STEP-uP Lessons Learned: Professional Development Case

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This professional development case study for STEP-uP centers on an STC unit entitled Food Chemistry. In Food Chemistry students investigate the basic nutrients found in a variety of common foods. Students learn that specific chemical and physical tests can be used to determine whether a food contains starches, sugars, fats, or proteins. They use iodine to test for starches, glucose test paper for glucose, brown paper for fats, and Coomassic blue for proteins. Students perform these four chemical and physical tests to identify the presence or absence of nutrients in foods. They predict and conduct independent research on nutrients. Students observe, record, organize, and interpret test results. Through predictions, discussions, and comparing results from tests, students become engaged in a science process that encourages problem solving and fosters the concept that, in science, results frequently connot be reported with "yes-or-no" answers. They learn to trust the data. They develop techniques to avoid contamination of the test samples. They learn the importance of repeating tests to validate results. They use nutritional information to make informed decisions about the foods that they eat. The unit includes 16 lessons of approximately 45- to 60-minutes each.

Expected challenges for teachers in implementing this unit included:

- Management of materials
- Leading minds-on discussions
- Focusing on the major conceptual learnings
- Using/valuing embedded assessments
- Fear about teaching "chemistry"

The challenges in providing professional development for this specific instructional unit were:

- Identifying trainers who understood the major conceptual learnings and were also able to model effective minds-on discussions
- Training the trainers—introducing conceptual storylines, setting standard expectations for content of all kit trainings
- Scheduling of training
- Providing training for "no shows" at the regularly scheduled training

Structure of Professional Development to Meet These Challenges

Given the time demands on elementary teachers for professional development in all content areas, the importance of providing a variety of structures to support the full implementation of Food Chemistry is imperative. Each teacher of Food Chemistry

attended a 4-hour Food Chemistry training that focused on "doing" the lessons, major conceptual understandings/standards, materials management, modeling a minds-on discussion, and experience with the embedded assessment. The evaluations of the kit training were quite positive.

Support for the elementary teacher includes:

- Training of Trainer session to "standardize" kit trainings and ensure high quality across trainings
- 4-hour Food Chemistry kit training
- District trainings scheduled at a central site and providing additional trainings for teachers who were "no shows" at their school sites
- Food Chemistry mini-training (2 hours) at Steering Committee Meeting for Science Liaisons (classroom-based teacher who supports kit implementation within his/her school), focusing on using all the nutrient tests and teacher implementation issues
- Science Liaison support within the school
- Science Resource Teacher support

As the typical teacher taught the kit, s/he was supported by the Science Resource Center staff who are available to answer questions and provide materials support. Science Liaisons, who experienced all the tests at a Steering Committee Meeting, were able to lend support in setting up tests, answering questions, and serving as a communication link with the Science Center. Science Resource Teachers, who were also trained on the tests and have a great deal of expertise in conducting minds-on discussions were available to model lessons, team teach, and further collaborate with the teachers.

In the past, there were no follow-up sessions with teachers after they completed a kit. This year, however, STEP-uP is instituting a 3-hour "lessons learned" session for targeted kits. A team of one Science Resource Teacher and the kit trainer(s) will facilitate the session. In these follow-up sessions, teachers will go through a protocol process that allows new and experienced teachers to share materials management solutions and identify how lessons build to conceptual understandings, and how to capitalize on "golden opportunities" to further student understanding.

Total professional development for a typical teacher for the Food Chemistry course varies from 7 to 16 hours depending on the amount of support a teacher needs from the Science Liaisons and Science Resource Teacher.

Match with STEP-uP Vision

Teachers are quite enthusiastic about the unit and feel empowered and supported to teach all the lessons. Science and the science kits were clearly an expectation that they supported. They felt their students would both enjoy the kit and learn a great deal that

about nutrient testing and information that applies to their lives. They expect their students to be scientists and to be fully engaged in all the activities and discussions. The teachers clearly understand the importance of providing both the hands-on lessons and the minds-on, meaning-making discussions. As I observed classroom implementation and interviewed teachers who participated in the training, each teacher expressed their desire for the kit training to give them experiences with vital lessons (especially experiencing all the nutrient tests followed by minds-on discussions) and to have more information on materials management and cleanup.

Overall the teachers I observed were teaching in the way they had been trained. However, at times the teachers were not seizing those "golden" moments to deepen children's major conceptual understandings. They were also confused about some of the tests. Two teachers tried to "pre-teach" the vocabulary related to the unit.

