

Research and Practice: in Science Education: Theories of Science Learning and Teaching. Education 212B

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In this course we will examine theoretical approaches to the learning and teaching of science including the nature of scientific knowledge, theories of how children learn science, approaches to scientific discourse, and perspectives on addressing diversity in science classrooms. There is a strong emphasis on the California State and the National Science Education standards. Theories discussed in the course will include but not limited to behaviorism, constructivism, social/cultural theory, and liberatory pedagogy. This course is required for the single subject science credential program at UCSC and is a direct introduction to Educ 212A, Science Teaching Methods for middle and secondary school.

Materials required

TEXT

Ogborn et al, (1995). Explaining Science, Open University Press.

Course Reader:

See contents below

Reflective notebook

Participants will keep a reflective journal of their reactions/reflections on course readings and activities. Journal entries will be used as a basis for class discussion, and as a place to take additional notes. In addition, journal entries will be submitted to course instructor for feedback and evaluation.

Handouts as necessary, please keep with notebook

Course Requirements and Evaluation

Required assignments: 4 short written pieces (2-3 p) and a final project (10-12 p)

Written assignment 1

Select a scientist, from any discipline in any science, present a short synopsis on their view of science, and how that informs your view, theoretically or practically

Prepare an oral presentation to the class, a 5-minute talk--

and a 2-3 page summary of main points.

Be sure to address the issue of difference. Please include how this scientist reflects the social and cultural norms of his/her discipline or era. If this scientist was considered a maverick or different because of beliefs /culture or background address how this diversity was accepted by the seminal minds of the discipline.

Written assignment 2—Designing for equity science learning

There are three main readings, Brown et al, Metz, and How People Learn (HPL) summary. Each of you will be reading 2 of these. Your job is to write a 2-3-page piece that describes how the theory in your two pieces has practical applications for classroom equity practice.

These are long pieces--

If you have Metz

Consider these points-

What would our curriculum look like if Metz were designing work in science for students of all ages and abilities-?

What does Metz think about so-called stage constraints on children's understanding?

If you have Brown et al

What does this piece say to you regarding the design of classrooms

What would Brown et al say about multiple access points for all kinds of learners?

All will read HPL summary and will make a comparison with the other piece read.

Be sure to include in this overview how a variety of learning styles are addressed by these researchers, and how access to science can be enhanced for all students.

Written assignment 3—Content learning in science and the standards

Select one from the articles on content learning and any added to the list- (or you may pick your own article on learning science content).

Write a 2-3 page piece that summarizes your view of the learning that is described in this piece.

Do you agree with the piece, disagree, why?

Be sure to address how/if these views reflect access for all to science and if they meet the California or national standards.

Could you use it to help design equitable classroom learning environments?

Alternatively you may compare and contrast two different articles.

Written assignment 4—Science Talk

From the articles available on talk and science, write a 2-3-page piece that compares and contrasts the four main writers, Wells, Gallas, Lemke and Ogborn

What is the main feature of each and

Where do they overlap? and/or disagree? Why?

How or if do they address equal access to science discourses for all learners?

Final Project

The Final Project can take one of three forms. It must integrate all the work we have done to date and take this into a new line of thinking. You must incorporate the California State Standards and equitable practices suitable for all learners. Your new line of thinking can culminate in one of three forms, curriculum design, critical review of a text or an independent classroom-based research project. The final document will be 10-12 pages long and have three main parts:

1. Context/Background

What you are doing and why, how it fits into the main stream of thinking of this course or how it differs from it. In either case you must use the course readings and discussion as a background for your new work. 1-2 pages

2. The main body of the piece

Your data and analysis, your critical review of a text or your curriculum design of three lessons plans and reflective rationale interspersed. (8-10 pages)

3. Lessons learned

What have you learned in doing this work? (1-2 pages)

1. A curriculum design piece (see below)

For the curriculum design piece see the design guidelines and I lesson plans for templates

Or

2. A critical review of a text--

For this there are many books on reserve at McHenry library and I have list of many others. You can also suggest your own.

Or

3. Independent Research Project. You must clear this with me first before you proceed.

Sample template for final curriculum design project

The curriculum design assignment should include the following:

1. Context:

Give an overview of the entire unit—

Give a reason for choosing this particular topic. Why is it worthwhile in science, or in life, or for the community? Why is this topic(s) important to teach to children.

2. Design

Three lessons in the format suggested (1-2 pages each).

These can be sequenced chronologically, or as beginning middle and end of the unit or some other arrangement.

Deliberate sequencing, Explain the sequencing you have chosen, why this particular order?

Place the three examples within the larger context of the entire design. For each activity, make sure you match activity to purpose, make the purpose clear both individually and overall. Include time for meaning-making.

Equitable Practice

Particular pedagogy styles or methods of teaching that have been selected and how this advances learning for all types of learners. How you will make meaning at the end, any particular participant structures or interest and why.

