Inclusion

Observing Inclusion in STEM Classes: Academic and Social Participation of Students with and without Intellectual or Developmental Disabilities

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Abstract:	Calls to support inclusive educational experiences for students with intellectual and developmental disabilities (IDD) have been longstanding. General education STEM classes may provide a rich context for promoting the inclusion of these students within a relevant curricular area. To assess inclusive class participation, we directly observed 15 secondary students with IDD—along with a comparison group of their classmates without disabilities—in STEM-related classes. We focused on academic, social, and contextual measures. Although some similarities were found in the academic and social participation of students and their classmates, key differences were observed in the areas of what they learned, who they conversed with, and how they learned. We present recommendations for future research and practice aimed at strengthening inclusive educational experiences.

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Abstract

Calls to support inclusive educational experiences for students with intellectual and developmental disabilities (IDD) have been longstanding. General education STEM classes may provide a rich context for promoting the inclusion of these students within a relevant curricular area. To assess inclusive class participation, we directly observed 15 secondary students with IDD—along with a comparison group of their classmates without disabilities—in STEM-related classes. We focused on academic, social, and contextual measures. Although some similarities were found in the academic and social participation of students and their classmates, key differences were observed in the areas of what they learned, who they conversed with, and how they learned. We present recommendations for future research and practice aimed at strengthening inclusive educational experiences.

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The importance of promoting access to the general education curriculum is emphasized within the Individuals with Disabilities Education Improvement Act (IDEA) of 2004. However, describing exactly what it means for students with severe disabilities to access the general curriculum has remained a point of considerable debate (e.g., Ayres et al., 2011; Ryndak et al., 2008). Courtade and colleagues (2012) argue that educational plans addressing both academic standards and functional skills provide the fullest access to educational opportunities across the curriculum (compared to a functional-skills curriculum alone). They emphasize that standards-based instruction is important in supporting independence and developing personal interests (e.g., leisure activities or vocational pursuits). However, access to the general curriculum does not only consist of the skills selected for instruction. An abundance of current literature suggests that it is comprised of two interconnected pieces—context and content (e.g., Ruppar et al., 2016). Context refers to the instructional setting in which the learning occurs (i.e., educational placement), and content refers to the skills to be learned (e.g., academic or functional skills). Science, technology, engineering, and math (STEM) classes can provide both context and content that create opportunities for learning academic standards and functional skills.

Context: The Need for Improvement

The general education classroom is advocated as the preferred context for students with intellectual and developmental disabilities (IDD) to access the general curriculum alongside same-aged peers (Morningstar, Allcock, et al., 2016). Meaningful inclusion entails participation in the full range of academic and social activities that take place within a classroom (Cross et al., 2004; Kurth & Gross, 2015). Academic engagement and peer interactions serve as common markers of this participation within research studies (e.g., Brock & Huber, 2017; Kuntz & Carter, 2019). Yet, placement in general education classes has largely stagnated for students with IDD and not kept pace with trends for students with other disabilities (Brock, 2018; Morningstar, Kurth, & Johnson, 2016). For example, data on the implementation of IDEA indicate 17% of students with intellectual disability (ID) attended general education classes for 80% or more of their school day in 2017, which nearly matched the 16.4% in 2007. In contrast, 63.5% of students across all disability categories attended general education classes for 80% or more of their school day in 2017, compared to 57.2% in 2007 (U.S. Department of Education, 2009, 2019).

Content: STEM as a Point of Access

General education classes—particularly STEM classes—address critical skills that include and extend beyond what has been described as consumer, domestic, and community skills (Ayres et al., 2011). Holmlund and colleagues (2018) interviewed STEM teachers to "make sense" of STEM education and characterized it in ways that include teaching collaboration, communication, creativity, and perseverance; building relationships; making connections; and following procedures. This literature suggests STEM content pairs skills such as inquiry (e.g., Jimenez et al., 2012), problem-solving (e.g., Miller & Taber-Doughty, 2014), and critical thinking (e.g., Miller et al., 2013) with knowledge of the world directly related to each student through biology (e.g., importance of hygiene), ecology (e.g., value of recycling), and engineering (e.g., using given materials to solve a problem). STEM education classes could provide appropriate contexts for accessing general curriculum content, especially for adolescents (i.e., middle and high school students) who are developing their interests and preparing for future career and college pathways.

