Integrating STEM Learning in Inclusive Classrooms: A Case Study on Accessibility and Innovation

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ABSTRACT
This study investigates the implementation of inclusive STEM education practices in K-12 classrooms, focusing on accessibility strategies and innovative pedagogical approaches. Through a mixed-methods analysis of 145 inclusive classrooms across 12 school districts, we examined how educators integrate adaptive technologies, universal design principles, and differentiated instruction to meet diverse learner needs. Data collection involved classroom observations, educator surveys, student performance metrics, and interviews with stakeholders over an 18-month period. Results indicate that classrooms employing multiple accessibility strategies showed statistically significant improvements in STEM engagement ($p<0.01$) and academic performance ($p<0.05$) among students with disabilities compared to control groups. Particularly effective were hands-on learning stations, peer collaboration structures, and technology-enhanced visualizations. The findings demonstrate that intentional integration of accessibility features benefits all students while specifically addressing barriers for those with disabilities. This research contributes empirical evidence to support the development of inclusive STEM education frameworks that prioritize both accessibility and innovation.
Keywords: STEM education, inclusive classrooms, accessibility, differentiated instruction, educational technology.

1. INTRODUCTION

The Evolution of STEM Education and Inclusion

The landscape of STEM (Science, Technology, Engineering, and Mathematics) education has undergone significant transformation over the past decade, shifting from traditional lecture-based instruction toward inquiry-driven, collaborative learning environments. Despite this evolution, accessibility remains a persistent challenge, particularly for students with disabilities who continue to be underrepresented in STEM fields. Current educational frameworks emphasize the importance of inclusion but often lack specific, evidence-based strategies for implementing accessible STEM learning. According to the National Science Foundation [1], students with disabilities comprise only 9% of STEM degree recipients despite representing approximately 19% of the general student population. This disparity highlights the critical need for educational approaches that remove barriers to STEM participation while maintaining rigorous content standards.

Research by Meyer et al. [2] demonstrates that inclusion benefits not only students with disabilities but enhances educational outcomes for all learners through increased collaborative problem-solving and exposure to diverse perspectives. The convergence of STEM education and inclusive practices represents an opportunity to address persistent achievement gaps while preparing all students for an increasingly technological society. However, as noted by Jackson and Wilson [3], many educators continue to perceive tension between maintaining academic rigor and accommodating diverse learning needs in STEM subjects.

Theoretical Frameworks for Inclusive STEM Education

Universal Design for Learning (UDL) provides a foundational framework for inclusive STEM education by emphasizing multiple means of engagement, representation, and action/expression [4]. This approach aligns with current understanding of neurodiversity and learning variability, recognizing that students access and process information differently. When applied to STEM instruction, UDL principles facilitate the design of learning experiences that are accessible from the outset rather than retrofitted through accommodations. Complementing UDL is the Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler [5], which emphasizes the intersection of content expertise, pedagogical skill, and technological fluency. In inclusive STEM classrooms, educators must navigate this complex intersection while also considering accessibility requirements. Davis and Martin [6] expanded upon these frameworks by proposing an "Accessible STEM Pedagogy" model that explicitly incorporates accessibility considerations into instructional design decisions.

These theoretical approaches emphasize proactive planning and recognize that inclusive STEM education requires intentional design rather than incidental accommodation. However, empirical research examining the practical implementation of these frameworks remains limited, particularly regarding specific strategies that effectively bridge theory and classroom practice.

Challenges and Opportunities in Implementation

Despite strong conceptual foundations, the implementation of inclusive STEM education faces significant challenges. Resource limitations, teacher preparation, and competing educational priorities create barriers to comprehensive implementation [7]. Many educators report feeling underprepared to adapt complex STEM content for diverse learners, particularly in subjects requiring specialized equipment or abstract reasoning skills [8]. Additionally, traditional assessment methods in STEM fields often fail to capture the varied ways students may demonstrate understanding. Emerging technologies present both challenges and opportunities for inclusive STEM education. While adaptive technologies and digital tools can enhance accessibility, they may simultaneously introduce new barriers if not thoughtfully implemented [9]. The rapid pace of technological change requires ongoing professional development and flexible instructional approaches. Furthermore, as STEM education increasingly emphasizes engineering design processes and computational thinking, educators must consider how to make these complex practices accessible to all learners. The intersection of these challenges creates a complex educational landscape requiring empirical investigation into effective practices. This study addresses this need by examining how successful inclusive STEM classrooms navigate these challenges through innovative approaches to accessibility and pedagogy.

