NIH SciEd24

Project Name: NeuroLab 2.0 (Adapting an authentic ISE experience for high school course integration and positive STEM outcomes)

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Project Website: www.NeuroLabSEPA.org

If SEPA project, URL for project on https://nihsepa.org/
https://nihsepa.org/project/neurolab-adapting-an-authentic-ise-experience-for-high-school-course-integration-and-positive-stem-outcomes/

Brief Program Description

NeuroLab is a multi-lesson, storyline-based instructional unit that is organized around a heritable movement disorder (congenital mirror movement disorder) with behavioral, neuroanatomical, developmental, cellular, and molecular developmental components. During this integrative classroom experience, students build – in stepwise fashion – an explanatory model of the movement disorder as they pursue their questions in a collaborative learning environment. To develop their models, students analyze, interpret, discuss, and connect real data obtained from human subjects and model organisms over the last several decades. The discoveries made by students through the analysis and interpretation of scientific data are gradually assimilated into working models that form a major focus of classroom discourse. Models undergo periodic revision and gradually increase in explanatory and predictive power as students progress through the NeuroLab sense-making trajectory (select examples of student work will be available for review during roundtable discussion).

Program and Participant Characteristics

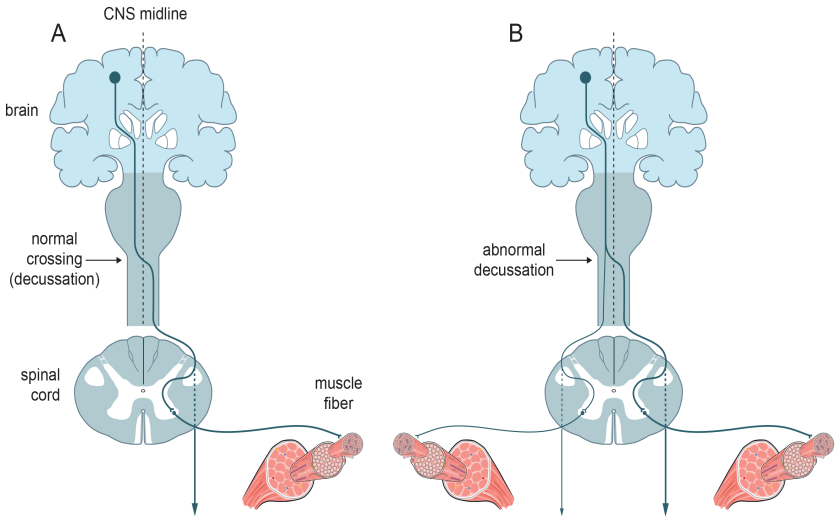
Program type
Supplemental Curriculum | Teacher PD

Setting(s): Formal

Types of participants
Students | Teachers | Scientists

Grade level(s) of participants
High School (9-12)

Characteristics of the populations you serve relative to DEIA:
Recruitment of teachers who serve ethnically diverse and economically disadvantaged students.



Program Activities

1. Co-design of a storyline-based instructional unit that bridges developmental neurobiology and clinical neuroscience
2. Professional Development experiences to prepare high school science teachers to implement the storyline unit in their high school science classrooms
3. Classroom implementation of unit
4. Evaluation of project impacts

Evaluation

Constructs measured

Self-efficacy for science practices

Content knowledge

Knowledge of scientific collaboration

Skills for scientific collaboration

Epistemological beliefs about scientific models

Methods

Tests/surveys

Analysis of student work

Design characteristics

Pre/post surveys or assessments

Project Lessons Learned

At the outset of PD experiences, some teachers expressed concerns over their students' ability to understand the ideas, concepts, and data introduced in the storyline. As PD unfolded and teachers recognized linkages to content that they teach in their life science courses, they seemed to be more confident in their students' ability to progress through the model-building mission.

Many teachers – including very experienced teachers – grossly underestimated the time required for students to engage in productive discourse centered on the creation/revision of explanatory models. Teachers' allocation of class time for this important component of the student experience is expected to improve over multiple classroom enactments of the unit. Tools to help teachers promote classroom discourse will be helpful.

Teachers' expressed initial ambivalence over their students' reactions to a new way of experiencing science, an unfamiliar way of interacting with classmates, and new ways of being assessed.

Many teachers expressed initial concerns over *losing the class* during database navigation. Concerns seem to be linked to managing the movement of a class through a given database and a perceived inability of students to recognize these data-centered experiences as being central to the daily practice of scientists.

Key Accomplishments and/or Findings

Key Findings Obtained to Date

Students and teachers seemed to enjoy the unit and understood how its various components helped them investigate the movement disorder. Most students agreed that it was clear why they were using different sources of evidence, and recognized that their questions and discoveries resembled scientists' multidisciplinary work.

Almost all students felt that creating their model helped them make connections between the unit's concepts and evidence. 93.1% (n = 148 of 159 students) mentioned that creating their model helped them connect different types of data or evidence a medium or large amount. 91% (n = 143) said that creating their model helped them connect science concepts or ideas to the same extent.

Most students not only saw the educational and scientific value of what they were doing, but were interested enough in the unit material to want to continue their investigations. Out of the 177 students who submitted post surveys, 145 (81.9%) identified at least one thing they would like to study or do more. Students wanted to learn more about the movement disorder and other genetic conditions, as well as neuroscience more generally. Some also wanted to analyze more biomedical datasets and construct models.

Analyses suggest that NeuroLab 2.0 improves student learning and motivation. Students answered questions before and after the unit about their self-efficacy for science practices and epistemological beliefs about scientific models. Paired-samples t-tests produced statistically significant (small to moderate effects) for both measures.

Peers strongly supported student learning. Most students noted that discussions with classmates were fairly helpful (38.6% of 158 responses) or very helpful (50.0%) for constructing their model. In the process, they learned about productive scientific collaboration. Over half reported large gains on items about the collaborative and socially dynamic nature of science inquiry. Nearly as many students learned as much about how to share their ideas and value others' contributions. Around one-third reported large gains in their ability to give and receive constructive feedback.