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School-Based Enterprises and Environmental Sustainability

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Abstract

This article uses an educational framework of environmental sustainability to examine the production process and the final products and services delivered by School-Based Enterprises (SBEs). Whereas the fledging literature on SBEs has extolled their many benefits for improving learning, it has been slow to acknowledge the importance of promoting ecological awareness through vocational education. This article defends the importance of "greening" SBEs in order to raise students' and teachers' consciousness about the importance of environmental stewardship, and it also explores key limitations faced by SBEs that attempt to follow such a framework. This environmental educational framework is used to analyze qualitatively the actual practices of SBEs in two public secondary schools in Colombia, South America.

Introduction

The goal of production is to produce not commodities,
but free people in harmony with nature.
—Adapted from John Dewey (1916)

A School-Based Enterprise (SBE) is a student-led productive activity that provides a product or service for the school or the community. Sometimes an SBE constitutes a course independent of the academic curriculum; other times it serves as a generator theme for the entire curriculum. An SBE is important for several reasons: it provides relevance, context, and concreteness to abstract material learned in the classroom; it supplies a product or service that is lacking in the school or community; it challenges the individualized nature of modern education by engaging students in a cooperative endeavor; it increases students' awareness of the connections between work and community well-being; it enables students to take pride in their work; and it allows students to develop confidence in their leadership capabilities. Examples of SBEs include raising crops and farm animals, manufacturing household items, operating a radio station, selling beverages and pastries, managing a restaurant, repairing old homes, maintaining local parks, and providing child-care services.

This form of learning through production is not new. Schools in many countries, including in the United States, have used structures similar to SBEs for decades (Borstel, 1991, 1992). Among the literature on SBEs in the United States is an often-quoted book, *School-Based Enterprise: Productive Learning in American High*

Schools (Stern, Stone, Hopkins, McMillion, & Crain, 1994) that laid out some of the theoretical and practical considerations for starting and consolidating SBEs, based on the stories of 16 high schools (for other relevant literature, see Brown, 1995; Singh, 1998). In this article I seek to extend this discussion by considering the environmental consequences of the production process and the products and services delivered by SBEs. More generally, I present a broad educational framework to assist educators in restructuring their current vocational practices to promote environmental stewardship. Given the heightened global consciousness regarding environmental problems, the field of vocational education would appear ripe for this kind of exploration.

The inclusion of environmental concerns in vocational education is in fact a natural extension of the application of a social justice lens to work education (for examples see Dentith, 1997; Gregson, 1996; Kincheloe, 1995; Simon, Dippo, & Schenke, 1991). This lens has been identified as essential for teaching students from low-income backgrounds how to challenge oppressive systems of belief such as classism, racism, and sexism. Given that poor and ethnic minority students constitute a disproportionate percentage of the student population in vocational programs, it is essential for teachers to foster in them an understanding of the political nature of education. This political consciousness would allow students to see the connections among low-income communities, social problems, and environmental deterioration, which go hand in hand with poverty. People in poor communities are exposed to a wider array of environmental and social harms than are residents in higher socioeconomic areas, including mediocre air and water quality, homes with toxic levels of lead and asbestos, neighborhoods with few parks and poor sewage systems, land prone to erosion and heavy deforestation, substandard nutrition, and inadequate health care. Although vocational education (or any form of education for that matter) is incapable of directly solving these problems, a heightened social and environmental awareness may lead students to understand that these conditions are not inevitable, but rather result from political and economic decisions that can be reversed.

Given that vocational education provides one of the clearest links between learning and economic productivity, it is important for career and technical educators to ask themselves about the environmental impact of any line of production or service. All forms of production involve an exchange of matter and energy, which inevitably carries with it an environmental effect (see, for instance, Ashworth, 1995). If vocational education is designed to have the least possible impact on natural resources, these lessons can positively affect students' daily lives and perhaps even influence the type of employment they will seek after graduation. Borrowing from John Dewey (1916), the ultimate goal of production is to produce not commodities, but free people who live in harmony with nature. For instance, in the United States, the environmentally friendly trade programs at La Follette High School in Madison, Wisconsin, and Birmingham Seaholm High School in Birmingham, Michigan, are

two rare examples of vocational programs that take environmental concerns seriously (Wolf, 2001). At both schools, students build homes and adapt existing buildings following eco-architectural principles, addressing such issues as energy efficiency, resource conservation, and indoor air quality. Despite the success of these and other programs, very little research has been done on the connections between the natural environment and work education (Dippo, 1998; Lakes, 2000), leaving practitioners, even those with the best of intentions, at a loss about how and where to start. Thus, in this article I seek to contribute to this inchoate literature by assessing the strengths and weaknesses of environmental SBEs that enjoy very few financial resources.