2. LITERATURE SURVEY

Inclusive education research has evolved significantly over the past two decades, moving from a focus on placement and accommodation toward more sophisticated models of participation and universal design. Early work by Burgstahler [10] established foundational principles for accessible STEM education, emphasizing physical access to laboratories and adapted materials. Subsequent research expanded these concepts to address cognitive access and meaningful participation. A comprehensive review by Thompson and King [11] identified persistent gaps between inclusive education theory and STEM-specific implementation, noting that many studies focused on single disability categories rather than broadly inclusive approaches. Research examining technology integration in inclusive STEM classrooms reveals mixed outcomes depending on implementation quality. Studies by Chen et al. [12] demonstrated that technology alone does not improve accessibility without corresponding pedagogical adaptations. Their three-year longitudinal study of tablet implementation in science classrooms found that teacher training in accessibility features was the strongest predictor of improved outcomes for students with disabilities, more so than the mere presence of technology. Similarly, Marino and Beecher [13] found that technology integration must be paired with explicit strategy instruction to benefit students with learning disabilities in mathematics contexts.

The application of Universal Design for Learning principles to STEM education shows promising results across multiple studies. Research by Basham and Marino [14] demonstrated that science units designed with UDL principles from the outset resulted in higher engagement and achievement for diverse learners compared to traditionally designed units with post-hoc accommodations. A large-scale study by Ok and colleagues [15] involving 37 inclusive middle school classrooms found that UDL-based math instruction produced statistically significant improvements in conceptual understanding for both students with and without disabilities. These findings suggest that thoughtful design benefits the entire classroom ecosystem rather than serving as specialized accommodation. Professional development research indicates that sustained, collaborative learning opportunities produce more substantial changes in inclusive STEM teaching than isolated workshops. Israel et al. [16] documented the outcomes of a year-long professional learning community focused on accessible computer science education, finding that participants demonstrated more sophisticated understanding of accessibility strategies and higher implementation fidelity than comparison groups. Jordan and Arriaga [17] found that co-teaching arrangements between STEM and special education teachers produced more robust accessibility practices than consultation models, particularly when both educators received joint professional development.

Assessment remains a particularly challenging aspect of inclusive STEM education. Traditional assessment methods often create barriers for students with disabilities while failing to capture the range of ways students demonstrate understanding. Research by Thurlow and Kopriva [18] examined alternative assessment strategies in science education, finding that performance-based assessments with multiple response options provided more valid measures of content knowledge for diverse learners than traditional paper-based tests. Yu et al. [19] demonstrated that formative assessment practices incorporating student choice and multimodal response options improved both engagement and performance measures in inclusive mathematics classrooms. While these studies provide valuable insights into components of inclusive STEM education, comprehensive research examining the integration of multiple strategies in authentic classroom settings remains limited. The present study addresses this gap by investigating how successful inclusive STEM programs coordinate accessibility approaches across curriculum, instruction, assessment, and learning environment dimensions.

3. METHODOLOGY

Research Design and Participant Selection

This study employed a mixed-methods sequential explanatory design to investigate inclusive STEM education practices across multiple educational settings. The research occurred over an 18-month period from September 2018 to March 2020, encompassing parts of two academic years. We utilized purposive sampling to identify 145 inclusive classrooms across 12 school districts representing urban (42%), suburban (37%), and rural (21%) communities. Selection criteria required classrooms to: (1) teach STEM content as a primary focus, (2) include at least three students with identified disabilities, and (3) self-identify as implementing inclusive education practices. The final sample included classrooms across elementary (38%), middle (33%), and high school (29%) levels with an average class size of 24 students. Within these classrooms, 23% of students had identified disabilities, including learning disabilities (47%), autism spectrum disorders (18%), attention disorders (15%), physical/sensory disabilities (12%), and intellectual disabilities (8%).

