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ABSTRACT

One of the challenges faced in teacher education is how to teach preservice teachers about complex topics, especially those that involve the roles of the teacher and students relative to one another and to what is being studied. This paper describes a secondary science methods course and presents activities from the course which allow teachers to assume roles beyond those with which they come in with. Scoring guides are one such activity and are presented as an example nested within the context of the course. (CCM)

USING SCORING GUIDES TO TEACH PRESERVICE TEACHERS ABOUT STUDENT-CENTERED LEARNING

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One of the challenges we face in teacher education is how to teach preservice teachers about complex topics, especially those that involve the roles of the teacher and students relative to one another and to what is being studied. Most of our students come to teacher education with expectations based on their own experience as students, and sometimes also with a point of inspiration like a particularly good teacher, or an episode in which they had the "ah-hah" experience of realizing that they had had a positive effect on someone else in a teaching situation. Thus, our challenge is to build on these romanticized images--and to do this we have to encourage our students to look at them critically, and possibly reject all or part of them in order to develop more robust and realistic views of teaching.

Within this scenario, our preservice teachers also usually come to teacher education with deeply-rooted assumptions about who controls what in the classroom. They most often believe that a big part of the teacher's job is to decide what will be taught when, figure out how best to deliver this knowledge to eager young minds, and to then test those young minds to see what they have acquired. Early in teacher education, they often learn about constructivist views of learning, and are confronted with differing "visions" of teaching: student-centered, problem-

based, hands-on -- and then are challenged to figure out what these visions mean for the teacher, i.e. how a teacher might make these work in the classroom setting.

As a methods course instructor, I try to structure activities that will stretch preservice teachers by challenging them to define and describe roles that they will take in classroom teaching. In doing so, I purposely include some activities and assignments that assume roles beyond those that they come to the course with. Essentially, I have selected activities that I have found to be incompatible with the narrow, romanticized view that most of them possess. Scoring guides are one such activity, and are presented as an example, nested within the context of the course.

What is the nature of the methods course?

The ten-week secondary science methods class is structured to demonstrate some of the growth and development that many teachers plan for across a school year. The first class meeting has much to do with the physical layout of the classroom, and setting up the first few days of school to lay foundations upon which to build the rest of the year. As the quarter progresses, topics are selected to build on our own foundations of understanding, such as finding out what one's students know via open exploration and other activities, classroom validation processes for student-generated ideas and data, structuring lessons around lab activities, assessing students' progress and understanding, language-rich science instruction, and so on.

Guest speakers on fire safety, chemical safety and disposal, and the use of animals in the classroom provide expert views on important topics.

Throughout, one continuous theme in this course is 'developing a classroom culture of increasing expectations.' The essence of this theme is the idea that over a span of time, teacher and students share some evolving history, and that if one views this history as developmental, one can "build students up" to some pretty dramatic accomplishments. In the course, I choose to represent this process by focusing on the role of writing in science teaching and learning, which mirrors my own development as a teacher of Biology and Developmental (Creative) Writing. The scoring guide is an artifact of a particular stage in this process, one that students must "build their students up to". By their nature, the scoring guides themselves can represent positions on at least two continua, one going from simple facts to complex and interrelated understandings, and one from being a scoring guide for simple-known-answers towards being a guide for scoring more open-ended written responses.

We now move from considering the methods course, a "teacher education" context, to considering the details of scoring guides, and how they are used in the high school science classroom. Following this exposition, we will return to consideration of the use of scoring guides in the methods class, including a more complete discussion of the value of this particular tool, and some preservice teachers' responses to it.

What is a Scoring Guide and how is it developed?

A scoring guide is a key for scoring a piece of written work, and it is intended for use by students to evaluate their own or their peers' work. It includes scaffolding statements that assist the evaluator in the process, including point values and how to assign them. It may include content considerations, as well as those related to the form of expression ("genre") and the purpose of the written communication. Scoring guides are different from rubrics, although they may share some features. And, they go beyond the traditional test keys that may be best applied to multiple choice, true/false, and short (known) answer items, by allowing open-ended questions and creative responses. My scoring guides also include feedback of two kinds: noted strengths, and suggestions for improvement.

My experience with scoring guides is that students want immediately to have input into them. The first time I used scoring guides on an essay test, a number of students commented, "I wish I'd seen the scoring guide when I was studying for the test." I took them up on this request, and began posing open-ended test questions the week before the test. During that week, a recurrent task in our classroom was developing scoring guides for each of the questions. This brought an honesty to my teaching that I had not experienced before. No longer was I holding all the marbles, deciding the rules for playing the game. Instead, the students' understanding was "We gotta learn this stuff, because we're going to have to write about it for the test."