The article is divided into four sections: first, it presents a framework of environmental education as it relates to the production of SBEs. Second, it focuses on the methodology used to explore two public secondary schools in Colombia, South America, that have for several years implemented SBEs with an environmental orientation. Third, it uses the educational framework developed in section 1 as an analytical tool to study the Colombian SBEs. And finally, it discusses the difficulties of fostering environmental protection in light of the obstacles schools encounter in implementing their vocational programs.

Conceptual Base for the Study

During the last two decades, several publications have made explicit the connections between Western schooling and the global ecological crisis (e.g., Bowers, 1987; Hutchison, 1998; Orr, 1994; Smith & Williams, 1999). Among other topics, these publications have focused on philosophical issues concerning the purpose of education, alternative curricular and pedagogical strategies, the links between school and community, the importance of local lore and trans-generational communication, and the green design of K-16 buildings. A ramification of this growing literature is the connection between environmental sustainability and vocational education, or for the purposes of this article, SBEs.

The following framework, adapted from the work of Smith and Williams (1999) and John and Nancy Todd (1984), may prove useful in guiding educators to design and implement environmentally sensitive SBEs. It consists of a series of principles that, without being mutually exclusive, can serve as a starting point for any school that wants to implement a green vocational program or modify an existing one. Not all principles are applicable to every SBE, and the list should not be followed dogmatically. Rather, it can stimulate educators to think about the most appropriate applications of these ideas. This framework need not be restricted to SBEs but could be applied to other forms of vocational education, including career academies, clusters, occupational high schools, and magnet schools (for a complete list of possibilities, see Grubb, 1996). The framework consists of the following principles:

1. Focus on local knowledge and skills that support ecological renewal.
2. Use nature as a model for design.

3. Employ sustainable methods of cultivation and management.
4. Integrate living systems.
5. Make products that are durable, repairable, remanufacturable, and recyclable.

Focus on Local Knowledge and Skills That Support Ecological Renewal

Prior to the widespread implementation of the Western model of schools and universities worldwide, it was common for villagers and townspeople to rely on local knowledge, skills, traditions, and technologies that emerged from the interaction of the locality with the surrounding ecosystem (Bowers, 1992). In pre-modern times, elders also played an important role in the maintenance of ancestral traditions and the propagation of local histories. With industrialization and Western schooling becoming common in most nations, local knowledge and skill have been gradually displaced and ignored, leaving elders feeling that they are inadequate contributors in guiding youth in their transition into adulthood. Moreover, increases in family mobility, electronic means of communication, and modern forms of transportation like the automobile have undermined young people's sense of belonging to a particular locality. To counteract these trends, it is imperative for educators to assist students in generating appropriate responses to local problems based on resources available in the local ecosystem and in the collective wisdom of the community.

Use Nature as a Model for Design

Barry Commoner, a leading environmentalist, has emphasized that ecosystems are the only systems humans are aware of that maintain stability and protect their members and interrelationships over a long period of time. Therefore, it makes sense to use the ecosystem as a guiding metaphor for changing the operation and structure of social systems and technologies (Commoner, 1992, p. 11). Although there is not complete agreement among ecologists regarding the basic principles that govern the behavior of ecosystems, most observers agree that ecosystems display at least the following six principles: interdependence, carrying capacity, diversity, resilience, relationships, and energy and matter flows. The last principle, energy and matter flows, can serve as an example for explaining nature as a model for design. All ecosystems are open systems that require a constant flow of energy and matter. Energy enters an ecosystem in the form of solar energy; matter enters as water and carbon dioxide, among other forms. Plants, which use these elements in their growth process, are eaten by primary consumers (e.g., cow), which are in turn eaten by secondary consumers (e.g., puma). After plants and animals die, their organic material decomposes. Decomposers, such as bacteria and fungi, release carbon dioxide and mineral salts. Plants absorb these inorganic compounds, and the whole cycle of energy and matter flows begins again. An important lesson gained from this

principle is the absence of waste. What for one organism is refuse for another is a feast, as in the case of manure decomposed by microorganisms.

