good for the village to look nice.”

[Insert Figure 5]

These post-interviews also addressed the connection between the economic-political action of the stream’s reclamation and the improvement in its state. One student explained, “They started to protect the stream. There’s workers at the stream, they changed its path, dug and the water follows a new path, because the pipes were closed from the filth and the water didn’t flow, they started to pick up the garbage bit by bit.” This student’s explanation reflects his understanding that protecting the stream will bring about an improvement in its state. In other words, the government’s political-economic initiative of improving the water infrastructure is associated by the students with environmental principles.

#### *The political-economic / sociocultural dimension*

The political-economic / sociocultural dimension addresses the relationship between political-economic concerns and social ones, and how this relationship influences sense of place. One central element arising from this category in our study is the issue of the bridge. The bridge over the stream provides access and mobility to the residents of the village, and 37% of the students’ drawings referred to the bridge as a

gateway to the external environment. On the other hand, the bridge obstructs the stream's natural flow and causes flooding in the villagers' houses. It is constructed of precarious pipes, which become clogged with filth and prevent the water's flow. It also often breaks as a result of rain and flooding, which negatively impacts the villagers' ability to get around.

The students expressed different perceptions toward the bridge before and after the intervention program. Before the program, they addressed the problems they have getting to school due to the frequent flooding and destruction of the bridge (in the sub-category "the stream as a source of danger"). One student explained, "The bridge broke from the storm, we didn't go to school because the students and teachers couldn't pass over the bridge to get to school." After the bridge was upgraded and paved, the residents' mobility drastically improved, and this was noted in 17% of the post-intervention interviews. One student explained, "There was no road over the stream. There were only pipes and a small bridge. I like the new bridge. The old one would break, and the new one is a road. We pass through it."

Another topic raised in this category is the regularization of waste disposal. Because there were no organized waste disposal services in the village, the residents were forced for years either to burn their garbage or to throw it in the stream, actions that became accepted norms in the village. Some of the students' pre-interviews (45%) reflect their awareness of this, in statements like "Where would they put the garbage, near the house?! Where can they go with the garbage, that's why they dump it in the stream," "People throw garbage in the stream because there's nowhere else to put the garbage."

The interviews from after the intervention program reflect an increased awareness (60%) of the connection between the political-economic situation and the norms of cleanliness in the village. Thus, for instance, after the waste disposal was regularized, one student explained, "It's good that now we have bins and put the garbage in them and protect the stream. Today we see the bins and if there's something to throw away it goes in the bins, not the stream." The students' statements expressed their awareness of the direct relationship between the availability of the bins and pro-environmental behavior. For example, "We still burn; we don't have a bin. We asked but they didn't bring one. It's not good to burn, it pollutes the air, but where should we put the garbage?"

#### *The personal dimension*

The personal dimension refers to individuals' experiences in the place, their perceptions and the processes that shape their sense of identification, reliance and connection to the place. This category includes the students' descriptions of (a) their personal experience of being in both healthy and unhealthy stream environments, and (b) their desire to protect the stream and their descriptions of the changes in their personal environmental behavior.

Personal experiences are very important, since they can foster a sense of respect and appreciation towards nature. Analysis of the students' interviews before the program showed that their experiences of the Hebron Stream were ambivalent (94%). On one hand, the students described negative experiences, like falling in the stream, getting dirty and suffering from intolerable smells. On the other hand, they described enjoyable experiences at the stream (see Figure 6). To some extent, this reflects the lack of other alternatives in the area for safe places to play. The students' ambivalence is reflected in statements like, "I play there [by the stream], me and the children, sometimes I like to play there. The smell bothers me but I put up with it" and "I like to throw rocks into the stream at the ducks, and we have fun putting

bottles in and having contests, whoever has the fastest bottle, and sometimes I don't feel well because the stream water gets on me."

The intervention program created an opportunity for the students to encounter healthy streams, in the hopes of tapping into their ability to form an attachment to the stream based on positive experiences. Many of the students' post-intervention interviews (84%) describe their positive emotional experiences in these healthy streams. For example, "I saw Habsor Stream ... it is pretty ... and I enjoyed going on the bridge; we went over the water and saw how the turtle lives in the water. And we saw birds drinking from the stream."

[Insert Figure 6]

People's responsible behavior toward the environment is a primary factor in its protection. The students' post-intervention interviews showed that 60% of them expressed a desire to protect the stream as a natural resource, and claimed to have changed their behavior. For example, "I throw garbage in the trash bin. In the past we threw it in the stream. It's better to throw it in the bin. If we used the stream it would get dirty"; "I used to pick flowers. Now I don't, there are animals and plants in danger of extinction and we must not pick plants. In the past I threw garbage on the floor. Today I saw there are people who care and don't throw in the stream and I started not to throw."

#### *The personal / political-economic dimension*

The overlap between the personal and the political-economic dimensions was characterized by two primary themes. The first of these was the transition from the students' pre-intervention expressions of pessimism regarding the possibility of positive change to their post-intervention optimism. The second theme was the students' post-intervention critiques of remaining flaws and "glitches" in the environment's reclamation process.

Our pre- and post-intervention data analysis showed a marked change in the students' feelings toward the stream. In the pre-program interviews, many of the students (59%) expressed feelings of anger and hopelessness towards the stream, making negative predictions about its future. For example, "The stream won't change. If now no-one does anything ... in the future they will?! It will be even more dirty ... people multiply and they'll dump more garbage" and "I want them to cover up this stream. It's not important at all. I say they can block it up and it would be better." In contrast, nearly all of their post-program interviews (96%) expressed greater optimism, and the hope that the situation will improve (see Figure 7). For example, "In the past I thought the stream was dirty because people threw garbage in it. And today there isn't a lot of garbage in the stream. I thought the stream would not change and would get worse. Today I think it will improve and people won't dump garbage in it" and "Two years ago I wasn't happy with my village because it was full of garbage on the roads. Now that they started to take care of the garbage and clean, I like the village more and I'm very happy." In other words, before the program the students saw no change in their environment, and so they did not think that things would change in the foreseeable future. A change in that situation generated the conditions for the students to build a new connection with the stream, a connection expressed as feelings of hope and optimism about the stream's reclamation.

[Insert Figure 7]

The data analysis showed that, in addition to expressing their newfound hope, some of the students (22%) also made references to flaws in the stream's reclamation process. For example, "The stream is still dirty.

You can't swim in it or drink from it. It smells bad, doesn't look good"; "They cleaned around it and got the garbage out ... but the color of the water is not like water you drink." Even more of the students (51%) addressed problems with the regularization of the waste disposal system in the village. For instance, "They brought us bins. We use them, but they fill up and no one comes to empty them ... so we sometimes burn."

#### *The personal / sociocultural dimension*

This category includes two primary themes: the students' descriptions of (a) their personal feelings towards their community's environmental behavior and (b) their personal experience of trying to promote environmental behavior in the community.

Some of the students' post-intervention interviews (25%) reflected their concern over the improper environmental behavior of other villagers following the implementation of the reclamation program. For example, "I'm not so pleased. There are people who look after the village and the stream and people who don't. There are people who are responsible and want to protect and improve the village, and there are people who don't care" and "I'm glad and angry. I'm glad they gave us trash bins, but angry because there are lazy people who don't go thrown in the bins and throw on the floor."

One goal of the intervention was to develop the students' sense that they were capable of creating change in their own community. In one activity, the students watched the film, *Pay It Forward*, which portrays children's ability to create change. After watching the film, there was a class discussion about the possibility of making change, in which the students practiced the *Trevor method* (from the film). In this method, one person helps three people who need help, and each of those does not need to pay that favor back, but rather *pays it forward* to three additional people, etc. In this manner, the positive results of the act pass on and its effect keep rippling out in different directions. Additional activities addressed ways of expanding the circle of people involved in the protection of the stream.

