Non-refereed Journals

Clemente, R. (2015). Start at the beginning: Unpacking experience to gain insight on how to teach science. Journal of Success in High Needs School. Invited article for an issue devoted to the Next Generation Science Standards. Will be found at http://acifund.org/college-leadership-support-initiatives/journal. This link is no longer active. ACI is the Associated College of Illinois https://acifund.org/

Start at the beginning: Unpacking experience to gain insight on how to teach science.

This article focuses on one assignment in an undergraduate course I teach titled, EDN 326 Elementary Teaching II. Its catalog description states,

> Development of teaching methods including instructional and assessment strategies where K-12 students engage in learning experiences that improve their abilities to apply knowledge that will develop their abilities to analyze, evaluate, and create. Emphasis on differentiated instruction, indirect teaching methods, and teaching and assessment strategies that facilitate higher-level learning. (North Central College, 2014-2015, p. 108)

What is not evident from the catalog description is that the focus of the course is teaching science. The intent of the course is to use topics in 1–6 science and those related to instruction (e.g., inquiry) as a means for them to experience and apply them. By expanding teacher candidates' teaching repertoire they add to their abilities to facilitate first through sixth grade students learning so that these future students can achieve to the best of their abilities.

Abell, Appleton, and Hanuscin (2010) remind us that "learners come into a learning situation bringing with them their preexisting ideas, skills, and feeling that are organized in the mind as sets of clusters of ideas and experiences" (p.25). Teacher candidates as learners have ideas, expressed, repressed, and nearly forgotten, that influence them as they navigate their way through a teacher education program (Bransford, Derry, Berliner, Hammerness, & Beckett, 2005; Chessen & Shaw, n.d.; McCulloch, DeCuir-Gunby, Marshal, & Caldwell, 2013; Portalupi, 1995).

In order to tap into past experiences as a learner and to explore teachers' practices that color and shape those experiences, my student write an autobiography of their science experiences (see Appendix) by the second week of the term. My overall intent is two-fold. First, I want them to think more broadly about science, science teaching and how their attitude about science teaching has been molded. Second, I revisit themes that emerge from the autobiographies throughout the course as a

mean of illustrating that learning unfolds, is not a fixed proposition (Dweck, 2006), and there are many effective teaching strategies. The autobiography is an invitation to become re-aware and armed with understanding and become more receptive to other ways to teach.

Teacher candidates' introductions to the autobiographies sets the tone for what I will read.

> "I'm not sure where to even begin. I have a terrible memory and most of my childhood is a blur to me. My dad is a doctor and has always tried to push science on my sister and me….He loves science very much. I on the other hand hated science" (E.M.).

> "What I remember about my science education growing up is limited as it was many, many years ago and the way that it was taught was less than memorable" (C. K.).

> "What does science mean to me? Well, to answer that question it means a whole world-wide of experiments, great teachers, and peer pressure" (A. B.).

> "Science growing up was a love hate relationship with me. Before I started going to school my mom would always do fun little science projects with us….when I was about four my mom let me play with dish soap and a straw" (D. V.).

These are some of the voices of my students as they prepare to discuss their experiences with science and science teaching and learning. The longest section of the assignment is for students to discuss their in and out of school science experiences. To "prime the pump" I often ask students to think about their earliest experience with science and to talk with their shoulder partner. As we share a few of these (and I share mine as well, an encounter with a skull that my physician father had from medical school) it helps them recollect more experiences. They are also reminded to call home and talk to a parent or guardian about their early years. What they have to say can be poignant and represents the curriculum being taught and reveals teaching strategies, teacher attitudes, and the current pressures that shape these that are found in schools:

> "My earliest memory of science would have to be in first grade when we grew plants. Let me just start off by saying that this activity was the start of my hate for science" (E. M.).

> "I was looking forward to fifth grade. This was the year of the famous potato experiment. Instead we all had to do so many practice tests for the standardized test we needed to take that year. So all year the only science we had was reading different articles for reading and writing practice. It was not fun" (D. V.).

