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TEAC 452V/852V: Curriculum Principles and Practices—A Peer Review of Teaching Project Benchmark Portfolio

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Preserve Science Teachers' Learning about Inquiry-based Instruction

A Peer Review of Teaching Portfolio

ABSTRACT

I framed the course under study around an essential question which was: How does a scientific classroom discourse community support student learning? Inquiry-based instruction is a cornerstone of science teaching; thus, I investigated preservice science teachers' learning about how to teach science through inquiry-based instruction. By the end of the course all of the students had improved their understanding of inquiry-based instruction and were able to generate better science lessons that align with national and state-level science education standards. I attribute this to using educative assessment methods that allowed students to revise their work until they had achieved a basic level of mastery.

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Selected Course: TEAC452V/852V Curriculum Principles and Practices (Secondary Science)

Preservice Science Teachers' Learning about Inquiry-based Instruction

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1 INTRODUCTION

1.1 OBJECTIVES OF PEER REVIEW COURSE PORTFOLIO

My goal for this teacher action research project was to better understand how to improve students' learning of how to teach science through active and inquiry-based learning experiences. The majority of the preservice secondary science teachers in our teacher education programs have rarely experienced inquiry-based science instruction themselves and even in their clinical experiences in grades 7-12 science classrooms they do not see many examples or have the opportunity to practice teaching science through inquiry-based approaches. I selected the second of a two-course sequence in teaching methods to study. I focused on three aspects of teaching this course: (1) the instruction and learning opportunities I provide to my students, (2) the quality of the feedback I provide to them on their major assignments, and (3) the learning gains that the students demonstrate about how to teach science through inquiry-based instruction.

In my construction of the portfolio I investigated preservice science teachers' learning about how to teach science through inquiry-based instruction. I collected the students' major assignments and focused my analysis specifically on how well they understood a standard model of inquiry-based instruction and how well they could apply this model and to their own teaching practice (e.g., science lesson plans, a lesson study project, and a curriculum unit). I also provided students with the opportunity to reflect upon their learning of teaching science through inquiry mid-way through the course by responding in writing to metacognitive prompts. I gave them a diagnostic test (not graded) the first day of class and then gave them their test back at the end of the semester to have them annotate and/or correct their original responses. I provide an analysis of the whole group's performance as well as examples of high-, medium-, and low-achieving students' work that illustrates the range of learning that occurred from the beginning to the end of the course.

My department, the Department of Teaching, Learning, and Teacher Education, is also engaged in the documentation of preservice teacher education and learning for national certification of our teacher education programs, so my efforts mirror the department's focus on meeting learning objectives. In fact, I was responsible for drafting the secondary science learning objective for our secondary science program as part of a larger document that was submitted last fall to the college and university for their approval.

1.2 DESCRIPTION OF THE COURSE

TEAC852V Curriculum Principles and Practices (Secondary Science) is the second science teaching methods course that preservice science teachers take in our secondary science teacher education program, either as undergraduate secondary science education majors or graduate students, who are seeking an initial secondary science teaching endorsement. The course content builds on foundational pedagogical approaches to teaching science (e.g., inquiry-based instruction), and weaves numerous strands from the range of educational coursework that students take as part of their teacher certification, such as human cognition, understanding diverse learners (e.g., English language learners, students with special needs). As preservice science teachers my students take their science subject matter knowledge classes either before or concurrently with this class outside of the college of education in science departments.

In this advanced methods course I use a model of a scientific classroom discourse community that originated from my research experiences with professional development of science teachers. The essential question for the course is: *How does a scientific classroom discourse community support student learning?* I focus on deepening preservice teachers' understanding of the nature of science, how to use a variety of oral and written discourse strategies that are derived from social-constructivist learning theory, how to use academic language development strategies, and scientific inquiry. The goal of this course parallels the goals of other advanced methods courses in our department's secondary teacher education programs; it is the last course before preservice teachers are approved to start their student teaching.

The goals of this course are tied closely to the National Science Teachers Association (NSTA) Teacher Preparation Standards (**Appendix A**). These standards focus on: (a) knowledge of subject matter; (b) a capacity for planning inquiry-based science lessons; (c) instruction that provides K-12 students with opportunities to engage in scientific practices and communication; (d) building a safe and productive learning environment; and (e) using formative and summative assessment methods. Because of the strongly clinical, theory-to-practice, nature of the course, I expect that preservice science teachers will be able to: (a) write and teach science lessons; (b) understand how to improve science lessons and learning experiences for students based upon their assessment of student work and discourse; (c) design overarching curriculum documents (e.g., a unit of study, year-long curriculum plan) using science education standards, and inquiry-based learning principles. I articulate these expectations in a set of course outcomes that I have included on the syllabus (**Appendix B**). As future science teachers they must master these basic teaching skills in order to be prepared to teach; their future students depend upon me to hold students to a high standard of achievement.

TEAC452V/852V was a course I taught for the third time last fall semester (2013), but it was the first time that I taught a combined section of undergraduates and graduate students as well as having both groups from both of our secondary science teacher education programs in the same class. I also wanted to refine the course curriculum based upon my last two instances of teaching it and receiving feedback from prior students. I also had a teaching assistant who is a master science teacher and my doctoral advisee in science education whose long-term professional goal is to be a teacher educator. Thus, as another goal for the course I wanted to model what I do as a teacher educator and mentor him by provide co-teaching opportunities and feedback about his instruction as we planned and taught lessons and assessed students. This was also for the purpose of preparing him to teach the first science methods course independently in the spring 2014 semester. Together we updated the curriculum (TEAC 451V/851V) for the incoming new cohort of undergraduate students in the spring 2014 semester. Because he had observed the curriculum and instruction in the second methods class as a teaching assistant and we discussed the challenges that the students had throughout this course (e.g., struggling to understand how to create inquiry-based lesson plan and how to teach science with active learning), we brainstormed ways that the first methods course can better prepare the new cohort for their second methods class. I believe that this careful analysis over the multiple-semester teaching methods sequence in the program will provide a more tightly connected continuum of learning for these preservice science teachers graduating from the department.

2 TEACHING METHODS/COURSE MATERIALS/COURSE ACTIVITIES

2.1 TEACHING PHILOSOPHY

My students belong to two distinct audiences, preservice teachers (grades K-12, at both undergraduate and graduate levels) and science education professionals who are pursuing advanced degrees in curriculum and instruction. Philosophically, I subscribe to a social constructivist (e.g., Vygotsky, 1986; Wenger, 1998) view of teaching and learning informed by essential findings in psychology (Dweck, 2000), human cognition and neuroscience (e.g., How People Learn, NRC, 2000, NRC, 2005). In particular Wenger's (1998) social theory of learning is the most useful to me as a teacher with four key components: (a) meaning, (b) practice, (c) community, and (d) identity. Thus, learning occurs respectively as: (a) experience, (b) doing, (c) belonging, and (d) becoming. Consequently, for every course I teach I design activities and projects that address each category of learning in particular ways:

a) **Meaning/Experience:** I engage my students in collaborative inquiry of meaningful, real-world issues within and among educational systems (i.e., classroom, school, district, state, national, and sometimes international);
b) **Practice/Doing:** I require application and practice to develop proficiencies;
c) **Community/Belonging:** my courses are structured both to encourage students' social interaction with their classmates and their larger professional community;
d) **Identity/Becoming:** I encourage my students to consider their own beliefs and self-efficacy about education, teaching, and learning at small and large scales.

Through designing curriculum, classroom activities and benchmark assessments I seek to both model and build a community of learners. Through the range of educational scholarship that I have studied (e.g., theory, research, methodology, policy, psychology, philosophy) and my own research findings, core aspects of my teaching practices are grounded in: (1) relevant and meaningful assignments for both skill building and conceptual understanding; (2) educative assessment (Wiggins,1998); (3) equity issues, specifically gender, socioeconomic status, ethnic and language minorities; and (4) cutting-edge models for science teaching (e.g., scientific classroom discourse communities (Yerrick & Roth, 2005). While the essential aspects of my teaching philosophy remain consistent from audience to audience, I have different goals for each. I will outline these learning goals in the next two parts in the next section.

