

This research is based on the importance of teaching ecology in art education through constructivist connections and empowering middle school students to write, illustrate, and judge their ecological narratives. Marshall (2006) proposed using constructivism in ecological teaching, based on major theoretical approaches including connectionism (Bransford, Brown, & Cocking, 2000). Such learning theory advocates project-based learning, in which lessons build on each other, and themes focus on important life meaning (Anderson & Milbrandt, 2005). “Knowledge construction replaces personal expression, object-making, and aesthetic pleasure as primary goals of art practice... Image or object making is viewed as an integral part of a learning process” (Marshall, 2006, p. 18). Thus, from a constructivist point of view, art making generates knowledge, not by coming up with new facts, but by reinterpreting and restructuring knowledge (Sullivan, 2005). In order to generate knowledge, Caldwell and Moore (1991) studied drawing as preparation for narrative writing in the primary grades. Their study compared drawing and discussion as a planning activity for writing to determine their effects on narrative writing of 42 second and third graders. Drawing is an effective rehearsal for narrative writing and can be more successful than the traditional discussion. The teacher modeled writing with a group storyboard, encouraged added details, and required students to share stories with a partner.

Stokrocki and Delahunt (2008) similarly studied a class of fourth graders analyzing the plot of the anime *Nausicaa*, an ecological story that involves super bugs with flow maps. A flow map is a drawn summary of an action sequence, somewhat like a storyboard (Hyerle, 1995). This activity revealed gender distinctions; in this case, female attraction to the caring female heroine, and male excitement over action sequences. What kind of gender differences would we find in our students' narratives?

An illustration is a verbal or visual act, whether drawing, photograph, or mixed media. Visual and verbal modes of learning can be woven together in the classroom. “Language need not and should not be separated from its initial visual component. This way, all types of learners can benefit” (Olson, 1992). Some art educators heralded scientific illustration (Gainer & Child, 1986); others were more interested in fantasy drawings; still others, the narrative (Wilson, 1984). In her analysis of children's spontaneous narrative drawings (10-year olds) in Greece, Labitsi (2008) discovered that her subjects failed to show figures visually and were more interested in showing action. Children were more comfortable describing unfolding sequential action. She analyzed Kress and van Leeuwen's (1996) narrative structures, which is the drawing of sequential actions and change processes. They identified several narrative structure categories in children's drawings using vectors, which are connecting directional thrusts among objects or characters. Jewitt and Oyama (2001) found strong directional thrust formations in characters' bodies or limbs, objects they are holding, and even in their eye line. She found 10 instances of unidirectional transactional action, eight instances of non-transactional action, seven instances of mental/verbal processing, and occasions of bi-directional action. Conflicting characters usually show bi-directional movement when they lift their arms or weapons. How would our students illustrate their narratives and show movement?

We also integrated ecology by focusing on desert creatures. Integration is a process of creating relationships and a way to connect ideas across disciplines to make them interdisciplinary. Interdisciplinary art may best be taught in a concept-based curriculum

that centers on some life-based issue, in this case, one that uncovers complex meanings, multiple perspectives from artistic views, and develops empathy and social action among people (Parsons, 2004). Blasingame, Erickson, and Woodson (2005) attempted to develop students' appreciation of a local sculpture by determining their reflective success in their Art and Writing Interdisciplinary Project. In our case, studying the desert creatures and their relationships to each other and their environment became our focus. Integration also enables small grassroots partnerships that can start with a master teacher and local culture (Stokrocki, 2005). Cole and Knowles (1993) explained, "True collaboration is more likely to result when the aim is not for equal involvement in all aspects of the research; but rather, for negotiated and mutually agreed upon involvement where strengths and available time commitments to process are honored" (p. 486). Integrating research with teaching and program development can be a transformative process, personally and socially, because it changes what participants see, think about, and pursue in the future (Graue & Walsh, 1998). More specifically, we focused on the concept of *ecology*, the study of organism and system connections. When teaching a colloquium on "Art & Ecology," Neperud (1995) argued that first-hand experience was an essential foundation upon which to build ecological concerns. He also added the need to build team spirit, links with community, and multicultural concerns and multidimensional networks. Gradle (2007) believed that ecology is "firmly rooted in an understanding of relationality...and the co-ethical nature of co-dependent connections among beings and natural/built communities" that demands participatory knowing (p. 397). We also based our integration on the ecological life issue of predator and prey, with all its complexities to inspire student empathy/care for the animals.

