Professional Development Case Description
TUSD D.E.S.E.R.T. Project
LSC Year 4
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The Tucson Unified School District (TUSD) elementary science curriculum consists of three kit-based modules at each grade level. These modules, refurbished and maintained by the district's Science Resource Center, are delivered to every teacher in the district for a period of 8-9 weeks, Each module provides 30-45 hours of instruction and is consistent with the recommended time allocated for instruction in most kit manuals. TUSD's modules are primarily from FOSS, however there are also modules from Insights and STC. The module discussed here is FOSS, Structures *of Life*, which is part of the 4th grade curriculum. The Big Ideas in this module are that plants and animals have identifiable characteristics and that plants and animals have physical and behavioral adaptations that help the organism to survive. There are four sets of lessons used to develop conceptual understanding of living organisms; *The Origin of Seeds* - to describe and compare types of seeds; *Growing Further* - to explore germination and plant growth through use of a hydroponics system; *Meet the Crayfish* - to look at physical and behavioral characteristics and their adaptive value; and, Meet *the Land Snail* - to provide a comparative study of two animal's physical structures and behaviors. Teachers are encouraged to keep the plants and animals after the module is sent back to the center to permit long-term study and extend student investigations of life cycle and adaptation.

Challenges for teachers in this module are to:

- Shift the focus from investigations as isolated, fact-finding activities to a series of linked events which develop students understanding of basic life science concepts (the Big Ideas and supporting evidence) in the module.
- Develop a long-range plan for conducting the investigations over an extended time period, at regular intervals suitable to observe both short and long term changes and cycles in living organisms. In contrast to the physical and earth science modules, *Structures* investigations cannot be readily compressed or randomly executed. Unfortunately, in some school cultures there is less emphasis on daily instruction in science, than in mathematics or language arts. This results in insufficient time allocated to acquire the data students need to develop and reinforce the concepts in the module.
- Understand the nature of the biological concept of structure and function (adaptation)
- Gain adequate background information about the anatomy and life habits of the two illustrative animal models.
- Become comfortable with basic issues of care, feeding and maintaining live animals and plants in the classroom
- Ensure a positive classroom climate to support proper handling and care of live organisms.

As in all the other FOSS modules, underlying challenges for novice users are to

- Encourage the teacher to teach the complete module, rather that selecting activities
- Utilize effective questioning strategies to promote development of science concepts and critical thinking.

- Identify mathematics connections to introduce, practice or reinforce mathematical skills and thinking strategies during the science investigations. In particular, organizing date into charts and patterns and graphing
- Identify language arts skills the students can develop through the module.

The biggest challenge for design of the nine-hour basic workshop is to determine which aspects of instruction best support the first time user. It is impossible to provide or attend to all the pieces during the first round of implementation. This issue is complicated in that the workshops are not limited to first time users. There may also be participants who have experience with kits at other grade levels. The teachers' understanding of inquiry learning and their overall level of teaching expertise are also quite varied, which has strongly influenced the design of the basic workshop. The sessions are frequently customized to honor the need of the current participants. Participant feedback at the end of each session informs the facilitator's next steps.

Other challenges for the facilitators are to:

- Have plants at appropriate stages of development for study in a short period of time
- Address mathematics and language arts skills in the context of the module, since these are areas of heightened concern due to high stakes testing. The plans incorporate graphic organizers and journaling strategies to promote student thinking and communication skills
- Introduce rationales for investigating animal behavior. For example, we discuss the urge that students have to influence the behavior of crayfish and snails by manipulating them, rather than just observing the natural behavior patterns that occur without human interaction.

Since our instructors are lead teachers with elementary backgrounds, we utilize university scientist partners to help develop their knowledge of the structures and behaviors of snails and crayfish needed to support adult learners in the workshop. In many instances a scientist partner is present for all or part of the workshop.

