Title:
Empowering Elementary Students' Ecological Thinking Through Discussing the Animé Nausicaa and Constructing Super Bugs

Journal Issue:
Journal for Learning through the Arts, 4(1)

Author:
Stokrocki, Mary L., Arizona State University
Delahunt, Michael, Copper Canyon Elementary School

Publication Date:
2008

Permalink:
http://escholarship.org/uc/item/1cm011rg

Acknowledgements:
Biographies:

Dr. Mary Stokrocki is Professor of Art at Arizona State University, a National Art Education Association Distinguished Fellow, and World Councilor of the International Society for Education through Art.

Michael Delahunt is an art teacher at Copper Canyon Elementary School, Paradise Valley, and in the Interdisciplinary Ph.D. Program at Arizona State University.

Keywords:
ecology, learning, constructivism, anime, flow map, synthesis, metaphor

Abstract:
Ecological teaching models and evidence of success in public schools may be lacking. We created a constructivist ecological model using the animé Nausiscaa with fourth graders in a Scottsdale, Arizona school. The animé involves the epic adventure, good and evil battle to affect the future of the human race. We documented results using questionnaires, photographs, and students' written final statements. An art teacher introduced the animé, followed with students' analysis of action sequences, demonstrated how to make three-dimensional super bugs, and questioned students about ecological concerns. Our major research question was how did discussing the animé Nausicaa and making super bugs empower children to reinterpret bug powers and learn about ecology. We offer explanations of surface and deeper influences. While most responses regarding bug powers were bad--offensive and defensive, two emerging good categories related to ecology were recycling and pollinating. Students showed some empathetic understanding and constructed a few ecological connections between their inner and outer worlds.

Art educators use movies and animation to motivate students to do art projects. Alternative instructional approaches include empowerment through media discussion and critical thinking. *Empowerment* is the act of transferring power, giving confidence, or building self-esteem. With power comes responsibility. Media education is crucial today if children are to become informed, empowered consumers. Buckingham (2000) advocates that education needs "more coherent and consistent initiatives at the level of educational and cultural policy that will enable children and parents to become informed, critical participants in media culture" (p. 144). Equipping students with critical thinking skills will help change attitudes and allow students to pursue diverse opinions (Chung, 2007).

Teaching about Ecology in Art Education

"Why is everyone talking about environmental issues?" Chambers and Desai (2007) noted that these are critical times for the field of art education. *Studies in Art Education* also dedicated an issue to the theme of eco-responsibility (Stout, 2007). These concerns involve the field of ecology. ***Ecology*** is "concerned with relationships among living organisms and their surroundings, including human societies and their geographical environments" (Lankford, 1997, p. 49). Lankford called for ecological stewardship, which involves 1) a

pledge to promote ideals of right over wrong; 2) recognition that a person's actions concern societal and environmental wellness; and 3) choices and behaviors that must respect people and their habitats.

Art educators advocated for ecological awareness with a special theme issue of *Art Education* (Krug, 1997) and in other related articles (e.g. Anderson, 2000; Blandy, Congdon, & Krug, 1998; Hicks, 1992/93; Jagodzinski, 1987). Research on ecologically based art experiences for elementary school children in art education is rare. For example, Birt, Krug, and Sheridan (1997) reported results of their ecology unit at the Pickering Elementary School in Ohio aimed "to help the school community discover the unique natural beauty within their own backyard" in Ohio. Stokrocki and Samoraj (2003) documented the "green school" in Poland that featured cultural as well as environmental ecology.

Recently, Marshall (2006) promoted ecological concerns through substantive art integration. With pre-service teachers, she designed a model unit for middle school students to compare and contrast art concepts and other discipline areas. This model project involved "The Life and Times of Supernatural Hybrids," wherein students invented hybrid animals by drawing their geometric shapes and overlapping organic lines and details. Then they studied animal supernatural powers from myths and spiritual traditions and synthesized animal

parts to create new beings. Assessment devices included reflection charts that connected art, science, mythology, and storytelling using constructivist theories in which students actively constructed their own knowledge. Assuming the role of natural science museum curators, students reviewed and explained three unique qualities of their creatures**,** based on categories such as protection devices, perspective eyes, and strength in limbs. No evidence of teaching the unit to young students was presented in the article.