Some of the students' post-interviews reflected their willingness to take action at the community level. For example, "I learned that we can change the stream, explain to people and try to talk to the people, try to put bins near"; "We can change and develop, and there are many solutions. We'll ask for trash bins, and make rules that you can't burn, and explain to people why burning is forbidden."

Though 35% of the interviews reflected the students' *desire* to take action, references to *actual* action being taken to change the behavior of others are notably absent. As Table 3 shows, the interviews did include very few references (5%) to the difficulty of taking such action. One student said, for example, "I learned that if my friend litters I should tell her not to. We were in the field and I told her not to litter and she laughed at me and said, 'there's lots of garbage here'." Another student told us that she anticipated a similar reaction if she tried to talk to others about their behavior, claiming that "when we tell our cousins and our neighbors [not to litter] they will laugh at us."

#### **Discussion**

This part of our article is divided into two sections. The first section provides a reflection on the study's research methodology, offering recommendations for researchers based on how this study's data were gathered and analyzed. The second section focuses on the pedagogical challenges of implementing place-based education programs for communities in transition who live in unsafe, contaminated environments, and offers three concrete pedagogical recommendations. This latter section begins with two factors in

our intervention program that, in our opinion, were greatly beneficial to its effectiveness, and concludes with a review of several points at which our study revealed the potential tension between the ideals of place-based education and the circumstances that defined this particular project in the field.

1. *Balancing the dictates of the model with the realities in the field: A note on applying theoretical models to concrete empirical situations*

Ardoin's (2006) multidimensional model of sense of place comprises four distinct but overlapping dimensions: biophysical, sociocultural, psychological, and political-economic. According to Ardoin, "recognizing these interconnected dimensions" can help us as researchers gain a more accurate understanding of sense of place "as a multifaceted and integrated concept" (p. 121). Our study's results support Ardoin's claim that these four dimensions are a "consistent" factor in sense of place research, since our data did indeed include evidence of all four dimensions. They also support her claim that the biophysical dimension "encompasses" the others, and is the omnipresent "stage" upon which all human/environment interactions are played out (Ardoin 2006, p. 115). One conclusion we can therefore draw is that this theoretical model can indeed be useful as a framework for the conceptualization and systematic assessment of empirical data about individuals' sense of place.

However, even as our findings reinforce the basic structure of Ardoin's model, they also show that manifestations of sense of place cannot always be associated exclusively with just *one* of Ardoin's dimensions, but often represent a meeting place where multiple dimensions overlap. Indeed, this overlapping seems to have been more prominent in this study than in previous studies that have analyzed sense of place (Ardoin et al. 2012; Ardoin et al. 2014; Moseley et al. 2015). Why should this be the case? There may be a number of pertinent factors in our particular research setting that influenced the extent to which manifestations of the different dimensions blended together.

The first factor is that the Bedouin communities in the Negev are currently undergoing a fundamental transformation, including a relatively rapid transition from a semi-nomadic to a sedentary and more *Western* lifestyle, politically-induced changes to their physical environment and, most recently, major environmental changes due to the reclamation of the Hebron Stream area. As a result, the students participating in our study live in an unusually dynamic environment, which is continually changing not just in their lifetimes, but before their very eyes. We suggest that the unusual dynamism of their biophysical context may have made these students more aware of that context than they might otherwise have been, which could explain the prominence of its overlap with the other dimensions. In contrast, Ardoin et al. (2014), in their study of sense of place amongst youths in East Palo Alto, California, found that they made very few references to the biophysical dimension, even when explicitly "encouraged in interviews to consider the biophysical setting of the community" (p. 488). It is therefore likely that, in our study, the current instability of the students' biophysical context highlighted its presence, and its interactions with the political-economic, social and psychological dimensions of their experience, making them more noticeable than they might have been in a more stable environment.

The second factor concerns the socio-cultural context of these particular students. Bedouin society is strongly collectivist, emphasizing the importance of group unity, and perceiving individuals largely through their position as a particular part of the group. Bedouin villages are divided into sub-sections, each of which belongs to a different extended family (*Hamoula*), meaning a grandfather, his sons, their

sons, and all of their wives and children (Manor-Rosner et al. 2013). The social structure of Bedouin society is thus reflected in their physical environment as well, so that all individuals live their lives surrounded by, and in constant interaction with, the social group to which they belong. As Whitesell et al. (2006) point out, collective identity is “embedded within the social context,” defining the self largely through its relationship to others in the social group, and through “its participation in the collective” (p. 1488).

The strong group identification of the students in our study was reflected in the fact that they often phrased their responses and descriptions using the term “we” rather than “I,” indicating the presence of what Whitesell et al. referred to as “collective self-concept”. This may be one reason why the psychological dimension in our study often overlapped with the socio-cultural dimension in the manifestations of the students’ sense of place. In this way, our findings contrast with those of Moseley, Desjean-Perrotta and Kharod (2015), who studied sense of place amongst US pre-service teachers and found that all of their references to their sense of place “contained aspects of the psychological dimension and emphasized the importance the place held for them as an individual” (p. 40). For example, their interviewees often described their sense of place in terms such as, “It is a place where I find peace within myself. It is a place where I can go to escape the business of this world to enjoy nature. It is a place where I center myself” (p. 39). Such descriptions differ markedly from the statements like those we gathered in the very large category, “positive social experiences near home,” where the students described their enjoyment of nature as a communal rather than a solitary experience. This tendency to emphasize the social over the personal remained evident even when the students spoke of the natural environment in similar terms as “a place of peace” (i.e. they described it as a place where *we* can sit and play).

The third factor is the students’ age. This study focused on elementary school students – an age that studies of sense of place have shown to be an important time, in which individuals’ place attachment and meaning begin to form, and later influence the development of their identity (Briggs et al. 2014; Morgan 2010). Studies have shown that the development of young children’s sense of place is different from that of adults. For example, while adults have been shown to ascribe meaning to their environment based on aesthetic, social and historical criteria (Pretty et al. 2003), children tend to assess their physical environment in a more immediate, tactile way, through direct interaction and in direct relation to what they can and cannot do in that environment (Derr 2002). Thus, for instance, Avriel-Avni et al. (2010) found that children who lived near a nature reserve did not necessarily include it when asked to draw pictures of their home environment, since – despite the reserve’s proximity – they did not have regular access or direct interaction with it. These results, like ours, emphasize the importance of the concrete and the immediate (vs the more abstract conceptualization that is more readily available to adults) for how students perceive their home environment.

The students in our study, however, differ from the subjects of most other sense of place research because the environment in which they live is highly rural. Unlike the children in Avriel-Avni et al.’s (2010) study, these children live *inside* a natural environment, and they therefore have a great deal more direct, daily contact with nature than children who live in urban environments who must rely on others to *take* them to nature. The students’ immediate access to the environment in question may be one reason why the descriptions they provided were more directly reflective of the holistic, day-to-day reality of what a

place is, referencing the multiple interactions between the dimensions rather than more analytically addressing specific dimensions in isolation.

Overall, our findings emphasize how significant the potential impact of the specific research setting can be when applying a theoretical model of sense of place to the results of an empirical study. Our data revealed an element that is not clearly addressed in Ardoin's (2006) model – namely that the places in which the model's different dimensions overlap are those that were most prominent in the Bedouin students' expressions of their sense of place. We might not have noted this phenomenon had we not taken a *flexible* approach to the application of this theoretical model to our own, empirical research. Our research therefore highlights the importance of tempering theoretical models with a complementary inductive analysis of the data, rather than simply imposing the categories dictated by the model upon it. This independent, inductive content analysis allowed us to assess how the model's various components were behaving in this particular situation, and whether this behavior was reflected by the model in its current form. As the case of our study shows, critical assessments of this type corroborate and strengthen some elements of a good theoretical model, while challenging or expanding upon others.

