

# Using Drawings to Assess Student Perceptions of Schoolyard Habitats: A Case Study of Reform-Based Research in the United States

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## **Abstract**

*This case study describes the development and field-testing of a research-based scoring rubric for analyzing elementary students' schoolyard habitat drawings. To justify schoolyard learning experiences in U.S. schools, teachers, program evaluators, and others need valid, reliable, and objective assessment tools for determining if, and how, these learning experiences influence students' perceptions and understandings of ecological concepts. Three different raters used the 7-item rubric to evaluate 77 drawings. A high degree of inter-rater score reliability was found and no significant differences were found between scores of different raters. To determine if the rubric could detect measurable differences in drawings made by students of different genders, academic ability levels, and ethnicities, scores were compared and analyzed by subgroup. Results indicate that it is possible to develop a quantitative, easy-to-use tool for analyzing drawings and identifying differences in students' perceptions of their schoolyard habitats.*

## **Résumé**

*Cette étude de cas décrit le développement et les tests sur place d'une recherche axée sur une rubrique de notation pour analyser les dessins d'habitats scolaires des élèves de l'élémentaire. Pour justifier les expériences d'apprentissage dans les cours d'écoles aux États-Unis, les enseignants, les évaluateurs de programmes et autres intervenants, ont besoin d'outils d'évaluation valides, fiables et objectifs pour déterminer si et comment ces expériences d'apprentissage influencent les élèves dans leurs perceptions et leur compréhension des concepts écologiques. Trois différents noteurs ont utilisé la rubrique en 7 points pour évaluer 77 dessins. On a trouvé un degré élevé de fiabilité sans différence significative entre les résultats des différents noteurs. Pour déterminer si une rubrique pouvait déceler des différences mesurables dans les dessins faits par des élèves de sexes opposés, de degrés d'aptitudes académiques et d'origine ethnique différents, on a comparé et analysé les résultats par sous-groupes. Les résultats indiquent qu'il est possible de développer un outil quantitatif et facile d'utilisation pour analyser des dessins et identifier des différences dans les perceptions des élèves de leur habitat scolaire.*

The formal education system in the United States is in the midst of a massive reform effort focusing on two key issues: standards and accountability (Champagne, Lovitts, & Calinger, 1991; National Research Council, 1999). As part of the standards-based education movement, all lessons and learning activities in K-12 American schools must be tied to state and/or national standards in four academic subjects: reading, writing, mathematics, and science. To justify taking students out of traditional classrooms and into natural schoolyard environments, teachers must be able to provide school administrators, parents, and other interested parties with evidence that these outdoor experiences result in measurable, standards-related learning. Although compelling arguments can be made to support the use of schoolgrounds for more general student benefits, such as play, social development, and skills development (Malone & Tranter, 2003), teachers, school administrators, and educational policymakers in the U.S. will not embrace the schoolground learning movement until empirical evidence is provided that the academic benefits of such experiences can be quantified and objectively measured for all types of learners.

### Assessing Schoolyard Learning

Empirical research studies have demonstrated that outdoor schoolyard learning experiences can be more effective than traditional indoor classroom instruction when teaching about topics addressed in the U.S. National Science Standards, such as basic ecological concepts and local habitats and organisms (Cronin-Jones, 2000). Unfortunately, most studies investigating the impacts of schoolyard experiences on learning have relied on traditional paper-and-pencil assessments such as multiple choice tests. While traditional assessments are useful measures of learning for certain types of students, many other types of learners do not perform well on verbally-based assessments (Armstrong, 1994). As a result, the educational reform movement in the U.S. now advocates the use of a variety of assessment strategies in order to provide all types of learners with opportunities to demonstrate their understanding (Wiggins, 1998). In the U.S., the need for alternatives to traditional verbally-based assessments is especially great in rapidly-growing areas like Florida, Texas, and California, where the school-age population is becoming more culturally diverse and the population of non-English speaking students is growing exponentially (U.S. Census Bureau, 2005).