Constructivist Connections

Learning is generally regarded as a process of gaining information. Marshall (2006) proposed using **constructivism** in ecological teaching, based on major learning theories including Dewey's (2001) pragmatic progressivism, Piaget's (1963) individual autonomy, Vygotsky's (1978) social learning, and Bransford, Brown, and Cocking's (2000) connectionism.. 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). Such knowing can be referred to as *art as research*, where art education inquiry concentrates on learning that is connected to other disciplines.

The Role of Animé

The art of **animé**, based on the word *animation* (to bring life and movement) can motivate discussion of major life issues such as ecological sustainability. To help students understand messages and related art forms, study of animé requires critical thinking discussion questions to enhance learning. Bransford and others (2000) argued that the ultimate goal of **learning is understanding and its application** to meaningful situations. This requires not only art making, but also critical thinking. Art educators have explored adolescent experiences with animé /manga in Japan (Wilson, 1999, Toku (2001a) and Taiwan (Chen, 2007; Manifold, 2005). Graham (2007) argued, "A critical study of visual culture creates opportunities for students to consider their own cultural assumptions from other perspectives and consider issues of justice, power, representation and privilege" (p. 384). Our study involves elementary students visually and verbally exploring animé and three-dimensional sculptures. Our research questions were:

Did elementary school students make connections with ecological thinking?

Did elementary school students construct hybrid "super bug"creatures**?**

Did students reflect on their creatures?

Did we empower students?

Context and Participants

Mary Stokrocki invited elementary art teacher, Michael Delahunt, to join her in this collaborative research study. A veteran teacher of 20 years, Delahunt is a doctoral student at the Arizona State University. Copper Canyon Elementary School (CCES), where he teaches, is a high-income school in Scottsdale, Arizona. The observed class consisted of 25 Caucasian students (12 males and 13 females). The teaching unit lasted for 18 forty-minute class sessions).

Unit Overview

We planned and taught a sample unit plan and documented results using pre/post questionnaires, interviews, and photographs. Static picture study is a means to aid students in understanding moving pictures and animé. Students who are already involved in studying these art forms can profit most from static picture study. Four decades ago, Lanier (1966) argued for studying new media as an integral part of art education. Since then, education paradigms have

shifted to include study of the effects of teaching new media. Stout (1995) argued that such exploration of meaning through questioning hopefully enables students to recognize "the coexistence of several right answers" (p. 183). Arizona State Department of Education Standards (2007) focuses on teaching thinking skills of creating, relating, and evaluating new media though visual culture.

The unit lessons we taught consisted of students 1) viewing the animé *Nausicaa*, following-up discussion in classroom, 2) filling-out a pre-questionnaire, 2) discussing super bugs, plants, power, and ecology; 3) using a bubble map on theme; 4) planning a flow chart that emphasized sequencing, constructing super bugs out of recycled materials; (5) filling out a post-questionnaire on what they learned; and (6) posting questions on the website Ask the Biologist. We were concerned with students' thinking abilities, mostly their comprehension of their synthesis -- solutions. Comprehension is an ability to interpret information based on prior learning and synthesis is the ability to combine ideas into a product (Huitt, 1992).

Introduction of the Animé

The idea to use the animé, *Nausicaa of the Valley of the Wind* (Miyazaki, 1984), as a motivation for our unit originated with a lecture by Deborah Deacon (ASU Asian Studies instructor) on the art of animé. She spoke about how Susan Napier, who taught an ecology

course at the University of Texas at Austin, used the *manga* form of *Nausicaa* as a text. We used the DVD version, because it was more appropriate to use with elementary students.

This ecologically mindful animé, directed by Hayao Miyazaki (1984), takes spectators on a trip through time and space to the enchanted Valley of the Wind. During this epic adventure, good and evil battle affected the future of the human race. To preserve her planet's natural resources, the warrior princess Nausicaa must excite her people to defend their homeland against an brutal invading army.