Employ Sustainable Methods of Cultivation and Management

SBEs dealing with renewable resources, such as crops, livestock, trees, and the like, can play a vital role in motivating students to switch to sustainable methods of cultivation and management. In the case of agriculture, a sustainable approach uses biological controls, crop rotation, composting, mulching, and other low-input strategies to avoid the use of synthetic fertilizers and pesticides. This approach also uses less water, protects the biological richness of the soil, and prevents erosion. In the case of raising livestock, a sustainable approach uses feeds and forages free of synthetic chemicals, physical environments that allow animals ample movement to express normal patterns of behavior, and a diet free of hormonal growth promoters and antibiotics. In the case of forestry, the quantity of the renewable resource removed does not exceed the amount that grows in the interval between harvests, and an effort is made to maintain the habitats of all native plant and animal species. Sustainable methods of production provide win-win situations, where producers and consumers benefit and biological diversity is enhanced.

Integrate Living Systems

Human and nonhuman life constitute systems nested in larger systems that are fully integrated. As Barry Commoner stated succinctly in his 1971 classic *The Closing Circle*, "Everything is connected to everything else." Systems form web-like structures that are symbiotic and interdependent. A forest presents a good example. A tree is a living system composed of roots, a trunk, branches, and leaves. Each of these is composed of tissue, which in turn is made up of a collection of cells. Simultaneously, the tree is part of a larger ecosystem called a forest, which is part of a biome. Such interrelationships at the micro and macro levels could be elaborated endlessly. The point is that no living system can exist in isolation from other living systems. Social systems that follow this integration tend to be very resilient and to withstand outside pressures, just as an ecosystem does.

Make Products That Are Durable, Repairable, Remanufacturable, and Recyclable

This principle does not apply to SBEs that provide a service or a perishable good (e.g., a student-run radio station or a student-maintained orchard). Instead, it is applicable to SBEs that produce a consumer good for sale. An environmentally sustainable SBE should steer clear of the notion that disposable products are desirable because they are cheaper. Products that are durable, repairable, upgradable, remanufacturable, and recyclable must be the goal of any SBE. Extending the useful life of a product allows educators to send the critical message to students that any form of production has an environmental impact. The throwaway quality of today's

commercial products has the all too appealing incentive of a low price, making them attractive to producers and consumers. However, too often these products are of poor workmanship and require frequent replacement. Not only are natural resources squandered, but also human labor is denigrated. The educational function of SBEs places them in an ideal situation for promoting the concept that consumers benefit from paying a higher up-front cost for a durable product. Students can experiment with different materials and forms of production without fear of losing their "jobs" or losing customers, as workers in a real firm would.

Methodology

A qualitative research methodology was used by means of in-depth interviews, direct observations, and document analysis. This method was used to probe the following questions:

> "Do schools that foster environmental stewardship and have a vocational component follow the educational framework suggested by the literature? If so, how? If not, why not?"

To answer these questions, I contacted the Colombian Ministry of Education, which provided me with a list of schools considered models for the rest of the nation in terms of promoting environmental sustainability. I used four criteria in selecting schools from this list for examination: First, I chose only public schools because Colombian public schools tend to operate with small budgets and serve low-income students. These characteristics increase the potential for generalizing results. Second, I selected secondary schools. Although the literature is rich in descriptions of environmentally sensitive elementary school programs, there is a dearth of case studies of secondary schools with a similar philosophy and practice. Third, I sought one rural, one semi-urban, and one urban school (but I was only able to gain access to a rural and semi-urban school). Again, my rationale was to ensure the results were generalizable to as many settings as possible. Fourth, the schools had to have a vocational component. Based on these criteria, I obtained a purposeful sample of two schools: the Fernández Guerra Secondary School (better known as Ferguerra), located in southwestern Colombia, and the Tomás Herrera Cantillo Secondary School (better known as Peñoncito), located in the northern part of the country. During the 1990s both schools had set up one SBE per grade level to promote environmental awareness and protection.

After contacting the two schools and obtaining the appropriate permissions, I spent several months at each school in 1997 and 1998, conducting a qualitative study of various aspects of the schools (for an analysis of the schools' academic curricula, see Arenas, 2001). One key motivation for the schools to accept my presence was that I would provide information to help them improve various aspects of their schools, including their vocational programs. Prior to my arrival, administrators and faculty were informed about the objectives of the study and the use of the educational

framework for environmental protection. School officials liked the idea of using a deductive approach whereby a framework developed elsewhere could be used in assessing their SBEs. It was determined that a deductive approach would be superior to an inductive one given the broad theoretical literature that already exists regarding the greening of the economic system and production processes in general (albeit there is a dearth of literature connecting it to vocational education). This etic perspective, as it turned out, provided a starting point for systematically analyzing the environmental advances of their SBEs, something they had not previously done.