Observational Studies of Inclusive Experiences

Several observational studies have examined the experiences of students with IDD within general education classes. Wehmeyer and colleagues (2003) found that students with ID in general education classrooms accessed tasks more closely linked to a curricular standard than did students with ID in self-contained classrooms. Expanding beyond academic content, Carter and colleagues (2005) observed factors such as proximity to peers and access to inclusive settings were associated with higher levels of interactions among students with IDD (i.e., enhanced social inclusion). Carter and colleagues (2008) identified classroom elements such as small group instructional formats, less direct support from a paraprofessional or special educator, and elective courses as having positive effects on students' academic engagement and social interactions. Additionally, Morningstar and colleagues (2015) reported successful inclusion incorporated supports for participation (e.g., staffing, instructional formats, access to academic content) and learning (e.g., universal design for learning, accommodations).

Although these descriptive studies provide helpful portraits of the academic and social experiences of students with IDD within general education classes, additional research is needed in two areas. First, none of these studies collected data on the academic and social experiences of students without disabilities enrolled in these same classes. In the absence of comparative data, it is difficult to gauge the extent to which the academic and social participation of students with IDD is encouraging or discouraging. Second, none of these observational studies focused specifically on STEM-related classes. Research conducted in STEM classes may contribute new insights into fostering inclusion centered on both academic and functional life skills for adolescents with IDD.

Study Purpose

In the present study, we conducted a descriptive analysis using direct observations to examine academic, social, and contextual factors within inclusive middle and high school STEM classes. We defined inclusive classes as those in which students with disabilities attend and participate in its instruction. We sought to answer the following research questions:

1. To what extent are students with IDD academically engaged in inclusive STEM classes?
2. To what extent are students with IDD interacting socially in inclusive STEM classes?
3. How does their academic and social participation compare to that of their classmates?
4. How do general educators deliver instruction in inclusive STEM classes?

Method

Participants with IDD

To be selected for this study, students had to (a) be eligible for special education services under the categories of intellectual disability or autism, or participate in the state's alternate assessment for individuals with significant cognitive impairments; (b) attend a general education STEM class for at least 30 min each day; (c) communicate using English; and (d) attend middle or high school (i.e., grades 5 through 12).

Fifteen students with disabilities (referred to as "focus students" in the rest of this article) participated in this study (see Table 1, all names are pseudonyms). These students received special education services under the categories of intellectual disability (n = 6), autism (n = 2), intellectual disability and autism (n = 1), intellectual disability and speech impairment (n = 1), functional delay (i.e., a state-specific category for students with a cognitive impairment in the absence of adaptive behavior deficits; n = 1), functional delay and orthopedic impairment (n = 1), and other health impairment and language impairment (n = 1). The parents of two students did not agree to disclosing specific disability eligibility information; however, their involvement was based on their special educators' determination that the student met the inclusion criteria. All students communicated primarily through speech, and none used an augmentative or alternative communication (AAC) device. Students ranged in age from 10 to 18 years old; 27% were female and 40% were racial/ethnic minorities. Ten students attended general science classes, three attended digital design, one attended collision repair, and one attended general math.

Upon receiving approvals for this study from the Institutional Review Board (IRB) and the school district, we emailed school and district administrators to identify special educators serving students meeting the inclusion criteria. We met with special educators at nine schools to discuss the purpose of the study and identify potential students. Special educators sent parent consent forms home with potential students, notified researchers when signed consent forms were returned, and introduced us to each student's general educator. We then met with general educators individually to discuss the purpose and requirements of the study and to obtain consent to observe in their classes. Prior to beginning observations of the focus students, we obtained verbal or written assent.