2.2 OVERALL GOALS FOR TEACHING & LEARNING

My goal for preservice teachers of science is that they are knowledgeable and prepared to teach science. Because preservice teacher education culminates in a professional degree, I draw upon a vision for professional practice illustrated by a conceptual framework for 21st century teacher education (Bransford & Darling-Hammond, 2005). I also employ research findings (e.g., Report of the AERA Committee on Research and Teacher Education, 2005) and current standards for preparing highly qualified and effective teachers (National Science Teachers Association Teacher Preparation Standards, 2012). In preparing future teachers I must design curriculum that weaves together multiple strands of educational issues and theory so that preservice teachers can understand why those issues and ideas are educational foundations as well as model how to teach science, thus I act as a bridge between theory and practice. When I teach science methods courses, I endeavor to use, and explicitly draw attention to, educational issues and theories, but also provide and model instructional strategies that these future teachers can use to plan science lessons and then practice in their clinical settings with children and youth. Additionally, it is important to make preservice K-12 teachers aware of key educational standards (e.g., in the past the National Science Education Standards (NRC, 1996), now superseded by the Next Generation Science Standards, 2013; Benchmarks for Scientific Literacy, AAAS, 1989). As I teach from a social-constructivist stance, I also teach teachers how to build their own scientific classroom discourse communities, which also is a direct application from one of my major research foci.

2.3 COURSE OUTCOMES

I framed the course under study (TEAC452V/852V) around an essential question (Wiggins & McTighe, 2006), which was: *How does a scientific classroom discourse community support student learning?* I shared this with the students and referred to it nearly every class meeting using one or more question elements as they connected to the focus of the class:

1. How do teachers' experiences, beliefs, perceptions and attitudes affect their science instruction?
2. What is active learning (e.g., inquiry-based science instruction and how it is similar and different from hands-on learning) and what cognitive learning principles is it based upon?
3. What is, and isn't, science? In what ways is science done? (i.e., the nature of science)
4. Relevant science instruction (i.e., how do we provide meaningful science experiences for students?)
5. How can we bridge students' everyday understandings and language and the academic culture and language of science?
6. How do educational standards, learning principles (i.e., human cognition), and pedagogical knowledge affect instructional planning?
7. What are the different purposes of assessment in science?
8. How does assessment inform instruction? (i.e., formative assessment)

Particular questions were connected to each class meeting agenda so that the students could see the alignment of inquiry, topics, and learning activities. By the end of the semester each had been addressed by at least two classes. In the syllabus I also provided students with the course outcomes (Box 1).

Box 1. TEAC452V/852V Course Outcomes

Awareness

Students will have the opportunity to explore, independently and as a discourse community, their understandings of:

1. the purpose of science education;
2. their beliefs about teaching science;
3. how inquiry-based science instruction gives underrepresented students (e.g., ethnic minorities, girls, low SES, and learning challenges) and students with special needs greater access to learning science;
4. the integral role of formative assessment in teaching and learning; and
5. how students learn from both cognitive and social-constructivist perspectives.

Active Learning

Students will be provided with:

1. written prompts to reflect upon their understanding of science education issues;
2. examples of various types of instruction and classroom discourse structures with which to teach science; and
3. activities that model various types of inquiry-based science lessons.

Practical Application of Theory

Students will have the opportunity to:

1. practice designing their own science lessons and units; and
2. conduct a lesson study project to analyze their assessment and instructional practices using student work.

2.4 Teaching Methods

I used a framework of a scientific classroom discourse community to organize the critical elements of the course (e.g., learning principles, formative assessment practices) to deepen students' understanding of inquiry-based science instruction and patterns of discourse in science lessons. For example, throughout the course I consistently modeled the use of inquiry-based science lessons using peer-to-peer oral discourse over traditional lecturing and triadic dialogue patterns (i.e., IRE) dominated by the classroom teacher. I drew from the other coursework to help students make connections from theory to practice. One student commented on the end-of-semester course evaluation, "I felt that a great deal of thought and preparation went into the design of the course." Another stated, "There was a strong emphasis on classroom strategies for student involvement and communication."

I arranged for the students to take a field trip in September to the Spring Creek Prairie Audubon Education Center so that they could learn more about the connections between informal and formal science education. I invited speakers throughout the semester, including two that addressed the new engineering education standards that are part of the NGSS. I also included a guest lecturer from Population Connection who provided lesson plans for learning about human population growth, environmental issues, and sustainability of natural resources. About half-way through the semester I also asked four of the students' cooperating teachers to serve on a panel of experienced teachers to field questions that the students had about teaching science. One student commented, "I liked the guest speakers we had come in. I also enjoyed learning more about the integration of engineering into education. I liked when we were able to participate in activities I can use in my future classroom."

2.5 Course Assignments

The major project for the course was to enact a lesson study cycle. Students were to plan and teach two science lessons in their practicum placement in their cooperating teacher's classroom and document students' learning from each lesson and also analyze the effectiveness of the first lesson and use what they learned to plan a stronger second lesson. This project was outlined and broken into key phases in the syllabus under the course assignments section along with all of the other work for the course. Other significant assignments included a year-long curriculum plan for a selected science class (e.g., middle school life science, upper level high school chemistry) and a teaching unit (4-6 weeks) on a major, overarching science standard.

2.6 Assessment of Learning

One of my goals is to generate curricula that allows for flexibility to meet students' learning needs through formative assessment practices. My on-going feedback on students' work is specific, promotes an academic focus, and intellectual exploration of ideas. I believe that assessment should be educative (Wiggins, 1998), and thus promote understanding and growth within the instructor as well as the student. My philosophy of teaching subscribes to the edict that having high standards for student learning will result in greater learning for students. While my standards are very high, students are provided with detailed product descriptors and rubrics for assessing their work so that they understand what my goal and their target is and how to reach it. In this way I am also able to model sound teaching practices. My goal is to provide clear communication, especially around my expectations for student work and how assignments will be graded. If students turn in major assignments that do not meet the expectations of the course I return work to students with comments and instruct them to re-do the assignment based upon the constructive feedback I have provided them. Thus, student grades are a result of continuous improvement and mastery of the material. I address student performance in the next section.

3 Analysis of Student Learning

3.1 Whole-group Measures & Examples of Student Growth and Achievement

The distribution of student performance is shown below in Table 1 for all of their assignments. These grades reflect any post-revision work that students engaged in which is not indicated here, but for any assignment about 10-20% of students redid their assignment. The average final grade was an A- (92.2%) with a range of B (86.7%) to A+ (98.9%). Table 2 summarizes the grades for individual selected students who represent low-, medium-, and high-achievement and their growth. Table 3 summarizes selected example students and their progress over time with a summary of their learning trajectory.

Table 1. *Whole class grades for each assignment after revisions*

Assignment	Range	Minimum	Maximum	Mean	Std. Dev	Variance
Sci Notebook Check #1	100	0	100	94.44	19.03	362.26
First Lesson	22	76	98	89.89	5.11	26.10
Second Lesson	18	82	100	93.89	4.66	21.72
Sci Notebook Check #2	28	72	100	95.41	6.42	41.17
Year-long Plan	16	84	100	91.52	4.64	21.49
Unit Plan	20	80	100	87.89	5.58	31.10
Teaching Philosophy	15	85	100	94.33	5.04	25.38
Lesson Study Project	15	85	100	93.48	3.98	15.87
Presentation	15	85	100	95.15	3.83	14.67
Final Grade	**12.20**	**86.70**	**98.90**	**92.27**	**3.29**	**10.85**

Table 2. *Examples of low, medium, and high-performing students' grades after revisions*

First Name	1st Lesson Plan	2nd Lesson Plan	Year-long plan	Unit Plan	Teaching Philosophy	Lesson Study Final Report	Final Grade
N- (low)	84	82	85	79 to 83	92	85	86.70%
S- (low to medium)	73 to 88	88	90	80 to 91	90	88	90.50%
M- (medium to high)	85 to 93	97	88	88	98	95	93.70%
L- (high)	93	99	100	100	100	98	98.90%

Table 3. *Summary of example students and their learning of inquiry-based instruction*

N- (low) struggled for the majority of the course and was often asked to redo work. She was willing to engage in revision, but only made small incremental changes. While she did have a better understanding of how to teach science, she tended to default to generalities.