> "My most memorable experience with science was during my junior year of high school. I took Weather and Environment. This class provided a lot of hands-on experience. We had a field trip and a lab down on the Riverwalk. We were in groups that went out on the paddle boats to collect information on the depth of the water. Later we used this information to create a geographic map showing the contour lines for the depth of the lake. We also collected algae and other specimens that we examined under a microscope. This was memorable because it was an actual experience in the field" (S. B.).

> "We created 'Elephant Toothpaste." Hydrogen peroxide, dish soap, and yeast as a catalyst were used for this experiment…None of us expected the reaction that took place. . . It also helped to have a teacher that was so passionate about science" (E. M.).

The autobiography culminates with an analysis of the evidence from their past to consider when science was positive and when it was negative. Typically the negative experiences represent learning as reading, answering questions, taking tests, or made incomprehensible because explanations were too complex, inadequate, or students were blamed for their inability to be able to learn.

> "The direct teaching method that most of my science classes have been comprised of have left me cold and uninterested in science" (C. K.).

> "The classes that were by the textbook were not memorable at all. These provided very little experimentation or inquiry" (S. B.).

Science is characterized as positive when it is hands-on, relevant, experiential and facilitated by knowledgeable passionate teachers.

> "Positive experiences that I had were due to my teachers being so passionate about the subject and wanting us to succeed no matter how many times they had to explain something to us" (E. M.).

> "I truly believe that the positive science experiences [occurred] when the teacher is passionate about the subject and involves the students in the lesson" (C. K.). "

> Most of my positive experiences have been when I was younger because there were no social barriers to view science as nerdy or hard-work. . . . Students could create something so intrinsic and creative that it made science seem interesting and rewarding" (A. B.).

Most heartening is that the collective experiences of my students show that there are passionate engaging teachers who design interesting units/experiences throughout their education. As you might suspect some are turned off by science by middle school and others are ignited by a college class.

My students come to understand that to teach science you need to be enthusiastic ("Teachers should be excited and ready to teach each topic" E. M.), student-centered ("This means coming up with experiments that will interest them, engage them and ultimately teach them" C. K.), creative (raising a butterfly and a baby chick were visual and allowed me to be involved in science" (S. B.), and unafraid to teach using a range of teaching strategies ("Give students multiple options for learning science: through packets of information, science experiments, videos, and using websites to explore the world of science" (F. C.).

Since this assignment comes at the start of the term, I look for opportunities to refer back to the themes that have emerged and use them to support other experiences in the course. For example, many of my students have never engaged in a long-term inquiry. At the end of week one I launch either a five-week moon journal or mealworm journal experience. I encourage them to seek as many opportunities to teach science during their field experience or to explore whether their cooperating teacher would be open to an integrated lesson. Many teacher candidates primarily experience traditional teaching and a narrow curriculum with today's emphasis on reading and mathematics often reinforcing the negative experiences they have had. To counterbalance these I incorporate a range of indirect teaching methods such as a jigsaw on differentiated learning, a 5-E cycle exploring electrical circuits, or application of science process skills through a biodiversity experience or solar system experience.

Ultimately by the end of our ten-week term I hope that many of my students embody what one of my students concluded in her summary of her science autobiography,

> I never really pictured myself as someone who liked science but when I look at all the positive and negative experiences I have had with science, the positives outweigh the negative. . . It is interesting how science today is about encouraging inquiry. . .Science may have seemed like a little part of me, but now it is something that I look forward to learning more about each day from my own experience and from my future students. All I know is that science is an on-going, interesting, and enthusiastic process. (A. B.)

References

Abell, S. K., Appleton, K., & Hanuscin, D. (2010). Designing the elementary science methods course. New York: Routledge - Taylor & Francis.

Bransford, J., Derry, S., Berliner, D, Hammerness, K. & Beckett, K. L. (2005). Theories of learning and their roles in teaching. In L. Darling-Hammond and J. Bransford (Eds.). *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp.40-87). San Francisco, CA: Jossey Bass.