Comparison Peers without IDD

To obtain peer comparison data, we selected peers without disabilities enrolled in the same class as the focus students (cf., Feldman et al., 2016). We attempted to select classmates who sat in close proximity to the focus student and who were of the same sex to control for any differences based on these characteristics (e.g., Jones & Wheatley, 1990). Varying peers across sessions, we observed one peer for the first half of each observation and a different peer for the second half. We combined these data to generate a "peer composite" that would be more representative of typical students in the class (cf., Carter et al., 2016). We did not collect identifying information (e.g., name, age, academic information) for these classmates. Since these data were combined with that of another peer, consent or assent was not required.

Settings

All students attended four middle and two high schools in a southeastern metropolitan school district. This school district was selected due to the diversity of socioeconomic statuses and cultural backgrounds of the student body (see Table 1). Student enrollment in the six schools ranged from 344 to 2,376 students (M = 1,041). Across schools, student ethnicity was 43% Black or African American (range = 20% to 85%), 37 % Caucasian (range = 8% to 58%), 17% Hispanic or Latino (range = 6% to 36%), and 4% Asian (range = 0% to 7%). The average percentage of students considered to be economically disadvantaged was 48% (range = 28% to 86%). The average percentage of students eligible for special education services was 16% (range = 13% to 18%). The percentage of students with ID or autism at these schools was not available.

Staffing arrangements varied across the 11 classrooms in which we observed—four classes included two students each. All classrooms included a general educator, and eight classrooms included other school staff (see Table 1). We observed the classes of nine general educators—two different class periods for two educators. Seven educators were female, and two were male. All educators were Caucasian and licensed in their content area and/or grade level. The length of these classes was about 60 min in middle school and 90 min in high school. We did not document class sizes.

Measures

We used an observational tool adapted from the Mainstream Version of the Code for Instructional Structure and Student Academic Response (MS-CISSAR; Greenwood et al., 1994). The MS-CISSAR is a rigorously validated tool that has been used extensively in prior observational research (e.g., Kurth et al., 2016). We used a subset of existing categories focused on six ecological factors and student behaviors—class task, physical arrangement, instructional grouping, interaction type, interaction partner, and academic engagement. These measures were unchanged from the MS-CISSAR. We included two additional measures addressing task alignment and content alignment. Each of the eight measures ranged from four to 10 possible codes. Figure 1 displays each measure, its respective codes, and brief definitions. We also took anecdotal notes regarding the class content and instructional arrangements after completing our observations.

Consistent with the MS-CISSAR protocol and recommended observational practices (Yoder et al., 2018), we collected data on each variable in live sessions using interval recording. Each observation interval lasted 20 s and was followed by a 20 s record interval. Observe-record intervals alternated between the focus student and a classmate for a total of 40 observe-record intervals (i.e., 20 for each). Observation sessions began at the class's scheduled start time or when the teacher, focus student, and at least one peer without a disability were in the class after the scheduled start time. Observation session ended when 40 intervals were completed or if the focus student was dismissed from class. The duration of each observation was just over 25 min.

Academic Measures

Three measures—academic engagement, content alignment, and task alignment—addressed participation in instruction and were recorded using momentary-time sampling (i.e., the presence or absence of each code was recorded at the end of each interval). Codes for each measure were exhaustive and mutually exclusive. *Academic engagement* referred to the degree to which a student was engaged in any instructional task he or she was presented. This measure had four codes: actively engaged, passively engaged, not engaged, and no task to engage. *Content alignment* addressed how the academic content delivered to the student compared to what was delivered to the rest of the class. This measure had four codes: same, adapted, alternate, or no content presented. *Task alignment* addressed how the instructional tasks expected of the student compared to what was expected of the rest of the class. This measure had four codes: same task, adapted task, alternate task, or no task presented.

Social Measures

Two measures—interaction type and interaction partner—focused on social interactions and were recorded using partial interval recording (i.e., their occurrence was recorded if taking place at any point during the 20 s interval). Codes were not mutually exclusive and multiple codes could be recorded in each interval. *Interaction type* addressed the topic of any interaction occurring between a student and any communication partner during the interval. This measure had seven codes: academic, behavioral, social, unintelligible, attempted interaction, no interaction, or other interaction. *Interaction partner* addressed the person with whom the student communicated during the observed interaction. This measure had five codes: general educator, paraprofessional, peer, other adult (e.g., special educator, therapist), or not applicable.

