Secondary Science Analysis: 2001-2002
Teacher Research Network
December 2002

CONTEXT

The context section of each profile includes the following information:

(1) *Teacher* – description of license (including source and type), background and experience, position held (distribution of teaching load, grade level, subjects taught), year of participation
(2) *School and Community* – description (urban/rural, public/private, etc.)
(3) *Class Observed* – description of students (number, gender, ethnicity, disabilities); course type (required/elective, grade level, frequency and class length, subject, team-taught, etc.); text or other curricular materials
(4) *Classroom* – physical layout (desk layout, computers, sinks, storage, etc.)
(5) *Instructional Resources* – perceived adequacy; include textbook and curriculum
(6) *Overview of Observed Lessons* – goals, type of class (lecture, activity, laboratory, etc.), where lesson fits into unit (paragraph detailing each lesson)
(7) *Researcher Information* – including relationship to teacher, number of observers/researchers, researcher's discipline areas as relates to class observed

1. Teachers: There were five teachers included in the secondary science analysis from the year 2002; three with 9-12 biology licenses, one with a 9-12 chemistry license, and one with a 9-12 physics license. All hold 5-8 general science licenses. Three teachers received their certification through a special 5th year program.

Pseudonym	License	School	Subjects Taught	Year of Teaching	Year in TRN Study	Class Observed – required or elective
Olaf Olson	5-8 general science; 9-12 chemistry	rural	earth science, physical science, chemistry, physics	third	third	8th grade earth science - required
Joe Shedd	* 5-8 general science; 9-12 life science	small town	7th grade earth science, 8th grade life science, advanced biology	second	* first	advanced biology – elective; 8th grade life science - required
Trisha E	* 5-8 general science; 9-12 physics 5th year certification	urban, private, college prep	8th grade general science, other preps?	first	second	8th grade general science - required
Marty M	5-8 general science; 9-12 life science; 5th year certification	urban, private college prep	biology, ?, ?	second	third	10th grade biology - required
Matt W	5-8 general science; 9-12 life science; 5th year certification	* small town, private, college prep	biology, anatomy	second	third	10th grade biology - required

** = assumed, but not explicitly reported by the researcher*

2. Schools and Communities: Two teachers teach in urban settings, two in small towns, and one in a very small town/rural school. Three teachers (urban and a small town) teach in private schools, while the other two are in public schools.
3. Classes Observed: All teachers had approximately 24 students in the observed class, except for Joe, who had 19 students. Nearly all students in all of the classes were Caucasian. Sex ratios were relatively equal except for Olaf's classroom (2/3 girls), and Joe's classroom (2/3 boys). All classes met once each day for approximately 45-50 minutes. Joe's life science class was a semester class, while all of the others were yearlong classes.
4. Classrooms: Conditions varied among these teachers' classrooms as follows:

Pseudonym	**Desk Layout**	**Lab**	**Sinks**	**Prep**	**Computers**	**Storage**
Olaf Olson	rows of single desks	yes – separate room	front of room and in lab	no	one for teacher	yes
Joe Shedd	rows of single desks	no	yes	yes	yes – five for students	yes
Trisha E	?	no	no	no	yes – separate room	limited
Marty M	?	no	yes	no	one for teacher	yes
Matt W	?	no	only in back office	no	one for teacher	yes

5. Instructional Resources: Matt and Marty have access to multimedia resources, however there are no statements mentioning these types of resources for the other teachers. All teachers have access to computers (with internet access assumed), with three having one designated for themselves, and the other two with computers available for their students.
6. Overview of Observed Lessons: An interesting note: four of the five teachers (all except Trisha) were engaged in a test review for at least one of their two lessons that were observed. This may be a coincidence, or perhaps there is a lot of testing going on in these classrooms.
7. Researcher Information: All researchers have had experience teaching science at the middle school and/or secondary level.

NOTE: Since there is so much variation in what actually "bubbles up" or stands out in each profile, I have decided to provide my own italicized sub-section headings underneath the standardized section headings to guide the reader in my identification of the most prominent points addressed and substantiated in the profiles of these five secondary science teachers.