The students in the class saw the first 20 minutes, preceded by a little introduction by Delahunt, and followed by a brief discussion of the animé. Students were highly attentive and eager to respond to the challenge of studying the film. Several students in each group indicated they knew this animé and/or other Miyazaki films. One boy said he had a copy of *Nausicaa* and enjoyed it greatly. The classroom teacher asked if she could borrow the disc and show the rest of the film to her class, because she was impressed at their enthusiasm about the work.

Findings

Pre-Questionnaire Results

Students responded to a pre-questionnaire after having seen the first 20 minutes of the film. When asked to identify the kind of film,

they said "animé." When asked the location of this place, twelve students answered, "Valley of the Wind," and some replied "jungle." When we inquired about when this was happening, sixteen students identified correctly "the future." We asked students to identify the major character and to describe her personality. Students responded, "She is adventurous (6); brave/hero (5); and kind/nice" (7). We then asked for their first impressions of the animé and their responses were mixed: "cool/awesome" (6), "weird/ freaky, strange, good," (3) but "scary" (3). One student explained, "A girl is trying to find why the deadly forest is attacking. A second student summarized the suspense, "Something very dangerous and serious braces you to see these scary bugs." Another student said, the girl [Naussica] wants to find out what the [bug] eye means. A third student guessed the theme: "She is trying to save the valley from the poisonous white dots that are falling off the plants." Other students posed the theme: "to rescue the valley (3) and defeat the bugs (3)." Two students introduced the character action: "Nausicaa is exploring the poisonous forest… just like her father." Pre-questionnaire results indicate that the animé suspense captured students' interest. Their responses were accurate and generally positive as they explained the action sequence and theme in the animé's first sequence. One student asked an insightful question for the future, "Why is the jungle toxic?"

Flow Maps

A **flow map** is a drawn summary of an action sequence, somewhat like a storyboard. Hyerle (1995) argued for the importance of this kind of learning or thinking map for students analyzing the plot and action sequence. Students viewed the remaining movie over a period of three weeks. They also saw some of the storyboard drawings used to establish the animé's sequence of actions on the DVD (Miyazaki, 1984). Students recorded an action sequence that they remembered as interesting in the animé. A male student chose the beginning of the film and explained the action sequence: The heroine, Nausicaa, finds something on the Ohm's (super bug's) shredded skin; she finds the toxic forest pretty; then she helps Lord Yupa, who is being pursued by the Ohms; and Yupa thanks *Nausicaa*. Two students chose the memory sequence in which *Nausicaa* is a little girl, who tries to save a baby Ohm, but her father and soldiers take it from her, intimating that it must be destroyed. In the middle of the film, a female student explained how Lord Yupa knocks on *Nausicaa's* bedroom door and discovers her having used a secret passage to a room where she has been studying plants from the toxic jungle. The most popular sequence was the end**,** in which fourteen students (66%) recalled that *Nausicaa* "is rescuing a baby Ohm from going into the acid lake" (Figure 1).

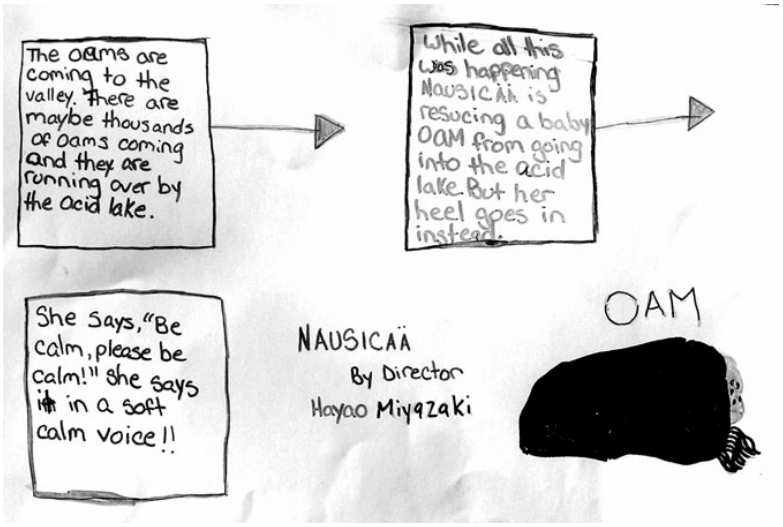

Figure 1. This female flow map example explained the sequence: Nausicaa rescues a baby Ohm.