S- (low to medium) was a student who initially held many misconceptions about how to teach science and was entrenched in his beliefs about how science should be taught. He appeared not to have done the assigned readings. He required more encouragement and at times engaged in debate about why he his work did not align with expectations. Over time he was able to correct his understanding and see some value for using inquiry-based science teaching methods.

M- (medium to high) upon starting the course had a solid understanding of inquiry and through feedback was able to refine this to a deeper understanding and higher achievement at the beginning of the course and then perform better independently for the rest of the semester.

L- (high) was a student who had a good understanding of inquiry-based instruction when she started the course and also had a high degree of confidence in how to generate lesson plans. Through more advanced critique of her work I was able to encourage her to refine her understanding to become more nuanced and sophisticated. She was one of the highest-performing students in the class.

Through a mid-semester metacognitive essay prompt ("How has your understanding of active learning and inquiry-based instruction changed so far this semester?"), I was able to check for their understanding about inquiry-based instruction. I also did this to direct their attention to this important aspect of the course as one of the main learning objectives. The following quotes are excerpts from the representative student examples:

N- (Low-achieving student):

> *"However, each time I plan a lesson I get a little better at being able to include inquiry based education….Since my first methods class I feel as if I have been able to distinguish between hands-on and inquiry-based learning. Especially with my experience in my current practicum. I am better able to see what kind of situations call for one and what types of situations call for another."*

S- (Low to medium-achieving student):

> *"Inquiry-based learning was a new concept to me when introduced last semester. I never had much of it while in school and was never a fan of it….I am still working to define the difference between inquiry and "hands-on" direct instruction….I see now how inquiry can be used to better engage students and give meaning to what it is they are learning….Teachers like myself must know their students and create a lesson that is within their ZPD."*

M- (Medium to high-achieving student):

> *"I have learned more about how complex the term inquiry can be in the classroom. Inquiry can range from more teacher to more student driven….Some students may need encouragement to discuss ideas in groups or with the class. Teachers can provide tools such as sentence starters in these instances to help get students participating in discussion. It is important for teachers to meet students where they are in their skills and abilities to do inquiry-based lessons….I have also learned more about the differences between hands-on learning and inquiry. Previously I had used hands-on lessons and inquiry lessons interchangeably. Now I understand that hands-on and inquiry are different in that hands-on activities can be used to facilitate inquiry but alone they are not inquiry. Inquiry lessons require students to be able to explore a new topic, which may include using hands-on approaches, and make predictions and questions….Inquiry practices in the classroom resemble the practices of scientist in the field."*

L- (High achieving student):

> *"Based on what we have discussed in class this year, I feel like the only way my understanding of inquiry has changed is that I now incorporate the concept of "investigative learning." I always thought that students had to be collecting the data and designing their own experiments for inquiry to be "true inquiry," but now I consider investigations of already presented data and ideas inquiry as long as the students are actively constructing their own understanding through self-determined discovery, investigation, or research of a topic….Prior to this class, I still understood that hand-on activities aren't necessarily inquiry learning because I've done my fair share of "cookbook labs" and didn't do a speck of inquiry. However, I probably would have still been considering these hands-on activities to be "active learning" because the students are actively doing something in the classroom. I now have a better understanding that active learning entails more than physically participating in a lab….Active learning should definitely incorporate more metacognition on the student's behalf so they are thinking about what they are learning and thinking rather than participating in rote learning."*

The first two students provide evidence that their ideas have changed but their responses are somewhat perfunctory and do not demonstrate the same level of self-reflection of learning by the other two students who were able to refine their understanding and provided clear examples of how their thinking had changed.

Another example of student metacognition and documentation of growth can be seen in the pre-post course diagnostic test. I focused on one item that required students to fill in a table to name and describe the elements of the 5E inquiry-based instructional model. I provide 3 examples (Figures 1, 2 and 3) of the four previously selected students to how N- was able to correct her misconceptions at a basic level, S- also corrected his ideas and added more detail to his response and finally L-, who started with a correct response but was able to elaborate upon her understanding in more sophisticated ways.

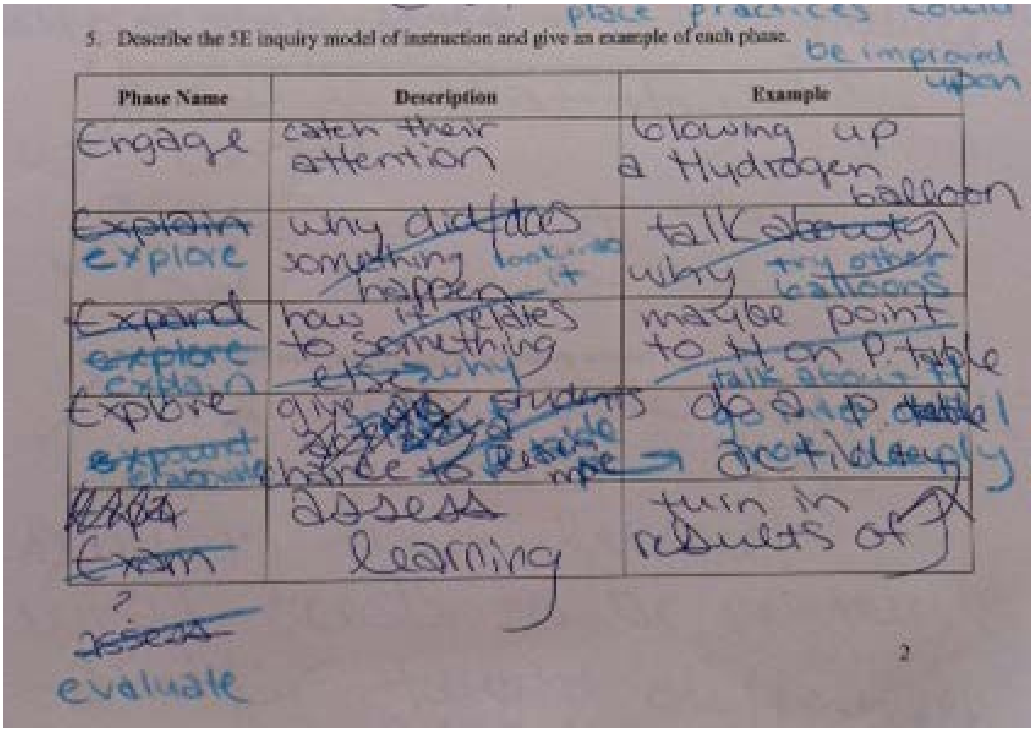


Figure 1. Low-achieving student, N- had many misconceptions of inquiry-based instruction and was able to correct her misconceptions at a basic level by the end of the course.

