Teacher Research Network
Secondary Science Profile Analysis
2000-2001

CONTEXT

Ten participants were involved in this year's study. Two (Kk and Te) were student teachers; five (Mm, Bd, Mw, Erica, and Bh) were first-year teachers; three (Olaf, Lars, and Ms) were second-year teachers.

The two student teachers were both completing a 5th-year certification program. One majored in life science, while the other majored in physics and minored in chemistry. Both were observed student teaching in general-science courses, one in 7th-grade and the other in 9th grade.

Four of the five first-year teachers held undergraduate degrees majoring in biology and were observed teaching 10th-grade biology. All four held a 5-12 life science license; two of these four also held a 5-8 general science endorsement.
The fifth first-year participant held a degree in social science and had a K-8 license that included a 5-8 general science, and a social studies endorsement; she was observed teaching 7/8th-grade general science. Four of the first-year teachers had graduated from a fifth-year certification program in 1999-2000.

The three other study participants were second-year teachers. One held a 5-12 license that included a 5-8 endorsement in general science; he was observed teaching 9th-grade general science. He had graduated from a fifth-year certification program in 1998-1999. One held two undergraduate degrees: a B.A. in Biology and a B.S. in Life Science teaching, a combination resulting in about 200 undergraduate semester hours of study; he was observed teaching 7th-grade life science. The other held an undergraduate degree in physics and was observed teaching 9th-grade physical science.

Five of the participants taught in urban centers while the other five taught in rural areas. Six taught at public schools, while three taught at college-prep private schools and one taught at a charter school that used an open/thematic concept. None of the profiles indicated significant diversity was present in any of the classes observed. Almost all participants were in their mid-to-late twenties, and one was in her mid-thirties.

KNOWING SCIENCE CONTENT

The category of science content is divided into four components: (a) opportunities for students to understand important, accurate, and appropriate content, (b) science for all students, (c) opportunities for students to understand the nature of science, and (d) curriculum constraints and decisions.

(a) Opportunities for Students to Understand Important, Accurate, and Appropriate Content

Prerequisite to opportunities for students to understand important, accurate, and appropriate content is the teacher's own sophistication of content knowledge. Concerns about the need to develop further content knowledge arose with both student teachers (Kk and Te). Te was concerned that some of her content knowledge was out of date, but both she and her cooperating teacher were pleased with the efforts and progress she was making in this regard. Kk appeared to have marginal understanding of the types of general-science topics she was encountering in the 9th-grade curriculum, however Kk had no problem referring students to outside sources for questions she could not answer.

The first-year teachers (Mm, Bd, Mw, and Erica) appeared to possess solid content knowledge pertaining to the lessons they taught with the exception of Bh whose understanding of science, particularly Earth Science, was described as "marginal". Bh was teaching 7th/8th-grade general science and held an undergraduate degree in social science with honors and a science endorsement on her K-8 license

The three second-year teachers in this year's study appeared to have a strong command of their content. In both lessons observed, Ms appeared to be comfortable answering student questions regarding content. In his interview, Ms described his extensive efforts to research the topic of propulsion on the Internet and by reviewing a conceptual physics textbook he had purchased the previous summer; Ms estimated his preparation time for this unit to be 30 hours of outside effort. While one unexplained inaccuracy arose in one of Olaf's lessons, he had high praises for his university science coursework in his interview, stating, "...they've served me extraordinarily well. The one nice thing is a lot of the teachers that I know feel that they don't know the information well enough to teach it. I know it backwards and forwards coming from this university and the science program." This confidence was reflected on Olaf's STEBI survey responses as well. Finally, Lars demonstrated a sophisticated knowledge of middle-school science content when he was readily able to identify common student misconceptions and could position his science curriculum within the larger context of the school's curriculum more readily than in previous years of this study.

(b) Science for All Students

A major component of bringing science to all students is the ability to foster connections to students' lives and interests, thus making content more relevant and meaningful. Six teachers (Kk, Te, Bh, Lars, Bd, Ms) appeared to focus successfully on making learning meaningful for all students. For example, the cooperating teachers of Kk and Te both commented on the significant focus Kk and Te placed on making science meaningful to students. Bd, a first-year teacher, drew on current events during both lessons observed and indicated he used current events as much as possible in his classes during his interview. During one of his lessons, he presented an actual dilemma about cloning encountered by a genetic scientist only one year earlier; the researcher noted that students were clearly torn as to how they would respond to such a serious, personal and professional challenge.