Participant Observation Methods

Our methodology was qualitative and primarily involved participant observation (PO), a process of describing, analyzing, and interpreting an everyday activity, in this case the results of a class unit, to understand it more thoroughly (Stokrocki, 1997). PO is so natural for teachers as they record their teaching methods and results in categories, almost as a story. PO implies that the researcher is learning from people rather than just studying them. Spradley (1980) calls it multi-person, multi-method, and multi-variable. We concentrated on a 14-day unit in one art class in one school. Students writing their narratives took longer than expected, from which the idea of illustrating one scene arose. Participant observation methods included daily note taking, pre- and post-questioning, and analyzing stories and artworks.

For *content analysis* of students' stories, we simply rated the artworks based on a narrative rating scale (borrowed from Caldwell & Moore, 1991): *Story* (setting, character traits, and plot development). For analyzing students' drawings, we used Barbara Flatt's art categories, developed specifically for the study. Categories included *illustration* (compositional spatial grounds), *creatures* (details and textures), and *action* (expression, projection) - each worth 3 points. (See Table 1.) By adopting Labitsi's (2008) category of vector-projection, we determined *movement*. We rated 18 students' drawings and stories and eliminated those students who did not finish. We also asked students to suggest categories in their final group peer assessment called "Critter Critique," so they could develop reflective abilities as they wrote about their work from different perspectives. They later voted on other students' artworks. We then asked students to suggest award

categories, to cast their vote for the best in each category, provide evidence, and offer constructive comments. Their categories were: "Best of the best, most creative, funniest, goriest, and most heartfelt." We were surprised when some of our highest ratings matched student voting. So we used their choices. Some categories also emerged during the study. The teacher added the category called "best use of art criteria," and two other categories emerged: "most heartfelt" and "transformation."

Further interpretingⁱ and negotiating findings occurred over the next year as we tried to make sense of the data. As issues evolved, findings collapsed into larger ones. Such research is complex, eclectic, contradictory, and context-bound (Stokrocki, 2004).

Description

Context

In a booming and rapidly expanding rural suburb of Phoenix, which was formerly cotton farmland, the Queen Creek Middle School was built in 2007. Classes met every day for 50 minutes for approximately two weeks. A new middle school opened the next year to accommodate the growing population.

Participants

Inspired by the illustrative paintings of Mary Stokrocki, former librarian Emily York wrote a book on ecology for children. The two researchers decided to motivate students to take care of their desert environment by bringing the book into the schools. Mary contacted art teacher Barbara Platt, a former student who was interested in doing this research with them, to coordinate her teaching to fit this project. Barbara Platt graduated from the BA program in Art Education at Arizona State University and was an Artsbridge Scholar Teacher there. She was enthusiastic to work on this project. They focused on one class of 18 seventh and eighth graders combined, because most of those students had finished the assignments. Eleven students were males and seven were femalesⁱⁱ. All student names are pseudonyms, while the teachers preferred to use their first names.

Barbara gave a prequestionnaire to 30 students with the following questions/answers. When asked what ecology is, the dominant answer was, "Don't know" (15/30; 50%). Some answers were correct, e.g. science or study of animals, ecosystem, or food chain; other answers were incorrect, e.g., economy or art. The question, "Where is the Sonoran Desert?" resulted in correct answer location: "In Arizona" (17/30; 55%). Seven students didn't know the location; others guessed countries, e.g. California, Africa. "What does 'illustrate' mean?" Frequent answers were, "Draw something (10/30), make picture (10/30) or paint (5/30). "Why is illustration important?" Students responded: "Can see more (7/30), what's happening (3/30); create (3/30); or explain a book (5/30), and express feeling (5/31)." Students seemed to understand somewhat the purpose of illustration. Barbara invited Mary and Emily to present their illustrated book on ecology to the class to further student understanding about their local ecology.