I chose a qualitative approach because each school had a unique model for providing experiential environmental education. At each school I conducted in-depth interviews of key stakeholders (i.e., students, parents, teachers, and administrators); direct observations of the various activities of the SBEs; participant observations of the entire vocational program; and an analysis of documentation, including the schools' mission statements and other administrative documents, articles from local newspapers, student homework, and reports prepared by the vocational teachers. Using several sources of data allowed me to triangulate key observations to strengthen the results of the study (Patton, 2002). Between the two schools I conducted a total of 18 formal interviews (based on open-ended questions) and about 40 hours of field observations. Prior to the observations, students were informed of the research objectives. The following are English translations of some of the questions asked of the teachers:

- Why were the SBEs started?
- Is there a relationship between the SBE and the academic curriculum? If yes, how is it manifested? If no, are there any plans to bring them together?
- What type of training, if any, did you receive to run the SBE?
- In what ways, if any, do you feel your SBE contributes to the larger environmental mission of the school?
- What are the main obstacles faced by your SBE?
- Do you feel your SBE should make a profit? Why or why not?
- Do you feel that you received adequate training at the university or SENA (equivalent to a community college) on issues related to environmental sustainability? If yes, in what ways? If no, in what areas would you like to learn more?

For the direct observations, I participated with the SBE instructors in the weekly classes for one month, sometimes as a co-instructor, other times as an observer. Generally, each class met for two consecutive hours per week. Whereas I looked specifically for examples of environmental sustainability during the formal interviews, I looked for the opposite in the field observations. Here the main focus was on locating and examining *negative cases* that disconfirmed my expectations and framework (Patton, 2002, p. 554–556). Specifically, I paid attention to conversations and aspects of the SBE that dealt with non-environmental issues (e.g., how to increase student participation in the SBE, how to make the product more efficiently,

or how to market it better). Just as with the triangulation of methods, this strategy helped to promote research validity. The negative cases were particularly important in understanding the many difficulties the SBEs encountered within the educational framework, and the limitations imposed by strict adherence to an environmental sustainability approach.

I analyzed my field notes at the end of each day or as soon as possible thereafter. I often shared my descriptions of events with teachers and administrators to verify their accuracy. At the end of the study, I delivered a written report and an oral presentation to the faculty, staff, and students of both schools. Following is a description of each school (for a summary, see the appendix).

Fernández Guerra Secondary School (hereafter Ferguerra)

Ferguerra is a semiurban secondary school inaugurated in 1941 as a private Catholic school and remaining so until the mid-1980s, when it became a public institution. The academically oriented school is located in southwestern Colombia in the town of Santander de Quilichao (pop. 50,000), department of Cauca (departments are equivalent to states or provinces). The town is near Cali (pop. 2 million), one of the most populous cities in the country. In the mid-1980s, feeling a general disenchantment with traditional methods of education, a small group of Ferguerra administrators and teachers proposed a new model of education that integrated the different disciplines around a theme of the local and regional ecology. They believed that by adopting a holistic approach revolving around environmental issues to which students could relate, they could encourage students to be more enthusiastic about learning and more willing to participate actively in improving their community. The rest of the faculty gradually embraced the model and slowly started to implement the new ideas—starting with 6th grade and adding a new theme to the next higher grade level with each successive year.

The afternoon session, where the environmental model was implemented, has 700 students and 30 teachers. In the mid-1990s, teachers decided to complement their educational model with an SBE for each grade level. Not all these SBEs meet the principles of environmental production, and for the most part they constitute an extra course unrelated to the other subjects.

Tomás Herrera Cantillo Secondary School (hereafter Peñoncito)

Peñoncito is a rural public school inaugurated in 1988 as a nonprofit private school, which it remained until the mid-1990s, when it became a public institution. The vocationally oriented school is located in northern Colombia in the village of Peñoncito (pop. 2,000), department of Magdalena. The village is near Mompox (pop. 25,000), one of Colombia's colonial gems. The school, started by local teachers and parents, was originally conceived with the goal of preparing students to understand, protect, and care about the region's heritage in all its manifestations, social, cultural,

and environmental. In comparison to Ferguerra, Peñoncito is an extremely poor school. It lacks the most basic services, including running water. The only source of water is an artesian well in the school compound that serves inadequately the needs of a school specializing in agriculture and livestock. Moreover, the school has no teachers' lounge, no cafeteria, only two makeshift toilets, insufficient desks for all students, and at most one textbook per classroom.

