

Abstract

Next Generation Science Standards are based on the concept of learning progressions (empirical tested understanding of how student learning actually progresses). This project was developed to contribute to foundational knowledge about how middle school students with learning disabilities can better learn science through the process of Serious Educational Game (SEG) creation. This study provides initial findings from an NSF funded project to improve science learning of middle school students with LD. Implications for inclusive classrooms are also described.

Supporting Literature

What is Project-Based Learning?

The goal of project-based learning is for the students to understand science content through first-hand experiences while solving authentic or real-world applicable problems that occur in the context of the project (Thomas, 2000). In the project-based learning pedagogy, the role of the teacher is to serve as a facilitator ensuring students' progress appropriately. This pedagogy emphasizes self-learning via a combination of practical activities, interactive discussions, independent operation and team cooperation (Tseng, Chang, Lou, & Chen, 2013).

What are Learning Progressions?

Learning progressions, are the meaningful sequencing of teaching and student learning expectations accounted for across disciplines, student developmental stages, and grades (Plummer & Maynard, 2014). Learning progressions describe how the practice of applying science concepts progresses over time, and how students are able to become proficient at these essential scientific concepts as they continue to receive adequate instruction (NRC, 2007). There are two different types of learning progressions: (a) *curriculum and instruction*—which consists of a series of concepts determined by empirical evaluation of the comprehensive scientific ideas within curriculum units, and (b) *cognition and instruction*—which shows how a student arrives at accurate scientific understandings (Shavelson, 2009).

References

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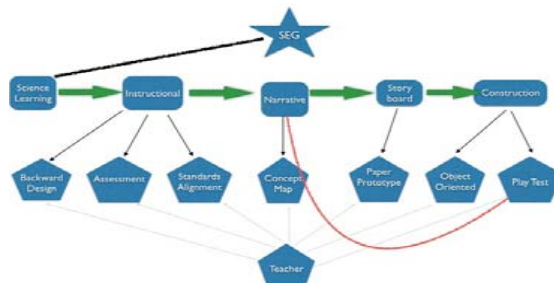
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Project-Based Learning Progressions

The current project drew from a model created by Annetta (2008) of Serious Educational Game (SEG) design and development. In this model, students are challenged to become the teacher of science content through an SEG.

- Distinct nodes of learning are created to aid students in the design process.
- Each learning node in the progression depicts knowledge and/or skills a student must attain before moving along the learning spectrum.
- Within each node are sub-nodes that can actually be considered learning progressions unto themselves. All the while, the teacher facilitates understanding and conceptual change.



NODE	Description
NODE 1: science learning	Students were taught science content about the advantages of renewable energy sources (solar and wind). A variety of modality and learning strategies were used including audio-visuals, semantic feature analysis, and strategic note-taking.
NODE 2: instructional	Students determine learning objectives they want to incorporate in their game based on science content they learned.
NODE 3: narrative	As part of the process of creating the SEG, students design an action-adventure story in which the characters and non-player characters participate with in the SEG with the goal of teaching the specific content of interest.
NODE 4: storyboard	Students created a storyboard that demonstrated the critical stages of the storyline for their game including how the characters interact within the virtual environment in order to facilitate meeting the chosen learning objective.
NODE 5: construction	Using the game platform, students virtually build their 3D SEG and play test it to determine needed revisions.

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Exemplars of Learning of Students with LD

NODES 1 (Science Learning)

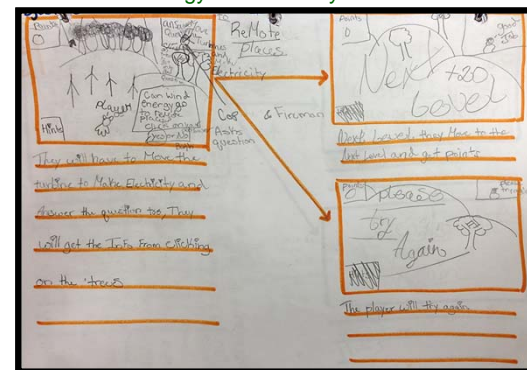
Test Question: What are the advantages and disadvantages of wind energy?

Pre-Test	Post-Test
An advantage is that wind energy makes things go faster.	The advantages are that wind turns a turbine to make energy.
One disadvantage is that wind energy uses turbines.	One disadvantage is that turbines are usually in wind farms, which can be expensive and also dangerous to birds.

Student Comment: "I learned that you can use wind turbines [to generate electricity]. I didn't know they were called wind turbines. Also, I learned a little bit about solar panels, and how they work."

NODES 2 & 3 (Instructional & Narrative)

Objective 2: Wind Energy for Electricity in Remote Places



Event 2: Narrative Excerpt for Electricity in Remote Places
 The player will move the turbines to generate electricity. Then the player will be asked a question to see what they learned. "Can wind energy go to remote places?"

NODE 4 (Storyboard)



NODE 5 (Construction)