The primary facilitator for *Structures of Life* since the project began has been a Collaborative Teacher CT (full time teacher leader). Prior to the grant this ten-year teaching veteran taught 4th grade, including the Structures of Life unit. Even though the CT has first hand experience with the module, we felt it was important for each workshop to have a classroom teacher who was currently teaching Structures of Life as a co-facilitator. The teacher who typically assisted recently became the director of our environmental field school campus and is no longer available to teach foundation level classes during the school year. She also taught the summer extension class on one occasion and may be able to continue this.

The PD design was developed with the assistance of the Project central staff and collaboration with a University scientist partner who is a professor in ecology and evolutionary biology. She served as an advisor, recommending some strategies for working with the animals and plants in this module. She also attended some of the early workshops, doing the activities as a participant and answering questions that came from the teacher participants. In the most recent workshop, a

University of Arizona graduate student with background in science education outreach was the co-facilitator with our CT.

In the workshops, the facilitators alternate the lead, guiding teachers through various sessions in the module. They model the 5 E's of instruction in the workshop design: engagement, exploration, explanation, extension, and evaluation. They emphasize reflection and closure at the end of each of the three, three-hour sessions.

There are approximately 200 fourth grade teachers at 72 elementary sites. Basic workshops for the *Structures of Life* module adopted in 1993 have been offered each year since then. When the D.E.S.E.R.T Project LSC began in 1998, the intent was to provide at least one basic and one enrichment workshop per module annually. This plan has been somewhat dependent on teacher enrollment--more sections if demand was high, and fewer if enrollment was low. To make the courses cost-effective a minimum enrollment of ten teachers is required. In the case of *Structures*, there have been four sections of nine-hour basic workshops, and one fifteen-hour workshop designed as a follow-up or enrichment for teachers who have attended the basic workshop. Since 1998 a total of seventy-five teachers have participated in the five *Structures* workshops offered. It is interesting to note that of the three fourth-grade kits, there is less demand for *Structures* workshops. The other two modules are *Earth Materials* (five basic and two enrichment) and *Electric Circuits* (eight basic, one enrichment section). The higher number of Electric Circuits workshops may be because it was recently adopted (in 2000). Possible reasons for the lower demand for the *Structures* workshops may be that;

1) Elementary teachers feel more comfortable or familiar with life science units than those in physical science,
2) Many teachers participated in Structures classes prior to those in 1998 LSC records, or
3) Some teachers express hesitation to keep and work with live organisms in the classroom. They don't want the added responsibility of maintaining plants and animals over time or they have concerns that classroom climate is not one in which they feel they can trust students to treat the crayfish and snails humanely. This final issue is one we have attempted to address with specific attention to issues of classroom climate in our site-based science learning forums as well as in the basic *Structures* workshops.

Other circumstances that have impacted these sessions are that during the first year of the Project, there was no release time for professional development due to a district-wide substitute shortage. This limited enrollment in basic classes to those teachers who were willing to come after school or during the summer. Incentives of stipends ($10/hr) or salary increment credits were provided, but this did not address the entire problem. In year two, the Project arranged to use Title II funds to hire specially trained non-certified staff to provide three hour fine arts lessons for students during the teachers' release time. While the original plan was to offer two-day, 15-hour workshops utilizing substitutes, the length of the basic courses was revised to 9 hours by the high cost ($150/teacher for three sessions) of providing this special staff and the limited number of persons available to serve in this capacity. At present, only the summer enrichment workshops remain 15 hours.

Additional challenges include scheduling the workshops to accommodate the Science Resource Center kit delivery schedule. Summer sessions ensure that teachers have information prior to

teaching the module, but doing the workshop in one block of time does not allow teachers to test and report back as easily as in the school year version where three sessions are scheduled two to three weeks apart. This version is still problematic because some teachers have the kit at a time other than when the sessions occur.

In order to meet these challenges the Foundation or Basic workshops were originally set up as 15-hour sessions during summer or after school. They were subsequently modified to reach more reluctant teachers or those unable to participate in after school/summer sessions to a 9-hour introduction consisting of three-hour sessions 1-3 weeks apart, during release time.