I – KNOWING SCIENCE CONTENT

Important Content

Science Standards

Only one teacher, Joe, mentioned that he considers any science standards when selecting topics to teach his students. It was reported by the researcher that Joe is concerned about how the topics he chooses meet the Minnesota Graduation Standards primarily, and then the National Science Education Standards secondarily (STII). Olaf mentioned that he does think about what it is that all students should know about science and chooses the content he teaches based on:

> "…what I deem is sort of important, what I've been exposed to or hear or what I see in the news that I think every person should know in science. Those are the sort of things that I look at, then I decide what I should teach. There's also a book, I think it's called Literacy…Literacy for Adults book. So I go through that and make sure my kids understand the science aspects of that" (STII).

When directly questioned, Olaf said that science standards did not influence what he currently teaches, but they would in the future when his district will require certain Minnesota Graduation Standards to be met (STII). There was absolutely no mention of any science standards in Trisha's, Marty's, and Matt's profiles.

College Prep Curriculum

Two out of the three teachers who teach in private schools (Marty and Matt) were reported to have a college prep curriculum, with the subtle insinuation by the researcher, or perhaps the teachers themselves, that this is not necessarily congruent with standards-based science content, and is driven by exams (although I am not sure which ones – internal exams? AP exams? SAT II subject exams?). The researcher wrote in Matt's profile that his "primary concern as dictated by parents and administration is to prepare students for college, though he appears to have more confidence and support to try new things. He still feels responsible for the college prep curriculum." The other teacher at a private school, Trisha, does not seem to be tied down to any particular curriculum (profile).

Science as Inquiry

Olaf feels as though his students do not have as much opportunity to do scientific inquiry. On inquiry, he states:

> "That's something we're lacking. This year they were able to do more labs and I've been talking to a few teachers around in the area. There's a teacher in (a neighboring town) who does poster presentations and science are most of it. And I'm slowly getting…getting them to have more exposure and inquiry-based stuff" (STII).

Mr. Olson has felt frustrated when trying to have students write up scientific papers where they do their own research on a topic:

> "…they come up with a scientific question and try and solve it. I've tried that but it ends up being really tough 'cause their questions end up being a little more advanced than how they can find the information" (STII).

Yet Trisha seemed to have no problem having her 8th grade students ask questions about and research global warming topics in what sounded like an inquiry-based context (see Science and Math for All: Student Choice and Personal Relevance section). It was not evident that any of the other teachers thought much about science as inquiry in their teaching.

Science and Religion

One teacher at a private school (Marty) purposely incorporated Catholicism within his lesson on the origin of life for his 10th grade biology students, and "made numerous connections between science and religion" (profile). It was not reported whether the private school where he teaches is religiously affiliated and encourages this.

Accurate Content

None of the five profiles contained any evidence, or statements concerning inaccurate content being taught in the classroom, nor was there evidence that any of the teachers were concerned with their content background and understanding science topics that they teach. One possible exception to this generalization is that Trisha did use global warming and greenhouse effect interchangeably in her class (STOI).

Appropriate Content

See next section under Student Choice and Personal Relevance

Science and Math for All

Student Choice and Personal Relevance

There was indirect evidence (reported by the researcher but not always substantiated) in all of the profiles that the teachers attempt to consider topics that relate to their students' interests and current real world experiences. Yet for two teachers (Olaf and Joe), it was reported that their students do not necessarily agree with their teachers' perceptions of how relevant their science lessons are.

Olaf attempts to connect the concepts he is teaching with his students' lives:

> …Mr. Olson brought up some real world examples for the students – he mentioned that salt would not dissolve in gasoline so that's why it can ruin engines, and that Jell-O is a supersaturated solution (STOI – concept development lesson)…. Mr. Olson feels as though his lessons are personally relevant to his students (average of 4.75, Personal Relevance questions, CLES) while his students do not necessarily agree with him (average of 3.1, Personal Relevance questions, CLES).