The other four teachers appeared to be less effective at making science relevant and meaningful to all students. The CLES-20 surveys indicated that Erica and her students agreed that in her class there is seldom a connection between the world and what she teaches. Olaf, on the other hand, was confident that he frequently made the science he teaches personally relevant to his students, averaging a score of 5.0 ("almost always") on questions 1-4 on the CLES-20 survey, while his students strongly disagreed with an average score of 2.1 ("seldom") on the CLES-20 survey. The other two teachers, Mw and Mm, may not have been seeking to make science relevant to the daily lives of all students because they may have perceived the school's heavy focus on college preparation to exempt them from the necessity of making science relevant to all students.

Not surprisingly, in four cases there appeared to be some correlation between the school's focus and individual teachers' approaches to the issue of science for all students. For example, Bh works at a community-based charter school where meaningful learning is a central tenet of their mission; it is not surprising that observations of her teaching yielded repeated evidence for such an approach. Ms indicated his new principal was exceptionally supportive of the type of teaching philosophy Ms proposed: getting kids actively engaged in the process of science by posing engaging questions and problems for them to solve under his guidance. He too held science for all as a primary goal of his teaching. Conversely, Mw and Mm taught at schools that were solidly college prep and their commitment to making science accessible to all students was questioned by the researcher.

(c) Opportunities for Students to Understand the Nature of Science

Some participants appeared to struggle with their own understanding of the nature of science. Bh, for example, indicated that everyone was a scientist when questioned about the nature of science during her interview, but she had difficulty elaborating on exactly what that meant. She alluded to the scientific method and the need to search for solutions to problems, but when asked what she thought science was, she indicated that she was not exactly certain. Erica's definition of fact, theory, and hypothesis described during her interview was described as "elementary" by the researcher. She defined fact as something to look up or something testable. A theory was a

hypothesis that has been proved time and again to be true. A hypothesis was an educated guess. (MnSTII)

Other teachers were deemed to have held richer understandings of the nature of science, but the evidence available from the profiles was limited. Te saw the nature of science for 7th graders as a way of looking at the world around them that helps them to make sense of it (MnSTII). Kk indicated, "Science is a way of looking at the world, its organization, processes, systems, and structures. As a science teacher I must help students get a better understanding of these systems and their complexity and how these systems interact within themselves and with other systems." (MnSTII)

In terms of providing opportunities for students to understand the nature of science, the data in the profiles were, again, limited. The clearest example of this component came from the profile of Olaf Olson. Based on his CLES-20 survey (average 4.8 for questions 5-8, CLES-20) and his interview, Olaf felt that he communicated the nature of science to his students. However, his students did not agree that these aspects of science were present in their classroom (average 2.2 for questions 5-8, CLES-20), and by Olaf's own admission, his students had little opportunity to actually do science (MnSTII and STOI). Like Olaf, Erica's students reported that only sometimes do students learn that science only provides some answers to questions asked; that science changes over time; and that science is a way to ask questions and seek answers (CLES-20).

(d) Curriculum Constraints and Decisions

All teachers in this year's study, except Bh, used a textbook to teach. Seven teachers used the textbook as the basis for the course (Bd, Olaf, Ms, Mw, Mm, Te, Kk). Lars based his curriculum on a combination of the textbook and the significant portion of materials he created himself (STII). Erica, on the other hand, reported that she had no tools to use to decide what was important content for the sophomore biology class she was teaching. She, therefore, used notes and her memory of her sophomore biology class when she was a high-school student. (MnSTII).

Bh was the only teacher who did not use a textbook at all. She was also the only teacher employed by a charter school that used an open / thematic concept; she was the 7th / 8th-grade teacher for the school, teaching all subjects. Bh relied heavily on outside sources such as speakers, and local community members with expertise in environmental science (MnSTOI, MnSTII). Indeed both of her observations revolved around a stream study with the local Department of Natural Resources.

Teachers in this year's study indicated a variety of levels of constraint on their curriculum. Four teachers indicated they felt little to no constraint in matters of curriculum decisions (Olaf, Ms, Bh, Kk), with the exception of the limited content knowledge for two (Bh, Kk). Three teachers (Bd, Mw, and Mm) felt somewhat constrained by the curriculum provided to them by their schools, while Te, a student teacher, indicated significant constraint in matter of curriculum and instruction from her master teacher.