The most important goals are to model the activities as they are presented in the manual to establish a familiarity with what the process and instruction might look like and to encourage teachers to complete the entire kit as suggested for their first time use. We also want them to practice reflective habits and note things they want to refine or investigate next time they teach the module.

During the workshop session the teachers refer to various strategies listed in the manual to allow them to become more familiar with what is available for support. We also show the kit video. (It is interesting how many teachers have not thoroughly investigated the modules' teacher resources until they come to the workshops even though they may have taught the kit!) All three sessions include both hands-on exposure and processing/reflective time. We invite more experienced teachers who attend the workshop to share tips that they find useful.

A typical teacher has access to professional development support prior to teaching this unit for the first time in several ways. Every school library has copies of the Kit manual and training videos produced by the publisher available for teacher check out. There is a science facilitator at each site who is a classroom teacher who has been provided with overviews of the elementary CORE science modules at each grade level. Science facilitators have also received training to support a site-based "kit club" structure which meets at three times during the module implementation: beginning, middle and end. These meetings vary in topic depending on the level of experience in the grade level groups. During the first year as a D.E.S.E.R.T. Cohort* school, a full time Collaborative Teacher (CT) visits the site on a regular basis. The CT conducts site based learning forums (six to seven two hour sessions) for all teachers on the five E's model of instruction with emphasis on use of focus and engage, explore and closure for each module lesson. The forums also promote collaboration in grade level groups to support implementation of the kits. CT's may co-teach lessons to model methods of instruction. Some teachers will have attended workshops on other fourth grade modules or modules at other grade levels previously taught.

* D.E.S.E.R.T. staff work intensively each year with a different subset of 20-25 schools. This provides more time to develop the science vision at each site and to understand the needs unique to each site.

The typical teacher has access to a variety of structures prior to and during the instructional unit. these include the science facilitator, kit clubs, CT support and phone, email access line to SRC

staff. There is also a web page for each kit on our district web site, and we are beginning to get teachers to contribute ideas to these pages that will support queries from other teachers.

After teaching the module, site-based Kit clubs (peer support), SRC phone support, CT coaching, modeling and consultation, and the 15-hour summer follow up or extension class are available to all teachers.

The opportunities that are available to each teacher represent about 30 hours of support for each kit: nine hours for basic classes, two to nine hours for site based kit clubs, and15 hours for extension class. This does not include the more generic learning forums, which provide overall support for effective implementation of all the kit modules. To date, 51 of the 72 elementary sites have been Cohort sites and have had learning forums for all teachers.

Classroom observations across the district reveal that instruction in this module spans a broad continuum from novice mechanical use to high levels of expertise. Collaborative Teachers suggested the three classrooms observed because they were currently using STRUCTURES OF LIFE and open to having visitors. I contacted each of these teachers to set up a visit to see how students were doing with the STRUCTURES OF LIFE module and how we might make professional development for this module more effective. They were told not to do anything other than what they had regularly scheduled for this science period. All teachers observed for this study are from Cohort 3 schools, which are in the first year of the collaborative site based work with D.E.S.E.R.T. Project this year. All teachers at these sites are currently participating in site-based learning forums facilitated by DESERT CTs to support collaborative study of effective teaching strategies to implement science modules. The choice of schools was limited to those who receive this particular kit during the rotation period when the case study was conducted.

Teachers A and B were identified because they were part of the most recent *STRUCTURES OF LIFE* workshop (completed 11/01). Since I had also attended this workshop, I was alert for any direct implementation of what was introduced at the workshop. The third teacher, C was recommended by the CT who is currently working in this school as being a teacher who is working very successfully with her students.

The school sites represent the diversity of our district, classroom A is in a suburban region where most children are from middle class families with a high degree of parental support and high test scores on state/district language arts and mathematics assessments. Classroom B is a bilingual classroom in the inner city school with lower income families. Classroom C is in an urban setting; the student population is ethnically diverse and has recently been targeted by the district to improve low test scores in reading and mathematics. Each class had between 20 and 25 students on the date observed.