Unit Framework

Students wrote short children's stories with Sonoran Desert creatures as the main characters, incorporating information about the ecology of the desert. They also created an individual watercolor painting (flat and graded washes) to illustrate one section of their own story. The lesson was part of the instructor's Careers Curriculum Unit (graphic and illustrators) and State Standards to teach writing and science. Students did research

on specific desert creatures and the general ecology of the Sonoran Desert. The narrative story criterion focused on three to five paragraphs with emphasis on Ideas/Content and Voice, from the *Six Traits of Writing*ⁱⁱⁱ (Hogue, 2002). The lesson also highlighted space concepts, such as overlap, emphasis (major character), perspective (three grounds), and implied texture. Vocabulary words that Barbara stressed were ecology, Sonoran Desert, illustration, and texture. Specific National Art Education Standards were (#5) reflecting upon and assessing the characteristics and merits of their work and the work of others and (#6) making connections between visual arts and other disciplines. The curriculum framework included prequestionnaire, illustrator visit, prewriting, and post questionnaire. Formal assessment consisted of rubrics determined by bell work, story draft, rough sketch, final copy of story, and watercolor painting.

The Illustrator and Author Visit The Classroom

When we visited the class, Barbara announced, “Today is Read Across America Day” and explained how appropriate our visit was to share our illustration teamwork. Emily began by explaining that an illustration is the art/process of making pictures for a story. She continued, “While most authors usually write the story first, Mary’s paintings inspired me to write a story about the desert for my granddaughter!” Emily then read the story, “Lindsey’s Desert Surprise” (York & Stokrocki, 2007). (See Figure 1.) Students followed the story by looking at individual books at each table. Student’s responses were “Cool—wavy lines, earthy colors, and prickly textures” (art concepts that they had just learned).

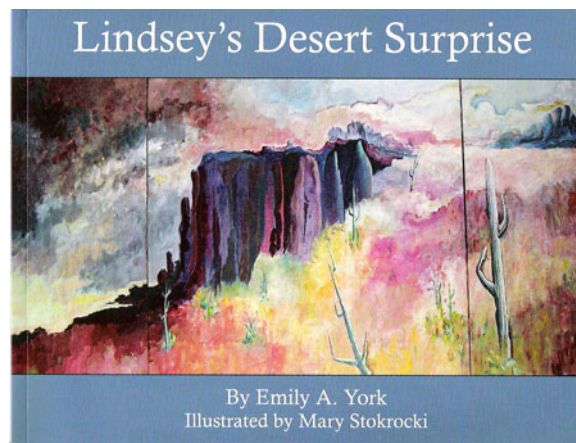


Figure 1. Motivating Illustrative Book

Mary asked, “What did you learn from the story?” The students replied, “About the desert experience, [it’s] wild.” Another student reacted to the painting technique as “Wet on wet watercolor, which the teacher had just covered. Then Mary asked about their favorite illustrations. Boys favored predator-prey stories, such as an action sequence of a “coyote chasing its food (rabbits).” Females loved the bobcat, which they thought was “a kitty.” Mary then explained that *ecology* was about studying how all creatures (even human ones) relate to each other and to their environment, in this case, the desert. Then she asked why we should we take care of the animals and desert. The researchers ran out of time so students were asked to reflect on this question later.

Story and Book Illustration Project

Barbara invited students to write and illustrate their own ecological story: She stated, "Pretend that you are a desert creature. Tell a short story of a typical day in your life." Then she listed questions for them to consider: "What kind of home would you live in? What would you eat? Where would you sleep? Who would be your friends? Who would be your enemies? What adventures would you have? What was the surprise ending? Pick one part of the story and illustrate it." She included the following criteria: 1) Write five paragraphs with emphasis on ecological ideas; 2) Write in first person; 3) Keep the story interesting to keep a young child entertained; 4) Make the main character a Sonoran Desert bird, insect, or mammal; 4) Give information about the relationship between creature and desert; 5) Include foreground, middle ground and background and different textures; and 6) Use a variety of watercolor techniques.

Barbara provided a wide selection of books with photographs and illustrations of birds and animals for students' research. She shared information on the flora and fauna in the Sonoran Desert from websites (<http://www.cabezaprieta.org>; <http://www.arizonensis.org/sonoran>). Information included diet, habitat, and predators. She supplied step-by-step examples of how to draw birds and animals and had students make practice sketches concentrating on the contour shapes of the creatures and noting scientific details. One female, for example, drew sketches of desert skinks with unusual feet, small lizards from the book *Snakes and Lizards* (Golden Junior Guide). The researchers were not aware of this type of lizard. A second student preferred his preliminary hawk drawing with its various feathered textures (Figure 2) more than his final painting because he felt that he "messed up" his painting. Students seemed to appreciate the practice sketching and helpful directions. The researchers incorporated students' drawing choices into our findings.



