Professional Development in Science Education for Special Educators
Incorporating the 5E Model and Three-Dimensional Learning

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Abstract. This professional development program guided teachers of students with extensive support needs (ESN) in developing planning and teaching strategies. The strategies focused on the Next Generation Science Standards (NGSS) and three-dimensional learning through inquiry teaching using the 5E-instructional model. This roundtable focuses on data from the intervention development and field test phases of the project. The team used lessons learned from the field test to revise and design 21 online modules and a robust coaching system to be launched within an online platform. Teacher-level outcomes during these phases included feedback that guided revision of the self-directed modules, such as including additional narratives and vignettes reflecting authentic experiences for teaching science through inquiry to students with ESN at the elementary and middle school level. Teachers in the field test also recommended streamlining platform components to improve usability and ease of navigation between screens. The platform now has fewer buttons on a screen, clearer labels for navigation, and a visual progress bar.

Objectives

1. This professional development program responds to the emphasis of the NGSS.
2. Recognize that most students with ESN are included in alternate achievement expectations within science content standards that reflect the multidimensionality and three-dimensional learning of these standards.
3. Introduce a professional development model in science education for special educators (5E-SESE) designed to help teachers gain the critical knowledge and skills to transition to effective inquiry-based instruction in science for students with ESN.

The 5E-SESE Model

- Multidimensional science content
- The 5E model of instruction
- Universal Design for Learning (UDL) principles

The professional development system engages teachers in a series of 5E inquiry learning cycles where they experience the same type of learning cycle they will design and implement when providing science instruction to their students. This design is intentional so that teachers are supported in internalizing practices that will improve science teaching and learning.

Research

The research plan for this project includes five phases: (1) intervention development, (2) field test, (3) pilot test, (4) follow-along study, and (5) final intervention revisions.

Findings

- Teacher-level outcomes were measured during the field test phases of the intervention.
- Outcomes for students will be measured in additional pilot studies in the fall and winter of 2022.

For more information, visit the project website.

Table. *5E-Model Phases and Example UDL Lesson Design Considerations for Each UDL Principle*

5E-model phase and description	Multiple means of engagement	Multiple means of representation	Multiple means of action and expression
Engage: Teachers access students' prior knowledge, provide materials to generate interest and curiosity, and raise questions about the concept or phenomenon. Students ask questions, generate ideas, and show interest.	Choose a high-interest, relevant context or phenomenon that most, if not all, students would have familiarity with (Recruiting Interest).	Refer to a prior lesson and build on prior knowledge (Comprehension). Use textile cards to represent words and ideas (Perception).	Provide more than one option to respond to an Engage phase prompt; this can include a communication system (Physical Action).
Explore: Teachers provide experimentation opportunities, ask questions to redirect when necessary, and act as consultants. Students test predictions, make new predictions, gather evidence, notice patterns, and record observations.	Provide feedback that encourages and treats students as capable learners (Sustaining Effort & Persistence). Provide choices during activities when appropriate (e.g., weighing ice vs. water first) (Recruiting Interest). Reduce or increase the number of observations or data collected (Sustaining Effort & Persistence). Use timers and visuals to show expectations and steps in the activity or experiment (Self-Regulation). Provide visuals or organizers about lesson goal for students to self-monitor progress to goal (Self-Regulation).	Use organizers or prompts for recognizing and keeping important information (e.g., sentence starters, chart in science notebook) (Comprehension). Conduct repeated experiments, or segment longer experiments into smaller groups of observations, to allow multiple opportunities to see, hear, and touch (Perception). Chunk segments of the lesson as needed (Comprehension).	Give students choices for how to communicate expressively using a total communication system (Expression & Communication). Provide graphic organizers and templates for organizing and displaying data from an experiment or science activity (Executive Function).

5E-model phase and description	Multiple means of engagement	Multiple means of representation	Multiple means of action and expression
Explain: Teachers introduce scientific vocabulary to explain science concepts and challenge student misconceptions. Students use what they have learned to explain their understanding of the concept, which promotes a deeper understanding.	Use media and technology (e.g., interactive whiteboards) for active participation (Recruiting Interest). Vary the format within which the work can be completed (individual, small group with peers, whole class) (Sustaining Effort & Persistence).	Provide repetition for exposure to the language or symbol for the concept (Language & Symbols). Use consistent language for the concept or description within questions and explanations (Language & Symbols).	Use tactile cards for constructing an explanation (Expression & Communication). Ensure assistive technology includes necessary vocabulary for sentence construction (e.g., claims, evidence, reasoning) and recording results (Expression & Communication).
Elaborate: Teachers challenge and extend students' understanding and skills of the science concept by introducing additional science concepts and new contexts. Students apply their understanding of the concept to new activities.	Provide choices during activities when appropriate (e.g., weighing ice vs. water first) (Recruiting Interest). Reduce or increase the number of observations or data collected (Sustaining Effort & Persistence).	Conduct repeated experiments, or segment longer experiments into smaller groups of observations, to allow multiple opportunities to see, hear, and touch (Perception). Chunk segments of the lesson as needed (Comprehension).	Give students choices for how to communicate expressively using a total communication system (Expression & Communication). Provide graphic organizers and templates for organizing and displaying data from an experiment or science activity (Executive Function).
Evaluate: Teachers evaluate student progress toward achieving the learning objectives. Students assess their understanding and abilities.	Select appropriately complex questions (Sustaining Effort & Persistence). Use visuals and timers to communicate expectations and times (Self-Regulation). Provide choices for formative assessment (Recruiting Interest).	Provide written instructions, graphic organizers, or picture supports along with oral directions (Comprehension).	Provide visual images (e.g., photographs) and tactile objects to use for student products (Expression & Communication). Give students choices for how to communicate expressively using a total communication system (Expression & Communication).

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