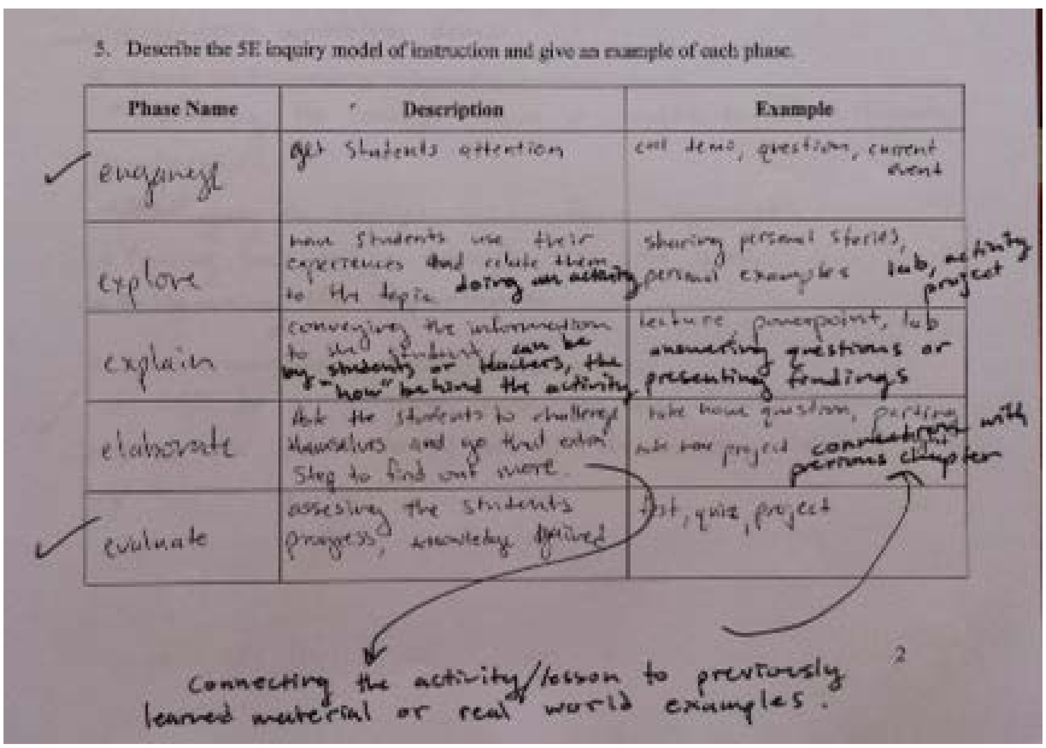
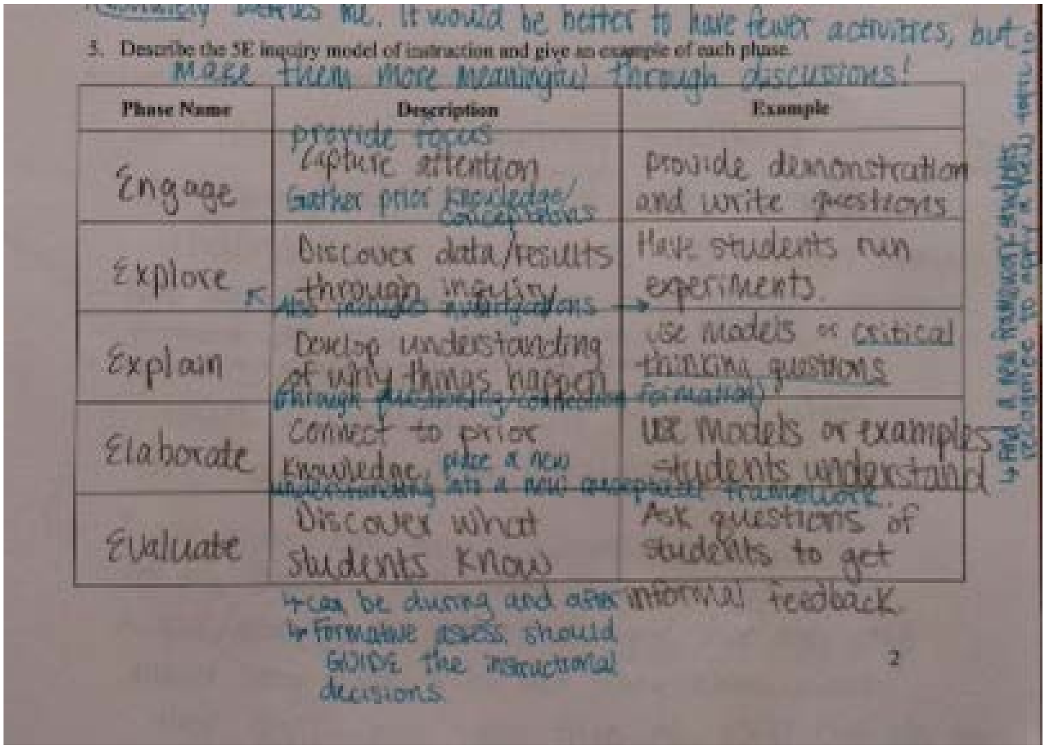


Figure 2. A medium-achieving student, S- was able to correct his original incorrect ideas about inquiry-based instruction and added more detail to his response at the end of the course.


It would be better to have fewer activities, but make them more meaningful through discussions!

5. Describe the 5E inquiry model of instruction and give an example of each phase.

Phase Name	Description	Example
Engage	provide focus Capture attention Gather prior knowledge/conceptions	Provide demonstration and write questions
Explore	Discover data/results through inquiry	Have students run experiments.
Explain	Develop understanding of why things happen	Use models or critical thinking questions
Elaborate	Connect to prior knowledge. place a new understanding into a new conceptual framework	Use models or examples students understand
Evaluate	Discover what students know can be during and after Formative assess. should GUIDE the instructional decisions	Ask questions of students to get informal feedback

2

Figure 3. High-achieving student, L-, who started with a correct response, but was able to elaborate upon her understanding in more sophisticated ways.

By the end of the course all of the students, including the example students had improved their understanding of inquiry-based instruction and were able to generate better science lessons that align with national and state-level science education standards. I attribute this to using educative assessment methods that allowed students to revise their work until they had achieved a basic level of mastery.

3.2 Undergraduate and Graduate Student Learning: Similarities and Differences in their Evaluation of the Course

Having both levels of students in the same section of the course for the first time was challenging, in some tangible and intangible ways. Within both groups there was variation of performance by the students. I returned assignments to be redone to the graduate students as well as the undergraduates. The MAst students seemed to grasp the course content more easily and required fewer revisions to meet the expectations of the course. However, I observed that as a group many of the students arrived with a lower-than-expected level of understanding of inquiry-based instruction, which surprised me. This combined section of both undergraduate and graduate students was a more challenging group than when I had just the graduate students by themselves. One graduate student offered this observation about his/her classmates:

> *"I'm not sure why the other students think that turning in a weekly assignment is so terribly difficult, but the level of work was not overwhelming, some of the students just*

[have] better time management skills. Just to clarify, I did hear complaining from both undergrads and graduate students. I think the herd could be thinned a bit."

This comment resonated with my own observations of some of the poor quality work that was turned in and lack of internal motivation also made me wonder why some of these students had chosen to be teachers. In our department we struggle to recruit and select applicants who will be good teachers. Even if a student has a high GPA it does not ensure that they possess the key dispositions that will support their capacity and growth to be an effective teacher. [i] However, the majority of the graduate students seemed to view the process more as a natural part of their own learning and refinement of understanding how to teach rather than an academic hurdle.

Overall, the graduate students rated the course and me as an instructor more favorably than the undergraduate students. I am not sure why this was the case, as I had not interacted with either group prior to teaching the course, but on most items on average the graduate students rated me 0.2 to 0.6 higher than the undergraduates on many of the items. Not wanting to write this difference off to merely group membership, as I am well aware that the differences within groups are greater than they are among groups, I plan to interview selected students as to why this might have been the case as I will be faced with the same situation again the next time I teach the course.

The past two times I taught the course I had 15 and 17 students in each section, so having 27 students in this section was also particularly challenging and made it more difficult to cultivate strong relationships with more reserved individuals in a larger than normal group; fortunately Aaron was an effective TA and as a master science teacher contributed positively to the classroom community. One student commented that Aaron and I had been, "Supportive instructors, great teamwork."

