Arts for Academic Achievement

A Descriptive Report on the Development of an Embedded Course on Observational Drawing and Science

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Introduction

During the 2006-2007 school year Arts for Academic Achievement (AAA) established a work group of high school science teachers, district science curriculum specialists, a visual artist, and AAA staff to develop an embedded course on integrating observational drawing and science instruction. The new course would join the embedded courses on Readers' Theatre and Tableau that were being offered by AAA for the first time during 2006-2007.

The concept of embedded courses represented a new venture for AAA which, until fall 2006, had featured project-based collaborations between individual teachers, or a small group of teachers, and an artist. The embedded courses were a departure from the project-based collaborations in several ways. First, the embedded courses offered professional development to a group of teachers rather than the individual focus in AAA projects where an artist worked with each teacher in his/her classroom. The embedded courses were also distinct in that they trained teachers in specific arts-integration strategies, whereas the collaborative projects focused on strategies of the teacher and artists' choosing.

The embedded courses enabled AAA to stretch limited resources by involving more teachers than was typical in an AAA project, and to address teachers' concerns that they didn't have the time and energy to develop an AAA project from scratch. As the AAA program manager described:

"It goes back to 'How does the program adapt given the overwhelming time and energy requirements of teachers in this climate?' If we can do the background work. If teachers can help us identify the needs of students, then we can be the facilitator to pull together resources and design something that is available to teachers."

The program manager also noted that this approach can help AAA be more equitable and spread arts integration around the district. More funds can go to doing projects in classrooms rather than having teachers and artists create them anew. The embedded courses also fulfilled a desire AAA had long had to have teachers work with the artist and learn more about the art form before they develop lessons for students.

As part of a larger study of AAA, program staff asked the University of Minnesota's Center for Applied Research and Educational Improvement (CAREI) to document the course development process. The purpose of this report is to describe: 1) the process AAA staff used to develop the course, and 2) how two teachers, who were involved in developing the course, integrated drawing into their science instruction.

Methods

The data collection plan for this descriptive study emerged as the work group's process evolved and the program manager and the researcher sought out opportunities for data collection. Ultimately, the following served as data sources: a) interviews with 2 high school science teachers, a district secondary science curriculum consultant, the artist, and the AAA program manager; b) participant observation in 2 work group sessions; c) observation of a planning session between an artist and a teacher prior to the artist's first visit to the classroom and observation of the teacher's instruction after the artist's visit. The researcher made written notes during the observations and the interviews

were audio-recorded and transcribed. The researcher reviewed the transcripts and observation notes in order to prepare this report.

Findings

As described by the program manager, the work group was formed in response to an expressed teacher need. During the previous school year, a high school biology teacher and a book artist had collaborated on an AAA project and, based on the success of that project, the teacher wanted to further explore how visual arts could increase students' understanding in science. AAA staff also learned that for an AAA project in 2006-2007, another high school science teacher had expressed interest in working with a visual artist to incorporate observational drawing into a plant unit. To address these needs, AAA established a work group to indentify the intersections of drawing and science and develop an embedded course that could be offered by AAA during the next school year.

The work group included two high school science teachers, a visual artist, two AAA staff, the AAA program manager, and a district science curriculum specialist[1]. Remarking on the involvement of the curriculum specialists, the program manager said, "I'm pleased that C&I is part of the cohort thinking about how drawing and biology overlap." She explained that AAA had asked the Curriculum & Instruction department to become involved in the work group because AAA staff did not feel they had sufficient expertise in science to develop rigorous connections between drawing and science. The visual artist who participated in the work group was very familiar with the AAA program and had been an AAA coach for several years. In addition, the artist had long been interested in how drawing might facilitate a deeper understanding of science.

The group met 6 times from December through June. The artist taught the participants the basics of observational drawing, emphasizing the aspects of drawing she thought would be most useful for science learning. The instruction included the following:

- gesture
- contour line
- varied pressure
- negative space
- general to specific
- relationship and proportions
- color and texture
- perspective (plan, elevation, section)

The artist and program manager planned the activities for each work group session based on input from participants, needs that were emerging, and the ultimate goal of discovering intersections between drawing and science and developing an embedded course. As the group experienced each lesson, they generated ideas about how the lesson's processes could be useful to students in understanding science concepts and processes. The teachers often took some of the strategies back to their students and then described the experience at the next work group session. In this way, the classrooms served as laboratories for the ideas that emerged from the work group's experience of

[1] Two other high school science teachers and a second science curriculum specialist also participated on a limited basis; each attended one work group session.

being taught observational drawing by the artist. One of the work group's sessions was held in one of the teacher's classrooms. The group observed the artist working with students and then used the descriptive review protocol to describe what they observed. The next section illustrates some of the connections the group articulated between drawing and science by describing how the 2 teachers incorporated the experience into their instruction.