The enemy army [Tolmekians] used the baby to lure the Ohm herd to the Valley of the Wind. Nausicaa is wounded, saved by the Ohms, and the story ends. The popularity of the end sequence probably is due to the fact that the end was the most recent memory for students or that it had the most action. Male students seemed especially to react to the action sequences (Figure 2). "The flow map was useful for film reflection because it helped students take another look at a section," said Delahunt. This activity revealed gender distinctions, in this case, female attraction to the caring female heroine and male excitement over action sequences.

Figure 2. An unusual visual interpretation was one male student's {WHY DENOTES singular possessive?] color-coded action sequence: red for weapons and warriors, green for Nausicaa, and blue for the Ohm bugs.

Final Project

Super bug sketches and assemblage sculptures were good tools for ecological reflection. In preparation for synthesizing bugs of their own designs, Delahunt encouraged students to draw "studies" of bugs from books about insects, spiders, scorpions, and other small critters (Figure 3). Delahunt offered such materials as foam rubber, pipe cleaners, and wire; demonstrated how to glue and attach wires, and, finally, he provided markers and paint for details.

Figure 3. Students to draw "studies" of bugs from books about insects, spiders, scorpions, and other small critters.

*Comparison of bugs***.** In a class discussion, Stokrocki challenged students to "compare the bugs in the animé *Nausicaa* to the ones in our world today." Students responded, "[They were] bigger; they survive in the forest as a food source. The fox squirrel became a pet. Delahunt inquired, "How did she teach it?" One student noted that Nausicaa tamed it. Delahunt asked, "How?" Another student replied, "Nausicaa had power. She stunned insects…blinded with rage…. with flash grenades." Delahunt coaxed, "What is similar?" Another student replied, "Both [are] threatening." Stokrocki asked, "What bugs are helpful?" Students answered, "Worms dig up soil, spiders kill [other bugs], and bugs kill diseases." Stokrocki directed their attention to a displayed chart on *Bug Abilities* (Smart Kids, 2007). One child

exclaimed, "Wow, worms have five hearts!" Students were able to surmise that bugs are beneficial for cultivating the soil, managing bug populations, and for fighting disease.

*Students' final artist statements***.** For a post questionnaire, Delahunt directed students to write an artist statement about the bugs they created. His questions were: "What is it? Where does it live? What good and bad things [powers] does it do? What does it eat? What did you learn from *Nausicaa* and from the study drawings?" Dominant themes and descriptions of bugs' powers and examples follow.

The final statement included: 1) creative names for synthesized bugs; 2) identification of parts; 3) analysis of bug actions or powers; 4) synthesis of parts; 5) ability to make meaning by supporting claims; and 6) what they learned. While some students' titles were predictable, others were quite creative, such as "Trashy Bashy eats only disposed old items." Tat described, "My bug is a Hollywood star [striped creature]. It lives in Brizail [sic] and eats pasta. Its favorite food is rigitoni [sic]." Such descriptions may be evidence of metaphoric thinking, that which requires the union of dissimilar things (Lakoff & Johnson, 1980). See Figure 4.

Figure 4. Another female student explained, "Scropian Butt. It's Itallian for the Toliet surviverys [sic]. It loves to eat 80 flies and 40 bees for a snack."

Most students combined two to three sculptural parts as in this example (Figure 5). "Turgion Fly is made out of [eight] spider's eyes and legs, scorpion's body [pincer & stinger], and a butterfly [feathers]," interpreted one female. Only four students succeeded in identifying these parts, such as "wormlike body and butterfly wings." Students might have been preoccupied with finishing their artwork more than in writing their reflections.