Figure 2. Student valued his preliminary hawk drawing, because he felt that he had messed up his painting.

Findings

While the students were planning their backgrounds, the researchers noticed some students drawing baselines at different levels to indicate space. Mary then saw several

students draw mountains as a series of triangular mountains, indicating that they were drawing stereotyped shapes of what they knew, but did not see in this terrain. Mary pointed out to students that the mountains nearby are more square and flat (mesa).

Five stories were highly creative, and six drawings seemed entertaining. Our simple analytical results revealed that five of the stories started as the typical fairy tale--once upon a time. Three student stories featured life cycle (a day in the life) and daily routines (eat and sleep). A few stories showed metamorphosis or change. Other themes were playing games like tag, with some accidental results, such as "The snake was chasing (the voles) and sprang at them only to bite a small cactus." Most student stories, especially from male "macho" viewpoints, highlighted the predator/prey theme. Examples included: *Phil and Monty's Wild Adventures* and *Crackdown 2008* (Cops & Robbers). Story narratives can range from metamorphosis to the dramatic, and in this case, predator/prey and are similar to the villainy-villainy/nullified story type (Wilson, 1984).

Students included thematic information about the predator/prey relationship between creature and desert. They were concerned about survival and protection. An example was, "I had a crazy day when I woke up. I went to the waterhole and realized that I slept through the entire attack. I was happy that coyotes didn't know that I was there." One notable ecological animal fact was that lizards could regenerate. In his story, *Stinks in the Desert*, another student wrote, "One sunny morning, Skinky woke up in a happy mood. On his way back to his house, a snake jumped out and bit off its tail. Stinky screamed! Mom said, 'Ok, it will grow back again.'"

The students chose the snake as their favorite Sonoran desert creature. Nine chose the snake and identified three kinds—rattler, diamondback, and black snake. Other popular creatures were rodents (4), lizards (4), scorpion (4) and birds (eagle, hawk, and owl). Their research revealed specific desert creatures, such as the Gila monster (3), skink, white throat wood rat (a.k.a. pack rat), golden eagle, and black tailed jackrabbit (a.k.a. desert hare). Most students (16/18) humanized these creatures with human names, such as Larry the Lizard, Jake the Snake, and Gary the Golden Eagle. Students also imbued stories with human feelings like the Sad Diamondback Snake or "Alex (tortoise) had a crush on Lucy." Expressive moods were dominant.

Then students voted on "*best of the best*" painting and story during their Critter Critique. They chose *The Snake Family*, because of its story (most action) and illustration (with most detail). (See Figure 3.) JR wrote,

Once in the desert lived Mama rattlesnake and her four babies. The bad thing was that they lived near a lot of predators. Mama was really scared about the safety of her babies as they traveled through Gila territory to find food... but Mama knew they had to move on. Finally she found some food. Unfortunately one of them died of hunger.



Figure 3. The Snake Family

The most *creative story* was “The Mojave Rattlesnake,” because the author “strung out” the words. The story has strong use of (first) person and incorporates environmental information. This rendition features creative spelling to heighten emotions. The scenario unfolded: wood rat and woodpecker are playing together. Gila monster threatens to eat them, chases them, and they get away. Snake said, “I sssaw yyou two getting away.... So I like to sssssee if youuu can get awayyy from meeeee. I like to chasssse my foood before I eeat it” [sic]. Jackrabbit became involved in the chase, snake ended up accidentally biting a cactus, and “rattlesnake didn’t eat solid food for seven years.” The pack rat and woodpecker were safe again. In a second story, rattlesnake explains, “We [my friends] all go out *slithering* together Friday night. We like to pick on birds. When we shed our skin its kind of like a birthday party.” The creative use of words-- repeating letters to stretch the anguish and using colorful action words, such as *slithering*--is amazing for seventh and eight graders.

In a third example, House Mouse Sue “longed for adventure...got out, met a (collared lizard) friend Boomer, and gets chased by hawk. She cried, ‘Heellpp Meeeee!’ Boomer responded, ‘Quickly, come over here’ (to hide behind a rock).” (See Figure 4.)