2. *The ideal vs the real: Implementing place-based education programs for communities who live in unsafe, contaminated environments*

One question that invariably arises during the implementation process is whether the educational goals laid out by the environmental education literature are compatible with circumstances that meet educators in the field. This point is exemplified, for instance, in Tzou, Scalone and Bell's (2010) study of the experiences undergone by young people as they navigate within and through the different sites of environmental education. Tzou, Scalone and Bell note that environmental ideals appropriate to education in affluent, middle-class environments are not necessarily applicable to other places and populations. Thus, for example, teaching the ideal that “the earth would be so much better off if we all just walked more” and encouraging people to “enjoy walking just for the sake of walking” rather than driving a car is only appropriate in an area where streets are safe (p. 112). In other places, where walking in the street can lead to “real threats to personal safety,” walking may not be a reasonable course to recommend (p. 113). In this section, we describe three different aspects of this engagement between educational goals and practical circumstances, as experienced in our study. In the first, we show how specific challenges to implementation can be successfully managed or circumvented. In the second, we show how circumstances can even be harnessed in order to make learning more meaningful and effective. In the third, we address several points in which circumstances prevented us from fully realizing our pedagogical goals.

a) Redefining the ‘place’ in ‘place-based’ – maintaining the importance of visiting a healthy natural environment

According to the research literature, place-based education should include experiences in the students' immediate environment (Eijck 2010; Smith 2002; Sobel 2004). However, the hazards of the environment in which our students live placed constraints on both the time and the proximity of direct access to that environment which the project was able to provide. In our study, we were able to compensate for this limitation by providing alternative natural environments.

The place-based education approach upon which this study was based is built upon the idea of forging connections between learners and the places in which they live by giving them opportunities to have experiences in their local natural environments (Sobel 2004; Herman et al. 2018). However, the immediate environment in which students in this study live was highly contaminated, and as a result they came into the program with negative experiences, feelings of alienation towards the stream, and a disregard for its importance in the ecosystem. Their experience of the stream's pollution affected their connection to their local environment.

Because the students' polluted physical space was a limiting factor in their ability to imagine a clean and healthy natural environment, we needed to find an *alternate* place for them to experience a *healthy* stream that was similar to how the one in their own environment *could* be. According to Avriel-Avni et al. (2010), learning about a place means changing the learners' point of view of that place or offering them new way of experiencing it by, for instance, separating an object from its habitual context and relating it to other contexts. Thus, in this study, the Hebron Stream was recontextualized for the students through comparisons with other, healthy streams. And indeed, their experiences in these other, parallel natural environments seem to have changed the way the students experienced their own environment, opening their eyes to possibilities that they had not entertained before.

The decision to include visits to healthy streams in the intervention program was based partly on the notion that spending time in these environments would provide the students with positive experiences, which would in turn encourage them to form an attachment to their own stream. Indeed, we found that visiting healthy streams allowed the students to enjoy a variety of positive experiences in a stream environment. The students' descriptions of their positive emotional experiences in healthy streams contrasted sharply with the negative experiences in the Hebron Stream that they had described before the intervention. The students described their enjoyment of the *hands-on* learning experience in direct contact with the natural environment, as well as the enjoyable experience of playing and splashing in the stream water. These results are supported by those of other researchers, who have found that students enjoy the opportunity to directly engage with and learn from the environment (outdoor learning) (Ballantyne and Packer 2006; Lavie-Alon and Tal 2015).

On the cognitive level, learning in the healthy stream environments also taught the students about the importance of a healthy stream to its local ecosystem. This new understanding was reflected in their post-intervention drawings and interviews, in which approximately one-third of the students portrayed the stream as a healthy ecological system. A basic pedagogical characteristic of place-based learning is its reliance on the outdoor learning environment. The fact that the Hebron Stream unit included extensive outdoor learning was, according the literature (Dillon et al. 2006), most likely central in the development of the students' understanding of ecological system. It thus further supports the idea that place-based education programs help students develop their understanding of how ecosystems work through direct experiences with a local ecological system (Endreny 2010; Hashimoto-Martell et al. 2012; Keynan et al. 2014).

Importantly, our results showed that the students' increased understanding of the stream's ecological purposes also increased their comprehension of its value, and specifically its potential benefits for them as a part of the ecosystem. The students noted that the stream was important not just because it should

be supporting the local “plants and animals,” but because “we can use the stream [to] water the animals and the family.” The students’ post-intervention descriptions of the stream as a potential source of sustenance and recreation reflected their newfound acknowledgement of the contribution it could make to their own community’s subsistence and wellbeing. These findings are supported by those of a previous study conducted amongst high school students living near a polluted stream in Pennsylvania (Zimmerman and Weible 2017). That study showed that following a place-based education unit that focused on the students’ understanding of the relationship between their community and local water quality, the majority of the learners recognized the direct relevance of the watershed’s health to the health of their community, declaring that local pollution and destruction was unacceptably disruptive to community activities such as hunting, fishing, spending time in nature, and drinking clean water.

The recognition of a place’s importance can be an important factor in encouraging environmental behavior, as shown in Jeziorski and Therriault’s (2018) study of students living near the polluted St Lawrence River in Quebec. This study, which was conducted amongst 16-17-year-old high school students, found that the students who ascribed importance to the landscape with which they come into contact were more likely to express the need for collective engagement, and the feeling that they have the capacity to act upon their stated goals. Their study, like ours, highlights the benefits of using the local environment as a learning context.

Though direct causality is extremely difficult to prove, we believe that the students’ experiences in the healthy stream environments are likely to be at least partly responsible for the post-intervention inclusion of the stream in their portrayal of their home, and for their acknowledgement that the presence of the stream in their home environment is a good – and even necessary – thing. As Eilam (2012) points out, students engaged in learning with a live ecosystem model explore meaningful and relevant environments for them, process information and reflect it into new conceptualizations. With that in mind, it is possible that the students’ enjoyable experiences in other streams contributed to their increased desire to include the Hebron Stream within the sphere of their home environment, in the hope that, when improved, it could be the site of similar positive experiences. Moreover, their understanding of the ways in which healthy streams can be important may also have encouraged them to incorporate the stream in their description of their home as a local resource. This would support the claims of multiple researchers regarding the fundamental importance of individual experiences in forming the basis for place attachment and place meaning (Scannell and Gifford 2010; Manzo 2005). As Kudryavtsev et al. (2012) note, sense of place can be developed through direct on-site experiences, especially if these are positive, frequent, and spread over a long period. In the case of *our* place-based program, accomplishing this required us to stretch the definition of *place* beyond the students’ immediate natural environment to other, nearby places, which could serve as a surrogate source of educational and inspirational experience.

b) From resignation to responsibility – the benefits of combining education with reclamation

In this second aspect of our program’s implementation, we harnessed the difficult conditions in the students’ environment by conducting the place-based intervention *simultaneously* with the rehabilitation of the stream and the regulation of the disposal of waste in the students’ village. The improvement of these infrastructural elements highlighted the political-economic dimension of sense of place by

emphasizing the condition of places, and how they are experienced and influenced by external economic and political factors (Ardoin et al. 2012). In this case, for instance, these factors were whether or not the village is formally acknowledged by a national government and allocated the funding and resources required for proper waste disposal.