Standards

How is it related to the California State Standards

3. Lessons Learned

Your reflections on the process

Please draw from your previous class work, e.g. scientist study, activity modification, classroom observations, content piece from web etc, to amplify this discussion.

Course Evaluation

Attendance is required. No more than 3 absences. Passing (P) is equivalent to a B grade for graduate courses (70-80% of all points). Papers can be revised. Late work with valid excuse, only, accepted.

Evaluation will be on the basis of participation, presentations, and written work:

- 4 multi-page written documents (approximately one due every two weeks) **30%,**
- Participation in class discussions of the readings, videos or other activities **20%,**
- oral presentations (2) **10%**
- A reflective course notebook **10%**
- An end of quarter research paper **30%.**

Each assignment will be returned with the following rubric:

	Grade
Excellent/outstanding work	A
Very good work	B
Satisfactory work	C
Needs revision	D

Narrative Evaluation Format

Overall, this student's participation and written assignments indicated

- impressive
- well-developed
- a good working
- satisfactory
- uneven
- minimal
- understanding of the ideas in the course.

Class participation:

- made strong contributions to class meetings
- was clearly engaged during class meetings
- contributed insightful ideas and supported other students' learning
- listened actively and contributed to the classroom dynamics
- attended class regularly
- was usually present
- attended irregularly
- was often absent

Written assignments

The required essays were usually:

- extraordinary, with coherent analysis that integrated ideas and evidence in well-developed and eloquent reflections
- very well developed, with clear connections between ideas and evidence to support the arguments
- of good sound quality, reflecting active engagement with the topic, though in places the work would have benefited from being pushed further
- satisfactory though somewhat uneven, at times sketchy and not sufficiently grounded in the course materials or not addressing the topic fully
- not satisfactory, either showing a lack of adequate engagement with the topic or not turned in at all.

The required notebook showed:

- extremely thoughtful engagement with the ideas
- thoughtful engagement with the ideas
- uneven engagement with the ideas

The required presentations showed:

- extremely thoughtful engagement with the ideas
- thoughtful engagement with the ideas
- uneven engagement with the ideas

The required research paper showed

- extremely thoughtful engagement with the ideas
- thoughtful engagement with the ideas
- uneven engagement with the ideas

Items below apply to only some students:

I observed impressive progress in _____ understanding of the course material, as evidenced by improvements in understanding of the readings and class material, or depth of analysis of ideas and evidence, or coherence and organization of ideas expressed.

_____ went beyond the assigned work in class by _____ (extra presentation, optional rewrite, optional reading annotation).

This was clearly honors quality work.

Of the 9 writing assignments _____ were late or missing

Below is a schedule of the readings and the anticipated weekly topics. .

Each written assignment follows the written description given above.

Expect that there will be changes

Week 1

The Nature of Science

1. Chiappetta. et al 1, (1998) The nature of Science (chap 1) in Science Instruction in the Middle and Secondary Schools. Prentice Hall.
2. Gallas, K (1995) What is science? In Talking their way into science. Teachers College Press.
3. Selected readings of diverse scientists on the process of science

Assignments

Read Case study 1

Read both Gallas & Giappetta

Be ready to discuss both

Pick out salient features (at least three) for each piece

Written assignment 1 (see above)

Week 2

Inquiry: an introduction

1. National Research Council (1996). Images of inquiry in the classroom, National Science Education Standards.
2. Chiappetta et al (1999). Background for teaching science. In Science Instruction in the Middle and Secondary Schools. Prentice Hall.
3. Selected reading on inquiry science teaching

Assignments

Read/skim both articles

Be prepared to discuss salient features

5 minute presentation on scientists' view of science

Class discussion emphasis

Meta issues how do weeks 1 and 2 overlap in main points.

How are our views of science determined by our social/ cultural background?

Compare NSES and California State Standards on Inquiry/Investigation.

Written assignment 2—Designing for equity science learning (see above)

Week 3

Science Standards and Teaching

1. National Research Council (1996) National science education standards.
Summary piece
2. California State Science Framework and Content Standards, K-12
3. National Research Council (1996) National science education standards.
Science teaching standards

Assignment

Reading 1 and 2

Class discussion

Comparing the content standards across grade levels and content. We will do a direct mapping of the National and California content standards. We will look closely at grades 6-12, dividing out as small groups to deeply examine one grade level then teach this material to the rest of the class.

Reading 3—choose from one of the available readings on teaching with the California standards in mind.

Class discussion that compares and contrasts these readings

Week 4

Learning

1. Brown, A. L., Ash, D., Rutherford, M., Nakagawa, K., Gordon, A., & Campione, J.C. (1993). Distributed expertise in the classroom. In G. Salomon(Ed.), Distributed Cognitions
2. Metz, K. (1995). Reassessment of developmental constraints on children's science. In Review of Educational Research.
3. National Academy Press (1999). How people learn. Bridging Research and Practice
4. National Academy of Science (2000). How people learn. Bridging Research and Practice
Learning with Understanding Seven Principles, National Academy Press.