KNOWING PEDAGOGY

This category is divided into five sections: (a) Kinds and appropriateness of activities, (b) Kinds of thinking used / classroom discourse, (c) teacher's role in class and discourse, (d) assessment, and (e) external resources.

(a) Kinds and Appropriateness of Activities

The teachers in this year's study used a variety of learning activities. Seven teachers indicated in their interviews that they used cooperative learning or group work (Bd, Lars, Kk. Mw, Te, Mm, Ms). While many (Kk, Mw, Te, Mm, Ms, Lars) were effective in their usage of cooperative learning (MnSTOI), two (Bd, and to a lesser extent Kk) appeared to have some difficulty arising from classroom-management problems (MnSTOI). Bd experienced discipline problems during cooperative learning that hampered student learning (MnSTOI), while Kk expressed concern about classroom management during cooperative-learning activities (MnSTII) and was becoming more effective at classroom management (MnSTOI). Mw and Mm expressed some concern about

using cooperative-learning activities and group work because of parental and administrative expectations about exam results. In contrast, Ms experienced significant positive feedback from students and parents after using cooperative learning and other creative ways to engage students in lessons.

Other learning activities that were identified during observations or described in interviews included field trips (Bh), stations (Bd, Lars), independent student projects (Mw, Mm, Ms), Y-charts (Bd), and labs (Erica). Two profiles indicated that students spent a significant amount of time in passive roles. Olaf stated that the ratio of seatwork / lecture to lab activities is "unfortunately about 100 to 1 easy. 1000 to 1" (MnSTII) and Erica indicated she lectures about 60% of the time (MnSTII).

Two of the profiles provided definitions of what constituted an activity for the teachers. Bh indicated that an activity "is anything that students do that gets them actively involved with science" (MnSTII). Te appeared to hold a highly inclusive definition, indicating that textbook reading was an activity if done at appropriate times in small bits to help develop a concept (MnSTII).

(b) Kinds of Thinking Used/Classroom Discourse

In several of the classrooms observed, discourse emerged that explicitly empowered students to express their ideas, understandings, and opinions (Mw, Kk, Bh, Lars, Ms). When asked in his interview about the role of discussion in class, Mw answered, "I want them to have an opportunity to share what they know. I know from personal experience that I learn best when I have the chance to share my thoughts. I want kids to feel comfortable doing so in my classes." Mw did this in both lessons observed (MnSTOI). Kk attempted to engage her students in class discussion and brainstorming. After clarifying her expectations about student involvement and prompting the class three times to participant using leading questions, the students began to open up (MnSTOI). Te engaged students in several large- and small-group discussions in both lessons observed (MnSTOI). Bh and Lars invited students to think critically and express their personal opinions about ethical issues (MnSTOI, MnSTII). These beginning teachers (Mw, Kk, Bh, Lars, Ms) were successful with the techniques they employed to engage students.

At least two of the profiles provided evidence that teachers were actively fostering an environment conducive to the kind of emotional risk-taking involved in meaningful learning. Twice during one of his observations, Ms asked open-ended questions related to propulsion and why things "go", then had each student write down their thoughts on the question before sharing with their neighbor or eventually with the large group (MnSTOI). When asked why during his interview, he said some students would not even try to explain in a large group unless they had an opportunity to respond to themselves first. Lars, too, showed sensitivity to such needs through expectations he establishes early in the semester, "You don't have to like the person sitting next to you, but you do have to respect them" (MnSTII) and by defending students should they be criticized for asking questions (MnSTII).

Three teachers expressed a desire to strike a balance between student-centered and teacher-centered approaches. In these classrooms, students do have a voice, but the teacher provides clear parameters and structure within which students operate. Lars aimed to establish such a balance in his teaching. The inquiry that unfolded in his classroom was quite structured and guided carefully by the teacher (MnSTII, MnSTOI). He implemented numerous hands-on activities for his students, but still lectured regularly. Likewise, Mm valued a balanced approach. In his interview, Mm recalled a video he saw in graduate school that described research comparing traditionally taught biology courses and constructivist-based biology courses at the college level. He indicated that a combination of the two approaches worked best, especially for a college-prep school. The third teacher, Erica, may present more of a dichotomy than a balance. Erica's students seldom asked for clarification of ideas raised by the teacher in class or expressed concern about anything that gets in the way of their learning biology (CLES2(20)) Conversely, she and her students agreed that the students do often help her plan what they are going to learn and what activities work for them (CLES2-20)).