The results of our study revealed a change in how the students described the environment near their home, and their expectations for that environment's future. Before the rehabilitation program, in the pre-interviews, the students expressed feelings of anger and hopelessness towards the stream, making negative predictions about its future and claiming that it would not change, or would get worse, and that they did not think that things could possibly improve in the foreseeable future. In the face of this bleak outlook, some students went so far as to say that things would be "better" if the stream could simply be "cover[ed] up."

The students' pre-intervention attitudes recall those expressed in other studies, which have shown that living in an environment severely lacking in infrastructure causes feelings of helplessness, and an inability to take responsibility for one's natural environment (Kollmuss and Agyeman 2002; Strife 2012). It is therefore likely that harsh economic, political and infrastructural conditions can be obstacles that prevent people from engaging in environmental behavior (Kollmuss and Agyeman 2002). The issue of poor infrastructure was similarly addressed in Adams and Savahl's study, which showed that African children (aged 13 and 14 and attending a school in a low-income area in the Western Cape Province of South Africa) believed that their municipal services were insufficient to keep their natural spaces clean, and that this belief led to a "repudiation of responsibility" and a "culture of inconsideration" towards nature, characterized by indifference and apathy towards their natural environment (2015, p. 204).

In contrast to these studies, however, our results revealed that *after* the intervention program the students declared themselves pleased with the changes and expressed a new optimism with regard to the improvement in the local infrastructure and stream's condition. Their post-intervention pictures portrayed hopeful versions of a clean stream that sustains plant and animal life, and their interviews raise the possibility that "children could play" in the Hebron Stream, and "look at the birds and the flowers around it."

Even the students' critical remarks about the glitches and inconsistencies in the program's implementation can be viewed as indications of this new optimism. The students' critical remarks following the intervention program were directed primarily at two objects: first, the failure of the reclamation and regularization process to meet their expectations, and secondly, the failure of other members of their community to behave responsibly toward the environment. Though the remarks themselves are negative, they are an indication that the program had raised the students' awareness of the importance of keeping the stream and the village clean, and nurtured their place-consciousness (Gruenewal 2003; Semken and Freeman 2008). Moreover, the students' disappointment is a reflection of their greater aspirations, and their newfound ability to envision living in a secure environment and achieving a real improvement in the state of the stream and their village.

Finally, the students' new optimism was reflected in their post-intervention references to the possibility of engaging in new and different behaviors in order to protect the stream. These ranged from individual behaviors, like making an effort to avoid polluting the stream themselves, to social behaviors, like trying

“to explain to people” why it is important not to pollute and making sure that the village is provided with enough conveniently placed bins. Lim and Barton (2006) argue that students’ sense of place is not simply about where they live, but “about how they appropriate their lifeworlds and what kind of ecological relationship they have with their lifeworlds” (p. 135). Our students’ declarations of their desire to protect their environment suggest that, following the intervention program, they may have begun to “appropriate” the Hebron Stream and its surroundings as part of their “lifeworld” and accept responsibility for protecting it.

The intervention exposed the students to the ongoing efforts to restore the stream and improve local infrastructure. This change in their environmental situation generated the conditions for the students to build a new connection with the stream, a connection they expressed as feelings of hope and optimism about the stream’s reclamation. In other words, the improvement helped the students to move from a non-productive state of fatalism and hopelessness to one of hope that the stream could be different and willingness to contribute to that outcome.

c) *The unrealized ideal: Obstacles and future aspirations in the implementation process*

Adapting place-based education programs to local conditions can be as challenging as it is important. Though the study presented here exemplifies multiple ways in which this adaptation was successful, there were also several points at which particular conditions prevented us from meeting important educational goals.

For example, one goal of environmental education that was complicated by the particular conditions in which this project was implemented is the incorporation of environmental activism into the educational experience. The literature has shown that, in addition to direct interactions with the surrounding environment, social and environmental activism can be a very powerful contributor to place attachment (Avriel-Avni, et al. 2010). While incorporating an element of activism was one of the intervention program’s original goals, we were ultimately unable to do so due to logistical considerations. First, we were unable to involve the students actively in the stream’s rehabilitation because it was accompanied by massive excavation work, and it was therefore deemed too dangerous for students to gather in the stream area. At the beginning of the process the students were able to take samples from the stream water, but thereafter they were only allowed to observe the reclamation from a distance. Secondly, plans to incorporate a community activism element after bins had been delivered to all of the villages’ residents were obstructed by delays and inconsistencies in the provision of trash bins for all of the village’s residents. The delays were due largely to logistical problems associated with the difficulties of accessing all of the village’s homes via unpaved dirt roads with garbage trucks in order to collect the waste. These delays affected the students’ ability to engage in social and environmental activism, because their parents, when asked to change their waste disposal practices, could answer that they had not yet received a waste bin.

Another key component of place-based education that was not present in the intervention program described here is the incorporation of elements from the students’ own culture into the learning process. Such an incorporation of knowledge from their own history and traditions is often cited as central to the success of environmental education for indigenous peoples (Aikenhead 2001). According to Cajete

(2000), indigenous communities have historically lived according to a “communal environmental ethics,” which stems from a general sense of kinship with all life, and an implicit presumption that the education of their children therefore includes learning “to live respectfully in their environment, in ways that would guarantee its sustainability” (p. 101). However, despite the acknowledgement of these potential benefits in the global academic community, the program that was the focus of this study did not involve the Bedouin community itself in its development. The program was initiated by the Ministry of the Protection of Nature, and carried out in practice by the Society for the Protection of Nature (SPN). From the Bedouin community’s perspective, both of these institutions represent the external authority of the State. The plan for the reclamation of the stream, like the educational initiative that accompanied it, was made without any significant input from representatives of the Bedouin community.

Studies have shown that integrating scientific and indigenous knowledge helps students develop an understanding of the fact that learning takes place in a complex system that includes their own experiences, culture and context as well (Castagno and Brayboy 2008; Glasson et al. 2010). Moreover, acknowledging the value of their own communities’ strategies for protecting their natural heritage and using natural resources sustainably can be a source of empowerment for children, and a significant factor in their willingness to participate in social change (Santos et al. 2005). There would certainly have been merit in exposing the students in our study to their own history within the local social-natural environment, and encouraging them to explore their community’s indigenous knowledge of practices from the Bedouins’ previous way of life, which included a range of scientifically valuable environmental practices and reflected their traditional sustainable lifestyle.

For hundreds of years, the Negev Bedouins maintained a healthy, balanced relationship with their natural environment. This balance, however, relied at least in part on the fact that their population was small, and nearly all of the waste they generated was organic and easily biodegradable. Today, Bedouin society has incorporated many modern, inorganic materials into daily life, and the contents of the waste it generates have changed accordingly (Meallem et al. 2010). The adoption of a sedentary life, and of many Western products and practices (e.g. disposable diapers, aerosol cans, batteries etc.) that were not part of the life led by their grandparents’ generation, means that many of the Bedouins’ traditional waste disposal practices are no longer suited to the community’s current needs. Bedouin society as it exists today reflects a combination of traditional and modern lifestyles. The manner in which it approaches waste management should reflect that combination as well. If both types of knowledge – indigenous and Western – were present in class, it could highlight the fact that environmental knowledge and behavior are not just something that is given to the students by an outside authority, but are part and parcel of their own heritage as well.

### *Conclusion and recommendations*

All over the world, indigenous societies are living in close contact with ‘Western’ society – not in isolation from it. Our study highlights the importance of conducting research that emphasizes the relationship between these societies-in-transition and place-based education, so that the latter can be properly adapted to address each community’s particular environmental needs.