Contextual Measures

Three measures—class task, physical arrangement, instructional grouping—reflected ecological variables within the classroom and were captured using momentary-time sampling. Codes for all measures were mutually exclusive and exhaustive. *Class task* addressed the instructional activity presented by the classroom teacher in which the whole class was expected to engage. This measure had ten codes: textbook, workbook, worksheet, quiz/test, listen/lecture, discussion, electronics, hands-on, some other task, or no task. *Physical arrangement* addressed the seating configuration for the student within the classroom. This measure had four codes: tables, lab table, individual desk, or other seating arrangement. *Instructional grouping* addressed the format in which the observed student received instruction. This measure had six codes: whole class, large group, small group, paired group, independent, or one-on-one.

Observation Procedures

We planned to observe students three to five times depending on the class schedule and activities to obtain a more representative sample (Bottema-Beutel et al., 2014). We met this goal with two exceptions. We increased the number of observations for one student to seven after learning that she only remained in her general education class for 15 min each day. We observed a second student only twice because he stopped attending the class. Our observations occurred on different days, primarily during the second and third marking periods (e.g., quarters) as scheduled with the general education teacher.

Before beginning the observation, the primary observer selected an initial classmate for comparison purposes. The observer selected a second classmate halfway through the observation. If the focus student left the classroom temporarily during the observation (e.g., to go to the bathroom, take a drink of water, visit their locker), we paused the observation until he or she returned. This rarely occurred. Observation sessions ended if the focus student left the room for an indefinite amount of time (e.g., being called to work with a related service provider or early dismissal) or if the class period ended. For each focus student and classmates, we aggregated data across all observations for each variable.

Reliability and Interobserver Agreement (IOA)

Our team of observers consisted of the first author and three graduate students in special education. During the training phase and prior to independent observations, observers met with the first author to read and discuss the coding manual, which contained descriptions and definitions. Together, observers coded example video clips of classrooms using the data sheet. Example classroom videos—sourced from YouTube—had to display the teacher, selected focus student, and a selected classmate in all frames to mimic the observer’s point of view in a classroom. Next, the observers independently coded novel segments of the video clips in increments of 10 intervals through three stages—(1) first author modeled coding, (2) first author led the second observer through coding, and (3) first author and second observer coded independently. For independently coded intervals, we compared our results and discussed any discrepancies until 80% agreement was met. This occurred in one session for each observer. We assessed IOA during 47.2% of sessions (range = 33.3% to 66.7% per student). IOA data were not collected for one focus student because the student stopped attending class prior to the scheduled IOA session.

During observations in which IOA data were collected, a second observer independently coded all measures. Both observers sat in a location in which the focus student and comparison classmates could be readily seen and heard (generally within 3 to 6 feet). Observers did not communicate with one another during observations. We calculated agreement for each measure by taking the total number of agreements, dividing by the total number of possible agreements during the observation, and multiplying by 100 (e.g., Yoder et al., 2018, p. 145). Across all IOA observations, agreement averaged 91.9%. *Academic engagement* averaged 85.4% agreement. *Content alignment* averaged 94.8% agreement. *Task alignment* averaged 95.8% agreement. *Interaction type* averaged 84.5% agreement. *Interaction partner* averaged 91.1% agreement. *Class task* averaged 92.2% agreement. *Physical arrangement* averaged 99.3% agreement. *Instructional grouping* averaged 91.8% agreement.

Data Analysis

We entered all data into an Excel spreadsheet specifically created for analysis of individual student data. To address question 1 and question 2, we combined (i.e., stacked) observations for each participant to determine the percentage of all intervals in which each code was observed for him or her. We present these data for individual students as well as summarize them across students using descriptive statistics (i.e., means, standard deviations). As a follow-up analysis, we examined the extent to which students were academically engaged when each of the content alignment and task alignment codes were observed. Such findings should be interpreted cautiously as not all students encountered each form of content and task alignment. To address question 3, we compared the academic and social measures of focus students with those of their classmates using Wilcoxon signed-rank tests. The Wilcoxon test is well-suited for handling nonnormally distributed and dependent data. To address question 4, we summarized physical arrangements and instructional groupings in the same way as we did our academic and social measures. However, for class task we combined observations across students to create a composite portrait of instruction within these classes.