Despite the larger than usual class size, I still wanted to provide constructive and specific feedback to all of the students on their course assignments, especially in the case of revisions. It was important that all student be able to master the core assignments (e.g., lesson plans, unit plan, year-long plan) by the end of the semester. I gave students back more work to be re-done than I had in previous semesters and this group overall seemed to need more calibration to program expectations than groups in past years. They did highly rate my willingness to help them (mode=5, mean =4.47, SD=0.93). One student wrote:

> *"Dr. Lewis gave us many tools that we can actually use in our classrooms. She gave us many resources that we can use or refer back to as we move into student teaching and our first year. Her feedback on all of our assignments was insightful and very helpful. I loved that she allowed us to rewrite our assignments after looking over her comments. It helped me to develop my best work possible. She was also very attentive to the needs of us students."*

Another student wrote: "The opportunity to build these professional pieces (teaching philosophy, year-long plan, unit) in a constructive manner. I don't know if the other students realize how helpful gaining an experienced opinion is for these projects."

The undergraduate students were in the same section as the graduate Master of Arts (teacher certification plus Master's degree) students. I have disaggregated the evaluation data and my own observations in order to be able to make some cross-group comparisons. I am reporting the mean overall score (for items 8-16 on instructor, mode was a 5), but will present all three (both, undergrad, and grad) means, SD, and modes for course and instructor question sets as reported by the course evaluation system. For the three question sets from the course evaluation I received the following evaluation from 100% of the 27 students:

University of Nebraska-Lincoln Student Evaluation Data

For items 1-19: 1 = never, 2= rarely, 3 = sometimes, 4 = usually, 5 = always

Course evaluation (items 3-7): Mean = 3.79, SD = 0.93, Mode = 4

Instructor evaluation (items 8-16): Mean = 4.13, SD = 0.92, Mode = 5

Learning evaluation (items 17-19): Mean = 3.64, SD = 1.02, Mode = 4

Overall rating: 1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent

Overall rating was "Good" (Mean = 3.11, SD = 1.09, Mode = 3)

3.3 Mentoring a Future Teacher Educator

Aaron Musson, one of my doctoral advisees, was my teaching assistant for the course, which was the first time I had an official TA in a course I taught. Before, during and after the course we spent a lot of time discussing the goals of the course, problem-solving student learning and what type of feedback to provide students and how to revise the curriculum and instruction throughout the semester. Aaron hopes to find a professor of practice position to teach future science teachers once he has completed his doctorate in educational studies. A major objective of working together to teach this second methods class was to redesign the first methods class by better understanding students' understanding of how to teach as they undertook the second course. We noted where the students were struggling and then set major learning objectives for students to complete in the first course so as to make the transition smoother to the second class for the future students. I involved Aaron in the syllabus revision before the semester started and we divided the grading equally. Periodically we needed to recalibrate our grading. For example, when we were grading the students' unit plans we graded the same students' unit and came up with a letter grade difference. Initially for this assignment I had not sufficiently explained my expectations to him, but our recalibration resulted in clearer sense of the learning objectives for him and made me think about how I could communicate more clearly to the students what I was looking for in their major assignments. While Aaron was very comfortable in his role as a science teacher he has had to think more broadly about what is important to teach future teachers. He has a tendency to want to over-pack a syllabus with a variety of resources, but is still learning how to balance showing teachers good resources and taking the time to debrief the importance of those activities and be explicit about how various teaching strategies can help students learn science.

Aaron has provided a memo about his perceptions of the teaching assistantship and how this fits into his long-term professional goal to be a teacher educator (**Appendix C**).

4 REFLECTION ON THE COURSE

There were some aspects of the course that I knew I needed to change from having taught it before. For example, knowing that the previous years' group had been very concerned about learning how to use classroom management strategies I did more explicitly provide time in the weekly agenda to provide what I called a "management moment" and share 1-2 strategies that they could use to address off-task behavior, setting up organization (e.g., by using a plan book), etc. This time students appeared to have received a sufficient amount of information to feel that they had some resources to draw upon as they taught in their concurrent practicum.

My major focus, for the course and for this portfolio project, was to improve my students' understanding of inquiry-based science instruction because I noticed early in the semester from the diagnostic test, my conversations with students, and their first lesson plans that there was a wide range of understanding and capacity to use inquiry-based instruction. Because I knew that many students were struggling with the concept, I was able to adjust my instruction to ensure that students had more examples of inquiry-based science lessons and I used more class time to answer questions and provide clarification. Even those students who generally understood inquiry-based learning and the underlying learning theory, were able to refine their understanding of inquiry and how to produce more engaging science lessons, in particular through their lesson study project.

My core approach to teaching the course was to model the use of various instructional strategies. I did receive a comment from the course evaluation that I had not modeled inquiry-based instruction through my own instructional approach. This comment troubled me as modeling is an inquiry-based approach to teaching, but also that when teaching a skill set, which is what a teaching methods course is mainly devoted to, one does tend to default to using more of a direct instruction approach. It would have been unreasonable to expect that students would engage in full open-ended inquiry about the best ways to teach. Thus, I tried to occupy the middle ground of guided inquiry in which we explored, in both small group and whole-group discussions and activities, how effective instructional strategies from the research base can be used in various teaching contexts. Now that I have thought this through beyond the student's comment, I better understand that I need to be more explicit with the students at the beginning of the course about how I have organized the class learning activities with which they will be engaged. I hope that with this extra dialogue that their expectations will be better aligned with the objectives of the course. I also realized that I need to provide students with smaller, more discrete assignments to provide them with more practice before they tackle the major course assignments.

There were some other aspects of the course that I did not anticipate as needing attention. One of my major goals for the course was to model a positive classroom community, but about halfway through the course I realized that while I frequently used small group discussion as an instructional strategy, I had not sufficiently modeled specific ways to develop this aspect. In the past I had taught the course to only one cohort of students who were already well-acquainted with each other. However, this time the undergraduates and the graduate students had taken their first methods courses separately at different times and with different instructors. While I had anticipated that there might be variation in their preparation I didn't attend to some more basic aspects of community-building. I realized, too late, that not every student in the class could name all of their classmates. While they had been working with each other comfortably in small groups and I had done an introduction activity in which they all constructed a personal "business card," this had benefited me more as their instructor than them as classmates. Next time I teach this course I will add some activities that will not facilitate their own community building in my class, but also be useful for them to use with their own students.

In the end I was satisfied with the majority of the students' progress; most of them exhibited growth over the course of the semester, even students who were highly capable were able to refine their understanding, critiques other lessons that they observed in their practicum placements with their cooperating teachers, and create stronger, more standards-aligned lesson plans. I attribute this not only to how I constructed the curriculum, but also how I assessed the students. If a student had less than an 80% (B-) on any major assignment, I required that they redo the assignment and attend to the feedback that they received. In viewing the grades for the course, they are all better than a B. Mastery of the course content was my goal for my students because I will not pass a student who is incapable of novice level teaching or better. Not only is my reputation on the line, but so is our program and university's reputation as the flagship campus for the University of Nebraska and the largest producer of science teachers in the state.

5 APPENDIX A: NSTA TEACHER PREPARATION STANDARDS

1. Demonstrate the major concepts, principles, theories, laws, and interrelationships of their fields of licensure.
2. Plan multiple lessons using a variety of inquiry approaches that demonstrate preservice teachers' knowledge and understanding of how students learn science.
3. Include active inquiry lessons where students collect and interpret data in order to develop and communicate concepts and understand scientific processes, relationships and natural patterns from empirical experiences.
4. Develop an instructional unit plan that is consistent with the goals and recommendations of State and/or National Science Education Standards. Preservice teachers will plan a unit in a specific science discipline that includes the nature of science, inquiry, the social context of science, and safety. The unit includes the construction of fair, equitable, and effective assessment strategies that are designed to measure student learning.
5. Effective teachers of all science licensures are able to create a learning environment and learning experiences for all students that demonstrate chemical safety, safety procedures, and the ethical treatment of living organisms. Effective teachers of science can, in a P-12 classroom setting, demonstrate and maintain chemical safety, safety procedures, and the ethical treatment of living organisms needed in the P-12 science classroom.
6. Effective teachers of science provide evidence to show that P-12 students' understanding of major science concepts, principles, theories, and laws have changed as a result of instruction by the candidate and that student knowledge is at a level of understanding beyond memorization. Preservice teachers will collect, organize, analyze, and reflect on diagnostic, formative, and summative evidence of learning.