More specifically, we recommend that place-based education programs consider the following points:

- a) When students' local environment is contaminated, the boundaries of that local environment should be expanded to allow the students to spend time learning in a healthy environment. This should be followed by a comparative dialog about their experience in the healthy environment and the contaminated one.
- b) Place-based education initiatives should work hand in hand with reclamation programs for improving the conditions of populations living in contaminated environments. This would allow students to reflect on and talk about their environment – how it is and how it could be – even as they watch it change.
- c) Combining local knowledge with educational contents based on Western science can be a useful means of tapping into students' sense of pride and personal empowerment, while providing them with tools for meeting new challenges created by changes in their community's traditional lifestyle.

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### Tables

Table 1: Description of the Two-Year intervention outdoor place-based education program

Table 2: Distribution of sense of place dimensions in the student drawings (N=107)

Table 3: Distribution of sense of place dimensions and inductive analysis categories in the student interviews (N=107)

### Figures

Figure 1: Dimensions of sense of place (Ardoin 2006).

Figure 2: Illustrates the process of analyzing the drawings

Figure 3: Example of pre- and post-drawings showing perceptual change about the stream – from a polluted stream to a clean one.

Figure 4: A drawing that exemplifies perceptual change about the stream in the village environment.

Figure 5: Example of a drawing that shows the connection between regularized trash bins and cleanliness in the village.

Figure 6: Example of drawing showing student's experience at another stream.

Figure 7: A drawing representing the stream's reclamation, with an explanation reflecting the student's optimism

**Table 1: Description of the two-year intervention outdoor place-based education program**

First Year		Second Year	
Field trip	Activity description	Field trip	Activity description
My village	<p>Part 1:</p> <ul style="list-style-type: none"> <li>- Identifying waste components and consumption habits.</li> <li>- Identifying the local methods of waste treatment in the village and the negative effects of these methods.</li> </ul> <p>Part 2:</p> <ul style="list-style-type: none"> <li>- Identifying students' experiences in the village, pretty places (like the field).</li> </ul>	Birdwatching in my immediate environment	<ul style="list-style-type: none"> <li>- Encounter with an ornithologist, learning about ornithologists' methods and tools (i.e. 'ringing', observing birds through a telescope).</li> <li>- Monitoring and observing birds in the local environment, identifying their characteristics.</li> </ul>
Hebron stream and immediate environment	<ul style="list-style-type: none"> <li>- Collecting water from the stream and comparing the tap water and Hebron Stream water.</li> <li>- Characterization of parts of the stream (flow, banks, stream bottom).</li> <li>- Observations on waste components in the Hebron stream and their quantities.</li> </ul>	My village, Hebron Stream and its immediate environment	<ul style="list-style-type: none"> <li>- 'My environment' clean-up activity.</li> <li>- Exploring and learning the route taken by waste, from home/school to the new collection bins.</li> <li>- Observation of the stream rehabilitation process.</li> <li>- Art Workshop – "How to draw a stream": Raising and clarifying personal feelings towards the stream environment through drawings and visualizing the area.</li> </ul>
Field trip to a 'healthy' stream – Habesor	<ul style="list-style-type: none"> <li>- Crossing the stream via the hanging bridge. Observation of the stream's twists and turns from above and identification of various elements in the landscape (hill, stream channel).</li> <li>- Identifying voices in the stream environment (quiet game).</li> <li>- Observations of the stream as a resource and a habitat (identification of interactions between animals, plants and the stream).</li> <li>- Visiting water reservoirs in Habesor Stream and identifying points of human/water interaction.</li> </ul>	Field trip to a 'healthy' stream - Ein Avdat nature reserve	<ul style="list-style-type: none"> <li>- Observations of the stream as a resource and a habitat: Identification of signs of animal presence (animals, tracks, ibex dung, burrows, etc.); Identification of different types of plants in the vicinity of the stream; Characterization of plants in the stream environment.</li> <li>- Exploring and comparing habitats of a channel of flowing water and a dry water channel.</li> <li>- Exploring the formation of the spring: through observation of the waterfall and the spring pool, observation of the rock layer.</li> </ul>
Tel Beer-Sheva National Park	<ul style="list-style-type: none"> <li>- Observation and comparison between Hebron Stream and Aroar Stream.</li> <li>- Identifying the human/stream relationship: descending into the well and observing the channel that conveys floodwater from Hebron Stream to the well.</li> </ul>	Beersheba Stream Park	<ul style="list-style-type: none"> <li>- Characterizing the rehabilitated Beer Sheva Stream: water (flow, stream shape, water clarity), animals, plants and human activity.</li> </ul>

Table 2: Distribution of sense of place dimensions in the student drawings (N=107)

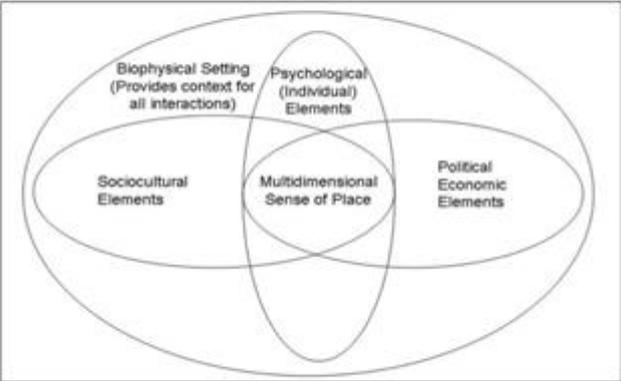
Sense of Place dimensions	Drawing components	Village Drawing			Stream Drawing		
		Pre-	Post-	p-value	Pre-	Post-	p-value
Biophysical	Hebron Stream	27%	62%	$\chi^2(1) = 25.92, p < 0.001$	97%	69%	$\chi^2(1) = 30.06, p < 0.001$
	Pasture	25%	36%	$\chi^2(1) = 2.67, p > 0.05$	4%	5%	$\chi^2(1) = 0.12, p > 0.05^1$
	Plants	79%	79%	$\chi^2(1) = 0.03, p > 0.05$	53%	77%	$\chi^2(1) = 12.83, p < 0.001$
	Waste in and near the stream	20%	13%	$\chi^2(1) = 1.67, p > 0.05$	78%	17%	$\chi^2(1) = 79.22, p < 0.001$
	Wild animals	12%	29%	$\chi^2(1) = 9.27, p < 0.01$	22%	31%	$\chi^2(1) = 1.94, p > 0.05$
	Stream in nature preserve	0%	1%	$\chi^2(1) = 1.005, p > 0.05^1$	0%	32%	$\chi^2(1) = 40.42, p < 0.001$
	Wild animals in nature preserve	0%	0%	Not applicable	0%	22%	$\chi^2(1) = 25.77, p < 0.001$
	Wild plants in nature preserve	0%	0%	Not applicable	0%	10%	$\chi^2(1) = 11.59, p < 0.01$
Political-economic	Bridge	12%	11%	$\chi^2(1) = 0.05, p > 0.05$	37%	44%	$\chi^2(1) = 0.95, p > 0.05$
	Garbage cans	6%	31%	$\chi^2(1) = 22.85, p < 0.001$	5%	3%	$\chi^2(1) = 0.52, p > 0.05^1$
	Roads and paths	64%	51%	$\chi^2(1) = 3.76, p > 0.05$	24%	8%	$\chi^2(1) = 8.74, p < 0.01$
	Village structures	34%	30%	$\chi^2(1) = 0.35, p > 0.05$	10%	0%	$\chi^2(1) = 11.59, p < 0.01$
Sociocultural	Domestic animals	23%	28%	$\chi^2(1) = 0.61, p > 0.05$	20.56%	24%	$\chi^2(1) = 0.43, p > 0.05$
	Houses	95%	95%	$\chi^2(1) = 0, p > 0.05$	38.32%	23%	$\chi^2(1) = 5.61, p < 0.05$
	People	23%	43%	$\chi^2(1) = 9.30, p < 0.01$	36%	24%	$\chi^2(1) = 4.95, p > 0.05^1$