Teacher A

Teacher A used some of the strategies identified by the work group with 9th grade biology students in an International Baccalaureate small learning community. The teacher had worked with a visual artist in the previous school year on an AAA project where students made a collage on the covers of their science notebooks. The teacher was pleased with how that project affected students and how it increased her knowledge of students' science interests. During 2006-2007 she wanted to explore how drawing could enhance students' science skills and knowledge. More specifically, the teacher wanted to make the dissection process more inquiry-based and help students understand that visual information is also a source of data in science. She also wanted students to understand the purpose of looking closely in science. Although the teacher had not previously provided any instruction in drawing during her science courses, she typically asked students, as part of the scientific process, to draw diagrams, set ups for experiments, and sketches of organisms.

The teacher decided to incorporate drawing instruction into the unit on invertebrate dissection. The unit started with students exploring the ethics of dissection. Then, the teacher guided students in the critical response protocol as they reviewed examples of science notebook covers that the previous year's students had created with collage. Students began their exploration of the invertebrate nervous system by creating wax models of the nervous system in the larval stage and the adult stage. For the artist's first session in the classroom, the students received caterpillars in different stages of development. The artist worked with students on the strategies of quick sketch and contour. On her second visit she included diagrammatic drawing, how to use measurement to draw with accuracy, and adding color and detail. The teacher and artist asked students to reflect on their drawing and speculate about the functions of the caterpillar's structures they had noted. To give students further experience with drawing, the teacher asked them to draw one of their wax models as a homework assignment. The artist who worked with Teacher A's students in the classroom was the same artist who participated in the work group. The artist worked with students in the 2nd, 3rd, and 4th period biology classes.

Working alone, without the artist present in the classroom, Teacher A incorporated observational drawing into a subsequent unit on vertebrates. In this case, students used drawing as a method of recording their data from dissection of a sheep brain. After their dissections were completed, the students worked in small groups to interpret the data, which appeared both in the form of writing and drawing, in their science notebooks. At the end of the year students again incorporated drawing as part of an assignment to create a book about an ethical issue in science.

When Teacher A reflected on how students were affected by the addition of drawing instruction to their biology course, she noted that drawing

- helps students to do more of their own thinking, and
- allows students who are English-language learners to show what they know.

In all of her science teaching the teacher strives to have her students be original thinkers, rather than tuning in to what they think she, as the teacher, is looking for. The teacher sees observational drawing as a strategy students can use to become original thinkers. As she explained,

"When you say it in words, just by the nature of language, it makes it a less open-ended task. By nature, drawing is a more open-ended task. The benefit for the student is that it allows them to do their own thinking, which is what we want, and sometimes words don't allow that."

At one point during the unit the teacher had asked students to draw a visual representation of how a synapse works. One of the students responded by drawing a pop machine. This impressed the teacher because she hadn't asked them to use a visual analogy, but this student did just that. In contrast, some students drew pictures similar to those shown in the text book.

During the units that incorporated observational drawing, the teacher often remarked to the work group and the researcher how beneficial drawing seems to be for her students that were English-language learners. The teacher observed that drawing allowed the students to show what they know when they may not yet be able to express it in writing. At the end of the school year, the researcher asked the teacher to select several science notebooks of students she believed had benefitted from the inclusion of drawing. During an interview, the teacher explored 2 notebooks, one from a male ELL student and the other from a female ELL student, and reflected on how drawing seemed to benefit her ELL students. She noted, *"ELL students, in particular, lack academic language to communicate what they're thinking. Communication in science is really important, but it doesn't have to be words. Yet, it can't be random [either]."* Pointing to a drawing in one of the ELL student's science notebooks the teacher said, *"This is really interesting. She's connecting prior knowledge about what a neuron looks like to a cross-sectional drawing of the frontal lobe of a sheep brain from lab."* The student may not have been able to articulate this understanding in words, but it was plainly visible to the teacher through the student's drawing.

In addition, one of Teacher A's goals for incorporating drawing instruction was to help students understand that drawings were data, just like the words they write in their science notebooks. When the teacher asked students to work in small groups to review the data in their science notebooks and draw conclusions, one small group of students successfully integrated their reading about vertebrate nervous systems with their sketches from the dissection of the sheep brain. They were able to make an accurate conclusion about how axons are arranged in the brain. The students then used a cross-sectional drawing of a sheep brain to convey their conclusion to their peers. The teacher cited this as an example of how some students had learned to use both drawing and words as data in drawing conclusions.

Having students do observational drawing in science class also provided the teacher with a formative assessment tool. As the teacher described,

"It allowed me to see the progression of students' thinking easier. I could use it almost as a daily thing to inform my instruction, whereas in the past I used it as an [summative] assessment tool. . . . Even if I just grab a couple notebooks each day – some that struggled, some that got it – I can use that to inform my instruction for the next day."