Data Collection Instruments and Procedures

Multiple data collection methods were employed to capture the complexity of inclusive STEM implementation. Classroom observations utilized the Inclusive STEM Practices Observation Protocol (ISPOP), a validated instrument developed by Williams and Chen [20] that measures implementation quality across four domains: physical accessibility, instructional accessibility, social inclusion, and cognitive engagement. Two trained researchers conducted a total of 435 observations (3 per classroom) using the ISPOP, achieving an inter-rater reliability of 0.87 (Cohen's kappa). Educator participants (n=187) completed the STEM Accessibility Practices Survey, a 42-item instrument measuring implementation frequency, perceived effectiveness, and barriers to implementation of inclusive strategies. Additional data sources included semi-structured interviews with educators (n=60) and students (n=45), document analysis of lesson plans and student work samples, and student achievement data from standardized assessments and classroom-based measures. Student outcome measures included both academic performance indicators and measures of STEM engagement using the validated Student STEM Engagement Inventory developed by Robertson and Johnson [21]. All instruments underwent pilot testing and validation prior to implementation, with psychometric properties documented according to established standards for educational research instruments.

Data Analysis Framework

Analysis followed a parallel mixed-methods approach with integration at both the data collection and interpretation phases. Quantitative data from observations, surveys, and student outcomes underwent statistical analysis using SPSS v25 software. Descriptive statistics characterized implementation patterns, while inferential statistics (t-tests, ANOVA, and hierarchical linear modeling) examined relationships between implementation variables and student outcomes. We controlled for demographic factors, prior achievement, and school-level variables to isolate implementation effects. Qualitative data underwent systematic coding using NVivo 12 software, employing both a priori codes derived from theoretical frameworks and emergent codes identified through constant comparative analysis. Initial coding was conducted independently by three researchers who then reached consensus on code application and thematic development. Trustworthiness was enhanced through triangulation across data sources, member checking with participating educators, and peer debriefing with external reviewers familiar with inclusive STEM education. The mixed-methods design allowed quantitative findings to identify patterns while qualitative data provided contextual understanding of implementation processes, creating a more comprehensive picture than either approach alone could provide.

4. DATA COLLECTION AND ANALYSIS

The data collection process yielded comprehensive information about inclusive STEM practices and their impact on student outcomes. Table 1 presents the distribution of accessibility strategies observed across participating classrooms, revealing significant variation in implementation patterns.

Table 1: Frequency of Accessibility Strategies in Inclusive STEM Classrooms (n=145)

Accessibility Strategy	Elementary (%)	Middle School (%)	High School (%)	Overall (%)
Multimodal content presentation	82.5	68.3	55.2	69.7
Adaptive technologies	54.3	67.8	71.4	63.4
Collaborative learning structures	78.9	74.6	61.8	72.4
Strategic scaffolding	85.2	79.3	65.5	77.2
Alternative assessment methods	45.6	51.2	58.3	50.9
Accessible materials/equipment	38.7	62.5	76.2	57.9
Explicit strategy instruction	74.3	65.8	45.2	62.8

Analysis of implementation quality revealed that while most classrooms employed multiple strategies, integration quality varied substantially. The relationship between implementation quality and student outcomes was examined using hierarchical linear modeling, with results presented in Table 2.

Table 2: Relationship Between Implementation Quality and Student Outcomes

Implementation Quality Measure	STEM Content Knowledge (β)	STEM Engagement (β)	Self-Efficacy (β)	p-value
Physical accessibility	0.27*	0.32**	0.24*	<0.05
Instructional accessibility	0.45**	0.52**	0.39**	<0.01
Social inclusion	0.31*	0.47**	0.58**	<0.01
Cognitive engagement	0.53**	0.48**	0.41**	<0.01
Overall implementation quality	0.49**	0.56**	0.47**	<0.01

*p<0.05, **p<0.01

Student performance data disaggregated by disability status demonstrated differential impacts of inclusive practices, as shown in Table 3.

Table 3: Mean Gain Scores by Disability Status and Implementation Level

Student Group	Low Implementation Classrooms	Moderate Implementation Classrooms	High Implementation Classrooms	F-value	p-value
Students with disabilities	0.42 (0.18)	0.68 (0.21)	1.27 (0.24)	16.38	<0.001
Students without disabilities	0.58 (0.15)	0.72 (0.17)	0.87 (0.19)	6.72	<0.01

Note: Values represent standardized mean gain scores with standard deviations in parentheses

Analysis of qualitative data revealed patterns in implementation barriers and enablers. Table 4 presents the frequency of identified barriers across school contexts.

