# Lessons about Science Learning and Advice from Two Groups of College Students


## Abstract

This study examines the science learning experiences across the lifespan of two groups of college students: adults with intellectual and/or developmental disabilities in a post-secondary inclusive program and a preservice secondary education teacher candidate program. Data were collected using a paired-interview approach in which students from each group interviewed one another about their science learning, and recorded responses using an online form. Similarities and differences emerged across and within the groups and are shared in a narrative format. Recommendations are made for current and future teachers for best practices in teaching science to all students, including those with a variety of disabilities.


## Subject/Problem

In the call for proposals for the NARST 2019 conference, the guidelines state that "we need to send clear and collectively generated messages informed by relevant research which can provide the basis for extended and reasoned conversation that rises above the din often created by charged and uninformed debate. Only this kind of conversation can lead to more informed public engagement and to decisions which result in more productive change." Yet, in the US, the science education that helps to inform individuals in order to allow them to publically engage in science varies considerably, particularly among individuals with disabilities. This study seeks to better understand the science learning experiences of all students, including individuals with intellectual disabilities, from the perspective of those individuals. Though a body of literature around best practices for teaching science to individuals with disabilities exists, including modified instruction in both science content and process skills, much of the suggested practices are based on research done *on* these individuals rather than research *by* or *with* them. As a result their voices are often muted, interpreted, or changed. To help clarify and amplify the voices of the individuals with disabilities in our work, we present narratives that are crafted using their own words, alongside those of their peers.

Recent research (e.g. Hwang & Taylor, 2016) suggests that integrating science into other content areas, including the arts, and using a STEM-based design approach such as the engineering design process can engage individuals with disabilities in science learning. These authors emphasize the similarities in the engineering design process and universal design for learning. Other authors suggest that graphic organizers and purposeful scaffolding of skills, content, and vocabulary can help enhance an inquiry based experience in science learning for these individuals (Abels, 2015; Jiminez et al,

2012). Taken together, these strategies offer ideas for enhancing engagement in science, from the perspective of the educational researcher or classroom teacher.

Our study builds on previous work (Authors, 2018) which offered recommendations for current and future science teachers to best meet the needs of individuals with intellectual and/or developmental disabilities using the *first person lived experiences* of three such individuals. The current study expanded the number of voices by using a paired interviewing approach. Students enrolled in two different programs at our institution--one designed specifically for adults with intellectual disabilities (The Career and Community Studies Program, CCS) and another traditional undergraduate teacher preparation program in secondary education (Educational Administration and Secondary Education, EASE)--were paired and asked to interview one another about their experiences learning science.

## Design/Procedure

Our work uses a narrative approach to make meaning. Riessman (2008) noted, “in narrative study, particularites and context come to the fore. Human agency and the imagination of storytellers (and listeners and readers) can be interrogated, allowing research to include many voices and subjectivities.” (p. 13) The participants in this study were paired and interviewed one another to tell and document their stories of science learning. As Riessman noted on page 24, “Storytelling in interviews can occur at the most unexpected times, even in answer to fixed-response questions.”

The interviews took place within the context of a seminar course, *Finer Things,* which included students from both programs (CCS and EASE). The course meets twice weekly for 90 minutes over an entire semester and guest faculty present modules on a variety of topics ranging from art and film appreciation to everyday chemistry. At the conclusion of a science unit (everyday chemistry in the fall, the science of water in the spring) the students were paired (one partner from each program) and given an online survey to use to interview one another. A different set of students from each program participated in the fall 2017 and spring 2018 semesters. They were encouraged to discuss their responses to the questions which focused on memorable science learning experiences, likes and dislikes about science teaching and learning, and recommendations for current and future science teachers. A total of 17 students from the CCS program and 18 from the EASE program participated in the interviews and agreed to share their responses with us.

Three coders read through the responses for each student, then categorized them deductively using themes that emerged in the Authors (2018) prior study as codes.