Classroom A: The teacher is new to 5^{th} grade but had previously taught at a middle school in the district for ten years. She was teaching the module for the first time. There are 25 students in the classroom. The length of the lesson observed was 1hour, 15 min. The topic was *Investigation 3 Part 4: Crayfish Territory* - Observation of territorial behavior of crayfish. The students worked in groups of 6-8 to observe tubs of crayfish and record their position on the crayfish

habitat maps provided. Other than to introduce the procedure, there was little teacher involvement in this task. Students basically examined their crayfish tubs and marked the locations of individual crayfish. Although the teacher did mention it, it was not clear to the students why they should not interfere with the animals before recording their position. Therefore, it seems unlikely that they will get a true picture of what crayfish do on their own. In this case, a smaller group of 1-2 students might be asked to record the data each day and report to the rest of the group using the maps. This would be a way to control the student disturbance to the crayfish.

Once the data had been recorded, students moved to *Investigation 4 part 3 The Snail Pull.* After a brief set of instructions from the teachers, each group of four was assigned a snail and a harness and the task of attaching it and determining how much weight the snail could pull. At the end of the investigation, each group shared their findings as to the weight their snail could pull and details that they observed about the snail's behavior during the pull.

In her introduction of the two activities, the teacher did take time to discuss with students why they were making observations over time with crayfish and why they were working on two different organisms. One concern I had was that students suggested that snails whose shells were cracked, thin and soft perhaps might be "molting" as the crayfish do. While it was not necessary to "correct" this impression, I was concerned that the teacher may also have thought this was the case. There was no time to follow up with her after the lesson to be sure what she understood and in fact, we have not as yet been able to find the actual cause of this occurrence.

The students were wildly enthusiastic about the snails, but the classroom climate was well established so that each group completed their tests as directed with much cheering and sense of awe about the snail's behavior. Each group reported their findings orally to the class at the end of the investigation. I did not see much evidence of data, either writing or drawing in student journals or any permanent recording of class data. Perhaps students could repeat the investigation to gather more precise data; since the snail's performance was so exciting, they might have missed some of the details. In addition to collecting quantitative data, the teacher's questions were directed at getting students to see the relationship between pulling the weight and movement of muscles. How did the snail move when it pulled the washers? There was quite a discussion of how a snail's strength to pull weight compared with their student's strength withlots of opportunities for mathematical thinking, estimation, ratio, discussion of conversions from pounds to ounces and then to metric units.

Classroom B's teacher is a third-year teacher in a bilingual classroom with 20 students. The classroom climate was excellent; students were focused and responsive to each other and to the teacher. There is an aide who seemed unprepared to help students with this particular investigation. The length of the session observed was 1 hour and 10 min. The topic was *Investigation 1 The Origin of Seeds Part 2 The Sprouting Seed Investigation 2 Growing Further, Part 1 Germination.*

The class discussion was about the characteristics of seeds before and after being soaked in water. Much of the lesson was focused on the vocabulary and ways in which students could describe and record their observations of the seeds during germination. Because the students in

this classroom are bilingual and this was the beginning of this germination unit, the teacher seemed focused on laying the groundwork for the subsequent student entries in the flip books they were using to record data. They talked about seed coat, size, and color. There was not much evidence of higher order questions in this session. Students did seem very engaged in making observations and recording information. Although students have several of each seed type to germinate, there was little attempt to provide a systematic structure for students to quantify their results. Most of the lesson was focused on establishing procedural routines which is appropriate at the beginning of the investigation. The teacher did have a summary discussion at the end of the observations period where students shared their findings. The lesson concluded with observation of the seeds in the class germinator and students watering their individual containers.