The teacher explained that she can tell if a student copied a diagram from the text or the Internet, or if they had to think for themselves about how to convey the information. As she paged through examples of students' science notebooks she reflected, *"You get so much more insight into the brains of your students than from a multiple choice assessment, or even an essay assignment."*

Teacher B

Teacher B used some of the strategies identified by the work group with 10th grade biology students in the Open small learning community. Teacher B had had no previous involvement in AAA but, like teacher A, he had always incorporated some drawing into his science courses as students documented their observations and their lab set-ups. The teacher had not previously, however, incorporated any explicit instruction in drawing skills. The teacher hoped that the addition of drawing instruction would improve student motivation and spark resistant students' interest in science.

As part of a plant unit the teacher brought in examples of prairie seeds and asked students to diagram them as they viewed them under the microscope. On another occasion he brought in 3D objects and had students do some quick sketches and contour drawings. When the artist came in a few weeks later, she gave students a page of geometric forms – sphere, cylinder, teardrop -- and helped students look for these forms in the objects they were drawing. She also worked with the students on shading to add dimensionality, contour drawing, and negative space. The students' task was to draw a plant completely and then draw just the flower of the plant. The teacher said that, as the students worked, both he and artist would circulate and try to model drawing skills for students. The artist who worked with Teacher B's students was a local visual artist with previous experience in AAA. The artist worked in Teacher B's classroom for a total of 5 sessions with the students in 4th period. After each artist visit the teacher would incorporate what the artist had done into his instruction for other class periods.

When asked to reflect on how the inclusion of drawing instruction affected students, Teacher B described how drawing helped students slow down and notice details, and built community among students.

- *"In order to get the drawing right, kids had to be careful with their observations. A lot of kids look at the forest and they shut down. In order to really see something, it takes time. . . . That slowing down is critical. Noticing the nuances of the plant. That I really think is invaluable."*

- *"Kids that didn't draw well would turn to those who had that skill. Kids that had empathy would show them how – slow down, here's how to shade it, that sort of thing. [I noticed] a little more openness, just discovering that someone else has that skill."*

The teachers also said that drawing helped motivate some students who were resistant to learning science, but it didn't motivate all of the resistant students, as he had hoped.

Students weren't the only beneficiaries of the experience. Teacher B said, *"It re-awakened my talent as an artist, gave me thoughts about how to motivate my kids. It clicks with the way I want to teach science."* As he went on to explain, *"I don't like to tell kids information. Drawing allows students to discover information for themselves. Drawing pulls out more of the science – you observe the sticky stuff [on a flower] and through experiencing it you remember what it's for."*

Other Findings

Both teachers noted that not all of their students became comfortable with drawing. One teacher described some of the students' resistance to drawing and remarked on the importance of not using the term "drawing." She explained, *"I was intentional about not calling it drawing. It was recording observational data. Qualitative data is different to interpret and recording what's useful is part of that."* She also noted, however, that students' attitudes toward drawing in science class seemed to improve as they did more of it. For next year, both teachers hope to introduce drawing skills earlier in the year so students can have a longer opportunity to develop their skills and employ them as a tool for understanding science. One teacher planned to give the students more scaffolding for learning drawing skills.

The teachers also commented on the value for students of having artists in the classroom. The teacher who worked with the artist during only one section of his science course remarked: *"The class that had the artist felt really special. Even if I had all 4 classes with the artist, all would feel special—they got to have an artist come into the classroom. Not a teacher, but an artist. I don't think the kids get that opportunity often."* The other teacher's comments reinforce the value of having an artist working with students: *"Bringing in a real artist brings more credibility to it than me doing it. I don't care what I say to students, there's an implicit message [when artist comes in to co-teach] that this is important, that adds rigor on some subliminal level to the students."*

All of the participants seemed to enjoy the work group sessions, both for the opportunity to learn strategies for observational drawing and the opportunity to explore together the connections between drawing and science. Many of the participants remarked on how natural the link was between drawing and science. The work group easily identified multiple ways that drawing could be incorporated into science instruction to benefit student learning.

Discussion and Conclusions

The work group process was clearly successful in identifying the intersections of drawing and science and creating and testing lesson plans to integrate drawing instruction into science courses. Both teachers saw clear advantages to offering students some drawing instruction and both planned to continue the work next year. As the science teachers in the work group pointed out, asking students to draw in science class is not new. What is new, and brings added value, is incorporating some instruction in observational drawing. The instruction can lessen the fear some students have about drawing in science and provide them with very specific skills to accurately reflect their scientific observations.

The work group, and the embedded course that will result from it, provides a mechanism for AAA to bring arts integration strategies to a wider group of teachers. In AAA projects, the emphasis tends to be on student learning. In an embedded course, teacher learning is also key. As one work group participant described it, *"The goal was to teach me so I can teach students. It's scaffolding for teachers."*

Future studies could explore the amount of drawing instruction that is needed in a science course to benefit student learning. Although the participants in this work group identified clear benefits for students, a continuing challenge is to make space in the science curriculum to teach drawing without jeopardizing the science content and processes students must take away from each course.