Peñoncito has 180 students and 12 teachers. As in Ferguerra, there is one SBE per grade, but unlike at Ferguerra, all SBEs meet several principles of environmental production. Moreover, the curriculum was developed around the SBEs, allowing for substantial integration among most subjects.

Results

To illustrate each principle of the educational framework, I present one SBE and some of the obstacles it encountered. In practice, each SBE could be used to illustrate more than one principle, which is not surprising given the overlap in the content of the principles. Therefore, the choice of SBE is merely expository rather than exclusionary.

Focus On Local Knowledge and Skills That Support Ecological Renewal

Peñoncito addresses this principle through the cultivation of a medicinal botanical garden by 6th grade students. The biology teacher began the botanical garden in the early 1990s. She had her students ask their mothers and grandmothers to list all the medicinal plants they knew, then to choose from the list those plants that were difficult to find. The teacher's assumption was that the rarer the plant, the greater the likelihood that it was becoming endangered, an assumption later corroborated by university botany students who were doing research in the region. The teacher, with the aid of some mothers, studied the lists and selected about 50 rare and common medicinal plants. Students found specimens of these species and planted them in the school garden. As part of the SBE, each student was charged with the care of several plants and two or three times a year goes to different towns in the region to sell them.

This SBE supports intergenerational communication by bringing together elders and students. The valuing of information that mothers and grandmothers have accumulated through generations brings to life an oral knowledge that is not codified in textbooks and is often neglected in the modern classroom. The SBE teaches students the skills of identifying and taking care of medicinal plants, and even protecting them from extinction. It also teaches students that they can rely on their own skill and knowledge, rather than the pharmaceutical industry, for palliatives for many common ailments.

One important obstacle for this and other SBEs at Peñoncito has been the lack of funds to improve them. Funds are scarce in great part because the municipal office (which under the decentralization process in Colombia is in charge of disbursing key funds for schools) has withheld much-needed funds as a way of punishing the school for acting as a watchdog in local politics. School officials see it as their responsibility to promote not only environmental awareness but also a larger sense of ethics in local politics. "The mayor sees in me an enemy," Peñoncito's principal said. "He even threatened me with jail if I kept pushing for our aqueduct. They [politicians] do not seem to understand that it's no longer business as usual. They're accountable to us now" (personal communication, November 25, 1998; I have translated all personal communications from the original Spanish).

Use Nature as a Model for Design

Ferguerra applies this principle in its 6th grade SBE, which transforms fruit waste into paper. Students obtain the waste from vendors of pineapple, banana, and *lulo* (a local fruit) juice and fruit in the town's main plaza. In the past, the skins, stems, and part of the pulp of these fruits would be thrown in the street as trash. Thanks to the cajoling of students and the local waste collector, vendors now put this refuse in plastic bags that are later retrieved by the garbage disposal company. Every two weeks the students collect the bags from the disposal company and take them to the school, where they manufacture paper, decorative boxes, and cards from the contents. The products are then sold at school bazaars and to local merchants. The SBE has become so successful that students have started to export their products to nearby towns.

Through this SBE the concept of waste acquires a new dimension. It is no longer seen as a nuisance but as an economic asset. Thanks to the students' efforts, the plaza remains clean, and the environmental consciousness of merchants and other citizens is increased. Given that the waste is free, students do not have to spend any money in acquiring the raw material. Moreover, students learn an innovative way to produce a basic product without destroying any natural resources.

A key obstacle for implementing this principle has been the lack of teacher training in sustainable development issues. The vocational education teachers received conventional vocational training and are therefore unaware of the various social and environmental dimensions related to production. Although the school provides professional development opportunities through the SENA (the Colombian national apprenticeship system, a postsecondary community college-type institution), these courses focus mostly on issues of efficiency and profitability, not on environmental sustainability. The teacher in charge of the papermaking SBE explained, "I knew about this project through my own experience as an artist, but not because of any knowledge of ecology or sustainability" (personal communication, October 13, 1998). Another vocational teacher said, "It has been really difficult to do stuff I wasn't trained for. I'm all for environmental education but frankly I learn as I

go along and I'm sure I make lots of mistakes" (personal communication, October 15, 1998). Teachers are thus forced to learn on their own or with other community members, which so far has been an inadequate substitute for more systematic training.