Alternative assessments receiving the most attention in the U.S. today include portfolios, drawings, interviews, observation checklists, writing/essay assignments, and performance tasks (Hein & Price, 1994; Liu, 1995). A major argument in favour of alternative assessments is that, unlike traditional assessments that focus almost exclusively on verbal and logical intelligence, alternative assessments allow students of different learning styles and

abilities to demonstrate their understanding in different ways (Armstrong, 1994; Ochanji, 2000). To quote Elliott Eisner (1999), “We have come to realize that the kinds of meanings that our students can make are related to the forms of representation they can employ themselves .... Each of the forms of representation that exist in our culture [such as] visual forms in art ... are vehicles through which meaning is conceptualized and expressed” (p. 658). Alternative assessments, such as drawings, can be used to reveal the distinctive understandings of individual students. Rather than merely requiring students to select a single correct answer from a limited array of choices, drawings, and other alternative assessments allow students to create their own personalized representation of their knowledge and perceptions (Eisner, 1999).

A major criticism of alternative assessments is that they can be more qualitative, subjective, and difficult to reliably grade than traditional assessments containing discrete items with clearly correct answers (Rieck, 2002; White & Gunstone, 1992). To ameliorate concerns regarding the subjective nature of alternative assessments, the American educational reform movement recommends the use of quantitative scoring rubrics (Bednarski, 2003; Jensen, 1995). Rubrics help an evaluator focus on specific components of a student task and thus can save considerable scoring time. When properly used, they can also ensure that the scoring of a non-traditional assessment is uniform across all students in a class or group (Palmquist, 1997). Finally, well-designed rubrics can be used with minimal training by multiple evaluators with a high level of inter-rater reliability, thus ensuring consistency between the scores assigned by different evaluators (Doran, Boorman, Chan, & Hejaily, 1993).

The majority of existing, empirically-validated scoring rubrics focus on student writing, speaking, and skill performance activities. To date, scant attention has been paid to the development of rubrics for quantitatively scoring artistic products, such as drawings, in any subject area, including environmental education. The use of drawings as an assessment tool in environmental education could provide insights into students’ thinking that aren’t possible with more traditional linguistically-based assessments (Gardner, 1993). As Arnheim (1969) and Vygotsky (1971) argue, art and thinking are closely connected and artistic representations reflect the artist’s thoughts just as much as written text reflects the author’s thoughts.

### Drawing as an Assessment Tool

Before developing the protocol for a schoolyard drawing assessment activity and an accompanying scoring rubric, the art education literature regarding drawing in elementary school was reviewed. In a four-year longitudinal study of preschool and kindergarten children, Clare (1988) found that small letter size drawing paper inhibits children’s drawing abilities. Thus, when asking students

to construct drawings for research or assessment purposes, large paper (legal size or larger) should be used. Clare also found that students produce more skilled and detailed drawings when a larger drawing surface is provided.

Several researchers have reported a correlation between the order in which an item is drawn and its relative size. Elementary-aged children do not plan out their overall drawings in advance and tend to draw the first item in a multi-subject drawing the largest. Succeeding subjects are drawn progressively smaller as the child runs out of available drawing space. These findings are significant because research indicates the subjects that are largest in a child's drawing are of greatest significance and emotional importance to the drawer (Clare, 1988; Edwards, 1979; Klepsch & Logie, 1982).

In a study investigating the relationship between emotions and objects in drawings, Seibert and Anooshian (1993) had 46 first and fifth graders draw pencil sketch maps of their schoolgrounds. Each sketch was evaluated by five raters to determine each student's object preferences. They determined whether or not objects actually found in the environment were:

- absent from the sketch,
- overemphasized in relative size on the sketch, or
- represented accurately in relative size on the sketch.

They found that most children omit objects they strongly dislike in their drawings. These findings are consistent with other research indicating that feelings and attitudes toward particular objects influence how individuals process information both verbally and graphically (Isen, 1984).

In addition to the value of drawings as a reflection of students' emotional perceptions, research indicates that drawings can reflect students' knowledge about the subjects in a drawing (Wilson, Hurwitz, & Wilson, 1987). Generally, drawings by elementary students include more details and realistic representations for subjects they know more about. Often, students completely omit drawing subjects they do not know much about.