Another set of considerations that were important to the students were standards for expression and presentation. This is the "grammar and spelling" part of evaluation that poses challenges for new and veteran teachers alike, but also encompasses issues of understanding and purpose in writing. The students discovered very quickly, during the first round of scoring, that many of their peers had not exercised much care in penmanship, grammar, spelling, and attending to the purpose of their writing. Simply put, many were in the position of trying to decipher illegible marks. So, when the issue of developing scoring guides came up, some suggested that points be given for these kinds of things, and we discussed the relative value of these to the content points. In all 3 classes, the students were satisfied with a relatively small percentage of the total points being allotted for such things, as I indicated that my own standards focused more on relating understanding of the content material. For an example of how this played out in the final product, see Appendix A.

To develop a scoring guide, students need to know what the question will be. For example, a common lesson in high school biology focuses on the molecular structures of proteins, carbohydrates, and lipids. My test question was, "Proteins are important in the human body. Tell what you know about their functions in the body, how they are made, and how their structure is related to their function." To make the scoring guide, the students began by brainstorming lists of important information to include in their responses. They did this work individually, some using textbooks and notes, and then I asked a member of the class to lead an

Figure 1: Student-generated list of important information about proteins

Essays:

* understandable words
* good spelling - for understanding
* organization or a plan attempt
* correct grammar + punctuation (sentence form)
* written neatly - legible
* gets point across

Content: Proteins -

* build + repair cells
* C, H, O, N, + others
* amino acids are basic units - strung together like beads (peptide bonds)
* diagram - structure of amino acid or explanation of structure
* groups - amino (NH_2) , carboxyl (COOH) (central carbon)
* R group - determines properties
* peptide bonds between amino acids
* definitions of dipeptide and polypeptide
* 3 structural levels
* aid in making enzymes, hormones, antibodies
* built from polypeptides
* assembly line of polypeptides

idea-gathering session at the chalkboard. During this time, I served as a recorder, making a "hard copy" of the ideas that would be useful later on. As ideas about content came out, students also mentioned other concerns they had about structure and genre (since they had used scoring guides before). Figure 1 shows what the students wrote. An important feature of the development process, when guided by students, is input and approval from the teacher. I used this opportunity to talk to the students about the relative importance of some ideas over others,

and to ask them to note which ideas seemed to be critical or more important to answering the question. After some discussion and further teacher direction, these agreed-upon ideas were underlined.

After the class ended, I took the recorded ideas and made the final version of the scoring guide (See Appendix A and B for examples). While students were not privy to the final published form of the scoring guide before they took the test, I had encouraged them to make notes as we wrote, the notes were recorded in a class notebook, and thus were available to any student. I encouraged them to practice-write responses as homework leading up to the test.

One important note: since I was teaching 3 periods of biology, each class developed it's own scoring guide. While they were similar, they were not the same, and my role led me to a conflict: do I impose my own need for parity, or do I allow a reasonable range of responses? I opted for the latter choice, on the basis of wanting as much student investment in the guides as possible and not wanting to do anything to diminish the students' trust. This just meant a bit more development time for me, and also meant that I had to be careful to use the right guide for each class!

How do scoring guides fit into the larger picture of the high school classroom?

The classroom described here and to preservice teachers in the methods course is different in some ways when compared to most of the classrooms in which they work in field experiences

and student teaching. Yet, it also reflects some of the many reform-based recommendations for improving science instruction in high schools. For example:

- students worked in various social arrangements (individually, in small groups, and as a whole class) to design and carry out sustained inquiry directed at answering questions they had generated, on topics selected or approved by the teacher.
- the roles of teacher and students were modified to create a learning community in which all members shared responsibility for what was learned, and students had some say in the selection and order of topics.
- assessment and evaluation strategies moved away from strictly known-answer, true/false, and multiple-choice formats to include the use of language for more authentic purposes such as to explain, persuade, elaborate, and evaluate.
- classroom validation processes formed a significant part of instruction, which moved many students to higher-order thinking tasks as they were engaged in inquiry.