Chessen, D. A., & Shaw, J. M. (n.d.). Science autobiographies: Effective assessment tools. Retreived from http://msacad.org/journal/octjournal/biog.htm

Dweck, C. (2006). *Mindset: The new psychology of success*. New York: Random House.

McCulloch, A. W., DeCuir-Gunby, J. T., Marshal, P. L., & Caldwell, T. S. (2013). Math autobiographies: A window into teachers' identities as mathematics learners *School Science and Mathematics, 113*(8), 380–389. doi: 10.1111/ssm.12041

North Central College. (2014-2015). *2014-2015 Undergraduate catalog*. Retrieved from http://northcentralcollege.edu/academics/curriculum/course-catalogs

Portalupi, J. (1995). Autobiographical understanding: Writing the past into the future. *Language Arts, 72*, 272-274.

Appendix

Science Autobiography

Before you complete this methods course, it is useful for you to consider your science experiences and what science means to you. Thinking about where you have been and where you are now will help you synthesize what you have learned. Being conscious of your science background and its effects on you will help you make decisions about how to teach science when it is *your* classroom.

Getting Started:

Think about your experiences with school science, scientists, science in the media, science outside of school, and science teachers. It does not matter how limited or extensive your experiences are, or how positive or negative they are. It only matters that you describe them honestly and thoughtfully.

Relate early memories of school science and your reactions. Write about your experiences with science and with school science up to now.

The following questions can help you **think through** your science experiences:

1. How did your family take an interest in science?

2. When you look back at your science education, what do you see?

3. How much science did you study in school (include college)?

4. When did you like science? When did you dislike science?

5. What were your teachers like? In what ways did some teachers help you learn or not help you learn?

6. In examining your story, when has science been a positive experience, a negative experience?

7. What personal experiences with school science, scientists, science in the media, and science teachers stand out for you?

8. What could/should a teacher do to help students learn science?

Clip art: http://school.discoveryeducation.com/clipart/clip/thinkingcapwhoa.html

Format of your autobiography.

It should have these sections *(please use headings for each section):*

Introduction (write this last…it should provide a brief overview of what you will cover in your autobiography)

My science education (earliest memories to today - yes, birth to now – address each year of school) - Mention both positive and negative experiences in this section (provide specific examples of experiences and describe your teachers – feel free to use initials or pseudonyms and the teaching strategies they used). Save your most memorable experience for the next section.

Most memorable experience (State why this was the most memorable and provide details and examples about the experience and describe your teachers and the teaching strategies they used.)

Looking at my experiences (Look at the experiences you wrote in the last two section, critique why some of your experiences have been positive and some negative.) State whether you noticed a common set of elements that made something positive or negative.

Teaching science (Given what you have re-examined about your science experiences/education, state how teachers should help students learn science.)

Summary (state what you have discovered or reaffirmed about yourself and your experiences with science)

Evaluation of Science Autobiography

Name _____

Score _____/_____

required topics addressed thoroughly (e.g., grade levels, family experiences, personal experiences)		2	1/0	required topics addressed inconsistently or not addressed
autobiography flows smoothly from topic to topic		3	1/0	autobiography choppy, lack of smooth transitions, organized poorly
autobiography is detailed and in depth (provides thorough examples)	5	3	1/0	autobiography lacks detail and depth
reflection is evident - states (a) what has been learned by looking at the past, (b) how this may effective them as a teacher of science, (c) what new perspectives have been gained.		3	1/0	(a) list of events and experiences with little or no reflection or critique (b) reflection made in absence of details and critique of past experiences
used headings to show sections of the autobiography			1/0	few or no headings used.
used electronic page numbering			1/0	lacks electronic page numbers
proofread for spelling			1/0	not proofread for spelling
proofread for grammar, syntax			1/0	not proofread for grammar, syntax
proofread for mechanics			1/0	not proofread for mechanics
title page and stapled		2	1/0	