A few researchers have investigated the relationship between children's drawings of a large-scale environment and their level of cognitive development. In a study involving 296 first through sixth graders, Neperud (1977) found that children cannot develop coordinated perspectives of large-scale environments until they are in the concrete operational stage of cognitive development (as early as second grade), but drawings can serve as general graphic representations of a student's perceptions of a large-scale environment even when they are in the pre-operational stage.

Tests for measuring the artistic potential and drawing abilities of students have been used since the early 1900s (Thorndike, 1913). Virtually all of these tests involve analyzing student drawings using five to seven indicators, each with a five-point rating scale. Researchers report that valid and reliable drawing evaluation instruments can be used for drawings made by children

as young as age 7 (Clark, 1993). Currently, no instruments and scoring systems exist for using drawings as a tool to assess student knowledge or attitudes in any academic subject area. Based on existing research, it appears that the best format for such an instrument would be a set of five to seven easily observable drawing characteristics with a five-point ranking scale for each characteristic.

Although published research on using drawing as an alternative assessment tool is limited, educational psychologists and researchers recognize the potential value of drawing as both a diagnostic and evaluative tool in academic subject areas. Since children tend to enjoy drawing more than answering questions, drawing assessments can reduce test anxiety (Lewis & Greene, 1983). Drawings have also been shown to be useful forms of expression for children who have difficulty expressing their thoughts verbally, either due to a learning disability or language barrier (Rennie & Jarvis, 1995).

Glynn and Duit (1995) and Dove, Everett, and Preece (1999) indicated that student drawings can be used as diagnostic tools to probe student understanding of a subject. Matthews (1992) reported that children use drawings to recreate concepts or objects with which they are most familiar. Glynn (1997) reported that students' initial drawings of a concept are usually simple representations, but as they learn more, their drawings evolve and become more sophisticated. Thus, he argued that student understanding of a concept or topic can be documented by having students create a series of drawings over time. By examining student drawings, educators can determine what concepts students actually understand, what knowledge gaps they have, and what misconceptions they harbor. For example, in their study involving 306 nine, ten, and eleven year olds, Dove, Everett, and Preece (1999) found that children's drawings of rivers could be used to evaluate their levels of understanding of river basins and directions of water flow and clearly diagnose misconceptions regarding these topics.

### Drawing as an Assessment Tool in Environmental Education

Although the use of drawing as tools for expression in environmental education has received strong support (Hoot & Foster, 1993; Wilson, 1993), limited research has been conducted to validate the use of drawings as assessment tools in environmental education. One area that lends itself to the use of drawings as an assessment tool relates to student perceptions of, and knowledge about, schoolyard environments. Drawings of schoolyard environments students have seen and experienced firsthand can serve as indicators of their attitudes and knowledge regarding these areas. As reported by Barraza (1999) and Van-Summers (1984), children's drawings can provide valuable information for assessing their environmental perceptions, knowledge, interests, and experiences.

A few studies using drawing as an assessment tool have been reported in the environmental education literature. This review of literature only summarizes studies involving drawings of natural environments or organisms. Strommen (1995) asked 40 first graders to draw pictures of forests and the living things in them. The drawings were scored using three criteria:

- number of “classes” of organisms drawn (e.g., plants, mammals, birds, fish);
- number of different types of organisms of each class drawn; and
- whether or not organisms were drawn in proper relationship with other components.

He found that young children draw trees and mammals more often than other classes of organisms and they usually draw only one type of a given class of plant or animal in their drawings. In addition, the majority of organisms are not drawn in proper relationship with other components of the drawing. He also found that children who had actually visited forests drew significantly more different types of plants and animals than students who had never visited a forest.

Hollweg (1997) used elementary students’ pencil drawings of schoolyard habitats to determine what they learned from participation in an outdoor environmental education program. Students were asked to draw and label all the living things in their schoolyards before and after participation in the program. She analyzed 105 sets of pre-post drawings using three criteria: Application, Organization, and Complexity. Application referred to whether or not students applied specific ideas addressed in the environmental education program in their drawings. Organization referred to the logical coherence of the entire picture while complexity referred to the amount and type of detail included in the drawing. The rating scale for each criterion included three choices:

- Noticeable Change,
- Some Change, and
- No Change.