Employ Sustainable Methods of Cultivation and Management

Ferguerra has implemented an SBE that faithfully adheres to this principle. For their 9th grade SBE, students make plant pots and curtains from bamboo shoots that they cultivate themselves. This SBE started in 1995 when teachers at the school contacted a local environmental organization, which donated 5,000 bamboo starters on the condition that students would plant the starters and, once they grew to an appropriate size, would transplant half along the banks of the local Quilichao River. In exchange, the organization agreed to pay the school the equivalent of $0.20 US per stem planted along the river. The students cultivate the bamboo stems using organic methods, and with the half they keep, students make plant pots and curtains for sale. By cultivating their own bamboo, it is quite easy for students to harvest sustainably. At the same time, they combat erosion and protect the river from sedimentation. One student summarized what appeared to be a common sentiment: "I love this project because I have a great time planting bamboo with my classmates and I get to go to parts of the river that I generally wouldn't go to on my own" (personal communication, October 13, 1998).

Other SBEs at Ferguerra, however, do not follow this or any other ecological principle. For instance, the broom-making SBE managed by 7th graders is by and large a conventional enterprise with no concern for sustainability. To manufacture the brooms, students buy the wood sticks from a local lumber company and the whisks (made from synthetic fiber) from a regional wholesale company. Neither of these components is produced sustainably. When the teacher in charge was asked about this problem, she said, "We started this project because a local drug rehabilitation center offered to train our students how to make brooms. It was a great opportunity that we didn't want to miss and we don't feel we are in a position to suggest to them the use of sustainable materials. Also, it's difficult to find sustainable materials as substitutes" (personal communication, October 14, 1998). If the relationship prospers, the teacher concluded, then Ferguerra would be in a stronger position to suggest some changes.

Integrate Living Systems.

Most of the SBEs at Peñoncito adhere to the cardinal rule of integrating living systems. For instance, the aquaculture (fish farming) SBE for the 10th and 11th grades uses waste from the organic garden. The vermiculture SBE, devoted solely to compost making, uses leftovers from the 6th, 7th, and 8th grade SBEs. Soil from the bottom of the aquaculture ponds—enriched with fish excrement—serves as an

excellent fertilizer for the greenhouse and the various gardens. This basic integration combines production and waste-elimination processes in a single system. Another advantage of integrating the different systems is that this reduces the costs of acquiring basic materials. In this case, compost and fish food is obtained for free from several SBEs.

The aquaculture SBE in particular has proven to be an extremely important experiment. Local residents practice mostly subsistence fishing, despite being surrounded by at least 11 marshes of colossal size. Fishermen tend to use nets with very small holes, catching adult and young fish alike and thus reducing the fish population in the waters, making the practice unsustainable. Realizing the enormous economic potential that aquaculture has for the region, the school has devoted the upper two grade levels to its study. The school started by building two large fish tanks—essentially by digging two large holes lined with clay to prevent water seepage, then waiting for the holes to fill with rainwater. The students added young fish of two different species *(mojarra* and *bocachico),* which they feed with plankton and organic waste. Not enough fish have been produced to allow for the marketing of any, but with greater experience and knowledge, fish production promises to become more successful in the future.

One aspect of integrating systems is the push to unite the academic and vocational curricula. At Peñoncito this has not been a problem given the original vocational orientation of the school and the fact that teachers and parents want both activities to be as closely aligned as possible. Plus, although academic schools enjoy more prestige than vocational ones, in the region around Peñoncito most schools are vocational, and thus there is little pressure to change. Ferguerra, in contrast, is an academic school and as one teacher said,

> I don't think it would be prudent for us to concentrate our curriculum around the SBEs because it could be perceived as the "vocationalization" of the school, and many parents would not see that in a good light. We've been able to secure parental support in part because we're academically rigorous, and parents hope that will translate into better jobs in the future. If we were to become more vocational, it could be perceived as a move in the wrong direction. (personal communication, October 14, 1998)

This impression was corroborated by several parents, who said they liked the school as it was. One parent said that although the SBEs were important, they "were not as important as academic courses" (personal communication, October 18, 1998).

Make Products That Are Durable, Repairable, Remanufacturable, and Recyclable.