Assignment

Half class reads 1

Half class reads 2

Whole class reads 3

Jigsaw discussions

Hand in written assignment 2

Discussion of assignments. Be prepared to summarize and defend your written piece
Read Ogborn et al chap 1

Week 5-6

Learning and The Content of Science

Content readings (one reading is to be chosen from this list, and more articles will be added)

1. Cartier, J. & Stewart, J. (2000) Teaching the nature of inquiry: Further development in a high school genetics curriculum Science and Education (9): 247-267.
2. Hammer, D, (1996). More than misconceptions: Multiple perspectives in student knowledge and reasoning, and an appropriate agenda for education research. American Journal of Physics 64(10) pp 1316-1325.
3. Mayr, E. (1988). Is there an autonomous biology? in Toward a new philosophy of biology.
4. Minstrell, J. (1999). Implications for teaching and learning inquiry: A summary. . In Teaching and Learning in an inquiry-based classroom (Eds.) J. Minstrell & E. Van Zee: AAAS.
5. Southerland, S. A. et al (2001) Understanding students' explanations of biological phenomena: Conceptual frameworks or P--prims. Science Education 85(4) 328-347.
6. Wright, R. (1999). The accidental creationist: why Stephen Jay Gould is bad for evolution. New Yorker. December. pp 56- 65.

Read Ogborn et al chap 2 and 3

Hand in reflective notebooks for review

Read Cartier or Southerland on life science
and be prepared to take a view and defend your ideas

Read Minstrell or Hammer on the physical sciences

Written piece 3

Choose one of the other articles in the list not read already.
Be prepared to discuss it in class.

Week 7-8

Talking and Explaining Science

1. Gallas, K (1995) Science Talk In Talking their way into science. Teachers College Press. (chap 2)
2. Lemke, J. (1993). Two minutes in one science classroom. Talking Science: Language, Learning and values. Ablex.(chap 1)
3. Ogborn, et al (1995) Classroom explanation and science, in Explaining Science, Open University Press. (chap 6)
4. Ogborn, et al (1995) Dynamics of explanation, in Explaining Science, Open University Press. (chap 6)
5. Wells (1999) Dialogic Inquiry chapter in Action, Talk and Text, Teachers' College Press.

Assignments

Wells and Gallas

Three salient features of each

Read Lemke

Compare to Gallas and Wells

Read Ogborn Dynamics of explanation chap 6

(Compare to three previous readings)

Classroom discussion on dialogue and equal access to diverse students, multiple ways to indicate that learning has occurred.

Written piece number 4

Week 9

Assessment

- 1 Black, P. & Wiliam, D. (1998). In side the black box. Kappan.
2. Chiappetta. et al (1998) The nature of Science (chap 14) in Science Instruction in the Middle and Secondary Schools. Prentice Hall.
3. Selected reading

Assignment

Read Black

Week 10

Equity and Science Teaching and Learning

1. Rosebery, A.S., Warren, B, Conant, F. R., & Hudicourt-Barnes, J. (1992) Cheche Konnen: Scientific sense-making in bilingual education. Hands On! 15(1), 1, 16-19.
2. . Stigler, J. and Hiebert, J. (1999). Teaching is a cultural activity. In The Teaching Gap.

- (Chapter 6, pp. 85-101). The Free Press.
3. Ash, D. (2003) Reflections on Scientific sense-making conversations in two languages.
 4. Hunter, L. Center for Applied Optics Minorities in the Sciences: Annotated Bibliography.
 5. Selected Readings

Assignments

Read Rosebery & Warren and Barnett & Hodson

Final project is due

Oral and 1 page summary due

See separate write-up guidelines of project

Addendum

References

TEXT

Ogborn et al, (1995). Explaining Science, Open University Press.

Other Online resources

National Research Council (1995) National science education standards. (1995)
Center for Science, Mathematics, and Engineering Education (more titles from CSMEE)
<http://books.nap.edu/books/0309053269/html>

Steve Olson and Susan Loucks-Horsley, Editors (1998). Inquiry and the National Science Education Standards: A Guide for Teaching and Learning. Committee on the Development of an Addendum to the National Science Education Standards on Scientific Inquiry, National Research Council
<http://www.nap.edu/catalog/9596.html>

Inquiry: Thoughts, Views, and Strategies for the K-5

Classroom: A monograph for professionals in science,
mathematics, and technology education

Written by Institute for Inquiry Staff and Colleagues for the
FOUNDATIONS series, published by the National Science Foundation.

<http://www.exploratorium.com/IFI/resources/ifibook.html>