Seventy-five percent of the drawings analyzed showed a change in the level of application while fewer than 50% of the drawings showed changes in organization or complexity.

In a study comparing drawings of children in England and Mexico, Barraza (1999) asked more than 700 seven, eight, and nine year olds to draw pictures of different places on Earth. She found that Mexican children gave significantly more importance to drawing rural, natural places than English children. In addition, she reported that more than one third of the children in her study depicted environmental problems in their drawings.

Most recently, Smith, Meehan, and Castori (2003) developed a rubric for assessing third graders’ drawings of their perceived relationships with animals. They used this tool to determine if exposure to an Animal Ambassadors

curriculum changed student perceptions of their relationships with animals. The scoring rubric included four criteria:

- positive, neutral, or negative relationships with animals;
- direct, indirect, or no interactions with the animal(s) drawn;
- relative distance between the animal and the child; and
- whether the animal and the context of the animal were real or imaginary.

Their study demonstrated that children's drawings can reveal the nature of the relationships they perceive they have with animals and that changes in these perceptions resulting from educational intervention can be documented with drawings.

### Purpose of the Study

Based on a review of literature in the fields of art education, alternative assessment, and environmental education, it seemed possible and desirable to develop a scoring rubric that could allow educators and researchers to use drawings as a tool for objectively assessing student perceptions of schoolyard environments. As reflected in the *National Science Education Standards* (1996) and other major documents associated with current educational reform efforts in the U.S., "assessments" as they were conceptualized for this study are not limited to graded measures of student learning outcomes, but are also used to improve teaching practice, evaluate curricula and programs, determine initial student conceptions, diagnose areas of weakness, and document areas of student progress. Thus the two major purposes of this study were to:

- develop an easy-to-use, reliable, valid, quantitative scoring rubric for assessing elementary students' drawings of schoolyard habitats; and
- field-test the rubric with a variety of learners to determine if it could be used to identify significant differences in the drawings made by different sub-groups of students.

### Data Sources and Study Sample

As part of a larger funded research study, the researcher had access to several elementary schools with recently-created schoolyard habitats. Seven schools in Florida (U.S.) agreed to participate. The environmental education contact at each school randomly selected 11 students from grades 2 through 6 who regularly used their schoolyard habitats as outdoor study areas. For later reference when using the scoring rubric, site visits were made to each school and photographs and videotapes were made to document the layout and contents of each site, including specific components such as

ponds, birdhouses, butterfly gardens, and trails. Plant and animal species abundance and diversity inventories were also conducted.

During site visits, the 11 students from each site met in their school's library or cafeteria. Students were each given a large (28 cm x 43 cm) sheet of paper and coloured crayons and asked to draw and label the outdoor learning area at their school. The broad term "outdoor learning area" was used instead of specific terms that could influence student drawings, like nature area, ecosystem, or schoolyard habitat. Students were not given a time limit for drawings, but most drawings were completed in 15 minutes. Students completed drawings indoors and out of view of their schoolyard habitats to make sure drawings were based on individual memories and perceptions. In addition, students were spread out for the drawing activity so they could not copy other student drawings.

### Rubric Design

Before viewing any student drawings, a seven-item scoring rubric was developed (see Appendix A). This instrument focuses on easily-observable criteria related to the content, rather than artistic quality, of schoolyard drawings. The criteria reflect the traits of children's drawings identified in research studies summarized at the beginning of this article. Each criterion has a score range of 1 through 5, with 5 representing the most desirable score. Total scores for the rubric can range from 7 to 35.

