Supporting Written Scientific Explanations of Middle-School Students with Learning Disabilities

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Abstract

This study examined written scientific explanations of 66 middle-school students with learning disabilities (LD) compared with a matched control group of students without LD following instruction in a science unit with embedded supports for writing explanations. Post unit explanations of students with LD were statistically significantly higher. There were no differences between post-unit written explanations of students with or without LD demonstrating matched gains, yet students without LD demonstrated more growth in overall content knowledge.

Problem/Purpose

Students with LD deserve high quality science instruction that supports them in becoming scientifically literate citizens (McNeill & Krajcik, 2007). Data from the 2019 NAEP science assessment (NCES, 2019) show students with LD scoring one standard deviation below their peers without disabilities. Using a Next Generation Science Standards (NGSS, NGSS Lead States, 2013) aligned curriculum can support students' development of deeper, useable understandings of big science ideas (Kaldaras et al., 2020). Writing scientific explanations, a NGSS practice, is particularly challenging for students with LD. Supporting explanation development is enriched when teachers provide direct instruction in how to write claims using evidence and reasoning, and evaluate others' claims using an explanation criteria guide (Herrmann-Abell et al., 2016). This study examined change in written explanations of middle-school students with and without LD following instruction in a NGSS-aligned curriculum that explicitly embedded structures and supports for students to construct written scientific explanations. Our hypothesis was developing students' ability to write explanations would impact their overall content knowledge related to the curriculum used.

Research Questions

1. How did the written scientific explanations of students with LD change following curriculum and instruction supports?
2. How did the written scientific explanations of students with LD compare to peers without disabilities?
3. How did change in writing impact students' overall content knowledge growth?

Methodology

Participants included 132 middle-school students from 27 rural, geographically dispersed school districts in western Kansas whose science teachers received professional development in using a NGSS-aligned curriculum, *Toward High School Biology (THSB*), related to understanding growth in living things. Using mixed methodology, this study examined the pre- and post-unit content knowledge assessments of students with and without LD, specifically examining their written scientific explanation responses (length of response, use of science vocabulary, connection to science ideas) to items embedded within the assessment given before and after their science teachers taught the *THSB* unit.

Data

Research Question	Pre	Post	Significance
Change in written explanation – students with LD			
Length of response	*M*=44.08 *SD*=31.49	*M*=59.08 *SD*=29.15	0.005*
Use of science vocabulary	*M*=2.03 *SD*=1.93	*M*=4.77 *SD*=3.65	0.000*
Connection to science ideas	*M*=0.08 *SD*=0.27	*M*=0.35 *SD*=0.65	0.001*
Comparison of written explanations – post-unit all students			
Length of response (with LD)		*M*=59.08 *SD*=29.15	
Length of response (without LD)		*M*=72.97 *SD*=48.75	0.34
Use of science vocabulary (with LD)		*M*=4.77 *SD*=3.65	
Use of science vocabulary (without LD)		*M*=5.03 *SD*=3.87	0.21
Connection to science ideas (with LD)		*M*=0.35 *SD*=0.65	
Connection to science ideas (without LD)		*M*=0.68 *SD*=0.99	0.22
Growth in overall content knowledge			
Students with LD (*standard score*)	*M*=1.15 *SD*=0.93	*M*=1.35 *SD*=0.95	0.21
Students without LD (*standard score*)	*M*=1.03 *SD*=0.79	*M*=1.75 *SD*=0.99	0.000*

Findings

This study supports the idea that providing explicit instruction and structured supports to guide students in writing scientific explanations, embedded within a NGSS-aligned curriculum, improves students' scientific content knowledge. Overall, for students with LD, the *THSB* unit proved to be a useful catalyst in improving their ability to develop and write longer claims using more scientific vocabulary and identifying more science ideas. Embedding explicitly taught lessons in how to write explanations, providing students with criteria for then evaluating a claim, and consistently practicing how to write an explanation was particularly relevant for students with LD, especially when noting that their post-unit written responses were not significantly different than their peers' responses. However, despite identifying significant change in written responses, students with LD did not show significant growth on the overall post-unit content knowledge assessment.

Implications

While more research on the positive impact of NGSS-aligned curricula, assessments, and instructional practices is ongoing, our study provides guidance to both general and special educators in the importance of providing explicitly taught supports for developing and evaluating students' scientific explanations.

References

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