Joe is concerned that "the topics be appropriate for the age level of the students" (STII). He does not specifically mention that the relevance of the topics is important to him, and there is a discrepancy between his perception (average of 4.75, Personal Relevance

questions, CLES) of their relevance an his students' perceptions (average of 3.75, Personal Relevance questions, CLES)

Trisha allowed her students to create a list of topics on climate to further research (STOI):

> …students came up with a list of research topics that interested them. Global warming was the main topic, and all the students jumped on the global warming bandwagon (profile).
>
> Trisha helped them divide into teams in preparation for doing further investigation on global warming in the computer lab (tomorrow). She told them that they would need to further focus their research efforts so that all groups weren't doing the same thing. She mentioned this would not be an issue. Home teams were established. These teams divided up into expert teams who prepared to return to their home teams to teach them the concepts they had learned. To assure key concepts were covered, she roamed the room during the preparation phase to add some guidance as needed. Very little was needed (profile).

In Matt's profile, it was reported that, "He felt it was particularly effective when they had some life experiences to draw upon, as they do within the subject of genetics" (STII). Matt also engaged his students in an activity that asks them to brainstorm characteristics of their immediate family and selves connected to characteristics discussed in our genetics unit (STOI).

Marty "understands the need to make science relevant and indicated that he tries to do so as frequently as possible, but that his primary concern is meeting their need to excel at the exams" (STII).

<u>Understanding of the Nature of Science and Math</u>

There is very little mentioned in the profiles on the teachers' understanding of the nature of science, or their attempts to incorporate the nature of science in their lessons. Only one (Olaf's profile) dealt with this topic in any depth at all, illustrating how Olaf finds it difficult to "do science" with his students and to integrate the nature of science into his lessons. Here is an excerpt from the profile:

> Mr. Olson definitely feels as though science is a way of looking at the world, but he seems to be at a loss as to how to get this idea across to his students:
>
> When I talk to people that have taken a lot of science in college, I can definitely tell cause they have sort of that analytical method to them that…looking at things a little differently. That's hard to tell my kids. We try to go over the scientific method, but things get a little confused and I think it's more…I think that's why some people gravitate toward science is because they see things or they've been exposed to that way of thinking and so they gravitate towards that, whereas if you're a child and maybe you don't have very analytical parents you might gravitate toward music (STII).
>
> When asked about facts, hypotheses, and theories, Mr. Olson mentioned, "he just kind of gives them (his students) a basic definition of each" (STII). There was no evidence that he explicitly models or incorporates these ideas into his science lessons, even the inquiry lesson (STOI – inquiry lesson). Yet, Mr. Olson feels as though he does address the nature of science in his classroom (average of 4.25,

Uncertainty questions, CLES) while his students generally do not agree with him (average of 3.4, Uncertainty questions, CLES).

One of Olaf's observed lessons was an inquiry-based activity, and he was aware of this and purposely designed it as such (STOI). Yet there was no evidence that he brought this open-ended lesson on pH indicators to any closure through the elaboration and application of these concepts.

The conspicuous absence of any statements and discussion about the nature of science with the other teachers is quite notable, since it is assumed that they were asked the same prompting questions during the interviews. Trisha was reported to have a good understanding of the nature of science, but there was scant evidence reported to substantiate this claim.

Curriculum Constraints and Decisions

Two of the three private school teachers feel constrained by the curriculum provided by the schools. They both expressed that they understand the need to make science relevant to their students, but that their primary concerns are with preparing students to do well on exams. The statements in their profiles reveal the distinct insinuation that the two are mutually exclusive (Marty's and Matt's profiles, STII, written by the same researcher).

The third private school teacher, Trisha, " feels much less constraint in matters of curriculum and instructional decisions than during her student teaching (which was in the same school) (STII). She feels empowered and supported by administration, students, and parents" (profile).

Other Constraints

Olaf did not mention any particular constraints, except for that "He did mention that grading was very time consuming and that he was "glad that the Supreme Court says it's OK that I can have other students grade other students' work. I don't want to get in trouble and when that ruling went through I was pretty happy. I try not to do it a lot, but it's tough. It's just a long time" (STII).