The research basis for each criterion and its scoring range is outlined below:

- *Criterion 1.* Students with a more thorough understanding of their schoolyard habitats fill up more of the available drawing area.
- *Criterion 2.* Students who are more aware of the diversity of features in their schoolyard habitats include a greater number of different features in their drawings.
- *Criterion 3.* Students with a more comprehensive understanding of their schoolyard habitats draw abundant features such as trees more than once, rather than just drawing one representative sample of each feature.
- *Criterion 4.* Students who think natural features of their schoolyard habitats, such as plants and animals, are more important than human-made features, such as boardwalks or seating areas, include more natural features in their drawings and draw these features proportionally larger than the human-made features.
- *Criterion 5.* Students with a broader ecosystem focus draw more complete pictures of their schoolyard habitats while students with a more narrow focus concentrate on drawing one dominant, isolated fragment of their schoolyard habitat, like a pond or butterfly garden.
- *Criterion 6.* Since language precedes logic, students with a more in-depth understanding of their schoolyard habitats include more labels and descriptive words.



- *Criterion 7.* Drawings of students with a more accurate understanding of their schoolyard habitats more closely match the actual layout, organization, and contents of the schoolyard site. Students who do not know as much about their schoolyard sites omit key features or place them incorrectly in their drawings.

### Rubric Scoring and Data Analysis

To determine if the rubric could be used consistently and reliably by different evaluators, three reviewers evaluated each drawing. In addition to the researcher, one reviewer was a full-time teacher at a K-12 public school and the other was an environmental education graduate student with extensive experience as an environmental educator in informal park settings. Each of the three reviewers independently evaluated and scored each student's drawing. Figures 1 and 2 contain samples of two different student drawings: one receiving a high score and one receiving a lower score.

Figure 1 was completed by a fourth grade, average ability, White, female student. Her drawing's average total score for the three raters was 30 out of 35 points. Virtually the entire drawing is covered with features; she included at least 10 different features in her drawing; she drew a few features, such as flowers and bushes, more than once; she clearly emphasized the natural features of her schoolyard habitat; she focused on the broader system rather than one small component; she used many descriptive words and phrases; and except for the fact that she drew only one tree, her drawing very closely matches her actual school site's features. Interestingly, this student's schoolyard habitat was destroyed about three months before this drawing was completed due to the installation of portable classroom buildings, explaining the large label "BEFORE" in the top right section of her drawing. This drawing reflects a very accurate memory of a site she had not seen for several months.



Figure 1. Grade 4, Average Ability, White Female.  
Score: 30 Points

Figure 2 was completed by a fifth grade, average ability, Black, male student. His drawing's average total score for the three raters was 9 points. Only a small portion of the available drawing area was used; only three features (a walkway, a pond, and one rock) are included in the drawing; no features were drawn more than once; he emphasized the human-made boardwalk more than any other feature; he only focused on a small fragment of his schoolyard habitat; he did not use any labels or descriptive words; and his drawing only matches two of the site's actual features (the boardwalk and the pond). It is interesting to note that although the actual schoolyard site is forested and contains many different kinds of trees and shrubs, this student did not include any plants, animals, or other living things in his drawing. In addition, this school's habitat area is located right outside his classroom window.

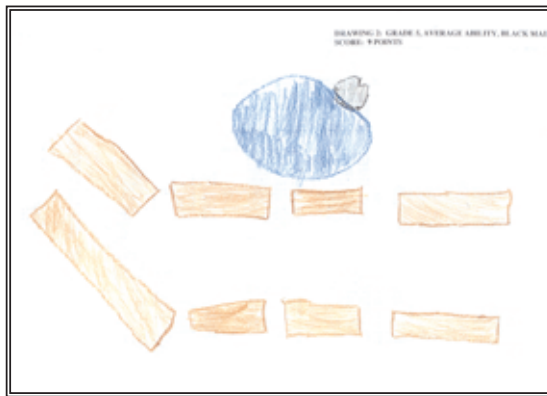


Figure 2. Grade 5, Average Ability, Black Male.  
Score: 9 Points

Once all 77 drawings were reviewed by all three raters, demographic data and rubric scores were entered into a database and analyzed. Based on the average of the total scores assigned to each student by each of the three raters, descriptive statistics including the range of scores and mean total scores were computed for the entire sample and subsets of the sample, including breakdowns by gender, academic ability level, and ethnic background.