A number of the teachers in this year's study indicated a desire to challenge students to think critically and to engage in meaningful discussion, as opposed to focusing primarily on memorization. These intentions, however, met with mixed levels of success. For example, in Bd's classroom, higher-order thinking was observed in small groups during discussions on ethical issues related to cloning (MnSTOI). His interview confirmed that one of his goals was to promote this kind of thinking. Classroom-management issues, however, lessened his effectiveness (MnSTOI) Lars, too, indicated that he aimed to train his students to be thinkers, and not just to memorize (MnSTII). Olaf also recognized the value of critical thinking; in his interview he stated, "They [students] always say, 'What are we supposed to memorize? What are we supposed to memorize?' And it doesn't work that way...I try to install that sort of critical reasoning, scientific method of looking at things." (MnSTII) However, it was clear that Olaf's efforts met with limited success in this regard. In particular, Olaf shared his frustration about designing inquiry activities. "I don't know how to produce...something that would help them with science inquiry. That's really hard. I mean I've tried it and it's just failed really bad." (MnSTII) He also indicated that that elements that result in an engaging class discussion elude him and while compelling class discussions spontaneously arise on occasion, "other days it's plug and chug". (MnSTII)

(c) Teacher's Role in Class and Discourse

Five of the teachers in this year's study indicated that their role in the classroom was to facilitate learning in a supportive role, as opposed to dispensing knowledge for students to collect (Ms, Mw, Mm, Lars, Bh).

For example, in their interviews both Mw and Mm indicated that they felt that students learned best from each other, and that their role was to help students get to the point where they could effectively interact with each other on topics (MnSTII). Lars and Ms also described their role as facilitators of learning (MnSTII). Bh devoted a significant amount of time and energy towards coordination of outside resources and contact people, as well as to planning for field trips (MnSTII, MnSTOI). She was committed to initiating learning in authentic contexts as much as possible, and even commented, "It would be a heck of a lot easier just doing a chapter in a text." (MnSTII)

Three teachers (Kk, Te, Bd) appeared to take on a role congruent with facilitator of learning, but specific evidence is less than clear in their profiles. All three of these teachers took on an active role in classroom discourse and valued student interaction during lessons (MnSTOI).

The two remaining teachers brought different perspectives on their role in the classroom. Erica saw her role as teacher to be more controlling than collaborative with students. And Olaf, a second year teacher, was still struggling to clarify his own understanding of his role as teacher. As he wrestled with tension between various roles, he was focused on level of engagement and motivation of students; concern about guiding student towards deep understanding of key science concepts was conspicuously absent from his perspective. In his interview, he stated,

> "Lately I've been getting a little down on the profession so I feel a little bit more like a babysitter than anything. But I don't know. Defining that [his role] is really tough. Sometimes I think of myself as just the person who exposes them to certain knowledge and that's one way. Other times I feel like I am a babysitter. Other times I feel like the teacher is meant to be there as a counselor. So it really depends on the day. Ideal days it would be someone that leads a discussion in science. That would be ideal. Those are the days that are the most fun for me...I think they have learned even more but again it's that energy level is really high, they're all on topic, it's really interesting and they want to know something about it. It's just one of those serendipitous, magical moments." (MnSTII)

(d) Assessment

Most of the teachers used informal and student-based / self assessment in class (Mm, Bh, Mw, Kk, Te, Bd, Ms). Te had students journal on their learning; for example, she had students journal for three minutes on how the systems of the body function together. Ms also used journals as an assessment tool. Of note is that Bd's effectiveness was limited in this regard due to classroom

management issues (MnSTOI, MnSTII). If and how these teachers used the results of informal assessment to tailor instruction and curriculum to specific student needs was, unfortunately, unclear.

In terms of grade-related (summative) assessment, all of the teachers used formal tests as one of the measures of student learning. Erica used traditional summative assessment instruments such as chapter tests made up of multiple choice and essay questions, as well as some quizzes. Olaf also used end-of chapter tests and quizzes, indicating his reasons for these methods were that they were "easy and fast" (MnSTOI post-interview). Four teachers used alternative assessments, but still relied on formal tests because of expectations stemming from teaching at a college prep school (Mm, Mw, Kk, Te). Lars based student grades on assessment tools such as Minnesota graduation standards performance packages, scantron / multiple-choice tests, worksheets, and practical lab tests. Ms and Bh also gave occasional tests, but their weight towards final grades was limited, for example, not more than 30% of a student's final grade in Ms' classroom.