Table 4: Reported Barriers to Inclusive STEM Implementation

Barrier Category	Urban (%)	Suburban (%)	Rural (%)	Overall (%)
Resource limitations	82.3	57.4	91.5	75.2
Time constraints	78.5	75.2	79.8	77.8
Limited professional development	65.2	48.3	84.6	63.7
Assessment pressures	72.1	68.5	52.3	65.4
Technical challenges	58.6	42.1	76.2	56.8
Curricular inflexibility	63.5	58.7	49.2	57.9
Collaboration difficulties	52.8	45.6	67.4	54.1

Correlation analysis between implementation quality and classroom characteristics revealed several significant relationships, as shown in Table 5.

Table 5: Correlations Between Implementation Quality and Classroom Characteristics

Classroom Characteristic	Implementation Quality Correlation (r)	p-value
Teacher experience with inclusion	0.37	<0.01
Professional development hours	0.52	<0.001
Co-teaching arrangement	0.48	<0.001
Administrative support	0.43	<0.01
Technology infrastructure	0.39	<0.01
Planning time allocation	0.56	<0.001
Percentage of students with disabilities	-0.12	0.28

These findings demonstrate that implementation quality was significantly associated with teacher preparation, institutional support, and resource allocation rather than simply the proportion of students with disabilities in the classroom. The data also revealed that high-quality implementation benefited all students while providing particularly significant gains for students with disabilities, supporting the core premise of universal design approaches.

5. DISCUSSION

Critical Analysis of Implementation Patterns

The empirical data reveals complex patterns in how inclusive STEM education is conceptualized and implemented across educational settings. The significant variation in implementation quality suggests that inclusive STEM education remains inconsistently understood and applied despite strong theoretical foundations. Analysis of observation data indicates that most classrooms (83%) employed some accessibility features, but only 42% demonstrated comprehensive implementation across all measured domains. This finding aligns with research by Castro and Morgan [22], who documented similar implementation inconsistencies in their multi-site study of inclusive science education. The significantly stronger relationship between instructional accessibility measures and student outcomes ($\beta=0.45$, $p<0.01$) compared to physical accessibility measures ($\beta=0.27$, $p<0.05$) challenges assumptions about inclusive education priorities. While physical accessibility modifications are often the most visible aspects of inclusion, our data suggests that instructional adaptations—particularly those involving multiple representation modes and flexible response options—have greater impact on student learning outcomes. This finding extends previous work by Zhang and Peterson [23], who found that cognitive access to curriculum was a stronger predictor of science achievement than physical modifications alone.

Notably, implementation quality varied significantly by grade level, with elementary classrooms scoring higher on measures of multimodal presentation (82.5%) and collaborative structures (78.9%) than high school classrooms (55.2% and 61.8% respectively). This pattern likely reflects the increasing content complexity and departmentalization at upper grade levels, creating additional challenges for accessibility implementation. However, high school classrooms demonstrated stronger implementation of adaptive technologies (71.4%) and accessible materials (76.2%), suggesting different but potentially complementary approaches across educational levels.

Comparative Analysis with Previous Research

Our findings both confirm and extend previous research on inclusive STEM education. The positive relationship between implementation quality and student outcomes aligns with Basham and Marino's [14] findings regarding UDL implementation in science classrooms. However, our study provides more granular analysis of specific accessibility components and their differential impacts. While Basham and Marino documented overall positive effects of UDL-based science instruction, our data demonstrates that cognitive engagement strategies ($\beta=0.53$, $p<0.01$) had significantly stronger relationships with content knowledge gains than other accessibility dimensions.

The differential gains observed between students with and without disabilities in high-implementation classrooms provides empirical support for universal design principles. Students with disabilities showed substantially larger achievement gains in high-implementation classrooms (mean gain=1.27) compared to low-implementation settings (mean gain=0.42), representing a statistically significant difference ($F=16.38$, $p<0.001$). Importantly, students without disabilities also demonstrated improved outcomes in high-implementation classrooms (mean gain=0.87) compared to low-implementation settings (mean gain=0.58), though the effect size was smaller. This pattern aligns with research by Ok et al. [15] while providing stronger empirical evidence through a larger sample size and more comprehensive implementation measures.

Our analysis of implementation barriers extends previous work by Rivera and Smith [24], who identified resource limitations and professional development needs as primary obstacles to inclusive STEM education. Our findings confirm these barriers while revealing significant contextual differences, with rural schools reporting substantially higher rates of resource limitations (91.5%) and professional development barriers (84.6%) compared to suburban settings (57.4% and 48.3% respectively). The strong correlation between implementation quality and professional development hours ($r=0.52$, $p<0.001$) underscores the critical importance of teacher preparation, supporting Israel et al.'s [16] findings regarding the impact of sustained professional learning on inclusive practices.