Inferential statistics included a one-way analysis of variance to identify significant differences in the way raters scored each item on the rubric as well as whether rater total scores for individual students differed significantly. Paired correlation coefficients of total scores were also computed to determine the level of inter-rater reliability. Finally, analyses of variance were conducted to determine if the scoring rubric could be used to discriminate between drawings and identify differences in scores of students from different genders, ability levels, or ethnic groups.

## Results

When total scores for the entire sample were computed, an approximate bell-shaped distribution occurred. Out of a possible 35 points, the most common scores ranged from 15.01 to 20.00 ( $n=28$ ) and 20.01 to 25.00 ( $n=22$ ). Only two students had scores between 5.01 and 10; 11 students had scores between 10.01 and 15; 13 students had scores between 25.01 and 30; and one student had a score above 30.01. The grand mean of all scores in the study sample was 20.02 ( $s.d. = 4.75$ ). Individual student scores ranged from 8 to 31.

An analysis of variance of total scores found no significant differences between scores assigned by different raters ( $p = 0.463$ ). Correlation coefficients between the total scores assigned by raters indicated a high degree of inter-rater reliability: 0.91 for Raters 1 and 2, 0.87 for Raters 1 and 3, and 0.93 for Raters 2 and 3.

When broken down by gender, an analysis of variance of mean scores revealed that female students' scores were significantly higher than those of male students ( $p = 0.002$ ). In addition to the fact that the mean total score for females (21.48,  $s.d. = 4.32$ ) was significantly higher than that of males (18.26,  $s.d. = 4.35$ ), the mean scores for female students were also significantly higher for all seven rubric criteria.

Regarding ability levels, mean scores increased steadily with increasing academic ability level. Low ability students ( $n=8$ ) had a mean score of 15.37 ( $s.d. = 2.84$ ) while average ability students ( $n=35$ ) had an average score of 19.62 ( $s.d. = 4.34$ ). High ability students ( $n=31$ ) had a mean score of 21.22 ( $s.d. = 4.51$ ). Interestingly, the three learning disabled and attention deficit disorder students had the highest mean scores (24.44,  $s.d. = 3.02$ ). An analysis of variance showed that differences in scores based on student ability level were significantly different ( $p = 0.003$ ).

The distribution of mean scores by ethnic group was fairly consistent. Although these differences were not significant ( $p = 0.158$ ), it is interesting to note that Hispanic students ( $n=6$ ) had the highest average scores (21.33,  $s.d. = 4.76$ ) while Black African American and Caribbean American students ( $n=10$ ) had the lowest average scores (16.63,  $s.d. = 5.49$ ). Mean scores for the three Asian and 57 White students were 19.89 ( $s.d. = 2.14$ ) and 20.44 ( $s.d. = 4.38$ ) respectively.

## Discussion and Recommendations

The results of this study provide strong support for the views expressed by Crook (1985), Thomas and Silk (1990), and others that children's drawings can provide insight into their thoughts and feelings about the natural world and serve as reflections of the images in children's minds. This study highlights the need for further research regarding the use of drawing as an alternative

assessment tool in environmental education contexts. The results of this study indicate that it is possible to develop a reliable, user-friendly instrument to generate a quantitative score for a qualitative work product, such as a drawing, and that a well-designed, research-based scoring rubric can be used to identify significant differences between drawings generated by individual students or different groups of students. The primary value of such a tool is that it provides a more objective means of comparing and analyzing qualitative student work products. The following paragraphs discuss potential reasons for, and implications of, the differences in drawing scores reported for students of different genders, academic ability levels, and ethnicities.

### *Gender Differences*

The significantly higher drawing scores for females raise important questions regarding gender differences at the elementary level. Since this scoring rubric does not focus on the artistic quality/technical skill of drawings, it appears that factors other than basic artistic ability influence the types of drawings made by male and female students. One hypothesis is that female students are more often encouraged to express themselves through drawings and other artistic products than male students. Female students may feel more comfortable creating drawings and therefore produce more complete or detailed drawings. Other research indicates that, at the elementary level, female students can focus on completing one specific task for a longer period than male students, who tend to rush through one task so they can begin another one (Koran, Morrison, Lehman, Koran, & Gandara, 1984).