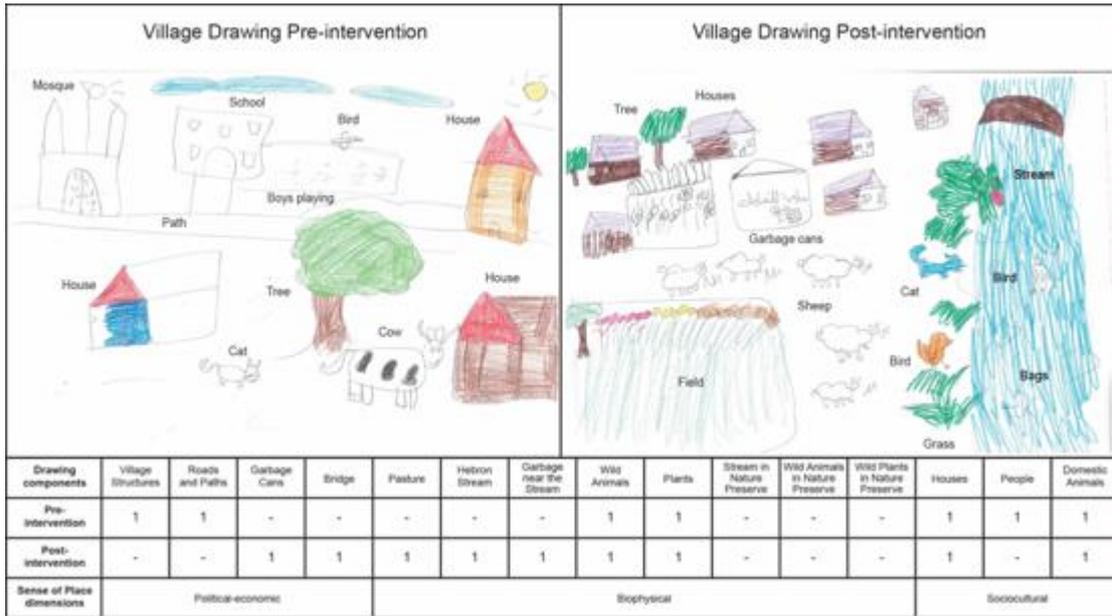
<sup>1</sup>More than 20% of cells have expected frequency less than 5.

**Table 3:** Distribution of sense of place dimensions and inductive analysis categories in the student interviews (N=107)

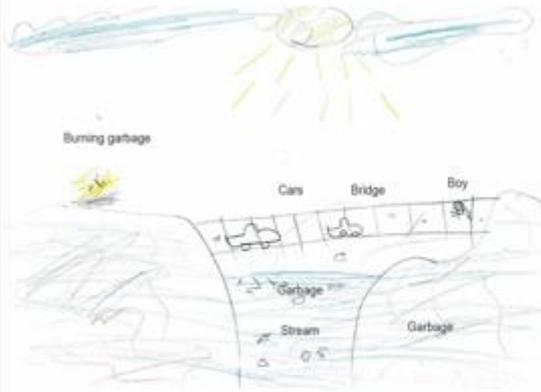
<b>Category (Deductive)</b>	<b>Sub-category (Inductive)</b>	<b>Pre- Post- (n=107)</b>		<b>Describes students' references to</b>
Bio-physical	The stream 'distorts' the landscape	92%	4%	The stream as aesthetically detrimental (e.g., saying "it is ugly," "it looks disgusting," "full of garbage," or describing it by listing the types of trash they habitually see there).
	The stream 'improves' the landscape	0%	33%	The stream as aesthetically pleasing (e.g., "the stream adds beauty to nature, it looks nice").
	The stream is not useful; it is harmful (to nature)	67%	13%	The stream as a source of harm to the environment (e.g., animals will eat the trash on the banks and die).
	The stream is an environmental resource	22%	78%	The stream's importance to humans (e.g., providing food, habitat, collecting water).
Socio-cultural	Attachment to friends and family	83%	9%	Their sense of social belonging, through parents, friends (e.g., "we all know each other," "we're all family," "we play with our cousins who are our friends").
	Attachment to domestic animals	67%	3%	Their sense of belonging and experiences with animals (e.g., herding sheep, caring for pets, ducks and chickens, pigeons, riding horses and donkeys).
	Positive social experiences near home	84%	6%	Highly regarded communal experiences near the village.
	The stream as a health hazard	66%	7%	The possible negative health ramifications of contact with stream (e.g., diseases, mosquito bites, foul smells).
	The stream as a natural treasure	1%	64%	The benefits of the stream's presence to humans (e.g., drinking, irrigation, using plants that grow there).
	The stream as a source of danger	52%	7%	The stream as a potentially harmful place (e.g., dangerous animals, flooding, bridge breaking, injuries from sharp objects).
	The stream as a place of recreation	37%	39%	The stream as a place in which to have fun.
	The stream as a neglected place	81%	30%	The stream as a place to dump garbage that people do not care about.
	The stream as a place to be protected	1%	80%	The stream as a place that should be looked after.
Political economic	The village area suffers from a lack of infrastructure	18%	17%	The village situation as suffering from a lack of things like paved roads, electricity and playgrounds.
	Improvement of the village area following infrastructure changes	0%	58%	Recent alterations in local infrastructure and corresponding enhancements to the bio-physical situation.
Political economic/ socio-cultural	Association of waste disposal habits with lack of alternatives	45%	0%	The social norm of dumping waste in the stream as related to things like a lack of trash bins, not knowing where else to put waste and wanting waste away from the house.
	Impact of infrastructure improvement on mobility of people in the village	0%	17%	The connection between the state of the bridge and the residents' ability to move freely in and out of the village.
	Impact of infrastructure improvement on village people's waste management practices	0%	60%	The connection between the village's infrastructure, the residents' ways of dealing with waste and the village's cleanliness.
Personal	Personal experiences in a polluted stream	94%	0%	Ambivalent experiences in the nearby polluted stream (e.g., liking to play there but becoming sick after falling in, fear of injury or illness from falling in,

				gathering toys and metal to sell on the banks, avoiding bad smells, seeing dead animals).
	Personal experiences in a healthy stream	0%	84%	Positive experience in healthy streams (e.g., wading in the water, enjoying the landscape, animals and plants).
	Personal pro-environmental behavior	9%	60%	Actions that benefit the environment (e.g., "I started not to throw in the stream, I throw in the bin, I protect animals").
	Difficulty adopting personal pro-environmental behavior.	0%	4%	Problems that prevent individuals pro-environmental behavior (e.g., "we don't have bin, I got used to throwing it in the stream").
Personal /political-economic	Pessimism regarding the stream's future	59%	4%	Lack of hope that the circumstances of the stream can change.
	Optimism regarding the stream's future	10%	96%	Hope that the circumstances of the stream can change.
	Ambivalence regarding the stream's future	15%	0%	Uncertain responses to questions about what will happen to the stream (e.g., "maybe it will change and be cleaner, maybe someone else will clean it").
	Uncertainty regarding the stream's future	11%	0%	Lack of confident knowledge regarding what will happen to the stream ("I don't know what will happen, maybe it will widen, maybe it will dry up").
	Critical view of the reclamation process	0%	22%	Problems with the stream intervention (e.g., water still polluted).
	Critical view of the waste disposal regularization process	0%	51%	Problems with the new systems to deal with waste (e.g., not everyone received a bin, delays with waste removal, bins filling up quickly).
Personal /socio-cultural	Critical view of the community's environmental behavior	1%	25%	Disappointment and disapproval of the community's lack of interest in environmental behavior.
	Desire to promote environmental behavior in the community	1%	35%	Personal pro-environmental behavior towards society (e.g., explaining to people, hanging signs, speaking to friends who litter, being a role model for others).
	Difficulties associated with leading changes in environmental behavior	0%	5%	Problems with encouraging pro-environmental behavior in society (I'm embarrassed to talk to other people, they will laugh at us, no-one listens to us).