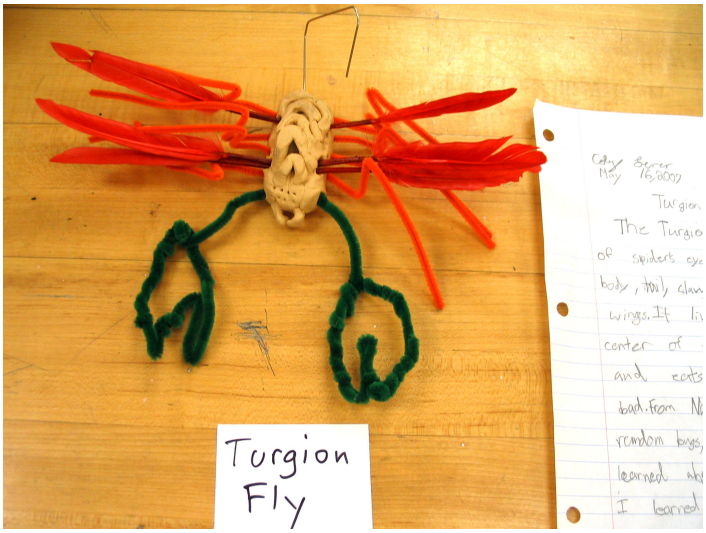

Figure 5. Most students combined two to three sculptural parts, such as this Turgion Bug.

Many students made power claims, such as kill bugs and pollinate flowers. Only a few students were able to connect several insect powers. An exceptional example was Mitchell who fused four insects and stipulated powers: "My bug has the body [armor] of a ladybug, intans [antennae] of an ant, the [fly] wings of a butterfly, and the stinger of a bee." He gave good ecological reasons for his pesticide judgment, such as "eats flies so they don't take over, smells bad, and gives off doses like the flue [sic]." A different ecological response was "getting along with others," denoting toleration.

Girls seemed to emphasize tame bug functions: recycling, pollinating, cleaning, reflecting, and biting. Some wrote, "Trashy Bashy eats only disposed, old items"; "my flying cat bug cleans

houses"; "he is covered in diamonds to scare away predators"; and "mine is a baby Spotterfly [that] collects pollen and bites a lot." In contrast, some boys' responses were obsessed with bodily discharges and gore: "Whenever they smell human snot, they attack"; "it smells like poop"; "it has the power to fart, and the smell could kill ten 6ft. people." Another boy fantasized, "The Tasmanian Beetle prey is Asians. It sticks to the throught [throat] ingesting its two stugs [stingers] into the victoms [victim's] neck. It sucks blood and in milaseonds [seconds], the victoms [victim is] dead; then it eats everything of the animal [sic]." While most girls' responses seemed domesticated, boys' reactions seemed wild and eager to offend. Responses from both sexes indicated the evolving ecological categories of recycling and pollinating.

Stokrocki and Delahunt also designed this ecology unit to empower students to think and analyze kinds of power, including their own. The researchers conversed with students as a group about the concept of "super powers." Stokrocki asked, "What is power?" Students responded: "Control, force, ability, and energy." She asked, "Who else has power?" Students answered, "Lord Yupa, who is wise and has a sword." Delahunt added, "Is it possible for bugs to have power? What kinds?" Students reiterated the typical concerns: "Bees sting to defend themselves; venom injects poison in you, and their shells are useful

for protection." One student answered, "Kryton's powers are flying, super strength, speed, and laser eyes." Delahunt asked, "Where does power come from?" Student answers included "From myself, in hand, born, [with it]." Delahunt clarified, "You mean inherited. "Who else [has power]?" Kids answered: "Bad people…try to kill people." One student finally noted, "We have the power to create." Stokrocki then asked, "What happens when you get sick from some bug virus?" Students responded in various ways about getting sick (like a stomach ache). Stokrocki further asked, "What kind of powers do students have?" They responded, "Five senses, control the world, and create our own bug art."

Stokrocki and Delahunt were very impressed with students' answers about what they learned from *Nausicaa*. Answers included "Make a bug from different bugs. Don't harm bugs and they won't harm you. Keep trying to get your bug just right." Persistent problem solving is what creative people even scientists do.

Conclusions

This study presents a constructivist teaching model about ecology and evidence of partial success in a public school. We were particularly interested in how using the animé *Nausicaa* encouraged children to think about ecology.

*Did elementary school students make connections with ecological learning**?***

We discovered most fourth graders were enthusiastic about discussing the *Nausicaa* animé, probably due to fourth grade science standards covering habitats. From child testimony, we discovered that students answered the pre-questionnaire with good suppositions, discussed questions about the animé with zeal, and offered good insights. Gender differences were marked by the girls' reactions to the caring female heroine and the boys' excitement about action sequences**.** Boys also seemed obsessed with bodily discharges and gore.