Essentially, this classroom most closely reflects Teaching Standard E of the National Science Education Standards (National Research Council, 1996):

> Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning. In doing this, teachers

- Display and demand respect for the diverse ideas, skills, and experiences of all students.
- Enable students to have a significant voice in decisions about the content and context of their work and require students to take responsibility for the learning of all members of the community.
- Nurture collaboration among students
- Structure and facilitate ongoing formal and informal discussion based on a shared understanding of the rules of scientific discourse.
- Model and emphasize the skills, attitudes, and values of scientific inquiry. (45-46)

Having described scoring guides and the classroom much as I would describe them in the methods class, I now return to the "teacher education" issues of preservice teachers' reactions to scoring guides, and some the instructional issues that scoring guides address.

How do preservice teachers react to the idea of scoring guides?

"You should publish this, because it's really good."--*Melanie, preservice intern.*

"Thank you for this. After hearing all of this rhetoric about student centered learning, we finally get to see how it might be done. I still have a lot of questions,

but I'm hopeful now that I see how someone has made this work." -*Ernest, preservice intern.*

When preservice teachers first see an example scoring guide, they want to know how it works. I often tease them with a one-liner: "Students use this guide to grade each others' tests and quizzes." Then there's a round of "wait a minute" and looks of disbelief. Instantly, more questions pop up, and I launch into an explanation with the following main points:

1. One must build a classroom culture that supports this kind of activity, and this takes time.
2. One must build the skills necessary for students to begin to do this sort of thing; once students begin with a simple example and the teacher has provided support for them, one can progress to more complex and daunting tasks.
3. The mechanics of using the scoring guide include:
    - each paper is read and evaluated by two peers, so some system for managing the paper flow in the classroom is required. I give each student two scoring guides and one paper at the outset, and once the first paper is scored, it is placed on a "graded once" pile, and the completed scoring guide is given to the teacher. Another paper is picked up from the "graded once" pile and is scored by the student. As they are completed, these "second readings" are paper-clipped together as they are handed in,

and I ask one of the students who finishes first to match these to the first set of score sheets and clip each set together.

- scores are examined by the teacher, who may act as "tie-breaker" in the case of scores that are more than 5-10% different. Teacher records scores in gradebook.
- evaluators initial or sign their evaluations. In some instances, authors do not put their names on their papers, but instead use an alphanumeric code approved by the teacher. This may be necessary to reduce bias, although the teacher will see all papers and scores too, and can catch blatant bias in that process.
- notes, texts, and other materials are allowed during the scoring process, as are discussions with other scorers and the teacher. Much learning occurs as students evaluate peers' work.
- eventually, students will want to develop scoring guides ahead of time, and this is where they take full control of their learning.

Most of the preservice teachers' questions have to do with management: both managing the process and moment, and managing the culture of the classroom to enable this kind of activity. The underlying message that you can't expect this to happen overnight in the classroom is clearly understood by most. My vision of the year as a continuum in which I strive to develop capacities in my students, and my thinking about the continuum of capacities, becomes the focus.

As preservice teachers continue to inquire about scoring guides, I look for an opportunity to remind them that each of them will become "master of the classroom universe"-- ultimately responsible for all that goes on there, but hopefully co-responsible with their students. Within the constraints of district and state curricular mandates (both style and substance), teachers do have quite a bit of latitude in how they achieve their goals....which should be "science for all", and "greater science literacy", but should also involve the teacher being intimately aware of the details of student learning at many points in the learning process.

The general consensus for the last two years in presenting scoring guides in methods classes has two points: it can be viewed as a kind of make-n-take activity, but the work required to develop and maintain the appropriate classroom culture is clear.

Future Plans and Goals

At present, I have not seen teacher education program graduates here using scoring guides in their classrooms. Yet, I am working with a number of graduates from the last few years who are committed to the idea of a progressive classroom culture of inquiry, infused with students writing about their own ideas.

Thus, I must seek examples from classroom teachers, and specifically sites in which to "finish the story" by documenting mini-cases of teacher(s) who decide to implement this kind of assessment practice, and the thinking, challenges, and dilemmas that go with it. This research

should be designed for more than my goal to develop a more complete understanding of this tool, but rather to focus on the students' developing capacities over time in such a classroom. Case studies of teachers and students working together in environments such as these will add much to our understanding of what "teaching to the Standards" means.

References

National Research Council (1996). *National Science Education Standards.* Washington, D.C.: National Academy Press.