Two teachers indicated a very limited use of findings from student assessment to alter up-coming curriculum and instruction. Lars and Olaf both referred to minor adjustments to planned curriculum, although it was clear that the primary purpose of student assessment was to assign grades (MnSTII). Whether the other teachers in this years study used grade-related assessments to tailor curriculum and instruction was unclear from the profiles.

(e) External Resources

The teachers used a variety of external resources in their classrooms. Kk, Ms, and Te used the Internet regularly for ideas or to find teaching materials. Seven teachers (Ms, Mw, Kk, Mm, Te, Bh, Lars) had access to computer labs, many of which could be used for virtual dissections or computer simulations. Ms, Mm, and Mr. Erickson had easy access to a television and VCR unit, while Mw had access to exceptional audiovisual technology, including a built-in LCD to show videos and make PowerPoint presentations. Olaf brought in current news items and articles for students to consider (MnSTOI, MnSTII). Others relied on people such as master teachers, other teachers, peers in the masters program (Kk, Te), and local community experts (Bh).

KNOWING STUDENTS

(a) Appropriate to Students

Material selected by all teachers except one (Olaf) appeared to be meaningful and relevant to most students in class. For example, while lecturing on amphibians, Erica used several agricultural analogies (MnSTOI). She later reported that she was aware that many of her students lived and worked on family dairy or horse farms (MnSTII). CLES2(20) scores on questions about relevancy are also an indicator of appropriateness of instructional materials selected; scores were average or above average on the relevancy questions for Bh, Mm, Ms, Bd, and Mw.

Mw and Lars were singled out as being particularly successful in this regard. Mw, while maintaining the college prep culture of his school, had enhanced his 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 made the class more meaningful to students.

Lars also took a variety of steps to ensure material was appropriate to students. He organized his curriculum to begin with a starting point accessible to most students: food webs. He explained,

> "Life Science tends to start out with cells...which make sense because everything is cells and you go up from there. But kids don't understand cells. They don't understand that's not a cell and a single microscope thing to them isn't alive, it's not a living thing. So I flip flop. I start with food webs. Sort of big picture things." (MnSTII)

Lars selected instructional materials such as science articles, "Eye Witness" videos, and a computer simulation about crosses between fabled dragons because he knows his students were "not really that interested yet in stuff out of a textbook. So it [subject

matter] needs to be very right there, they can see it." (MnSTII) He also indicated that junior high students tend be social and instead of squelching that characteristic, he exploited it thorough the regular use of group work. (MnSTII). In these ways, Lars ensured curriculum and instruction were appropriate to his students.

Olaf, on the other hand, struggled in this area. While he considered himself successful in linking science to the world of his students (CLES2(20)), he seemed confused about what he should do (contents, methods, anything) to connect more with his students (MnSTOI, MnSTII). He mentioned in his interview that female students were not as interested in certain topics (i.e. combustion engines) as his male students, but there was no evidence that he actively tried to connect with these female students on this or other topics (MnSTOI).

(b) Students' Roles in Class and Discourse

Teachers' expectations of student roles in class and discourse were essentially congruent with their views of the teacher's role and discourse observed in the classrooms. No notable contradictions were found in the profiles.

Two of the teachers described part of their students' role as developing skills used by professional in scientific domains. Ms wanted his students to "be scientists". He believed that all people were born amateur scientists and should approach the world accordingly (MnSTII). Lars sought to provide his life science students opportunities to develop skills of the classical naturalist: observation, classification, naming local plants and animals. He viewed being good observers as part of the students' role in his classroom (MnSTII, MnSTOI).

Another role mentioned by Lars was that of learning to become effective students. Part of their role in the classroom is to learn to arrive for class prepared, to take notes, to turn assignments in on time, and other such skills (MnSTII).

(c) Management of Social Aspects and Behavior

Five of the teachers (Mm, Ms, Mw, Erica, Lars) seemed to manage the class well. Off-task behavior was infrequent during both lessons observed for these teachers (MnSTOI). Mw, for example, used humor appropriately and appeared to know what students were doing outside of class (MnSTOI). His ability to connect with his students appeared to be a contributing factor to his success in terms of classroom management. Erica reported few problems with student behavior (MnSTII) and none were observed (MnSTOI). Lars had created an orderly yet appropriately flexible social environment for his students through clear directions to students (MnSTOI), useful questions accompanied by appropriate wait times (MnSTOI), and succinct classroom rules (MnSTOI).