Joe did mention that he feels constrained by lack of money for lab supplies. He was also concerned with meeting Minnesota Graduation Standards, but does not necessarily view this concern as a constraint (see "Important Content" – *Science Standards* section).

II – KNOWING PEDAGOGY

Kinds of Activities

What is an "activity"?

Marty believes an activity is anything that gets the students actively engaged in science. Trisha believes activities are, "any physical, mental/emotional experience that helps kids get into a concept" (STII). Olaf defines activities as "lectures, labs, demonstrations" (STII). There were no reports or statements in the other two profiles about the teachers' perceptions of science activities.

Time spent in the classroom doing "activities"

Olaf stated that about 25-30% of class time is spent on activities. (profile). The amount of time allocated to activities was not reported in any of the other four profiles.

Example Activities

Out of the eleven total classroom observations (two per teacher, except for Joe who was observed three times), three lessons were "labs" where the students were investigating (Olaf) or observing (Joe). Four were group activities where the students worked in groups to research a topic (Trisha), or ask each other questions (Matt). The remaining four were lecture and whole class discussion and were preparations for upcoming exams.

It was reported that Joe has his advanced biology students do a number of projects throughout the school year such as:

> …maintaining fish that could be freshwater, brackish, or saltwater fish in aquaria for two months. They maintained plants, propagated, and did some garden designs. They conducted behavioral studies of some animals such as frogs, toads, salamanders, reptiles, and lizards. Lastly, they were going to do some chicken embryology. [post interview]

Joe also takes his 7th grade life science students on field trips to the school nature area, but it was not reported what they actually did during these field trips.

Appropriate Activities

Addressing Subject Matter

There was not sufficient evidence stated in any of the profiles of the *specific* subject matter teaching and learning objectives determined by the teachers. Yet in four of the profiles, researchers reported that they felt as though the teachers' did select appropriate activities to accomplish their learning objectives for their students. Olaf's profile did not include any statements on the appropriateness of the activities for the learning goals.

Motivating Students

Perhaps a more prominent point is that most of the teachers feel as though they know the kinds of activities that motivate their students such as relevant topics (see discussion in "Important Content" - Science and Math for All - *Student Choice and Personal Relevance* section), activities that allow them to go beyond their textbook ("My own kids don't learn as well when they are bored. Textbooks are boring" – Trisha's profile), and Olaf's observations that even the struggling students would get involved in trying to figure out what was happening when he did a demonstration for the class: "I remember

this one student who really struggled and really wasn't interested in the science and she got up and messed around with it (Cartesian diver) and gave it her best shot" (STII).

Olaf feels as though he knows what kinds of activities motivate his students, and states that anything that has color, explodes, fizzes, things that are exciting, that burn, these makes good activities (STII). He referred to the cabbage juice indicator as the "purple stuff" during the inquiry lesson, and it was clear how excited the students were to record the color changes as they added different substances to this indicator (STOI- inquiry lesson). Yet, several lines of evidence exist to point towards Olaf's inability to put these motivating activities into a standards-based context that allows for successful student-led investigation and application of scientific concepts. For example, the researcher reported in Olaf's profile that there was no evidence of any application of concepts "covered" in the observed lessons. When interviewed (and also noted in the observations), Olaf mentioned that there was little opportunity for students to engage in dialog with each other about the concepts they were studying. This was also supported by the teacher and student CLES 2(20) scores, which were low (around 2-2.5) for the Student Negotiation questions.

Kinds of Thinking Used/Classroom Discourse

All teachers used class discussions to some extent, although there was little evidence that Joe deliberately encouraged class discussions. The rest of the teachers incorporated small group and/or entire class discussions in their lessons (Marty and Matt - exam reviews). Olaf's acid and base lab encouraged lots of idea exchanges among group members, but he did not explicitly encourage this:

> During the inquiry lesson, the students were quite actively consulting each other and comparing their observations and results. This behavior was not explicitly encouraged, nor discouraged, by Mr. Olson (STOI – inquiry lesson). Whenever there was dialog between Mr. Olson and a student, whether in large class situation or in a small group in lab, Mr. Olson did not encourage dialog from specific students, but instead asked questions and waited for any student to respond (STOI – both lessons).