Did elementary school students make hybrid "super bug" creatures?

Whereas other ecological art education models generally offer two-dimensional activities (Marshall, 2006), this unit offered three-dimensional critical thinking opportunities. We determined substantial success, based on a rubric that included a number of sketches, a flow map, number of sculpture parts and details, and a final artist statement. Students each drew two or more sketches of bugs. All students made flow maps to increase animé reflections and described important events in the animé sequence. Most students combined two to three sculptural parts, wrapped either wire or attached pipe cleaners, and added details (feathers, glitter, and rhinestones). But did students understand this critical thinking process?

Did elementary students reflect on their creatures?

Emphasis was not on art making. We were concerned with students' abilities of reflection, mostly their synthesis and comprehension of their solutions, which evolved from their flow maps, final artist statements, and class discussions, rather than the final art objects. Two-thirds (69%) of the students were able to synthesize two or more (16%) bugs, as evidenced in their bug titles and statements. Twenty students (63%) identified two or more unusual powers. Although they ascertained "typical" powers, such as killing and eating, some students stipulated super powers (strength, speed, vision), and obnoxious powers (bodily excretions). Students understood combining bug parts, but did not fully comprehend synthesis, demonstrated by their inability to elaborate on their answers. For example, they mentioned wings, but not the function of the wings. Huitt (1992) believes that synthesis, or creating, requires rearranging the parts in a new, original way. For fourth graders, this was the first time they had learned the concept of synthesis. These students had either no models or little experience with reflection and evaluation. Huitt finds that synthesis/creating/evaluating are at the same level of thinking with little hierarchy in some experiential cases. In this case, students' abilities were enthusiastic and exploratory -- introductory levels.

Analysis of students' artist statements about their super bugs' powers revealed evidence of their awareness of good recycling abilities, such as pollination and population control [eating flies], and maintaining species equilibrium. In comparison, analysis of "bad" powers revealed obsession with the word "kill" (35% of the students), specifically stings, messes, human waste, and even gory details. Students showed some evidence of forming creative titles or metaphor making.

In comparison to Marshall's (2006) model ecological unit promoting hybrid creature design, students in our study were much younger (fourth graders) and actually assembled their own super bugs. When reflecting on their creations, they used more aggressive powers (venom, sucks, drills, paralyzes, tortures, stings, bites, injects, pinches, and poisons) than the university students. This may be the result of the influence of popular media.

Deeper analysis of the issue of power revealed conflicts that students' imaginary names/concepts for their bugs may have emerged after their bug images were made. Students might not have fully understood the idea of power beyond the images of physical size and brawn that they see in mass media. They may have forgotten the animé message that they had identified in their pre-questionnaires and did not transfer the idea of power (to rescue the valley; defeat bugs).

Students need to understand that the concept of power is neither good nor bad, that it vacillates, and is created in different ways. Additionally, the current education system perpetuates an educational structure in which power lies in the hands of the teachers and administrators who have most of the power. Empowering elementary students to discuss animé and ask questions for themselves online was a novel experience for them. Students need explicit instructional models to develop their thinking skills. Also needed are other studies that focus on actual instructional learning experiences and how they impact students in the art classroom.

Teachers may not yet fully understand how to teach critical thinking strategies because creativity, with its associated meaning that anything goes, is still a dominant focus, even within new state standards. Teachers and students may also be confused about the meaning of the word "critical." They often think of studio technical critique, rather than of issues. Duncum (2007), however, recently warned educators not to omit the "fun" out of visual culture study and to acknowledge the contradictions and complexities of student culture. Teachers need to acknowledge students' pleasures, such as their "obsession with offensive behaviors" and use "playful pedagogies" (Buckingham, 1998, p. 5), such as adopting animé in the classroom.

Did we empower elementary students?