The activities reinforced the following concepts: seeds have a variety of properties, seeds undergo changes in the presence of water, a send is a living organism, seeds store food and provide protection, germination is the onset of growth, plants need water light and nutrients to grow. I wondered if the teacher could emphasize the idea of adaptation by asking students why they thought there were differences in the seed characteristics. This idea was not a part of the discussion. Without this "why" at some point, students may come away with the idea that the investigation was to grow plants, not to look at the ways different plants grow.

Classroom C: This teacher has taught for 4 years. This was the second time she had taught this module. She did not take the STRUCTURES OF LIFE class but is participating in the project's learning forums. The lesson was observed for one hour. The topic was *Investigation 4 – The Snail Pull*

The Teacher began class by reviewing a class chart of crayfish data. She asked students to identify the different characteristics they had observed about their crayfish, size, weight, number of legs, behaviors etc. There was some discussion of the need to standardize measurements since some groups had used English and some metric measures. The teacher then shifted to characteristics of snails and suggested that today the students would be looking at the characteristic of strength. She invited them to think of ways that they could find out how strong a snail was and whether the methods they suggested could actually be done in class. She then told the students that she had a way she wanted them to try to see if it would give them any information about how strong a snail was. All of this discussion indicated the teacher was confident in her understanding of where the lesson was going and that she wanted students to take away the big idea of how to develop ways to compare characteristics and adaptations among individuals within a species and between the species.

The whole class brainstormed various precautions they would need to take, problems with soft snail shells, avoiding the shell being crushed, not enough snails, and how to compare the abilities of snails of different sizes. They decided to measure the mass of the snail and the amount of mass pulled. Students were asked to make predictions in their journals before they were given the materials.

Once all the materials were in place, there was a FIRE DRILL. Students actually gathered up the snails and we took them outside with us! When the class returned they resumed their

investigations and began to collect data, which they recorded in their journals. Students were very surprised at the mass the snail could actually pull.

There was evidence of higher order questioning, particularly in the introduction of the lesson. The teacher had the expectation that students would think and work as scientists. She communicated this in the way she presented the guided lesson--proposing it as something they might want to try to gain more information about the organisms.

In each classroom visited for this study, pieces of the professional development workshops were incorporated in the lesson, such as graphic organizers, word lists, question folders, or use of predictions. There was also room for improvement in every classroom. It was not always clear that teachers were really seeing the underlying reasons for some of the activities. Because most of those I observed were somewhat new to the module, their use seemed to be fairly mechanical. There was evidence that students were completing the entire module and that what they were doing during my visit was not an isolated event. It is clear that teachers need several repetitions of teaching a particular module to incorporate all the aspects of instruction. Students are engaged in more hands on investigations; they are writing, drawing, and to some extent discussing what they are learning.

Areas that need more attention are questioning strategies, developing more quality student to student interactions, much of the learning is still teacher-student focused. There also needs to be much more practice in lesson closure.

One helpful modification in the professional development to support this module, would be to offer the basic workshops more frequently. Teachers could take them just prior to or during the time the modules were in their classrooms so that implementation could be simultaneous with the professional development support. The model we hope to develop is for grade level groups at each site to have regularly scheduled kit clubs during every unit they teach so that they have the opportunity to continuously reflect and refine their practice relative to the students' needs. Peer collaboration and coaching would help teachers to target individual needs at times when they need help the most and honor the existing expertise at the site. Central staff would serve as resources to support this process and structure. This has particular promise for the first time this year since there is now a weekly, two hour professional development block early release at every site. The challenge is to successfully introduce the kit club structure so that teachers realize the power of such regular collaboration and elect to continue this on a long term basis for continual improvement. The barriers to this are the huge number of competing initiatives the district has scheduled during this same block of time. Unless teachers and administrators at the site understand and value the kit club structure, it will be difficult to maintain. We would also like to encourage more web-based dialogue to support teachers' questions and suggestions about implementation, but this is down the road for us. Our experience so far is that while the CT is working at a site it is easier to maintain a focus on science. Without them and without strong site facilitator and principal support, embedding these structures is one of the bigger challenges in systemic reform. .