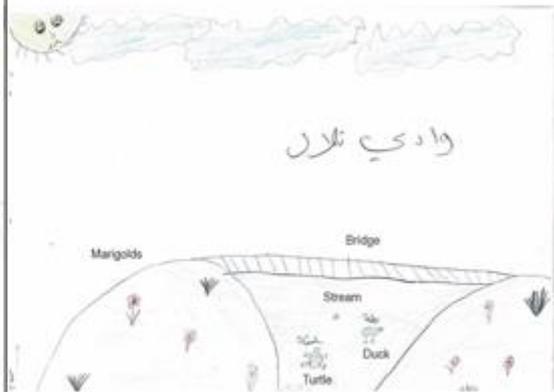
Stream Drawing Pre-intervention



The student explained:

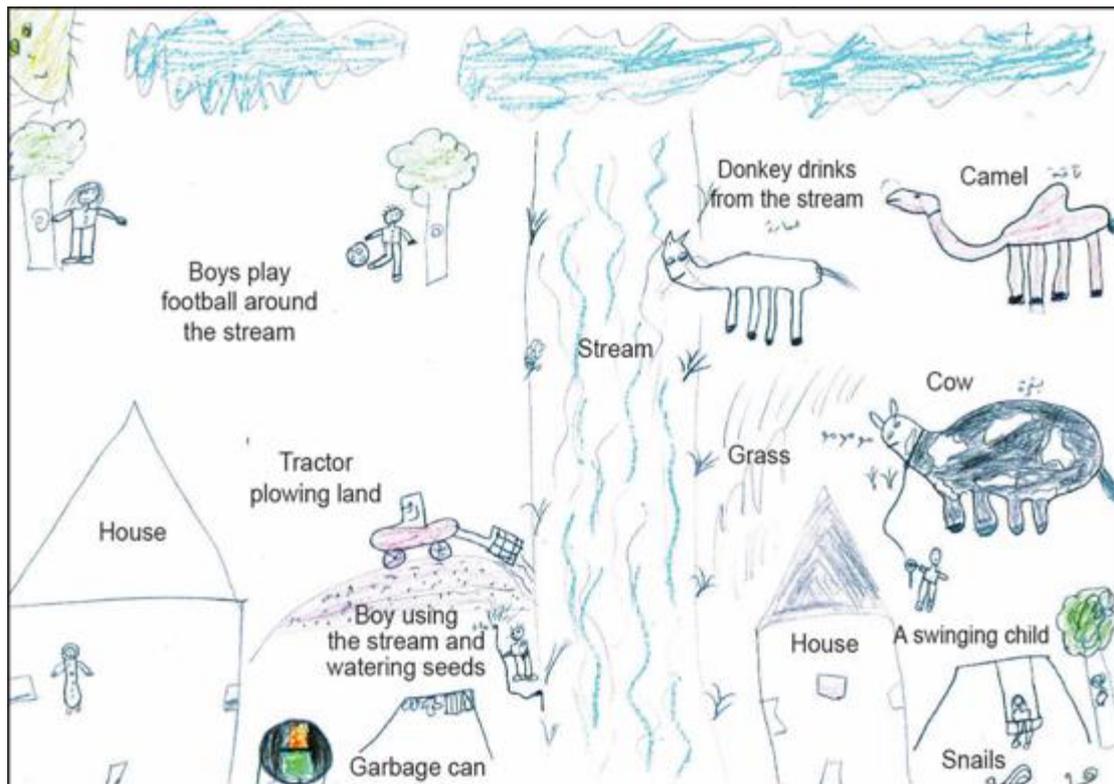
"I drew the stream. It is full of garbage. Its water is always dirty. There's a road...always dirty. There's fire near it...because they burn garbage. The children pass on the road."

Stream Drawing Post-intervention



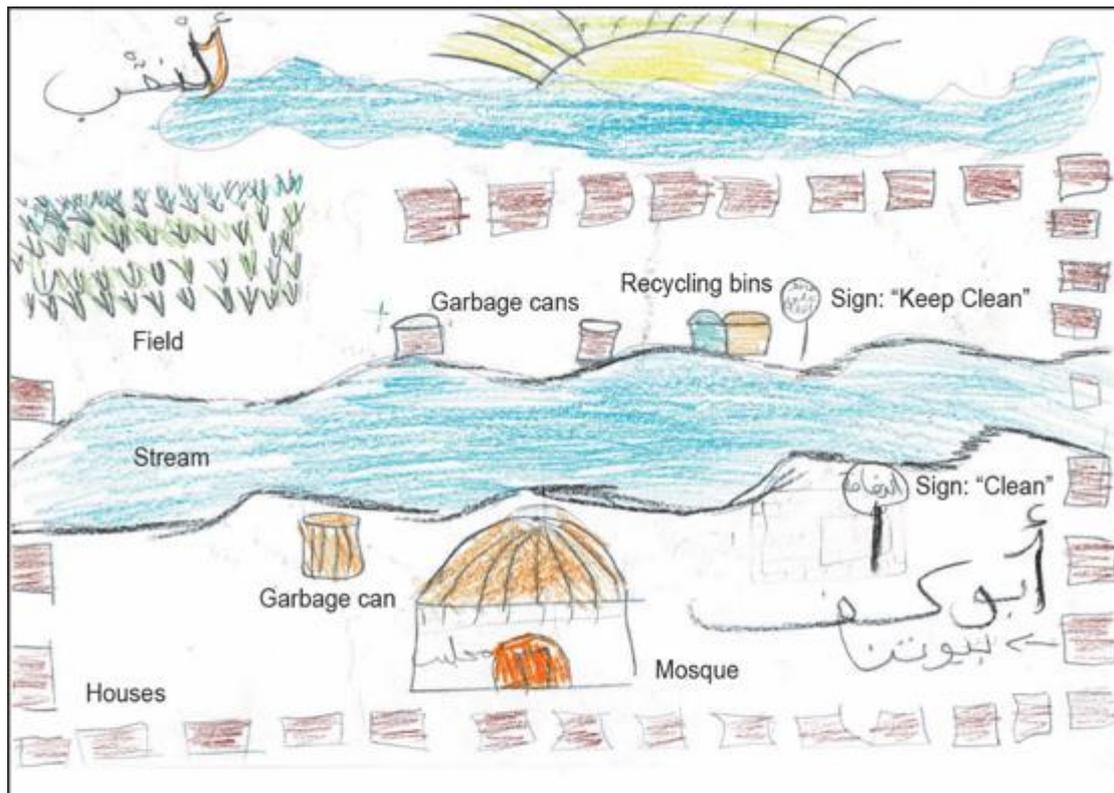
The student explained:

"I drew the Bsor stream like we went and saw it. I drew a turtle living in the water, a duck, flowers, a bridge because we crossed and saw marigolds. The view there is pretty...because there's no garbage and fith in the stream."