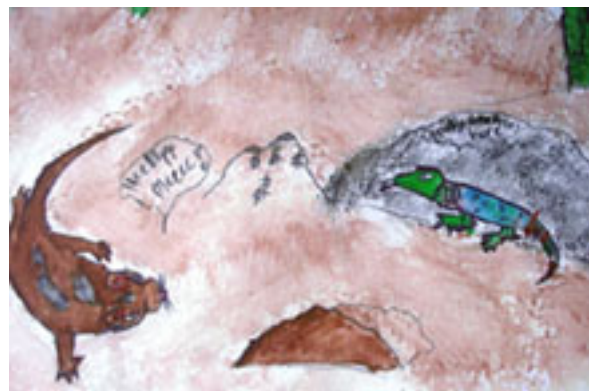


Figure 4. Close-up view featured the words, “Heellpp Meeeee!” The artwork also featured a mouse running to hide under a rock drawn from the aerial view.

Students' choice of "the funniest" stories included clever punch lines, such as "I hate fast food!" In another example, "Crackdown 2000," one boy commented, "Rats!" (Double meaning, rats as subject matter and frustration remark). In a third example, Gila monster boasts, "I must say it was a very good feast with a side of ants." Finally, one student (MR) wrote, "Yummy Lunch!" in a cartoon bubble in her drawing. (See this close-up in Figure 5.)



Figure 5. "Yummy Lunch!"

The *goriest* story was the students' next category selection with some evidence of *expression/projection*. Some boys (30%) enjoyed writing about violent details. For instance, "Hawk (Sheriff of the Sonoran Desert) and Eagle (his sidekick) investigate a crime against voles by snakes...so we flew down and tried to kill them (snakes). But Eagle got his jugular tore open and bled to death"[RJP]. Gory details, inspired by popular films, seem to interest males at this stage. Most students indicated countless action in their stories, yet in their illustrations only 33% of the students used movement, mostly in the form of projection (diagonal direction, such as limbs, open mouths, and eye direction). (See Figure 6.)



Figure 6. One third of the students used movement in the form of projection (diagonal direction).

Only three students, however, used *transformation*, the ability to change their character. Character transformation, the first example, occurred when “rattlesnake, who was mean to others, gets good when his parents find out he was such a tease.” Another transformation type was making the predator the prey. RJ drew adventures of his friend Scorp (scorpion) who saves his house from the desert rats who try to destroy it. RJ uses Scorp as bait to capture the rats. Other forms of transformation are physical growth, such as (snake) shedding skin (according to one student), and camouflage. One student remarked that Panchito blended (transformed color) with the color in the rock). (See Figure 7.)



Figure 7. “Panchito the Scorpion had many fears, but of all [sic] was the falcon. Panchito thought of an idea. He couldn’t take it anymore, so he decided to take courage and fight. He got out of his shade and stood for battle. The scorpion wins and gets away safely. He had glory and felt victorious. He had overcome his fear.” (KRJ)

Female stories highlighted “partying and love,” and students classified them as “most heartfelt.” Two female story examples and illustrations featured an animal birthday party, and another two such examples used the “turtle love” story. MF wrote, “Three years from the day they became one turtle, they were walking home from their nice peaceful walk when a hungry snake came...and ate both of the turtles. The only thing that was left was their shells.” (See Figure 8.)



Figure 8. The story “Tortoise Love” included the predator/prey theme.

For the *best use of art* criterion (extra category provided by the teacher), students chose the illustration, “Life of a Gila (lizard),” because of its unusual frame, use of space, cast shadows, and pattern. (See Figure 9.) Students explained: “Big cactus in front and small one in back; a road getting smaller in the distance; shadows were correct (in proportion to the cactus); and the dirt texture made with a watercolor sponge technique.” Although they couldn’t identify the proper art terminology, students could explain somewhat the realistic spatial factors. Students from ages nine to twelve are in the dawning realism developmental stage are struggling to learn the artistic conventions. Most students in the class were able to portray three different ground areas (fore/middle/back).



Figure 9. This illustration also featured extra spatial accomplishments, such as cast shadows, a road getting smaller in the distance, and unusual framing.

PostQuestionnaire

Our post questionnaire consisted of questions about the importance of relationship between creatures and their environment, hidden details, and artwork improvements.