Trisha was the only teacher to explicitly plan for classroom discussion in her teaching. In one of her observed lessons, she asked her students for their input on a topic, allowed them time and freedom to research this topic, and then required them to share their findings with each other (see discussion in "Important Content" - Science and Math for All - *Student Choice and Personal Relevance* section).

Teacher's Roles in Class and Discourse

Two of the classrooms were specifically identified as teacher-centered (Olaf and Joe) by the researchers. (Analyst's Comment: Interestingly, these teachers are the two public school teachers. Yet the other three were 5th year certification students, and all observed by the same researcher. But these may be interesting ways to group profiles: private and public; 5th year certification and conventional undergraduate degree).

> The evidence indicates that Mr. Olson's class is largely a teacher-centered classroom. For the test review observation, Mr. Olson was the one initiating the content-related questions for his students (STOI - concept development lesson). He did start the class by having some groups record their

> data on the board, but pretty much ignored the rest of the class and responded directly to those groups up at the board (STOI - concept development lesson). Both Mr. Olson and his students agree that the students do not have many opportunities for dialog with each other about their science ideas (average of 2.25 for Mr. Olson and 2.2 for his students, Student Negotiation questions, CLES).
>
> In all the observations, it is clear that Joe teaches in a teacher directed manner. He had good rapport with the students so they seemed to feel free to ask questions and respond well to him.

Two teachers, Marty and Matt, seemed to have a combination of teacher-centered and student-centered classrooms, utilizing teacher-led lectures and whole class discussion, yet at times allowing students to converse in small groups about the subject matter at hand. The evidence reported in the profiles suggest that the activities observed were more on the teacher-centered side, yet the researcher mentioned that Matt and Marty both encourage student interactions in their classrooms:

> Marty appeared to support this type of discourse through cooperative learning strategies in class. These were loosely structured (STOI). In the STII he supported this observation mentioning that he felt students learned best from each other. Both classes observed utilized significant student interaction.
>
> My opinion, again as a person who knows this school, staff and student body well, is that Matt, while maintaining the college prep culture of the school, has enhanced the curriculum with more student-centered pedagogy (student/teacher generated rubrics, independent projects, informal and student assisted assessments, etc.), and established a very good rapport with students. This has made the class more enjoyable for students. This opinion is supported via the STII.

There was some concern by the researcher that Marty may be initiating some less-than-effective methods of creating a "student-centered" classroom that in fact make it teacher-driven:

> Off-task behavior was frequent (several off task discussions occurred, some involving Mm) during both lessons (STOI). When asked about classroom management Mm indicated that he had excellent kids that were very academically oriented. Mm socializes with the kids often (STOI). He believes it is essential to relieve the stress of the college prep atmosphere. Still, in my opinion, there was too much off-task behavior, much seemingly initiated by Mm.

Trisha's role in her classroom is strongly suggested to be that of a facilitator:

> Te engaged the students in several large and small group discussions in both lessons, with particular emphasis on small group interaction with her brief interventions (STOI). Her teacher verified that this was a common practice. Te utilized open-ended questions as to foster thinking (STII).

Olaf's profile was the only one that explicitly reported the teachers' own view of their role in the classroom. Olaf's confidence in his teaching abilities was fairly high (average of 1.62 for self-efficacy questions, STEBI). Yet he is uncertain whether student learning can be influenced by effective teaching (average of 3.10 for outcome expectancy questions, STEBI). Here is his description of his role that conveys his frustration and uncertainty:

> A whole lot of everything. I guess that's sort of one of the problems. Everything from therapist to counselor, parent, disciplinarian, run the whole gammet. Unfortunately I think sometimes that

> teaching is a little low on the totem pole. And there's all these other issues you have to deal with. Especially (his town). It's a very poor community. And a lot of kids have problems, and I have to remember that. But on the other hand it's like I want to teach science, that's what I went into it for. So that's the one thing I found really frustrating, is the situation that these kids come from and then they get…when they get to school they're not really ready to learn. And you see that throughout the state, but that's something that's hard to teach people who are going into teaching is all those other things that you have to deal with. It's not a choice, you have to deal with them (STII).