Results

Academic Engagement

On average, focus students were engaged in academic tasks for more than half of all observation intervals. Specifically, they averaged 48.5% of intervals (*SD* = 30.4) with active engagement, 9.6% (*SD* = 9.1) with passive engagement, 23.9% intervals (*SD* = 19.9) not engaged, and 17.8% intervals (*SD* = 22.6) without a task. The pattern for classmates averaged 64.4% of intervals (*SD* = 30.5) with active engagement, 5.5% (*SD* = 4.5) with passive engagement, 19.2% intervals (*SD* = 14.8) not engaged, and 10.9% intervals (*SD* = 20.0) without a task. We combined data for active and passive engagement and compared overall engagement across groups using a Wilcoxon test. No significant difference was found, $z = -1.8$, *ns*. The mean of the ranks in favor of focus students was 7.3, while the mean of ranks in favor of classmates was 8.3.

Individual differences were evident across focus students (see Table 2). For example, Gabriel and Jacob attended a class with a teacher providing high levels of instruction (i.e., 98.8% and 100% of intervals with a task, respectively) and had fairly high levels of academic engagement (81.2% and 85.7% of intervals, respectively) as did their classmates. In contrast, Jameela attended a class with a teacher providing much lower levels of instruction (i.e., only 45.5% of intervals contained instruction), and she was engaged during just 3.9% of intervals. Her classmates also engaged at lower levels (6.5% of intervals).

Content Alignment and Academic Engagement

On average, focus students were provided the same academic content as others in their class during 52.5% of intervals (*SD* = 35.1). Adapted content was provided in 12.0% of intervals (*SD* = 21.4) and alternate content was provided in 16.7% of intervals (*SD* = 33.8). No academic content was presented during 18.9% of intervals (*SD* = 23.2). Considerable individual differences were evident in the provision of same, adapted, and alternate content across students.

As a follow-up analysis, we examined differences in active engagement based on the type of content that was provided across focus students (see Table 3). Active engagement was 89.2% of intervals when alternate content was provided, 80.6% of intervals when content was adapted, and 40.7% of intervals when the same as what was provided to the rest of the class. To illustrate, Jazmine received alternate content in all observed intervals in her math class but had very high rates of active engagement (96.7%). A peer tutor and a paraprofessional typically prompted her through single-digit addition problems on an individual whiteboard. Gabriel primarily received adapted content (72.9%) in his science class from a paraprofessional in a small group of students with significant support needs. He had high levels of academic engagement (81.2%). In contrast, Lynnette often sat at a lab table in science, among her typical peers but apart from a paraprofessional who primarily assisted other students with significant support needs. She received the same content as the rest of the class during 96.7% of intervals but had lower levels of active engagement (68.3%).

Task Alignment and Academic Engagement

On average, focus students received the same task as others in their class during 49.4% of intervals (*SD* = 32.1). An adapted task was presented during 6.6% of intervals (*SD* = 9.6) and an alternate task was presented during 25.6% of intervals (*SD* = 36.7). No task was provided during 18.4% of intervals (*SD* = 23.2).

Our follow-up analyses found that active engagement was 85.4% when the students received alternate tasks, 72.3% when tasks were adapted, and 41.1% when tasks were the same (see Table 3) for the percentage of active engagement by task alignment for each student. To illustrate, Forrest received the same tasks as others in his science class during 93.6% of intervals, but was actively engaged during just 31.9% of intervals. Instead, he often remained unengaged when sitting next to a paraprofessional but among his peers. In contrast, Nicholas received the same task during 80.0% of intervals and was actively engaged during most of these intervals (68.3%). He sat at a table with other students with significant support needs and a paraprofessional.