Theoretical and Practical Implications

The empirical findings of this study have significant implications for both theory and practice in inclusive STEM education. The strong positive relationship between social inclusion measures and student self-efficacy ($\beta=0.58$, $p<0.01$) reinforces situated learning theories that emphasize the social nature of STEM learning. This finding suggests that accessibility must be conceptualized beyond individual accommodations to include broader considerations of classroom culture and participation structures. The data also challenges deficit-oriented conceptions of disability by demonstrating that properly designed inclusive environments can effectively support high-level STEM learning for diverse students. From a practical standpoint, the strong correlation between implementation quality and planning time allocation ($r=0.56$, $p<0.001$) highlights a critical and often overlooked aspect of inclusive education. Educators consistently identified time constraints as the most pervasive barrier to implementation (77.8% overall), suggesting that scheduling and workload considerations must be addressed alongside pedagogical and technological solutions. The significant relationship between co-teaching arrangements and implementation quality ($r=0.48$, $p<0.001$) provides empirical support for collaborative staffing models that bring together special education expertise with STEM content knowledge.

The technology implementation data reveals both opportunities and challenges. While adaptive technologies showed positive relationships with student outcomes, qualitative data revealed that technological solutions sometimes functioned as "band-aids" without addressing underlying instructional design issues. This finding aligns with research by Chen et al. [12] and emphasizes that technology must be integrated thoughtfully within broader inclusive frameworks rather than deployed as isolated solutions.

6. CONCLUSION

This empirical investigation provides compelling evidence that effective integration of STEM learning in inclusive classrooms requires coordinated implementation across multiple dimensions of accessibility, with particular emphasis on instructional design and cognitive engagement strategies. The statistically significant relationship between implementation quality and student outcomes demonstrates that accessibility and academic rigor are complementary rather than competing priorities. The differential impact for students with disabilities in high-implementation classrooms underscores the importance of intentional design while confirming that universal design approaches benefit all learners. The findings highlight several critical factors for successful implementation, including adequate planning time, collaborative teaching arrangements, targeted professional development, and administrative support. The significant correlation between these structural factors and implementation quality suggests that inclusive STEM education requires systemic support rather than relying solely on individual teacher efforts. The integration of quantitative and qualitative data provides a nuanced understanding of both implementation patterns and contextual factors affecting inclusive STEM education. Future research should explore longitudinal impacts of inclusive STEM education on student trajectories, particularly regarding STEM career interest and participation. Additionally, investigation into specific accessibility strategies for emerging STEM practices such as computational thinking and engineering design would address important gaps in current understanding. This study provides a foundation for such work by establishing empirical connections between accessibility practices and student outcomes in contemporary STEM education contexts.

REFERENCES

1 National Science Foundation, "Women, Minorities, and Persons with Disabilities in Science and Engineering," NSF Special Report 19-304, Arlington, VA, 2019.

2 A. Meyer, D. H. Rose, and D. Gordon, "Universal Design for Learning: Theory and Practice," CAST Professional Publishing, Wakefield, MA, 2014.

3 K. Jackson and J. Wilson, "Math accessibility and teacher beliefs: Tensions in STEM education reform," Journal of Research in Science Teaching, vol. 54, no. 6, pp. 721-743, 2017.

4 CAST, "Universal Design for Learning Guidelines version 2.2," 2018. [Online]. Available: http://udlguidelines.cast.org

5 P. Mishra and M. J. Koehler, "Technological pedagogical content knowledge: A framework for teacher knowledge," Teachers College Record, vol. 108, no. 6, pp. 1017-1054, 2006.

6 T. Davis and A. Martin, "Accessible STEM pedagogy: A framework for inclusive classrooms," Teaching Exceptional Children, vol. 50, no. 2, pp. 96-104, 2018.

7 L. Florian and K. Black-Hawkins, "Exploring inclusive pedagogy," British Educational Research Journal, vol. 37, no. 5, pp. 813-828, 2011.

8 S. Avramidis and B. Norwich, "Teachers' attitudes towards integration/inclusion: A review of the literature," European Journal of Special Needs Education, vol. 17, no. 2, pp. 129-147, 2002.

9 P. Eden and J. T. Hamdy, "Digital equity and accessibility in urban STEM classrooms," Computers & Education, vol. 132, pp. 21-35, 2019.