How is your creature important to the desert? Although 39% of students first responded, “Didn’t know,” 39% of students later recognized that animals regulate pest

population (rodents, bugs). Surprisingly, three students simply mentioned the obvious fact, "Animals live there."

How is the desert important to the creature that you chose? The most recurrent answer was "Don't know (12/30, 39%). Some students (6/30) recognized the desert as a source of food, e.g. insects, and shelter, e. g. underground burrows, caves, & nesting place. Four students mentioned that cold-blooded creatures (snakes and lizards) need warmth and animals protect cacti.

What details are hidden in the artworks? Mary asked this question during her observations of students when they were judging their classmates' drawings. She noticed that male students tended to draw small details for added suspense to a story. For example, several students hovered around the illustration, "Crackdown 2000. "They noted hidden details, such as the underground rats (voles) in their burrow (See Figure 10).



Figure 10. Students noted hidden details, such as the underground rats hiding in their burrow.

At another table, students pointed out the tiniest details in another artwork: an owl sitting in a tree hole, a cat hiding in a cave, and a snake crawling out of the eye of a skull (JM). In a third work, a student pointed out the little bat hanging upside down, which she said "blended with the color in the rock," a remarkable example of camouflage. In such examples, students seem to become the vigilant character by depicting secret places.

In their final Critter Critique, the researchers asked students to give suggestions for improvement. When assessing others' drawings, most students were concerned with watercolor technique and realistic details. One pupil wrote, "You could have painted the background better." Another offered, "The fur is really great and wings look life real feathers." They enjoyed developing assessment categories, but had difficulty explaining their choices. Students need practice in discussing and valuing artworks.

Conclusions and Discussion

So what kind of re-interpretive knowledge did a constructivist point of view generate in students' understanding of ecology? Despite constant interruptions^{iv} and grammar problems, students came up with ecological ideas that were generally lively and, at times, imaginative. The researchers considered our constructivist teaching successful, because

students revealed and changed their misconceptions about the desert. In their prequestionnaire, students revealed their lack of understanding about the location and concept of the desert as an environment that receives less than seven to ten inches of rain a year (Arizona Science Standards, 2010). They misconceived the desert as being mostly wild and devoid of life. They were totally fascinated with the predator/prey theme--a matter of survival and similar to popular media race and chase sequences (Wilson, 1984). It is hard to determine if students understood the necessity of this natural population control, a matter for future in depth exploration. Even though we asked students to include information about the main character's relationship to the Sonoran Desert environment, some students seemed to have difficulty incorporating factual information in an engaging storyline^v. The teacher noticed that students who had lived the "rural" lifestyle longer seemed to embrace the project sooner than those who were new to the rural area, such as "transfers" from larger urban districts. Rural students had experiences with desert creatures and farming and had previous knowledge to increase their interest and confidence. This finding reinforced Neperud's (1995) argument for first-hand experience with one's environment. Teachers need to engage students with activities to promote awareness of their local eco-environments.

Students seemed to enjoy using first person narration and humor. In regard to writing, the more creative students allowed the content of their written stories to drive their paintings and vice-versa, leading to more expressive content in both. Nearly 45% of the students wrote in first person, an assignment criterion, indicating their imaginative use of role-playing as the main character. At other times, the story and the humorous comments in the cartoon bubbles completed narrative impact. Tieny and Lincoln (1997) explain that narrative stance as polyphonic with each character speaking for him/herself from no single viewpoint.

Although students indicated expressive action in the stories, only 33% (six students) could use projection lines in their illustrations to indicate movement, such as diagonal limbs, open mouths, and slanting eye direction (Labitsi, 2008). Only three students had facial movement—raised eyebrows or mouth frown direction. Some students found it difficult to be expressive in their drawings if their stories were not exciting. We need to directly teach the use of diagonal projections and movement devices for protection (not mere expression) in the future. Many students, however, understood the necessity for hiding for escape.