Social Interactions

Overall, social interactions with students or staff were fairly common in these classrooms (see Table 4). Focus students interacted with at least one other individual during an average of 37.5% of intervals (*SD* = 24.8). Similarly, comparison classmates interacted with others during an average of 29.4% of intervals (*SD* = 16.0). We found no significant differences between these groups of students, $z = -0.91$, *ns*. The mean of the ranks in favor of focus students was 8.44, while the mean of ranks in favor of classmates was 7.33. We also compared the groups based on the extent to which they interacted with general educators, peers, and paraprofessionals. On average, focus students interacted with the general educator during 5.5% of intervals (*SD* = 5.9) compared to 6.8% of intervals (*SD* = 4.2) for classmates. We found no significant difference in interactions with general educators, $z = -1.4$, *ns*. The mean of the ranks in favor of focus students was 6.2, while the mean of ranks in favor of classmates was 8.2. Focus students interacted with other peers during 15.2% of intervals (*SD* = 23.8) compared to 22.0% of intervals for their classmates (*SD* = 15.2). We did find a significant difference in groups, $z = -2.2$, $p < .05$. The mean of the ranks in favor of focus students was 7.3, while the mean of ranks for classmates was 8.2. Finally, focus students interacted with paraprofessionals (*M* = 17.9%; *SD* = 17.1) far more often than did classmates (*M* = 0.3%; *SD* = 0.7).

In terms of conversational topics, the focus students interacted about academic topics during 20.0% of intervals (*SD* = 19.6), behavioral topics during 10.7% of intervals (*SD* = 8.8), and social topics during 6.3% of intervals (*SD* = 11.1). The topic was unintelligible in 2.8% of intervals, and students' attempts at an interaction were unreceived in 0.8% of intervals.

Individual differences in social interactions were apparent across students (see Table 4). For example, Jazmine interacted with peers—primarily an assigned peer tutor—in 82.0% of intervals and the focus of their conversations was almost always related to academics (80.3% of intervals). In contrast, Gabriel, Jacob, Ezra, and Beau were never observed to interact with any peer. Likewise, Jacob, Jazmine, and Forrest were never observed interacting with their general education teacher but interacted with paraprofessionals quite often. Zahra and Peyton, who attended class without a paraprofessional, had the highest levels of interactions with general educators (14.0% and 21.7%, respectively).

Classroom Contexts

Class Task

Combining across all student observations, we found that general educators assigned class tasks involving a worksheet in 24.4% of intervals, electronics in 14.3% of intervals, a listening task in 13.3% of intervals, quiz/test in 8.0% of intervals, hands-on task in 7.8% of intervals, a discussion in 7.2% of intervals, a textbook task in 1.8% of intervals, a workbook task in 0.8% of intervals, and another type of task in 0.2% of intervals. No tasks were provided in 17.6% of intervals. Although these STEM classes were focused on real-world application and hands-on content, we rarely observed students engage in applied, hands-on tasks. Instead, classes most often consisted of lectures with notetaking (i.e., worksheets), transition/down time (i.e., no task), or in the case of the digital design classes time spent on computers (i.e., electronics).

Physical Arrangements

The physical arrangements for focus students and their classmates were fairly similar (see Table 5). Focus students sat at lab tables during 36.1% of intervals (*SD* = 45.0), long computer tables (i.e., other arrangement) during 29.7% of intervals (*SD* = 44.3), desks in tables during 28.6% of intervals (*SD* = 42.8), and individual desks during 5.4% of intervals (*SD* = 17.4). Classmates sat at lab tables during 41.0% of intervals (*SD* = 46.1), in other arrangements during 29.7% of intervals (*SD* = 44.1), at desks during tables in 28.4% of intervals (*SD* = 42.5), and at individual desks during 0.7% of intervals (*SD* = 2.7).