6 APPENDIX B: COURSE SYLLABUS

TEAC 452V/852V: Curriculum Principles and Practices (Science, Part 2)

Instructor: Dr. Elizabeth Lewis (elewis3@unl.edu)
Teaching Assistant: Mr. Aaron Musson (aaron.musson@gmail.com)
Meeting Time: Wednesdays, 4:00-6:50 pm
Place: 205 Henzlik Hall
Offices: Suite 211 Henzlik Hall
Office phone numbers: Lewis: 402-472-2251 Musson: 402-472-9074
Office Hours: Wednesdays, 3:00-4:00pm
* *Best way to reach us is through email. Appointments may also be arranged on an as-needed basis.*

Course Description

Prereqs: Admission to the Teacher Education Program at the undergraduate or MA level; completion of at least one single subject endorsement area course work with 2.5 GPA or better and TEAC 451V/851V with a C+ or better. Focus on practical issues in the area of teaching and learning as applied to the individual disciplines, including: curricular materials, the use of formative assessment to inform instructional decision-making, and classroom instruction with diverse populations.

****NOTE:** Undergraduates you must pass this class with a C+ or better to be allowed to proceed to student teaching. MA students you must have a B or better for your degree.

General Class Information

- All students are expected to adhere to the *UNL Student Code of Conduct.*
- Please turn all phones off, or to vibrate, and wait until class is over to accept/return non-emergency calls. No text messaging during class. If you have an emergency situation with which you potentially need to be available to accept an incoming call, please let me know at the beginning of class.
- Successful completion of this course is required for teacher certification through UNL.
- Missing one or more classes may affect your understanding of the course material and grade. During the semester it may be unavoidable to miss one class and there will be no deduction, but you are expected to make up the work missed and set up a time to meet with the instructor(s). Once you know you will be absent please inform me ASAP. If you have more than 2 absences, you will be advised to retake the course at another time.

Diversity

The University of Nebraska - Lincoln is committed to a pluralistic campus community through Affirmative Action and Equal Opportunity. We assure reasonable accommodation under the *Americans with Disabilities Act*. Students with disabilities are encouraged to contact me for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska - Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) Office, 132 Canfield Administration, 472-3787, voice or TTY.

Academic Freedom

Over the course of this semester we may address a variety of controversial topics including matters of race, gender, culture, religion, morality, sexuality, and violence. You have a right to believe whatever you believe about such matters and are encouraged to express your views on all matters relevant to the course, even if others in the class may be offended or upset by those views. You also have a right to express disagreement with whatever views I or others in the class express. Finally, you have a right to decide whether or not to modify your views. Your grade in the class will be based on understanding and reasoning, not on your opinion.

<u>Essential Question</u>: How does a scientific classroom discourse community support student learning?

Question Elements

1. How do teachers' experiences, beliefs, perceptions and attitudes affect their science instruction?
2. What is active learning (e.g., inquiry-based science instruction and how it is similar and different from hands-on learning) and what cognitive learning principles is it based upon?
3. What is, and isn't, science? In what ways is science done? (i.e., the nature of science)
4. Relevant science instruction (i.e., how do we provide meaningful science experiences for students?)
5. How can we bridge students' everyday understandings and language and the academic culture and language of science?
6. How do educational standards, learning principles (i.e., human cognition), and pedagogical knowledge affect instructional planning?
7. What are the different purposes of assessment in science?
8. How does assessment inform instruction? (i.e., formative assessment)

Required Texts & Technology

1. Lawson, A. (2010). *Teaching inquiry science in middle and secondary schools*. Los Angeles, CA: Sage Publications.
2. Wiggins, G. (1998). *Educative assessment.* San Francisco, CA: Jossey-Bass Publishers.
3. Wiggins, G. & McTighe, J. (2006). *Understanding by design: 2nd Edition*. Upper Saddle River, NJ: Pearson, Merrill, Prentice Hall.
4. Access to Blackboard
5. Flash drive

Recommended

1. Herr, N. (2008). *The sourcebook for teaching science: Strategies, activities, and instructional resources.* This is a good resource for the beginning science teacher.
2. Laptop computer/iPad that can be brought to class.

Other Useful Resources & References

General Science Education & Teacher Professional Development

National Science Teachers Association (NSTA). For $35 you can get a preservice teacher 1-year membership to NSTA and 8 issues of the grade level (i.e., elementary, middle, high school) journal that you prefer at http://www.nsta.org; the journal contains many practical lessons, activities, and strategies to use in your own classroom. ***If you join the UNL student chapter of NSTA you are eligible for a free 1-year online membership (i.e., no print journals).***

National Science Education Standards (1996) at http://www.nap.edu/readingroom/books/nses
The national standards are not a curriculum, but rather a guide for selecting content and designing lessons. Most states use the NSES as a base for their articulated state science standards.

Next Generation Science Standards (NGSS, 2013). New national science education standards have been drafted and are in the process of being adopted by states. Available at: http://www.nextgenscience.org/next-generation-science-standards

Benchmarks for Scientific Literacy (AAAS, 1993) The NSES incorporated this document and its predecessor, and visionary mission statement, *Science for All Americans* (1989). Found at http://www.project2061.org/publications/bsl/online/bchin.htm

Annenberg Media: *A Private Universe, Minds of Our Own.* You can download videos of student misconceptions AND science content on many science topics at http://www.learner.org/index.html

* Free registration to download and watch streaming videos.

NSTA Teacher Preparation Standards

1. Demonstrate the major concepts, principles, theories, laws, and interrelationships of their fields of licensure.
2. Plan multiple lessons using a variety of inquiry approaches that demonstrate preservice teachers' knowledge and understanding of how students learn science.
3. Include active inquiry lessons where students collect and interpret data in order to develop and communicate concepts and understand scientific processes, relationships and natural patterns from empirical experiences.
4. Develop an instructional unit plan that is consistent with the goals and recommendations of State and/or National Science Education Standards. Preservice teachers will plan a unit in a specific science discipline that includes the nature of science, inquiry, the social context of science, and safety. The unit includes the construction of fair, equitable, and effective assessment strategies that are designed to measure student learning.
5. Effective teachers of all science licensures are able to create a learning environment and learning experiences for all students that demonstrate chemical safety, safety procedures, and the ethical treatment of living organisms. Effective teachers of science can, in a P-12 classroom setting, demonstrate and maintain chemical safety, safety procedures, and the ethical treatment of living organisms needed in the P-12 science classroom.
6. Effective teachers of science provide evidence to show that P-12 students' understanding of major science concepts, principles, theories, and laws have changed as a result of instruction by the candidate and that student knowledge is at a level of understanding beyond memorization. Preservice teachers will collect, organize, analyze, and reflect on diagnostic, formative, and summative evidence of learning.

Overview of Course Assignments & Attendance Policy

Both 452V & 852V:

1. **Science Education Notebook/Participation (10%):** Two checks, includes data collection and essay assignments as well as in-class activity writing.
   Attendance: You are part of a learning community and your participation is critical to your success and the quality of the interactions people have during our class meetings. However, I recognize that sometimes unexpected and unavoidable emergencies occur. No penalty for 1st missed class meeting; 5% deducted from final grade for each additional missed class. You will be advised to retake the class at another time if you miss more than 3 classes. You are expected to make up any missed class activities and some of this work is graded via the notebook.

2. **Unit Plan (20%):** This will include all the materials to teach a 4-6 week unit, developing an essential question with supporting questions subsumed under the major selected concept. It will encompass the descriptors under one of the Nebraska State Science Standards. A complete description will be forthcoming as we begin to look at assessment in greater detail.