Some teachers (Bh, Te, Kk, Ms) were actively working towards making improvements in this aspect of their teaching. Both Bh and Ms were working towards making their lessons more engaging (MnSTII). While Te's master teacher indicated that she had excellent respect and control of the classroom, Te indicated she felt she was improving in this area (MnSTII, MnSTOI pre-observation interview). As for Kk, there were some behavioral problems in her classroom, but this has improved steadily according to Kk (MnSTII), her master teachers, and through several observations (MnSTOI).

Bd struggled with classroom management issues. Many off-task behaviors were observed, particularly during one of the lessons (MnSTOI). In his interview, Bd indicated that he did not perceive this to be as serious an issue as the researcher perceived it to be. He was optimistic and indicated he would work harder to find better activities to engage the students (MnSTII). Like Bd, Olaf appeared to underestimate the magnitude of the classroom management problems occurring in his classroom. He tended to let his students work in their own groups and did not interfere unless he needed to (MnSTII). However, during the observed lessons, some students were not in any group and thus were not actively engaged in learning (MnSTOI). Further, while Olaf felt he always gave opportunities for students to communicate their ideas (average 4.8 on

questions 17-20 of CLES2(20)), his students did not share this perspective (average 2.2 on questions 17-20 of CLES2(20)).

Two teachers discussed sources of frustration pertaining to classroom management issues. Mm indicated some students were very academically oriented and too focused on what would be on the test. If Mm could not make the connections for them, they sometimes became rude. And Bh was faced with some special challenges at a fledgling charter school that was heavily dependent on building and retaining student enrollment. Bh indicated she felt conflicted when dealing with difficult students, knowing that the school needed their enrollment (MnSTII). Further, lack of funding (related to low enrollment) resulted in no full-time principal to assist when a situation reached its boiling point (MnSTII). Bh also indicated that she was concerned about managing her class during fieldtrips; she had implemented six by the early spring of the school year (MnSTII).

ESTABLISHING AN ENVIRONMENT

The category on establishing an environment is divided into two areas: (a) management of physical facilities and resources (b) ensures physical safety in classroom.

(a) Management of Physical Facilities and Resources

For the two student teachers (Kk, Te), management of physical facilities and resources was not yet an issue. As for the in-service teachers, some had adequate space and equipment (Mm, Mw, Erica, Lars, Bh). Mm and Mw had ample teaching space (approximately 1200 square feet for 25 students) as well as office and storage space adjoining the classrooms. These supplementary spaces were managed and kept well organized by their supervisors (dean or department head). Erica, in turn, had a well-designed and well-equipped classroom / laboratory (MnSTOI). And while Lars had limited teaching space for the number of students per class, he appeared to have adequate access to needed equipment such as microscopes and computers. Bh seemed to have access to necessary equipment, materials, and space, however at times she felt overwhelmed with the high demands of managing these resources with little to no support.

Other in-service teachers were faced with some limitation regarding physical facilities and resources (Ms, Bd, Olaf). Ms taught in a classroom that was small, tightly packed, and had no storage space. He shared a science lab with three other teachers and so had to schedule the lab well in advance. Bd, too, taught in a small classroom (approximately 750 square feet for 25 students). While there was an office space, some loosely organized chemical powders were stored there; this was noted as a potential safety concern. Olaf's classroom was described as sparse and was not equipped for any major wet labs, neither was there any evidence any compensation made by Olaf for this shortcoming (MnSTOI).

(b) Ensures Physical Safety in Classroom

Within the limited scope of the observation data collected, three teachers emerged as having discipline problems that could have presented safety concerns. Safety was an issue on Bh's field trip due to behavior problems of two students (MnSTOI). These behavioral problems may be caused (or at least exacerbated) in part by limited access to resources and support. Behavior of some students during Ms' lab bordered on unsafe: kidding around, minor pushes that Ms attempted to stop twice, rubber bands were flicked once (MnSTOI). During a lab, one of Bd's students briefly placed a piece of paper on a heat lamp when Bd was not looking (MnSTOI). The small size of Bd's classroom may have been a contributing factor to discipline concerns. Other than these instances, researchers noted no safety concerns with regards to the other teachers (Lars, Erica, Kk, Te, Mm, Mw, Olaf). It should be noted, however, that the absence of concerns is not evidence of effective communication and enforcement of safety standards in the classroom.