10 S. Burgstahler, "Universal design of instruction: Definition, principles, guidelines, and examples," DO-IT, University of Washington, Seattle, 2015.

11 R. Thompson and C. M. King, "Inclusion and STEM education: A systematic review of the literature," International Journal of Science Education, vol. 41, no. 12, pp. 1611-1635, 2019.

12 X. Chen, G. Stoddart, and J. Kahn, "Technology integration and inclusive science teaching: Examining intervention effectiveness," Journal of Research in Science Teaching, vol. 53, no. 7, pp. 967-992, 2016.

13 M. T. Marino and C. C. Beecher, "Conceptualizing RTI in 21st-century secondary science classrooms: Video games' potential to provide tiered support and progress monitoring for students with learning disabilities," Learning Disability Quarterly, vol. 33, no. 4, pp. 299-311, 2010.

14 J. D. Basham and M. T. Marino, "Understanding STEM education and supporting students through universal design for learning," Teaching Exceptional Children, vol. 45, no. 4, pp. 8-15, 2013.

15 M. W. Ok, M. Y. Rao, B. R. Bryant, and D. P. Bryant, "A meta-analysis of interventions to improve mathematics outcomes for students with learning difficulties," Journal of Educational Psychology, vol. 111, no. 2, pp. 301-320, 2019.

16 M. Israel, S. J. Pearson, T. Tapia, Q. M. Wherfel, and G. Reese, "Supporting all learners in school-wide computational thinking: A cross-case qualitative analysis," Computers & Education, vol. 82, pp. 263-279, 2015.

17 K. Jordan and F. Arriaga, "Co-teaching in integrated STEM: Examining partnership dynamics and student outcomes," Teacher Education and Special Education, vol. 42, no. 3, pp. 244-261, 2019.

18 M. L. Thurlow and R. J. Kopriva, "Advancing accessible science assessments and justifiable accommodations: Implications of research for students with disabilities," Journal of Science Education for Students with Disabilities, vol. 19, no. 1, pp. 73-91, 2016.

19 J. Yu, C. Burniske, and S. Jansen, "Formative assessment practices in inclusive mathematics education: Supporting students with diverse needs," Education Sciences, vol. 9, no. 2, pp. 94-109, 2019.

20 P. Williams and L. Chen, "Development and validation of the Inclusive STEM Practices Observation Protocol," Journal of Science Teacher Education, vol. 30, no. 6, pp. 559-580, 2019.

21 J. Robertson and K. Johnson, "The Student STEM Engagement Inventory: Development and psychometric evaluation," International Journal of Science Education, vol. 41, no. 8, pp. 1052-1076, 2019.

22 R. Castro and T. Morgan, "Beyond accommodation: Inclusive science teaching in diverse classrooms," Research in Science Education, vol. 47, no. 3, pp. 675-692, 2017.

23 D. Zhang and J. L. Peterson, "A review of the effectiveness of science instruction for students with disabilities," Journal of Research in Science Teaching, vol. 55, no. 7, pp. 911-940, 2018.

24 C. J. Rivera and J. C. Smith, "Using a flipped classroom model to support accessibility in STEM education," Teaching Exceptional Children, vol. 51, no. 3, pp. 195-208, 2019.

25 H. Gardner and D. Perkins, "Multiple approaches to understanding," In C. M. Reigeluth (Ed.), Instructional-design theories and models: A new paradigm of instructional theory, Lawrence Erlbaum Associates, Mahwah, NJ, 1999, pp. 69-98.

26 B. Means and H. J. Walters, "Equity and access in STEM: Implications for inclusive educational technology design," Educational Technology Research and Development, vol. 67, no. 5, pp. 1315-1332, 2019.

27 K. Tobin, "Research on science laboratory activities: In pursuit of better questions and answers to improve learning," School Science and Mathematics, vol. 90, no. 5, pp. 403-418, 1990.

28 T. Scruggs, M. Mastropieri, and K. McDuffie, "Co-teaching in inclusive classrooms: A metasynthesis of qualitative research," Exceptional Children, vol. 73, no. 4, pp. 392-416, 2007.

29 L. Darling-Hammond, "Teacher education around the world: What can we learn from international practice?" European Journal of Teacher Education, vol. 40, no. 3, pp. 291-309, 2017.

30 D. Rose, A. Meyer, and C. Hitchcock, "The universally designed classroom: Accessible curriculum and digital technologies," Harvard Education Press, Cambridge, MA, 2005.