The kit training modeled many aspects of STEP-uP's expectations and vision, but several aspects were lacking which points to the professional development needs of the kit trainers. The two Food Chemistry kit trainers piloted the kit. One of them had done kit trainings in the past and is completing a Masters of Art in Teaching of Integrated Natural Sciences at Colorado College, which has given her a good working understanding of inquiry. The second kit trainer has been a Science Liaison for several years in one of our districts and has a fair amount of Earth Science background. A 3-hour Training of Trainer session held every August modeled what components should be in each kit training. Each kit training was expected to focus 80% of the time on the "doing" of the science lessons, including set up. Teachers were to participate in at least one discussion of the science content. Science standards, major conceptual understandings (via storylines), safety procedures, components of the teachers guide and general use of science notebooks were also expected to be part of the kit training.

I observed the first 4-hour Food Chemistry training. The trainers followed the expectations in that each component was included. However, addressing Science Standards and major conceptual understandings was cursory and confined to the overview of the kit. They were never mentioned again during the training. Teachers were not asked to reflect on how any of the lessons enhanced conceptual understandings or addressed Standards. The trainers did, indeed, use 80% of their time on "doing" the lessons. Again, however, they omitted many lessons, including the vital lessons of testing for protein and the final embedded assessment. At my insistence and with my assistance, they quickly added the protein test to their training. The trainers conducted an excellent minds-on discussion in which teachers furthered teacher learnings from one lesson. They also modeled excellent materials management strategies.

The three teachers selected for observation attended the first Food Chemistry kit training that I observed. All had prior experience teaching science kits and for each of

them Food Chemistry was a new kit. I wanted to track how effective one specific kit training was in furthering teachers' ability to implement the new Food Chemistry kit. One of the teachers was a Science Liaison (Teacher A), another (Teacher B) had participated in STICS (Standards-based Integrated Curriculum Strategies--a 150-hour precursor to STEP-uP), and the other (Teacher C) was a classroom teacher whose prior professional development included only kit trainings.

Each of the teachers demonstrated an understanding of the unit and how their lessons fit into the bigger picture. Each teacher continually brought students back to the question "What would a scientist do?" or "How would a scientist think about this?" They then would probe student thinking. In each case, the teachers led students to understandings rather than tell them answers. They also had the students organize their data and compare it with other groups. Each classroom was highly interactive, and a deep respect for students and their thinking was evident. Application to "real life" and integration of Literacy and Science in terms of use of science notebooks, research, and the use of reading materials were demonstrated as I toured the classroom.

Two of the teachers (Teachers A and C), however, missed golden opportunities to further student thinking. Teacher A asked students why it was important to put only one thing in the test cells, but failed to carry the discussion to the reasons for multiple tests. Teacher C led an excellent discussion regarding different groups getting different results in yesterday's tests. In the discussion students reviewed indicators, talked about the importance of multiple tests and the need to verify results, and to analyze what might have gone wrong. They then critiqued some of their reasoning to uncover hidden pitfalls. Later in the class, however, she had one group disregard their data (this group, in fact, had the same data as other groups but both spoke up and interpreted the results differently AND their interpretation was accurate). She did this because she missed the big idea that in science results are not always a clear-cut yes or no and since the teacher assumed that peanuts did not have starch, she disregarded the data and in turn had students disregard it. In addition, when one group determined that the egg white showed a change when iodine was added for the starch test, the teacher accepted that the "change" was a reaction because she did not fully understand how to use the control. Teachers A and B both understood the purpose of the control and were able to lead students to the understanding. All of them wrestled with whether or not to "preteach the vocabulary of the unit."

Next Time

The basic structure of the kit trainings is what STEP-uP expects; that structure, however, was not followed in the Food Chemistry training. In the case of Food Chemistry, the trainers were not perfectly clear about what the major concepts were, nor were they able to tie each lesson to the conceptual understandings, nor did they emphasize the "how to's"

of each of the tests. When our district first began using kits, each trainer sat with STEP-uP's PIs to review components of the trainings and major concepts before they did their first training. As the kit trainings have become regionalized, there has been less quality control and as new kits have been added, an assumption was made that successful trainers would transfer their competencies to the new kit. Clearly, STEP-uP needs to provide more professional development for our kit trainers.

STEP-uP is planning a two-day retreat for all of our kit trainers. At this retreat they will do intensive work in the conceptual understandings of their kit and connect those to each lesson. They will plan and finalize the details of their next kit training with feedback from STEP-uP PIs, Project Coordinator, and Science Resource Teachers. The training format will be critiqued by the STEP-uP leadership for focus on conceptual understandings, modeling of the IDEA inquiry model, number and importance of specific lessons utilized, trainer understanding of embedded assessments, and thoroughness of materials management modeling.

As mentioned earlier STEP-uP has also added a 3-hour "lessons learned" session after the teaching of the kit. We anticipate that the kit trainers and SRTs who facilitate this session will learn additional pieces that should be included in kit training. In these follow-up sessions, teachers will have an opportunity to view the kit through a more experienced eye, and through a reemphasis on major conceptual understandings they will be able to seize those "golden opportunities" to further student learning.