Only one profile elaborated on school district policy pertaining to this issue. Mw indicated that beginning in junior high, all students and a parent were given a safety contract which clarify procedures, rules, and consequences. Violations could result in elimination from all hands-on labs for the remainder of the semester; students could make up work using alternative means (MnSTII).

DEVELOPING AS A TEACHER
The category on developing as a teacher is divided into four subcategories: (a) elements contributing to preparation as a teacher, (b) self-reflection on teaching, (c) professional development opportunities, and (d) resources, support communities, and learning communities.

(a) Elements Contributing to Preparation as a Teacher
Teachers reported a wide array of elements contributing to their preparation as teachers (MnSTII). These included aspects of formal education, personal experiences, and other people / sources.

Formal Education:
- Student teaching (Te, Kk, Bh, Mm, Erica, Olaf)
- Undergraduate courses in science and / or education (Mw, Bd, Lars, Erica, Olaf)
- Graduate program (Te, Kk, Bh, Mw, Bd)

Personal Experiences:
- Own experience as a student (Mw, Bd, Erica)
- Professional & volunteer experience (Te, Mm, Mw, Bd, Lars, Olaf)
- Parenting and family experience (Te, Mm)
- Life experience (Te, Kk, Bh, Mw)
- Own interests (Bd)
- Independent reading (Lars, Erica)

Other People / Sources:
- Colleagues in the profession (Kk, Bh)
- Feedback from students (Bd)
- School curriculum (Mm)
- Research (Mm)

(b) Self-Reflection on Teaching
Seven teachers (Mw, Ms, Bd, Bh, Mm, Kk, Te) indicated that they thought of themselves as being reflective about their practice (MnSTII). Some teachers' profiles did not comment on this issue (Lars, Erica). Only one teacher (Olaf) revealed that he did not see the need to change the way he taught the observed lessons, and generally saw himself as a good science teacher (MnSTOI).

Evidence of varying degrees of reflective behavior were noted. Mw, Ms, and Bd were described by a researcher as being reflective, based on evidence such as results of extra research and thoughtful preparation, teacher behavior during lessons observed and discussions afterwards (MnSTOI, MnSTII). Olaf did have some future goals such as the incorporation of more hands-on learning experiences and experiments (MnSTOI post-interview), however, he all but discounted needing to know more about the developmental needs of his students.

> "...in the field I am going into, I have never come across needing to know the developmental stages of certain individuals. I mean, that usually takes care of itself. And maybe that's important for other teachers but I, as a science teacher, have not needed it. And I have to admit that talking to other science teachers, they feel the same way." (MnSTII)

(c) Professional Development Opportunities
Professional development opportunities had come in the form of science education workshops, conferences, meetings (Olaf, Lars, Erica, Te), speakers at district level (Lars), and working on presenting at a state science teacher's conference (Ms). Mm won a prestigious summer fellowship at Princeton for biology teachers and was thinking of beginning doctoral studies in science education. Three teachers (Olaf, Ms, Te) were members of national or regional professional organizations (which may have produced professional journals) and one (Te) subscribed to a national journal.

Lars took more drastic steps to secure opportunities for professional growth. He recognized the tremendous impact his previous employment experience at four nature centers had had upon his classroom teaching. This was one of the major factors contributing to his decision to leave the classroom and accept a position at a nature center in a large urban center. He hoped that this upcoming nature center employment experiences would yield equally rich professional development opportunities (MnSTII).

Some of the teachers expressed criticisms or unfulfilled needs with regards to professional development. Two (Olaf, Lars) indicated shortcomings in their undergraduate education courses. Olaf expressed the need for more methods courses and workshops that would show him how to "do chemical experiments, do science experiments, how to do physics experiments...so I would like to see more methods and probably less of the special ed classes and theory classes." He would like the education department to "...start realizing what's out there. What's really happening in these classrooms." (MnSTII). Lars, too, was critical of his undergraduate education experience. He stated, "In theory anyway, it [pointing to the education classes portion of his pie chart describing elements contributing to his preparation as a teacher] should be bigger, but it's not. It doesn't feel like it is for me." (MnSTII).

Other concerns and needs expressed pertaining to professional development were directed towards the schools. Erica wished she had received stronger support from administration and mentors during her first year of teaching; her science colleagues had adopted a "sink or swim" approach to helping her (MnSTII). Mw would have liked training from the school on how to better use the technology already available to teachers at the school. Bh was trying to survive and had little energy or time to pursue professional development at this point in her career. She could see that other teachers at her charter school were also being pushed to their limits (MnSTII).