The 8th grade SBE at Ferguerra follows the principle of making durable products by making picture frames out of scrap metal. The material is acquired at landfills at no cost. Students help reduce the amount of waste in the landfill, thus following the principle of viewing waste as an economic asset. Being made of metal, the picture

frames are generally extremely durable and resistant to breakage. The making of picture frames also benefits from added value (i.e., the cost of labor, energy, and processed materials minus the cost of raw materials), just as a typical remanufacturing process does. In both schools the issue of quality is addressed by having producers (students working at the SBE) and other students at the school use the product. This testing system has led to several improvements along the way.

Durability needs to be contrasted with other sustainability factors, however. When 11th graders at Ferguerra decided to print T-shirts, they chose Disney motifs for the designs. Several questions related to sustainability were not asked: What values were being promoted through the Disney designs? Was it possible to use local motifs (e.g., the local river, the school's logo, an important town landmark)? Were the inks used in printing nontoxic? Could the wisdom of local indigenous groups be used to learn about natural dyes? (There are several indigenous reservations close to Santander de Quilichao, Ferguerra's hometown.) Was the cotton used to make the T-shirts cultivated organically? If not, are organically grown alternatives available? Clearly, for many of these questions there are no easy answers, but the mere attempt to answer them raises students' consciousness. When I posed these questions to the students and the teacher in charge, it became clear that there was great eagerness to investigate these issues. As an 11th grader said, "I do like the Mickey Mouse logo, but it would also be nice to have an indigenous design. And maybe those [T-shirts] will sell as well as the Mickey Mouse ones" (personal communication, October 5, 1998). Just as with any SBE, the more a teacher understands about sustainability issues, the greater the likelihood that these will become an integral part of the SBE.

Discussion: The Limits of Environmentally Sensitive Production

This article has applied an educational framework for environmental protection as a theoretical guide to explore SBEs in two secondary schools in Colombia. In addition, it identified various issues that have surfaced during the establishment and consolidation of these educational programs, including coping with minimal financial resources, improving the role of teachers, overcoming obstacles to the integration of SBEs into the general curriculum, and identifying the difficulties in attempting to make every SBE environmentally sustainable. Although the focus of this article has been environmental stewardship, I do not mean to imply that the social considerations of the production and the final product are less important. Clearly, social and environmental issues need to be considered in tandem. Both sets of issues have been underexplored in the field of vocational education, but environmental issues even more so, thus the focus of this article.

Based on these findings, several conclusions can be reached. First, given that the primary mission of an SBE is to foster an exciting learning environment rather than to turn a profit, SBEs have greater latitude to experiment with alternative production and design processes that respect the integral interrelationship between human

communities and surrounding environments. Although profit-making businesses can (and some do) engage in forms of production that are respectful of environmental systems, the reality of the marketplace often pressures businesses to relegate this consideration to a secondary position. On the other hand, although it is not necessary for an SBE to make a profit, eventually it needs to break even to recover costs. This is especially true for schools with limited resources that may find themselves in the quandary of having to close down SBEs due to a lack of funds. For example, Peñoncito faculty fear that its aquaculture projects may suffer this fate if an aqueduct is not built to maintain an adequate water level in the ponds.

Second, while both schools suffer from inadequate teacher training in environmental sustainability, Ferguerra has suffered more because none of its SBE teachers have received any postsecondary training in this area. They were trained in normal schools that focused on academic, classroom-based pedagogies. These teachers support the environmental mission of their school, but by their own admission have little understanding of how to translate this concern into environmentally sensitive SBEs. Training in this area is hard to come by, and this absence will inevitably continue to affect negatively the SBEs at Ferguerra. Several Peñoncito teachers, in contrast, did learn about organic and low-input forms of production at the university because they were trained as agricultural technicians (not as teachers), and they knew that eventually they wanted to put into practice some of these ideas in their region.

Third, environmentally sustainable production is easier to implement in the primary sector (e.g., agriculture) than in the secondary and tertiary sectors (e.g., service and manufacturing). The more the production uses natural, renewable-energy-based products, the less the environmental damage and the greater the possibility of recycling or composting the final product. The closer the production is to nature and the fewer synthetic products used, the easier it is to detect and correct unsustainable practices. The bamboo cultivation at Ferguerra, for instance, can be kept organic and synthetic-free relatively easy, whereas making the broom production (with a stick that comes from a conventional lumber company and synthetic fibers that are fossil fuel based) sustainable would require replacing the materials currently being used. High-tech production (e.g., computer manufacturing), which requires a myriad of components, most of which are fossil fuel based, is even farther removed from nature and consumes more resources. Engineers and technicians involved in the final production and assembly of tertiary sector products have little knowledge of the origin of most of the components. To minimize the environmental impact, producers should ensure that their products follow strict energy-saving standards, are durable, and contain mostly or exclusively recycled components. On the demand side, consumers need to be educated to demand environmentally sensitive goods.