Appendix A

SCORING GUIDE - Ch 12 - ***Sarcodines*** AUTHOR _____

Question: *Imagine that a biologist reported the discovery of a sarcodine that moves by means of pseudopods and has a thick cell wall made of cellulose. Is this report likely to be true? Support your choice.*

First, read the entire essay. Concentrate on understanding what the author has to say. Then, fill in the following:

1. **Overall impression:** CLARITY (3-2-1) (3 is best, 1 is confusing) (3 max) _____
2. **Neatness:** (2-1-0) (2 is best, 0 is undecipherable) (2 max) _____
3. **Organization:** a) clearly states topic at outset (1-0) (1 max) _____

   b) has a plan (4-3-2-1) (4=good plan, 1=rambles) (4 max) _____

SUBTOTAL (10 MAX) _____

Now go back and read for *CONTENT:*

4. Author tells whether report is likely to be true:

   Yes = 1 pt.
   No = 3 pts.
   Doesn't say = 0 pts. (3 max) _____

5. Author says that movement by pseudopods requires a flexible membrane.

   3 pts. = best statement
   2 pts. = partial statement
   1 pt. = implied only
   0 pts. = not stated or implied (3 max) _____

6. Author states that cellulose walls are rigid.

   3 pts. = best statement
   2 pts. = partial statement
   1 pt. = implied only
   0 pts. = not stated or implied (3 max) _____

7. Author refers back to original statement. (1 max) _____

	SUBTOTAL (10 MAX) _____
Mechanics Subtotal from above(10 MAX) _____	
Content Subtotal from above _____ X 2 = (20 max) _____	
TOTAL (30 MAX) _____	

One Positive Comment: _____

One Suggestion: _____

Appendix B

SCORING GUIDE: EVOLUTION TEST AUTHOR

_____

1.Name FOUR of the five forces responsible for environmental change over time that we discussed in class:

You may give two points for each of the following responses:

_____*weathering,*

_____*volcanism (or volcanoes),*

_____*plate tectonics (or continental drift),*

_____*climate changes,*

_____*man*

2.Using the data table supplied:*(2 pts. each)*

a.What type of animal first appeared in the Pennsylvanian period?

_____*reptiles*

b.How long did the Permian period last?

_____*55 million yrs.*

c.How many years ago did land plants first appear?

_____*430 million years ago*

d.Which first came out of the water to populate the land, _____plants or animals?

_____*Plants*

Why?

_____*They only require water, sunlight, and oxygen-- and all of these were available on land. Initially the land environment was pretty wet. Animals would have to go through many adaptive changes to meet their many needs on land.*

3.Define and give examples of divergent evolution and convergent evolution.*(2 pts. each for definitions, 2 pts. each for examples.)*

_____*DIVERGENT EVOLUTION is defined as a process of several species resulting from a common ancestor over time. An example might be the birds, which are thought to have evolved from a common ancestor long ago. Today there are thousands of species.*

_____*CONVERGENT EVOLUTION is defined as a process in which members of different species develop similar traits or characteristics due to similar environments. The traits are similar in appearance and function, but not in origin. Examples might be the whales and porpoises that have developed fins similar to those of fish in appearance and function.*

****You may ask me about definitions or examples!*

4.Using an organism of your choice with an obvious adaptation, explain change over time according to LaMarck and Darwin.

*Give 1 point for mentioning the idea or key word listed, and one additional point for telling what it means. Use this guide as a checklist: ***see me if the author does not use a single organism and a single trait to show both theories!****

Lamarck states that

_____*change occurs because the environment creates needs for organisms*

_____*if an organism uses a body part in a particular way, the body part will change to meet the need.*

_____*if an organism does not use a body part, it will grow smaller and eventually become useless or disappear.*

_____*acquired characteristics are passed on to offspring,*

_____*over time, the species changes as these traits accumulate.*

Darwin states that

_____*overproduction occurs in nature. Many offspring are produced.*

_____*there is competition for survival among these offspring. They compete for food, water, shelter.*

_____*variations occur in species. Each member of a species has slight differences from other members, and some of these differences will make a difference in survival.*

_____*survival of the fittest (natural selection). Those individuals which fit the environment best will survive in greater numbers to reproduce.*

_____*over time, the species changes as these traits accumulate.*

5.Define:*(1 pt. for synonym, 2 for def., 3 for def + example)*

_____a.variation=*differences between members of the same species that make each unique. Examples for humans are hair texture, build, shape of nose, skin tone.*

_____b.species=*organisms that interbreed successfully in nature. All birds share certain similarities, yet there are thousands of species, and only those within a species can interbreed successfully.*

_____c.isolation=*in nature, members of a species are separated from other members of the same species by geographic or reproductive barriers. An example is two groups of minnows separated by creation of a waterfall.*

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