Georgia Institute of Technology

CEISMC

SLIDER®
Science Learning Integrating Design, Engineering, & Robotics

NSF

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Overview

A $3.5 million, five year grant from NSF's Discovery Research K-12 (DR-K12) program, granted to CEISMC.

Period: 10/1/09 - 9/30/14

QUESTION: What effects do robotics, engineering design, and problem-based inquiry science have on student learning and academic engagement in 8th grade physical science classes?

Team

Georgia Tech faculty and staff from a number of academic units (CEISMC, CETL, Math, Psychology, Biomedical Engineering & Computing), Georgia State University (for evaluation), and a national-level advisory board.

Teachers, principals and school system administrators representing Fulton County Schools (Bear Creek Middle), Cobb County Schools (E. Cobb Middle) and Emanuel County Schools (Swainsboro Middle) and the Georgia Department of Education.

Goals

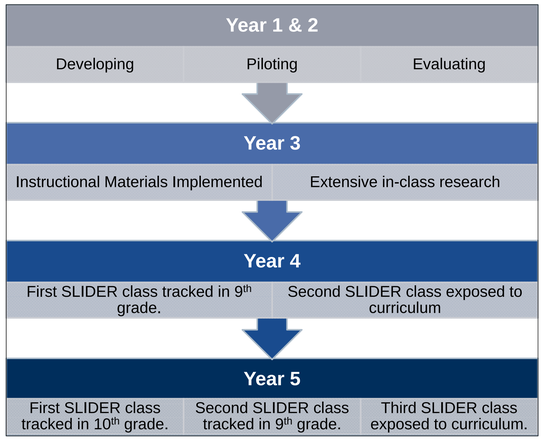
1. Design and implement a problem-based robotics curriculum as a context for 8th graders to learn physics and reasoning skills, and as a way to increase student engagement, motivation, aptitude, creativity and STEM interest.

2. Conduct research to determine the effectiveness of the program across all curriculum development parameters.

3. Determine how students engage the material across ethnic, socio- cultural, gender and geographic (rural, urban, and suburban) lines.

4. Measure the "staying power" of the experience as students move from middle to high school.

Timeline and Structure

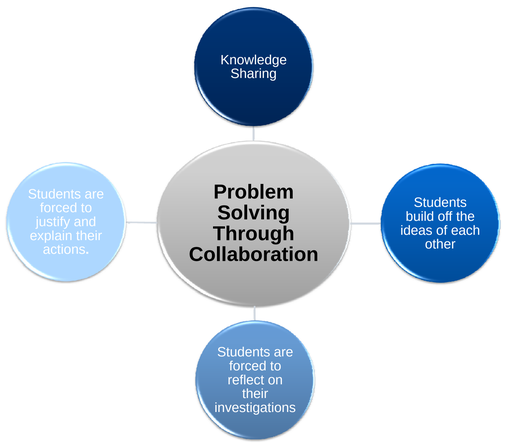


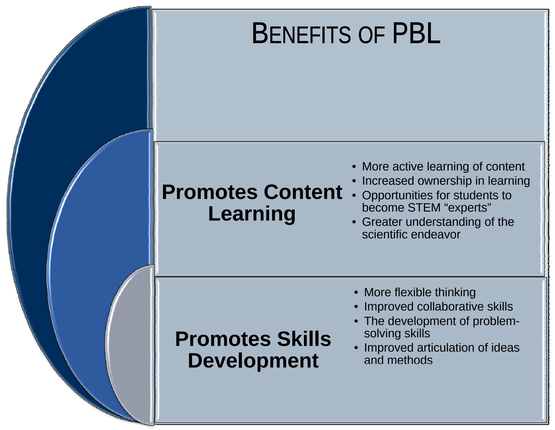
Curriculum Grounding

Problem Based Learning (PBL)

The SLIDER Instructional materials will be grounded in a problem-based learning (PBL) model of instruction. PBL is a cognitive-apprenticeship approach with roots in medical school training. In the approach, students work collaboratively to solve problems and learn in a group setting as well as individually. They indentify what they know, what they need to learn more about, plan how they will learn more, conduct research, and deliberate over the findings all together in an attempt to move through and solve the problem.

How PBL Works





Curriculum Design

Learning By Design ™ (LBD ™)

SLIDER® Science Learning Integrating Design, Engineering, & Robotics

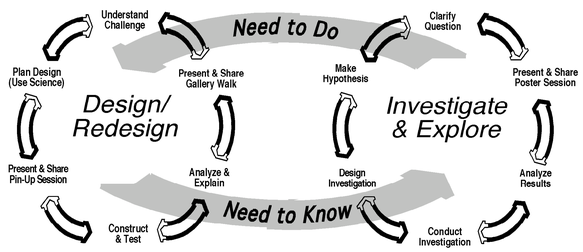
AND

Learning by Design™ Project-Based Inquiry Science for Middle School that Works

In designing the SLIDER instructional materials, the project curriculum developers will utilize the design, sequence, and methods created as part of the NSF Learning By Design ™ project. (SLIDER senior personnel Ryan and Fasse were part of the LBD project, and Janet Kolodner, the LBD PI, is a senior advisor on this project.) LBD is an inquiry, PBL approach to middle school science education founded in constructivist learning theory that aims to address the social and cognitive aspects of learning.

The LBD approach incorporates the cognitive model of case-based reasoning where students learn form the lessons they formulated during previous experiences. Throughout the course of an LBD unit students will design, test, explain and present in a group fashion through each stage of the lesson, emphasizing an important aspect of design – iteration.

LBD Cycles of Activities



Method

Using "*backwards design*" strategies, the SLIDER curriculum development team at CEISMC will create inquiry-based engineering design instructional materials for 8th grade Physical Science that use robotics as the learning tool and that are aligned with the Georgia Performance Standards (GPS). The materials will employ problem-based challenges that require students to design, program, investigate, and reflect, and then revise their product or solution. They will consist of three 4-6 week modules that cover the physics concepts of **Mechanics** (force, motion, simple machines), **Waves** (light, sound, magnetism, electricity, heat), and **Energy**. CEISMC will also design the teacher professional development necessary for effective implementation of the curriculum.

Potential Unit Questions

4-6 weeks each…

Launcher Unit: *How can engineers solve problems with robotics?*

- Collaborating and communicating with others.
- Creating scientific questions and investigations to answer them.
- Generating explanations and recommendations rooted in evidence and science knowledge
- Designing and programming with LEGO Mechanics and NXT systems.

Unit A: *How can we design robotic devices to transport resources and supplies for people in need?*

Student design a robotic device to transport water, food, or supplies to a community in need or distress, e.g. – drought stricken area, disaster relief water in drought-stricken Africa or UN relief in disaster area. Launcher unit may culminate with this unit.

- Forces, motion, energy, electricity

Unit B: *How can we design robotic devices to help communities create safe, clean, and enjoyable recreation areas?*

Students design a robotic device to sweep walkways and collect trash in public parks.

- Simple machines, light, waves, sound

Unit B: *How can we design robotic devices to assist with public safety?*

Students design a robotic device to sidentify and sipose of a toxic substance.

- Sound, chemistry, energy

Contact information

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