Discussing the powers of super bugs in the animé motivation through guided questioning empowered students to reflect on a humanistic animé message about futuristic environment concerns including caring for all living beings (Anderson & Milbrandt, 2005). The students were able to transfer some helpful knowledge about bugs: they cultivate soil, manage population, and kill disease. Costantino (2007) found that middle school students respond effectively to images that move them. In our study, most students remembered the salvation of the baby Ohm and interpreted Princess *Nausicaa* as caring, kind, and friendly to bugs. Observed students thus showed some empathetic understanding and constructed a few ecological connections between their inner and outer worlds.

Figure 6. Female students attended to the female heroine and her kindness to the baby Ohm. This sculpture made of foam parts resembles the baby Ohm.

Future Implications

Ecological issues are far more complex than we were able to tackle in a limited amount of time, but classroom exploration of such issues can be a basic step in promoting an initial dialog (Chung, 2007). Since lack of class time is a perennial problem for art teachers, we suggest that teachers:

1) View the animé for the first 20 minutes for students to capture the essence of the ecological message.

2) Use the DVD at other times for motivation or give it to classroom or science teachers for future interdisciplinary discussions.

3) Encourage students to continue/write their version of the story outside the school day. 4) Direct students to use a bubble map as a group or individually to determine their super bug's flexible powers.

5) Provide examples of how bug parts can transform/synthesis into other parts.

6) Urge students to consider different best answers (Stout, 1995). Examples would be to discuss students' questions, such as, "What kind of bug was the Ohm? Why is the jungle toxic? How would the baby Ohm see the toxic world from its viewpoint?"

7) Distribute/discuss the manga version of this animé (Viz, 2007) with students and bring actual bugs in the classroom so they can be explored up close and personal.

8) Offer oil-based clay into which students can stick recycled materials because this medium is flexible.

9) Discuss the healing powers of Nausicaa as *a curandera* (a spiritual healer and naturopath).

10) Invite practical ecological applications in school (ex. washing hands to prevent staph infection).

11) Summarize the unit with students and ask what questions could they Ask a Biologist[i] (Kazilek, 2006).

12) With older students, discuss hidden military, economic, and political problems (Pannebacker, 2007). 1

13) Finally, promote ecological caring of all species, especially fellow humans.

References

Anderson, H. (2000). A river runs through it: Art education and a river environment*. Art Education, 53*(6), 13-17.

Anderson. T., & Milbrandt, M. (2005). *Art for life: Authentic instruction in art.* New York: McGraw Hill.

Arizona State Department of Education (2006). Standards: Visual arts. Retrieved December 15, 2007 from http://www.ade.state.az.us/standards/arts/revised/VisualArts.pdf

Birt, D., Krug, D., & Sheridan, M. (1997). Earthly matters: Learning occurs when you hear the grass sing. *Art Education, 50*(6), 6-13.

Blandy, D., Congdon, K., & Krug, D. (1998). Art, ecological restoration, and art education. *Studies in Art Education, 39*(3), 230-243.

Bransford, J., Brown, A., & Cocking, R. (Eds.). (2000*). How people learn: Brain, mind, experience and school*. Washington DC: Commission on Behavioral and Social Sciences and Education, National Research Council, National Academy Press.

Buckingham. D. (1998). *Teaching popular culture: beyond radical pedagogy.* London: UCL Press.

Buckingham, D. (2000). *After the death of childhood*: *Growing up in the age of electronic media*. Malden, MA: Blackwell.

Chambers, G., & Desai, D. (2007). Notes for a dialogue on art education in critical times. *Art Education, 60*(5), 6-12.

Chen, J. (2007). A study of fan culture: Adolescent experiences with animé /manga doujinshi and cosplay in Taiwan. *Visual Arts Research, 33*(1), pp. 14-24.

Chung, S. K. (2007). An exploration of media violence in the junior high school art classroom. *International Journal of Education through Art, 3*(1), 57-68.

Costantino, T. (2007). Articulating aesthetic understanding through art making. *International Journal of Education & the Arts*. Retrieved August 26, 2007 from http://ijea.asu.edu

Deacon, D. (2007). *Otaku and academia: Scholarly approaches to Japanese popular culture*. Retrieved January 26, 2007 from www.otakuuconf.org.

Duncum, P. (2007). What we are learning about teaching popular visual culture. In J. Park (Ed.)*. Art education as critical cultural inquiry* (pp. 216-233). Seoul, Korea: Minjinsa.