3. **Year-long Curriculum Plan (15%):** This should be for one course you are likely to teach and will be based on the new Science Framework and the Nebraska State Standards. It will include essential questions and supporting questions from which you will base lessons. A complete description of this assignment will be available when we look at the big picture (see Chapter 12 in *Understanding by Design*).

4. **Science Lesson Study Project (40%):** An on-going project to practice and refine how to teach an inquiry-based science lesson. You may work with a partner or by yourself to do the following:
   (a) 1st lesson plan (10%)
   (b) (team-)teach, peer critique, re-plan, write a 2nd lesson plan with a comparison chart of old and new lesson plan changes and justification (10%)
   (c) teach 2nd lesson
   (d) give an in-class presentation (5%)
   (e) write a final report (15%).

5. **Final Paper: *Teaching philosophy, professional goals, and course reflection* (15%):** Revision of assignment from TEAC851V; a statement suitable for your professional portfolio and interviewing for a teaching position that includes your science teaching philosophy, long-term professional development goals for teaching science, and a metacognitive course reflection on your own learning throughout the semester.

<u> For MAst students only</u>:** Write proposal for capstone teacher action research project (part of spring semester work for TEAC 889….grade will be posted as part of that course). I will take some time with this group separately to review the requirements and process of designing this project.

Assignment Due Dates & Late Work Policy

Assignments are due as listed in a hard copy format; it is not our responsibility to print your work. If you have printer problems, email the file to me **before** class starts to show that you have completed the assignment and avoid a late penalty, but then follow up by turning in a hard copy to me or my mailbox (118 Henzlik Hall). If you need an ***extension*** to complete your work you must communicate with me at least **24 hours before** the assignment is due. If you have a ***planned absence*** you must turn your work in when it was originally due (i.e., give it to a classmate to turn it in or leave in my mailbox by the time class begins that day).

Work that is **late** without such prior arrangements will incur a late penalty of one letter grade per 24-hour time period and receive no credit after 72 hours (e.g., at the beginning of class I will collect your assignment, and for 24 hours the assignment is late with a deduction of 10% off, between 24-48 hours 20% is deducted, and 48-72 hours, 30% deducted).

Grading Scale

A = 100 - 93	C+= 79 - 77
A- = 92 - 90	C = 76 - 73
B+= 89 - 87	C- = 72 - 70
B = 86 - 83	D = 69 - 60
B- = 82 - 80	F = 59 - 0

Course Outcomes

Awareness

Students will have the opportunity to explore, independently and as a discourse community, their understandings of:

1) the purpose of science education
2) their beliefs about teaching science
3) how inquiry-based science instruction gives underrepresented students (e.g., ethnic minorities, girls, low SES, and learning challenges) and students with special needs greater access to learning science
4) the integral role of formative assessment in teaching and learning
5) how students learn from both cognitive and social-constructivist perspectives

Active Learning

Students will be provided with:

1) written prompts to reflect upon their understanding of science education issues
2) examples of various types of instruction and classroom discourse structures with which to teach science
3) activities that model various types of inquiry-based science lessons

Practical Application of Theory

Students will have the opportunity to:

1) practice designing their own science lessons and units
2) conduct a lesson study project to analyze their assessment and instructional practices using student work

"Pay attention not only to the cultivation of knowledge but to the cultivation of qualities of the heart, so that at the end of education, not only will you be knowledgeable, but also you will be a warm-hearted and compassionate person."

~ Dalai Lama

Class, Reading, & Assignment Schedule

***** Syllabus is subject to change. *****

Meeting		Agenda	Assignments for next class
1	Aug. 28	**Introduction to Building a Scientific Classroom Discourse Community** 1. Syllabi overview 2. Science notebooks and materials a. How to organize notebooks b. Writing-to-Learn 3. Science Teacher Business Card 4. Model of a Scientific Classroom Discourse Community 5. ***Knowing Your Students and LP #1: Addressing Preconceptions***. What do we know about accessing students' prior knowledge? 6. *Fish is Fish* (Leo Lionni, 1970). • What could Fish do to be a better student? • What could Frog do to be a better teacher? **Handout:** *How People Learn* (2005) excerpt 7. KWL: Teaching Science 8. Diagnostic test and ticket out the door: What questions and concerns do you have about teaching science? What do you hope to learn more about the mechanics of teaching science this semester?	**Homework** 1. **Read:** Lawson, Ch. 9 2. **Review** Spring Creek Prairie website and **write** 3 questions for the workshop facilitator about the center and the resources. *From TEAC451V/851V:* *I expect that you have read Lawson Chapters 2-8* *W.& McT. Ch.1, 2, 5, 7 & 9*
2	Sept. 4	**Fieldtrips/Outdoor Education,** **Connections to Informal Science Education** ***Meet at Audubon Center, Spring Creek Prairie at 4:30pm*** 11700 SW 100th Street, Denton, NE 68339 *Bring science notebooks to record notes and activities from workshop,* *dress for outdoor activities.*	**Homework** 1. **Due Sept. 11: Notebook essay #1** (150-250 words, typed): How could you use a resource like the Audubon Center at Spring Creek Prairie to teach science?
3	Sept. 11	**Review of Inquiry-based Instructional Methods** **** DUE: Notebook essay #1 **** 1. Fieldtrip recap & next steps a. Fieldtrip articles small group discussion b. Standards c. How would you use this type of resource? 2. Review 5E Model of Inquiry Instruction d. Foam activity revisited e. Using discrepant events (Engage) f. (Explore/Explain) Using data to write Scientific Explanations (Claims, Evidence & Reasoning):	**Homework** 1. **Read:** W. & McT., Ch. 3, and *Alien Abduction* (Shermer, 1997) 2. **Due Sept. 18: Notebook essay #2** (150-250 words, typed): Describe three ways you could use different aspects of inquiry to teach in your content area.

		i. What is a scientific explanation? ii. Tricky Tracks	
4	Sept. 18	**Nature of Science (NOS) & Science and Society** **** DUE: Notebook essay #2 **** 1. Organization: Using a plan book 2. Chemistry & inquiry a. NSTA article b. *Chemistry in the Community* text 3. Small group discussion (Shermer reading): a. What is, and is not, science? b. Nature of Science Activities: Mystery Boxes 4. Activity: *25 Fallacies That Lead Us to Believe Weird Things* 5. Reflection of changes in NOS and conceptual understanding through time (ex., Plate tectonic theory) 6. Establishing relevancy: bridging the everyday to the academic a. Using local & global issues and current events to connect to science instruction	**Homework** 1. **Read:** Lawson, Ch. 10 & Lesson study article (Bb)
5	Sept. 25	**Community Norms & Discourse** 1. Classroom management (partnering strategy): a. "Clock Buddies" 2. Reading discussion (jigsaw) 3. Setting up community norms for a scientific classroom discourse community. 4. What supports talking and writing in science? a. DiISC scales 5. What helps groups (small and whole) function?	**Homework** 1. **Read:** W. & McT., Ch. 9 & 10 2. **Due Oct.2:** Notebook Check #1
6	Oct. 2	**Using Science Standards** **** Due: Notebook Check #1 **** 1. Standards Overview a. AAAS: Benchmarks for Scientific Literacy & Strand Maps b. National Science Education Standards i. 1st version (1996) ii. Next Generation Science Standards (NGSS) (2013) 1. Framework 2. Disciplinary core idea (DCI) 2. Cooperating teacher panel	**Homework** 1. **Read:** Lawson, Ch. 12, W. & McT., Ch. 11 2. **Write:** 1st lesson plan for teaching ***Teach lesson by Oct. 15***
7	Oct. 9	**Conceptual Frameworks & Modeling Science**	**Homework** 1. **Read:** Lawson, Ch. 13,