Perhaps male student drawings receive lower scores because they do not spend as much time reflecting on their schoolyard habitats and completing a thorough drawing. Finally, this study found that the drawings of male students focus more on structural, built components of schoolyard habitats, such as boardwalks, seating areas, and benches, while female student drawings focus more on natural features, especially butterfly gardens, wildflower gardens, and pond areas. This gender difference may reflect early conditioning via toys, pre-school activities, and parental influences which cause boys to focus more on tools and human-made constructions such as roads and buildings while girls focus on more aesthetic aspects such as colourful flowers or beautiful birds.

### *Ability Level Differences*

The fact that drawing scores increase with increased academic ability level supports the idea that higher ability students have a more thorough awareness of, and knowledge about, their schoolyard habitats than lower ability students. Although the sample size was very small (only three students) it is important to note that students with learning disabilities/attention deficit disorders received the highest scores of any group, even high ability students.

These results are promising, and provide support for the idea proposed by Chambers (1983) and Rennie and Jarvis (1995) that drawings and other artistic products can serve as a useful tool for allowing students with limited verbal skills to adequately express their knowledge and perceptions. These results also support Chambers' argument that in addition to eliminating linguistic barriers, drawings enable comparisons between students of different ability levels and primary languages.

### *Ethnic Group Differences*

Differences in drawing scores by ethnic group should be interpreted cautiously due to the small sample sizes for some groups. This instrument should be field tested with a greater number of students from different ethnic groups (African American, Caribbean American, Hispanic, Asian, and Native American) to determine if the apparent disparity between scores of Hispanic and Black students is significant. In this study, the scores of Hispanic, White, Asian, and Native American students were closely clustered together and were all much higher than the scores of Black African American and Caribbean American students. These findings do support Alland's (1983) theory that cultural background affects the style, drawing strategies, and content of children's drawings. However, Barraza's (1999) study comparing the environmental drawings of Mexican Hispanic and White British students found more similarities in their drawings than differences. Clearly, the nature and extent of ethnic differences needs to be investigated more thoroughly.

### *Directions for Future Research*

Although the findings of this study support the value of using drawings as diagnostic and assessment tools, further research should be conducted to determine if drawings created over time can be compared and used to document changes in student knowledge and/or attitudes as a result of direct exposure to, and instruction in, schoolyard environments. Future studies could involve using drawing activities as a pre-assessment to document students' baseline knowledge and perceptions before implementing a schoolyard-based environmental education curriculum. Students could then complete post-assessment drawings and differences in pre and post scores could be used to document changes in student knowledge and perceptions.

This study provides encouraging evidence that drawings can be used as an alternative assessment tool to complement more traditional forms of learning assessment. In the current U.S. climate of standards-based, accountability-driven education, continued research using drawings to document student learning as a result of outdoor schoolyard learning experiences may help convince more teachers, administrators, and policy makers that schoolyard experiences do have a place in America's current vision of K-12 education.

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## Notes on Contributor

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## Appendix A

### Schoolyard Habitat Drawing Scoring Rubric

Directions: Circle the number representing the score for each criterion.

Criterion	Score				
1. % of drawing area covered with features	100 %	80 %	60 %	40 %	≤20 %
	5	4	3	2	1
2. Total number of different features on drawing	≥10	8-9	6-7	4-5	≤3
	5	4	3	2	1
3. Number of features drawn more than once	≥4	3	2	1	0
	5	4	3	2	1
4. Emphasis on natural vs. human-made features (frequency and size of natural vs. human-made)	all natural	even	all human-made		
	5	4	3	2	1
5. Level of focus (ecosystem fragment vs. entire system)	entire system			isolated fragment	
	5	4	3	2	1
6. Number of labels/descriptive words	≥4	3	2	1	0
	5	4	3	2	1
7. % match of drawing with actual site features	≥80 %	80 %	60 %	40 %	20 %
	5	4	3	2	1

Total Score: \_\_\_\_\_ (Maximum of 35)