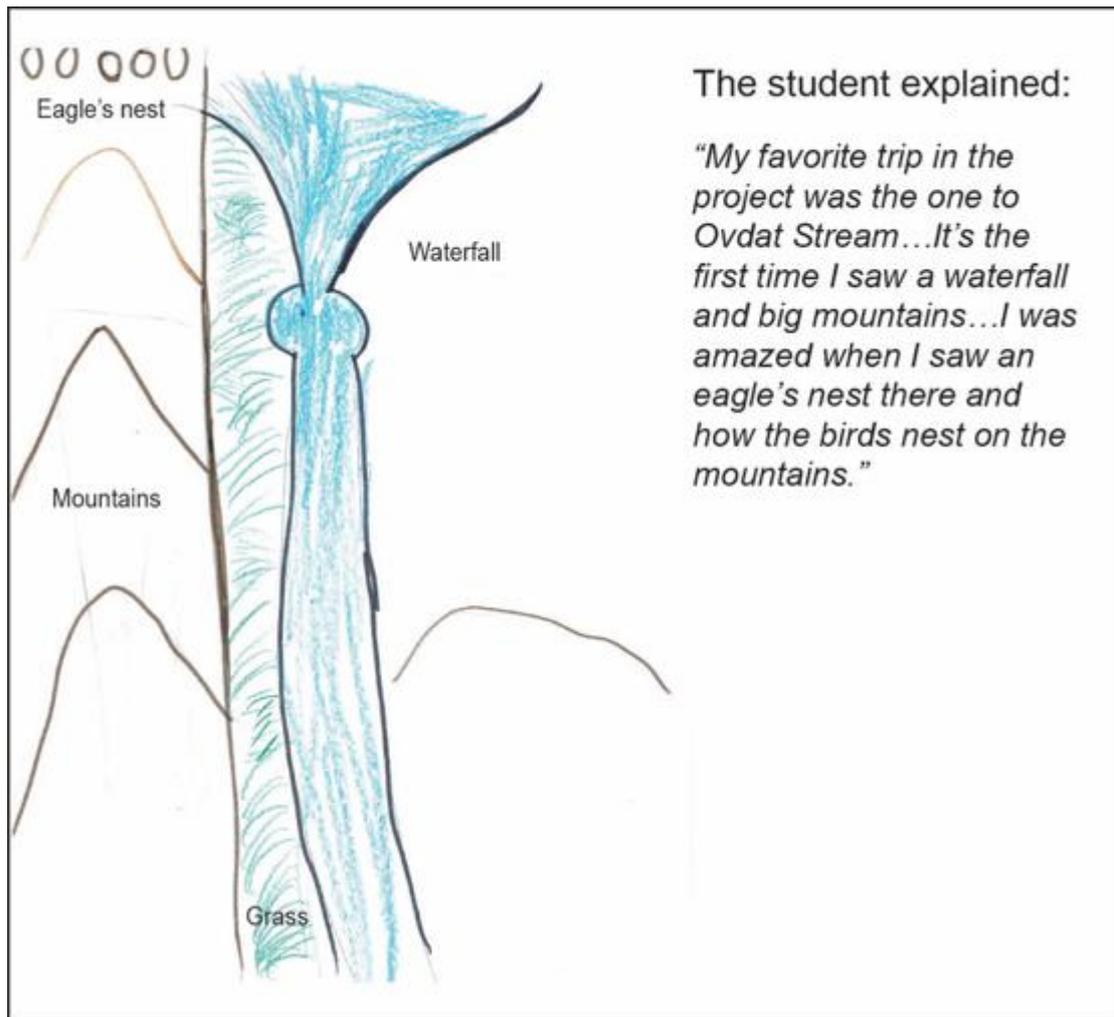
The student explained:

*"I drew my village, the wadi (i.e., the stream), houses, a donkey, a cow, a tractor plowing. I drew trash bins that the council gave the houses. It's good that we have bins now to put trash in and protect the wadi. Today we see the bins and if someone want to throw something away they do it in the bins and not the wadi. I drew children playing football near the wadi...a boy watering seeds, bringing the water from the wadi. I want it to go back to how it was, to water from it, and for plants to grow around it, to take clean water from it, because if we make it dirty we harm ourselves...the mosquitoes and bugs will bite us and we'll get sick. I drew a donkey drinking from it and it's clean and good. Our village is prettier with a clear, healthy wadi. We don't want it to be dirty."*



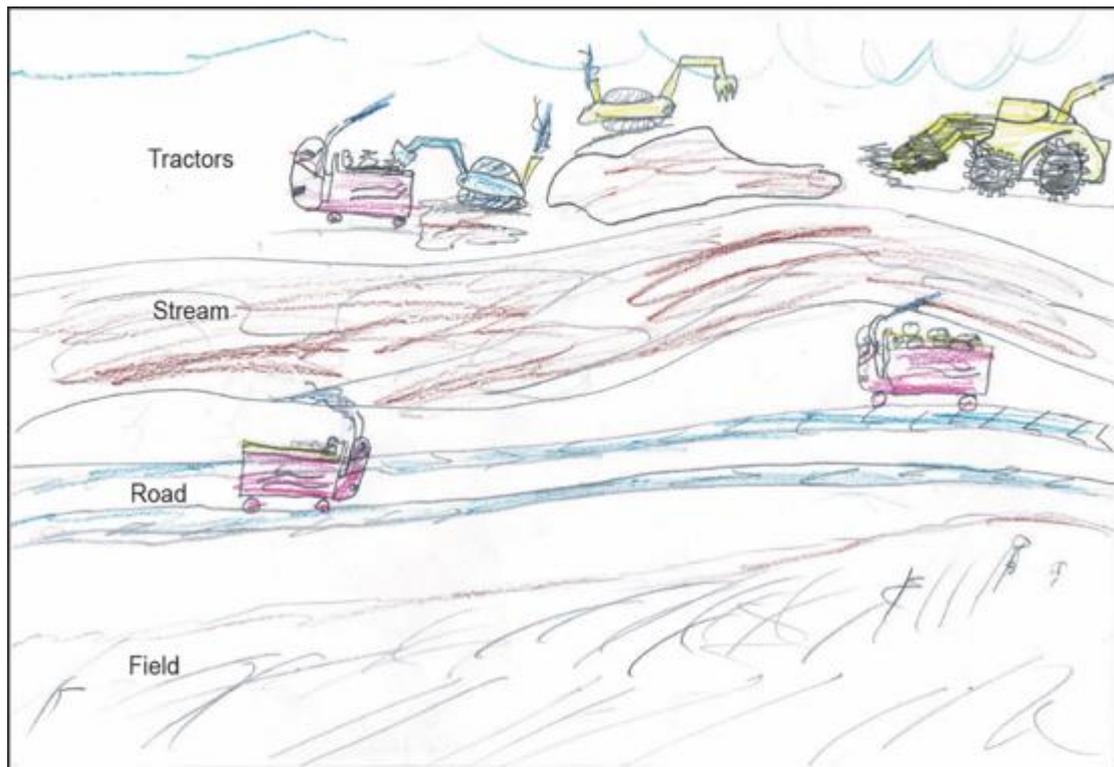
The student explained:

*"I drew garbage cans, a sign that says, 'keep things clean,' so our village will be clean."*



The student explained:

*"My favorite trip in the project was the one to Ovdad Stream...It's the first time I saw a waterfall and big mountains...I was amazed when I saw an eagle's nest there and how the birds nest on the mountains."*



The student explained:

*"I feel something good because our stream will change and be clean. At first the stream was disgusting, and nobody went there. Now it's better. We should go to the stream every day and see whether or not it's improving."*