Students thus seemed attentive to tiny desert details, multiple textures, and spatial grounds. Illustration is a means to an end for learning about something and not merely a decorative accompaniment to a story. They recognized a variety of obvious desert facts from prior knowledge, such as desert food sources. In their final assessment, and based on their own research, they learned about and drew some unusual creatures and shelters like voles in a burrow, a hawk in a cave on the mesa, skinks (lizards) in the rocks, and a snake hiding in a water hole. Nearly half of the students (7/18) were successful in portraying different textures--feathers, fur, prickly spine for protection, and dirt--made with a watercolor sponge technique. Six students incorporated three spatial grounds (fore/middle/backgrounds), and three students used unusual viewpoints, including fish-eye, bird's-eye, or rear view (Hickmann, 2008). Marshall (2004) advocated that using illustration as a research and discovery practice helped students connect art inquiry to scientific inquiry and in understanding and appreciating the world. In the future, we need

to emphasize the importance of different shaped rock shelters and cacti and show comparative anatomy charts on how to change creature ears, nose, and tails.

Gender differences were notable. Similar to Stokrocki and Delahunt's (2008) study of fourth graders gender differences in making flow maps, student narratives in this case ranged from male blood and guts stories (predator/prey) and female "heartfelt" love tales. Boys' drawings denote action (Milbrath, 2008). A number of the stories and paintings reflected students' personal social issues: boy meets girl, best friends, and family problems. Kristeva (1984) called narrative a gendered form, because research is dominated by allegedly "neutral" descriptions of social scientists.

Students maintained empathy and address moral issues. Many student stories portrayed physical or moral conflicts indicating empathy, the capacity to identify with other creatures' concerns, as in the emerging theme, "most heartfelt." These findings beg the question of why art teachers should care about teaching ecology through writing and illustrating. Since students lack first-hand experience with their local creatures, teachers need to invite local speakers (illustrators, museum and even fire department personnel) to motivate students to care for those creatures and the environment. Such learning is "multi-relational," a kind of moral learning based on a teacher's caring willingness to assist students, and for students to care for each other" (Noddings, 2002, p. 69).

Teachers need to develop art and writing connections with geography. The researchers need to develop more critical interdisciplinary content knowledge for student learning of local geography, such as desert life cycles as well as essential issues like survival and the human place in the preservation of this delicate and quickly disappearing wilderness. The Arizona Science Standards' Concept 5: Environment and Society advocates teaching specifically PO 1. Describe how, e.g. desertification, humans modify ecosystems and PO 2. Describe why, e.g. resources, economic livelihood, humans modify ecosystems (Arizona Department of Education, 2010). In this way, some transfer of ecological knowledge may transform what students learn, what educators teach, and how this relates to future local concerns (Blasingame, Erickson, & Woodson, 2005) as a form of ecological journalism.

Schools need to incorporate reflective and transformational ecological learning. The Sonoran Desert is an ecologically fragile area, dissected by a border fence that impedes the north-south migration routes of several animals in the attempt to stop human migration and drug traffic. As rapid population growth threatens the desert, students need to learn about the ecosystem, which includes garbage cleanup, curtailing pesticides, and predator killing. Observational drawing can help students' gain drawing skills (Graham, 2003) and perceive ecological details in their locality (Anderson, 2000), as well as develop artistic and scientific inquiry (Marshall, 2004) that includes "ecologically sustainable patterns" for eco-justice (Bowers, 2001); place-based education (Blandy & Hoffman, 1993); and moving beyond art as personal expression toward reflective learning. Such critical pedagogy stresses empathic connections to natural and human communities, encompasses wonder about our local habitats, forces understanding of the destructive ideas that threaten them, promotes the incentive to change the situation (Graham, 2007), and offers the means to develop art education in a relational world as the ecology of place (Gradle, 2007).

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Endnotes:

ⁱ The first interpretation was the students'; the second was the teacher's; and the third, the researchers', all of whom were outsiders to this adolescent culture.

ⁱⁱ Although she introduced this project to three sections, Emily York was not present for subsequent lessons.

ⁱⁱⁱ The six traits are idea/content, organization, word choice, sentence fluency, voice, and conventions. Ideas need to be clearly presented reasons/examples and support from a text/reference. An author's voice or personality appears through words (Hogue, 2002). The Illustration project also featured: prewriting strategies, drafting, revising, editing, and publishing phases for which the art teacher was now responsible.

^{iv} Contextual problems were State AIMS testing, vacation days, a water main break, other subject field trips, and sports and information assemblies.

^v In their future Critter Critiques, teachers need to offer questions with optional answers. When asking students to give suggestions for improvement, ask students to offer more evidence of desert facts in their narratives by directing students to go to the website, "Ask the Biologist," for additional information.