Assessments (variety and expectations)

Formal exams seem to be very important to Marty and Matt, due to the numerous references made by the researcher in their profiles. These exams were reported to drive the curriculum, the types of activities planned for students, and the allocation of time allotted to these activities. It was assumed by the researcher that these exams limited the teachers' ability to engage their students in relevant, student-centered learning. (Analyst's Comment: Is this a valid assumption? Or is it clouded by the researcher's perception?). Marty and Matt were both reported to also engage their students in numerous "informal and student-based/self assessment in class" that are "under the veil of the exams that are critical in this college prep environment".

Trisha was reported to employ:

> …a lot of informal and student-based/self assessment in class, particularly through projects like this one. She also has the students' journal on their learning. The formal assessment was rubric-based where students self-assess and are validated by Te. She uses a lot of informal assessment throughout her classes as observed in both lessons. She constantly is working with groups and individuals to help them with their efforts.

Olaf uses traditional forms of assessment (multiple choice and true/false exams, text problems, lab reports). He also uses observation to see if his students are "getting it". He attempted to have his students do research papers, but discarded this idea because he felt as thought they choose topics that were too difficult.

Joe was reported to use exams, homework, lab sheets, worksheets; and some projects for his advanced biology class. It was reported that he used open-ended questions on the worksheets given to his advanced biology students, but there was no evidence of these kinds of formative assessments in his other classes.

Has Student Learning Been Achieved?

(Analyst's Comment: It is nearly impossible for a researcher to tell if student learning has been achieved in the short time they are in the classroom for the two observations. Thus the researchers focused on whether the teacher has any awareness of whether their students accomplished the learning objectives that the teacher set out.)

The three private school teachers, Matt, Marty, and Trisha, were all satisfied with their students' progress and performance on their assessments. The researcher noted in each of their profiles that the students seemed interested and engaged (however, in Marty's profile, the researcher did comment that, "Students seem lackadaisical in their attendance to the lesson, though their answers indicated that they were ready for the test.") Trisha, especially, reported that her students were enthusiastic about their global warming

projects, and frequently worked with her during study times before and after school. One could assume that Joe is aware of how well his students do since he collects homework and lab sheets to be returned the next day in class. There was some doubt insinuated by the researcher whether Olaf's method of informally checking with students to see if they "get it" is effective:

> During the test review, he asked factual questions that required one-word answers for the most part. He went on if he heard anyone from the class give the correct answer. (STOI – concept development lesson)

External Resources

The use of computers and the internet were mentioned by all of the teachers. Olaf and Trisha mentioned that they consider other teachers as important resources. Interestingly, no one was reported to be concerned about lack of resources for their classrooms.

III – KNOWING STUDENTS

Appropriate to Students

It was reported that Matt and Trisha all had high student scores (4.2 and "well above average") on the personal relevancy questions from the CLES 2(20), and the researcher concurred with this by observing high levels of student engagement. Joe and Olaf had lower student scores (3.7 and 3.1, respectively). They perceive their science classes to be more relevant (both Joe's and Olaf's averages were 4.75 - Personal Relevance questions) than their students perceive them to be. Marty's students' score was reported to be 3.6, and the researcher reported that the "material appeared to be meaningful and relevant to most students in the class".

It was mentioned explicitly that Joe and Matt had very good rapport with and concern for their students.