		Concepts **** Due: 1st lesson plan for teaching **** ***Learning Principle #2: Placing Facts within a Conceptual Framework.*** 1. Dweck (2010) reading discussion 2. Cognition resources 3. Card sorts & concept card mapping (Technology connection: Cmap tools) 4. Concept mapping versus semantic mapping **…………………………………………………** **DO NOT RE-TEACH SCIENCE LESSON UNTIL AFTER PEER CRITIQUE CLASS**	Wiggins, Ch. 1 2. Select core concept for unit plan.
8	Oct. 16	**Using a Theme to Organize a Unit of Study** 1. Whales Example 2. Energy (NSGG) 3. Review unit plan assignment	**Homework** 1. **Read**: Wiggins, Ch. 2 & 3 2. **Notebook essay #3:** (150-250 words) TBA 3. **Due Oct. 23:** Outline of unit plan
9	Oct. 23	**Assessment** ****Due: Outline of unit plan**** 1. NSES (1996) Assessment Standards 2. Assessment audiences 3. Changing emphases 4. Types of Assessment a. Alternative b. Authentic 5. 5E with assessment examples 6. Ticket-out-the-door: Mid-semester check	**Homework** 1. **Read**: Wiggins, Ch. 6 & 7 2. **Bring to next class:** original lesson plan, student work from the lesson, your observation notes
10	Oct. 30	**Using Formative Assessment Data *(Professional Learning Community Model)*** **** Bring lesson plan, student work to class for peer critique **** 1. *Understanding by Design*: Review of Key curricular design a. Clarifying content priorities b. Developing essential questions c. Types of teaching (when to use what) i. "Uncoverage" vs. "Coverage" with textbooks ii. Techniques to check for understanding 2. Lesson study peer critique of science lessons 3. Unit design feedback a. Entry points for the design process b. Logic of backward design	**Homework** 1. **Read:** W. & McT., Ch. 12 2. **Plan:** re-teaching lesson 3. **Due Nov.6:** Revised lesson plan with comparison to 1st lesson

11	Nov. 6	**Metacognition** **** Due: Draft of year-long plan**** **** Due: Revised lesson plan with comparison **** ***Learning Principle #3: Self-Monitoring & Metacognition.*** How to structure science-based reflection on one's learning. 1. Phases of metacognition 2. Learning logs 3. ePortfolios 4. Summary of learning principles and connection to teaching strategies 5. Guest: Engineering Education	**Homework** 1. **Read:** W. & McT., Ch. 13 2. **Due Nov. 13: Year-long plan**
12	Nov. 13	**Interdisciplinary Connections** **** Due: Year-long plan **** 1. Science & Art a. Art as inspiration b. Observation as a cross-cutting skill c. Art as an assessment/product 2. Science & Language Arts a. Science biography b. Non-fiction readings and science	**Homework** 1. **Due Nov. 20:** Draft of unit plan for peer feedback
13	Nov. 20	**Encouraging Equity and Diversity in Science** **** Due: Notebook Check #2 & Draft of unit plan for peer review **** 1. Plan book examples 2. Peer review: Unit plan 3. Issues of Equity & Science Education a. Prior knowledge b. Presentation & discussion 4. Guest: Rich Powers a. Middle school lesson example of integrating engineering content 5. "Little Bits" kits a. Building background knowledge b. Access to engineering content c. What could you do with students using these materials?	**Homework:** 1. **Read:** Lawson, Ch. 11 **2. Due Dec. 4:** Unit plan
	Nov. 27	**Thanksgiving Break: No class**	

14	Dec. 4	**Diversity (con't)** **** Due: Unit Plan **** 1. English Language Learners/Pluralistic a. Learning center framework 2. Cultural diversity a. Wonderwise: African plant explorer b. Video viewing focus c. Navajo pedagogy & Earth systems 3. Gender equity a. Project Explicit: Gender-Science IAT b. Myth of Pink & Blue Brains	**Homework** 1. **Due Dec. 11:** Teaching philosophy, professional goals & reflection paper
15	Dec. 11	**Engineering and science education** **** Due: Teaching Philosophy, Professional Goals**** 1. New Teacher Toolbox (NSTA): Homework & Teaching Philosophy 2. V-maps and science investigations 3. ePortfolio	**Homework** 1. **Due at exam:** Lesson Study Final Report & Presentations
*	TBA	**Exam Week, Presentations** **** Due: Presentations & Lesson Study Final Report **** 1. Lesson Study Presentations: Poster Carousel 2. Course evaluation 3. Closing	

7 APPENDIX C: MEMO FROM TEACHING ASSISTANT

Aaron Musson

18906 Benton BLVD
Elkhorn, NE 68022
Phone: 402-516-8814
Email: aaronmusson@gmail.com

To: Peer Review of Teaching Program

From: Aaron Musson

cc: Dr. Elizabeth Lewis

Date: 5th June 2014

Re: Account of Mentorship

For the past three years I have worked as Dr. Lewis's graduate assistant. Although I entered graduate school with seventeen years of teaching experience in private, public and post-secondary settings, I have benefitted from Dr. Lewis's mentorship during the thoughtfully planned, iterative and expanding teaching apprenticeship she set out for me. My apprenticeship and Dr. Lewis's mentorship has helped me understand the teacher education process, improve my own teaching and find a potential space within the teacher education community.

During my time as her graduate assistant, Dr. Lewis and I have worked together to gradually develop my capacity as a teacher educator. During my second semester as a graduate student, I worked as a teaching intern in Dr. Lewis's elementary science teaching methods class in preparation to teach the class during the following summer. My background is in secondary science teaching, and I was initially uncomfortable working in the unfamiliar space of elementary education. Dr. Lewis modeled her approach to the content and provided appropriate challenges, support and encouragement for me as her teaching intern. I welcomed her support and encouragement as I struggled the following summer, leading a class of future elementary school teachers on my own. I am unaccustomed to feeling like I haven't reached all my students, and Dr. Lewis helped me assess the course and my teaching. It is now two years later, and I feel a greater sense of confidence in my ability to work with preservice elementary teachers and to make the content of the class accessible and meaningful to my students as I prepare to teach the class again this fall.

I attribute most of my comfort working with preservice teachers to the gradual assumption of teaching responsibility in the first secondary science teaching methods class, and in my understanding of the scope and sequence of both teaching methods courses. On Dr. Lewis's suggestion, I arranged to shadow Dr. Tilgner's undergraduate Methods 1 class in the spring of

2013, and in the following fall, Dr. Lewis deployed me as her teaching assistant in Secondary Science Teaching Methods 2. In contrast to my previous experience as her intern, I had more to contribute to the course, and for most of the semester I believe Dr. Lewis and I were as much "co-teachers" as we were "professor and TA." Dr. Lewis observed and critiqued one of the classes I taught; she provided detailed feedback, and we discussed ways I could refine my teaching approach.

My immersion in the content of the second methods course informed my construction of the course syllabus for my version of the first methods class. I worked with Dr. Lewis over the 2013-2014 semester break to develop the Methods 1 course sequence and content. Dr. Lewis provided help as I needed, particularly by insisting upon strong rationale for any content used in the class. Judging from the course evaluations, I taught the course successfully. I am currently teaching the Methods 1 course independently for the second time. Based on the template developed with Dr. Lewis, I have planned all aspects of the course, including scheduling guest experts and field trips, coordinating with our cooperating school district to schedule clinical experiences and to obtain permission for my students to interview high school students for a class assignment.

Dr. Lewis's approach to mentoring is multi-faceted and effective. I participated on the periphery of teacher education during my first teaching internship and have grown into a fully involved participant. Dr. Lewis has been and continues to be available to me as a coach and source of support, to point out areas of excellence and those areas that need work. The gradual increase of responsibility I experienced through my apprenticeship with Dr. Lewis has built my confidence in and ability to teach undergraduate- and graduate-level preservice teachers.

Sincerely,

Aaron Musson

[i] INTASC has assembled a document summarizing standards for teacher educators and professional development providers and outlines learning progressions for teachers. The learning progressions are composed of 10 standards for teaching and sets and describes three progression levels with increasing mastery in the areas of performances, essential knowledge, and critical dispositions.