A similar line of argument can be developed in favor of labor-intensive processes over capital-intensive ones. Schools like Peñoncito and Ferguerra tend to

rely on labor-intensive processes given the relative affordability of these forms of production, an important consideration for any poor school. Beyond the cost savings, a key principle is that the less mechanized a workplace, the easier it is to follow environmental guidelines. For the sake of argument let us assume that Ferguerra's papermaking SBE becomes so successful that the school decides to buy a large mechanical press. With this new technology more paper can be made with fewer hands, which would have the unintended consequence of giving fewer students the opportunity to learn the craft of papermaking (not to mention that it may even glut the market). More directly related to our analysis, students and teachers will be hard-pressed to determine how the machine was manufactured, adding a new layer of ignorance to the production process and increasing the likelihood of nonsustainability.

By this argument I do not intend to advocate eliminating capital-intensive forms of production or synthetic fossil-fuel-based products. Rather, I seek to tease apart the production process and help schools decide when it makes sense to use one form of production over another. If a school decides to use a capital-intensive process, it would be useful for teachers and students to do a Life Cycle Assessment (LCA), a process that identifies and assesses the emissions that occur and the origin of the raw and manufactured materials used during the life of a product. Doing an LCA would be an extremely useful educational exercise even if it is imperfect due to the limited amount of information and experience available at the school.

This leads to the last consideration. It is unreasonable to expect any SBE, or any organization for that matter, to be completely sustainable. SBEs are part of unsustainable practices that permeate the world in the social, economic, and environmental spheres. Living in modern societies inevitably means making compromises, and it is not particularly surprising to find a self-proclaimed environmental vocational program engaged in a mix of sustainable and unsustainable practices. For example, even if Ferguerra's broom-making SBE were able to identify a timber company that follows sustainable harvesting—no small feat in itself—the synthetic fibers would still need to be replaced, and even then questions of economic viability and social justice would need to be addressed as well. The lesson here is that any vocational program needs to be cognizant of when a compromise is being made and to determine the consequences of such a compromise. Students and teachers must discuss these matters fully and transform as many aspects of their SBEs as realistically possible. Ultimately, the educational framework presented in this article is useful only insofar as it provides some general and flexible guidelines to follow, without falling prey to dogmatic or fundamentalist positions.

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Appendix. Characteristics of Two Colombian Secondary Schools

Characteristic	Ferguerra	Peñoncito
Location	Semiurban. Located in Santander de Quilichao (Department of Cauca), near the city of Cali (pop. 2 million).	Rural. Located in the village of Peñoncito (Department of Magdalena), near the town of Mompox (pop. 25,000)
Status	Public	Public
Type of school	Academic	Vocational
Number of students	700	180
Number of teachers	30	12
Socioeconomic level	Serves poor students	Serves poor students
Selection of topics for SBEs	By teachers, but seniors select their own SBE	By teachers

Characteristic	Ferguerra	Peňoncito
Administrative support for SBEs	Yes	Yes
Environmental principles followed in SBEs	Some	All
Products or services Provided by the SBEs:		
6th grade	Paper made from fruit waste. Fruit waste is obtained for free. With paper, students make cards and decoration boxes for sale.	Medicinal botanical garden. Medicinal plants are sold.
7th grade	Brooms. Students buy the sticks and synthetic fibers. Brooms are assembled and sold.	Organic garden and rabbit raising. Produce and rabbits are sold.
8th grade	Picture frames made from scrap metal obtained for free. Picture frames are sold.	Greenhouse and veterinary services. Produce is sold and veterinary services are provided to local farmers for free or a small fee.
9th grade	Plant pots and curtains made from bamboo shoots planted by students.	Vermiculture. Compost obtained is sold.
10th grade	Hydroponics. Project is in initial stages.	Aquaculture. Not enough fish is produced for sale.
11th grade[a]	T-shirts. Designs are printed or purchased. T-shirts are then sold.	Aquaculture. Not enough fish is produced for sale.

[a]Colombian secondary schools only go up to 11th grade