Students' Roles in the Classroom and Discourse

There are several lines of observed and reported evidence that Trisha and Matt purposefully cultivate environments that encourage student discourse about their science learning. It was reported in Matt's profile that he employs "student-centered pedagogy (student/teacher generated rubrics, independent projects, informal and student assisted assessments, etc) " Trisha was reported to have "engaged the students in several large and small group discussions in both lessons, with particular emphasis on small group interaction with her brief interventions (STOI). Olaf thinks he does (average of 4.75, Critical Voice questions, CLES2(20)), but his students do not agree (average of 2.8, Critical Voice questions, CLES2(20)). Joe's "Critical Voice" scores are high and match those of his students, indicating that they feel as though they do "have a say" in their science classes (Joe's average was 5.0 while his students' was 4.4). It is not clear from Marty's profile what the norm for student interaction is, or how they feel about their role in the classroom. There were some references made by the researcher to off-task behavior, yet there were other comments on how engaged the students were.

Management of Social Aspects and Behavior

Considerable off-task behavior by the students was mentioned specifically in Olaf's and Marty's class observations, and small isolated behavioral problems were mentioned in

Joe's and Matt's class observations. There were no indications of any problems in Trisha's classroom. In fact, she had recently been named the associate principal for her middle school.

Olaf expressed extreme frustration at the social aspects of his students that he feels really get in the way of teaching and learning. Refer to quote from "Knowing Pedagogy" - Teacher's Role in Class and Discourse.

IV – ESTABLISHING AN ENVIRONMENT

Management of Physical Facilities and Resources

There were few notable statements in any of the profiles regarding any concerns about the teachers' use of the facilities, or any concerns they had with their facilities and resources except for the following:

Joe's students needed to wait to observe some of the slides because there were not enough to go around. Joe also obtained free flowers for his flower dissection lab to keep materials costs down since budgets were tight.

Matt's room was described as a "busy room with lots going on and being exhibited. They are allowed a great amount of freedom and responsibility, and it appears to work for the majority of the kids. The room appears safe."

In Olaf's classroom: "The pH lab went quite smoothly. All of the supplies were organized and put out for students to readily gather. The groups had been selected ahead of time and written down on post-it notes in the lab. The students helped each other and cleaned up very well. Time did not appear to be a factor at all in this lesson (STOI – inquiry lesson)."

Ensures Physical Safety in the Classroom

Olaf did mention some safety concerns to his students before they did their pH lab, but the students were not required to wear goggles when perhaps they should have been.

Joe does an entire unit on lab safety, had his students sign a safety contract, and also instructed students on safety matters before doing the flower dissection lab.

There was little information on safety reported in Trisha's, Matt's, and Marty's profiles, other than the fact that there were no safety concerns. All rooms, except for Trisha's had emergency showers or eye washes.

V – DEVELOPING AS A TEACHER

Self-Reflection on Teaching

Olaf did not turn in either of the post-observation forms, so there is no evidence about any self-reflection regarding the specific lessons observed, and little evidence came forth in the interview. He did mention, however, that he is trying to find time to visit area teachers to get some ideas for his classes (STII).

Matt, Marty, and Trisha described themselves as “very reflective”, but there is little evidence to actually support this assertion in the profiles. It was reported in their profiles that they all profess to examine their teaching and make improvements in the lessons based on their experiences.

It was reported in the profile that Joe was making strides in the timing of his hands-on activities and was actively thinking about ways to modify his lessons.

Professional Development Opportunities

All of the teachers reported to have been or will be involved in some sort of extra effort that will further their development as a professional science teacher:

- Olaf and Trisha will be working curriculum revision and/or development in their districts/schools this summer.

- Marty worked on curriculum development as part of a “prestigious summer fellowship to Princeton for biology teachers”, and is now considering beginning doctoral studies in science education.

- Matt and Joe mentioned their participation in science teacher workshops.

- Olaf, Trisha, and Matt belong to regional and/or national science education organizations, but there were no statements in their profiles regarding the advantages to these memberships for Olaf and Trisha. Matt commented that he regularly gets ideas from his membership subscription.

Resources, Support Communities, and Learning Communities

All of the teachers mentioned at some point that other teachers were helpful resources for them. Some of them mentioned their departments (Matt, Joe, Marty), while others looked outside their departments for support. Olaf still keeps in touch with his student teaching cooperating teacher and is making efforts to visit with science teachers in neighboring district when there is time. Trisha has considerable support from her principal and the parents, but feels as though her colleagues were initially “cool” to her, but are coming around.