Garoian, C. (1998). Art education and the aesthetics of land use in the age of ecology. *Studies in Art Education, 39*(3), 244-261.

Graham, M. (2007). Art, ecology and art education: Locating art education in a critical place-based pedagogy. *Studies in Art Education, 48*(4), 375-391.

Hicks, L. (1992/93). Designing nature: A process of cultural interpretation. *Journal of Multicultural and Cross-cultural Research in Art Education, 10(11)*, 73-88.

Hyerle, D. (1995). *Thinking maps: Tools for learning.* Cary, NC: Thinking Maps, Inc.

Huitt, W. (1992). Problem solving and decision making: Consideration of individual differences using the Myers-Briggs Type Indicator. *Journal of Psychological Type, 24,* 33-44. Retrieved June 2004, from http://chrion.valdosta.edu/whuitt//papers/prbsmbti.html

Jagodzinski , j. (1987). Toward an ecological aesthetic: Notes on a "green" frame of mind. In D. Blandy & K. Congdon (Eds.), *Art in a democracy* (pp. 138-163). New York: Teachers College Press.

Kazilek, C. (2006). *Ask a biologist.* Retrieved November 6, 2006 from http://askabiologist.asu.edu

Krug, D. (1997). *Art Education.* Special theme, Art & Ecology, *50(6).*

Lanier, V. (Project Director). (1966). Final report of the uses of newer media in art education project, Washington, DC: The National Art Education Association.

Lakoff, G. & Johnson, M. (1980). *Metaphors we live by.* Chicago, IL: University of Chicago Press.

Lankford, L. (1997). Ecological stewardship in art education. *Art Education, 50*(6), 47-53.

Marshall, J. (2006). Substantive art integration = exemplary art education. *Art Education, 59*(6), 17-24.

Manifold, M. (2205). Life as theater and theater as life: Art expressions of information–age youth. *Journal of Cultural Research in Art Education, 23*, 1-15.

Miyazaki, H. (1984). *Nausicaa of the wind.* Japan: Disney Home Entertainment presents a Studio Ghibli film.

Pannebacker, V. (2007, September 29). *Newly imagined communities: Human and non-human animal relations in Hayao Miyazaki's films*. Otaku and Academia: Scholarly Approaches to Japanese Popular Culture Symposium, Mesa Community College, Mesa, Arizona.

Piaget, J. (1963). *The origins of intelligence in children* (M. Cook, Trans). New York: Norton. (Originally published 1952)

Smart Kids. (2007). *Bug IQ.* New York: St. Martin's Press.

Stokrocki, M., & Samoraj, M. (2003). The green school" as an aesthetic, ecological and moral folk experience in Poland, *Journal of Cultural Research in Art Education, 21*, 44-59.

Stout, C. (1995). Critical conversation about art: A description of higher-order thinking generated through the study of art criticism. *Studies in Art Education, 36*(3), 170-188.

Stout, C. (2007). Eco-responsibility in art education. *Studies in Art Education*, special issue.

Sullivan, G. (2005). Art practice as research: Inquiry in the arts. Thousand Oaks, CA: Sage.

Toku, M. (2001a). What is manga? Influences of pop culture in adolescent art. *Art Education, 54*(2), 11-17.

Viz. (2007). *Nausicaa of the Valley of the Wind,* 1(2nd Edition). Manga Books. Retrieved August 26, 2007 from http://www.circle animé.com/1591164087.html

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University.

Wilson, B. (1999). Becoming Japanese: Manga, children's drawings, and the construction of national character. *Visual Arts Research, 25*(2), 48-60.

---

[i] An undergraduate student who loved animé, taught this unit to fourth graders at the Arizona Academy of Science and Technology. Students posed their own questions online, "Ask a Biologist" (Kazilek, 2006). Some of there questions were: 1) Why are there no gigantic insects? 2) What would it take for an insect to grow to an enormous size? 3) Are there any insects that have a poison or venom helpful to humans? The answer to the last question is promising: "Currently spider venom is being looked at in order to create pesticides that harm insects but not invertebrates. Scorpion venom, when diluted, may be a promising base in medicines for cancer treatment in future" (Era McCarthey, Personal communication, September 27, 2007).