(d) Resources, Support Communities, and Learning Communities

In their interviews, teachers indicated several sources for resources and support. These included the science department (Mm, Mw, Ms) or certain other science teachers (Bd), the principal or dean (Mm, Mw,Ms, Bd), university and master teacher (Kk, Te), regional science center (Lars), programs shared from environmental education center (Lars), Internet (Olaf), textbook (Olaf), and past experiences (Olaf). Most indicated the support they were receiving was adequate except Olaf, Erica, Bh (MnSTII).

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Reviewed by Cathy Summa (November, 2001)
Revised by Teresa Shume (December, 2001)

Comments on Secondary Science Analysis Procedure
Teresa Shume (October/2001)

(1) This year's profiles are much more consistent and even, making this undertaking much more manageable. Nonetheless, there are still significant differences in the ways that the authors of the profiles interpreted certain categories. For example, I am not convinced that all authors are operating from a similar interpretation of the nature of science. Further, some authors focused on the teacher's understanding of the nature of science, instead of the opportunities provided to students to understand the nature of science. These types of differences result in sub-groups of data, limiting the strength of assertions offered in these areas. Some other terms that suffered from multiple interpretations were "discourse" and "alternative assessment".

(2) In the Pedagogy category, there is a section entitled "Has student learning been achieved?". The variety of interpretations from profile authors prevented this category from being useful. Indeed, even profiles prepared by the same author presented a wide array of subtopics within this category. Further, this is a very hard question to answer without data from students such as samples of student work, samples of student work graded by the teacher, and interviewing students. The information presented in this category of the profiles was largely repeated in other sections and was interpreted so differently from one profile to the next that is was of little use and I recommend dropping it in the future.

(3) For many profiles, the information presented in the three subcategories pertaining to discourse was somewhat redundant. Perhaps we should rethink these categories or clarify them in such a way as to avoid this problem in the future. The three categories are: (a) Knowing Pedagogy / Kinds of Thinking Used and Classroom Discourse, (b) Knowing Pedagogy / Teacher's Role in Class and Discourse, and (c) Knowing Students / Students' Role in Class and Discourse.

(4) Profile authors did not all use the same abbreviations for instruments. This seems a mere annoyance, but it did result in the loss of some significant information in the section entitled "Appropriate to Students" under the category "Knowing Students". Six of the profiles referred to "CLES scores" without indicating if they were from the teacher, from the students, or a combination of both. Initially I thought these comments might have been referring to both teacher and student CLES results until I found a profile that stated, "CLES scores were well above average in the relevancy scale. Student scores on the CLES were at average (sometimes) in the relevancy scale."

(5) Initially I had used the titles "Mr." and "Ms" in the pseudonyms for Erica Erickson, Lars Larson, and Olaf Olson, however, I came to see that this might cause some confusion with the pseudonyms "Ms", "Mw", and "Mm". Consequently, I used the first name of their pseudonyms only: "Lars", "Erica", and "Olaf". A uniform system for assigning pseudonyms would be useful. Both my reviewer and I advise against using initials.

(6) My concern about the loss of resolution that occurs at each level of analysis in our protocol from last year's cycle is also relevant to this year's cycle. As observations are noted, the researcher filters out some raw data. When profiles are written, some of the richness in the data fades a bit. When the profiles are analyzed collectively, there is yet another loss of resolution. A pertinent example: Under "Knowing Pedagogy", the fifth section is about external resources. In the analysis, I described the array of external resources listed in the profiles. My astute reviewer asked about motivations these teachers may have had with regards to selection of external resources.

She explains, "Whether this group of teachers felt these were important for developing student learning, or were they simply responding to the 'cool' technology or trying to 'entertain' the video generation. I'm not certain it's possible to pull from the interviews / profiles, but it seems that this might be a reasonable question to ask. Certainly, I think the evidence supports that BH used outside experts for different reasons than did others in the study – BH is teaching in a setting that encourages such resources and alternative methods, which may be more threatening

in some of the more traditional settings the other teachers were faced with (like the group in the college-prep schools)."

When I returned to the profiles, I could not find enough evidence to form any sort of inference. I'm not sure what can be done about this issue or if it is simply an ineluctable limitation of this protocol. Perhaps we simply need to be aware of it.

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