Additional codes that emerged from the current study were also documented. The codes regarding science learning preferences for individuals with disabilities were:

- Avoided heavy reading material or mathematical formulas (Reading/Math)
- Included clear and specific instructions (Clear Instructions)
- Incorporated hands-on exploration and canonical experiments such as building volcanoes or growing butterflies (Hands-on)
- One-on-one assistance either during or outside of class by a teacher or aide (One-on-one)

The codes regarding recommendations for future and current science teachers were:

- Listen to your students
- Check in with students frequently
- Show enthusiasm for your content

The entire dataset was coded by the three coders, collaboratively. Discussion took place until agreement was reached. After discussion, several additional codes emerged, specifically related to recommendations for future teachers. We marked and coded for these trends as well. These were:

- Prepare well for class
- Provide models, frameworks, and examples when teaching

After organizing the dataset using the codes described above, we used a narrative approach to tell the story of the participants' science learning. What follows is an abbreviated narrative that touches on some of the themes that emerged in our study, but is shortened due to word count restrictions. A more complete story will be shared in our full paper.

## Analysis/Findings

Aside from the difference in the particular program, there were some other clear differences between the groups, namely age. The CCS students ranged in age from 19-25 (average age ~22) while the EASE students ranged from 19-22 (average age ~20). Yet, they had more in common than different, as they learned while interviewing one another.

Across both groups of students, when asked to reflect on their experiences learning science at the elementary, middle school, high school, and college level, participants often referred to specific hands-on experiences canonical experiments (e.g. the egg

drop experiment or building a model volcano), or field trips. Florida[1], a student in the CCS program reflected on a memorable middle school experience, “Pulling the plates without breaking them by pulling a tablecloth,” while Sam, an EASE student commented on, “watching the transformation of caterpillars into butterflies,” in elementary school. It should be noted, however, that certain trends did emerge that were specific to each group. Among the CCS students, one-off activities were often listed, and many did not remember much about their early experiences. On the other hand, the EASE students more often discussed the broader content or topic, such as Dakota’s response about her college science learning: “I am currently enjoying my science classes in college. I love biology and chemistry and I am currently in organic chemistry which is very challenging but I enjoy it.”

The theme of using hands-on exploration came forth in both groups as they began to discuss the things teachers did to help them learn science. R.W., a student in the CCS program talked about the way her fifth grade teacher, “did a lot of hands on things, [and] gave us the opportunity to be involved. [She even] used a huge slinky to demonstrate how fast the sound could travel!” Both groups also appreciated when teachers when their teachers showed enthusiasm, as DL, an EASE student reported, “They showed that they were interested in the subject and their excitement to discuss science made me excited to learn about science.” Many students in the CCS program, and a few in the EASE program also commented on the helpful ways teachers provided them with tools or scaffolds to aid in their learning such as providing handouts or modified readings. The two groups also both emphasized their frustration with science learning that included a heavy reading or mathematical load. In the words of DL, an EASE student: “I was not a big fan of writing lab reports, although I enjoyed doing most labs,” early on in the interview and later, “The parts of science that deal with math are frustrating for me. I am better at conceptual work rather than work based in formulas.”

Another common theme that came across both groups was a sense of frustration about the way their science teachers interacted with them. When asked about her science teachers, Dolphins, a CCS student said, “They ignore me,” while Florida, another CCS student felt frustrated, “when they’re not thinking about me or my friends.” Brittany, another CCS student offered that teachers should, “Be patient for any students who may need extended time on assignments.” These types of comments echo the narratives shared in our earlier work (Authors, 2018) and further emphasize that changes must be made to engage all learners in science. Kelly, an EASE student expressed similar frustrations and made some recommendations for teachers: “You

[1] All names used here are pseudonyms chosen by participants.

have to take your time. You must be willing to spend your lunch break helping a student who truly wants to learn but couldn't figure it out the first time. You have to really have the student in your best interest...science can be a difficult [content area] to grasp."

Through these conversations, the pairs of students were able to develop a sense of each person's own science journey, interests, and frustrations, and eventually find that they had much common ground.

## Contributions

Including the voices of diverse learners, including those with intellectual disabilities, in our discussion and recommendations for science teaching is a critical step to help us move towards a more democratic perspective on science teaching and learning. Science teacher educators and disabilities studies scholars within the NARST community can benefit from this talk and paper.

## References


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