The teachers varied on the relative contributions of different aspects of their backgrounds to their development as a science teacher. It is interesting they all omitted their science methods courses, and they also placed their certification programs lower on the list. Student teaching experiences, and their actual teaching jobs seem to be fairly influential. Here is each of their lists in order from the most influential to the least:

- Olaf – college science courses (not methods), student teaching, teaching assistant for college course, teaching English in Taiwan

- Trisha – life experiences, professional experiences, 5th year certification program, student teaching and parenting experience (tied)

- Matt – first year of teaching experience and undergrad science courses (tied), experience as a student, 5th year certification program and outside school experiences (tied)

- Marty – student teaching, research (science ed?) and school curriculum and volunteer experience (tied), family

- Joe – no information available from the profile.

Generalizations, impressions, and comments from the analyst:

Knowing Science Content

- Science standards (whether national or state) do not have much influence on the topics selected. Perhaps this is because 3 out of the 5 teachers were teaching in private schools. Yet their methods classes most likely focused on implementing standards in the classroom.
- Having students "do science" in an inquiry-based manner and making explicit the nature of science was collectively not a top priority of the teachers, although it appears that Trisha's classroom probably comes close.
- Doing well on exams seems to be a high priority among some of these teachers – again in the private schools mainly.
- All of the teachers strive to find topics that are relevant to their students' interest and age level, although their degree of success varies.
- Some teachers felt constraints were placed on their choice of curriculum due to the school's emphasis on exams. I wonder why they feel that relevant science topics and exam-oriented curricula are mutually exclusive? (I am concerned about a researcher bias concerning this point.)

Knowing Pedagogy

- Over 1/3 of the class observations were reviews for exams. Perhaps the classroom observations were skewed more towards the end a semester. Alternatively this suggests that a lot of time is spent preparing for and taking exams in secondary science classes.
- Projects were mentioned fleetingly in several of the profiles, but only one made it clear that a long-term research project was taken seriously as a form of assessment, complete with rubrics and presentations.
- Classroom discussions were frequently mentioned, but it was not clear that these discussions were carefully planned by the teachers, (with the exception of the long-term project mentioned above). It sounds as though a lot of "teaching on the fly" happens in these teachers' classrooms, under the loose guise of cooperative learning.
- Only one teacher consistently displayed evidence that he/she maintains a student-centered classroom.
- None of the teachers were concerned about their level of science knowledge and backgrounds and the accuracy of the topics and concepts they teach.
- Formal assessments are viewed as important by most of the teachers, and most mentioned that they use informal assessments as well, but the types were not specified.
- All teachers mentioned that they use the internet in their teaching – some very frequently. It was not made clear how they used the internet, whether it is to find ideas for activities, background information, etc.

Knowing Students

- Some classes viewed their science topics as personally relevant, whereas others largely did not feel that way. Most importantly, some teachers did not recognize that their students do not regard their science classes as relevant.
- The classes with the most off-task behavior were the same classes where there is a mismatch of teacher and student perceptions regarding the relevance of topics, and the opportunities for students to have a voice in their science classroom. The only classroom with no reports of any off-task behavior was the classroom that I regard as student-centered.
- Only one teacher was distressed about the social conditions and culture of his students and how this seems to interfere with his/her teaching and their learning.

Establishing an Environment

- None of the teachers were concerned about their physical facilities and/or resources.

Developing as a Teacher

- Most teachers described themselves as very reflective, but there was little evidence reported as to how they actually reflect on their teaching.
- All of the teachers have been or will be involved in some sort of extra effort that will further their development as a professional science teacher.
- All of the teachers mentioned at some point that other teachers were helpful resources for them.
- All teachers omitted their science methods courses, and they also placed their certification programs lower on the list of factors that influenced their development as a science teacher. All teachers placed their student teaching experiences, and their actual teaching jobs relatively high on this list.
- None of these teachers mentioned anything about learning from their students.

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Reviewed by Teresa Shume (January, 2003)
Revised by Alison Wallace (March, 2003)