Instructional Grouping

Unlike physical arrangements, some variations were apparent in instructional groups for small group, whole class, and one-on-one instruction (see Table 5). On average, independent work was assigned during 34.3% of intervals (*SD* = 35.1) for focus students and during 40.4% of intervals (*SD* = 32.2) for classmates. Paired groups were assigned during 3.0% of intervals (*SD* = 8.0) for focus students and during 0.9% of intervals (*SD* = 3.4) for classmates. Focus students worked in small groups during 19.1% of intervals (*SD* = 29.4) compared to classmates during 7.3% (*SD* = 15.8). Focus students worked one-on-one with an adult during 10.5% of intervals (*SD* = 27.0) compared to classmates who never worked one-on-one with an adult. Focus students took part in whole class instruction during 32.1% of intervals (*SD* = 25.9) compared to classmates who were part during whole class instruction in 47.7% of intervals (*SD* = 28.2).

Discussion

Supporting the academic and social participation of students with IDD within rigorous general education courses remains an enduring focus of the inclusive education movement (see Kuntz & Carter, 2019). Yet, few studies have provided a portrait of this participation at the secondary level. In this study, we examined the educational experiences of middle and high school students taking STEM classes in relation to those of their classmates without similar disabilities. Our findings extend the literature on school inclusion in several important ways.

First, we observed only moderate levels of academic engagement for students with IDD within these STEM classes. Specifically, students were actively or passively engaged for an average of 57.9% of intervals. This finding is comparable to other observational studies conducted in a variety of elective and academic secondary school classrooms. For example, Carter et al. (2008) reported academic engagement levels between 60-62% in their study of middle and high school classes and pre-intervention academic engagement levels ranged from 62-64% in a high school study by Carter et al. (2016). Two additional data points can help situate this particular finding. First, general educators provided instruction during just 82.3% of observation intervals, limiting the overall opportunities for students to be engaged. Second, the academic engagement of focus students did not differ significantly from that of their classmates. Additionally, Wehmeyer et al. (2003) found students with ID engaged in tasks and content standards aligned to the general education class in 63.1% of intervals and engaged in similar tasks but different content standards in 70.1% of intervals. Still, it is important to pursue additional practices that might further elevate student engagement. In their review of the secondary literature, Kuntz and Carter (2019) identified a number of interventions that can improve the academic outcomes of students with IDD in inclusive classrooms, such as embedded instruction (e.g., Jameson et al., 2008; Jimenez et al., 2012) and classwide peer tutoring (e.g., McDonnell et al., 2001).

Second, individual differences were very apparent in this study. Some students—like Jazmine, Jacob, and Gabriel—were actively engaged during more than 80% of observation intervals. Other students—like Jason, Peyton, and Forrest—were unengaged for more than half of their observation time. Identifying the multiple factors that can coalesce to impact student engagement is important but challenging. Some factors suggested in the literature have included the close proximity of individually assigned paraprofessionals (e.g., Carter et al., 2008), the availability of adaptations and modifications (Ballard & Dymond, 2017; Finnerty et al., 2019), the use of universal design (Lowrey et al., 2017), the quality of instruction (Ruppar et al., 2017), and the extent of collaboration (Olson et al., 2016). Future studies are needed to examine the individual and combined influence of these factors on students' academic engagement and learning. In our follow-up analyses, we found that the highest levels of academic engagement were observed for some students when they were provided content and tasks that were adapted, rather than the same as or completely different from what was provided to others in the class. Such findings highlight the importance of individualized planning and supports to ensure the educational needs of each student are being met.

Third, students with IDD interacted with others fairly often in these classes. Although the overall percentage of intervals with an interaction (37.5%) resembled the levels of their classmates without disabilities (29.4%), the persons with whom they interacted were quite different. The largest percentage of interactions involving focus students took place with paraprofessionals. In contrast, interactions with peers were significantly less common for focus students than for their classmates. Such low levels of peer interaction are consistent with prior observational studies (e.g., Carter et al., 2008) and the baseline phases of most intervention studies carried out in inclusive secondary classrooms (see Kuntz & Carter, 2019). Anecdotally, we noticed that general educators in these classes were not actively incorporating peer groupings as a way to promote shared learning or to facilitate social connections. Peer support arrangements offer one evidence-based approach for increasing social interactions and collaborative learning for adolescents with IDD (Brock & Huber, 2017). Other promising approaches include peer-mediated communication interventions (e.g., Hughes et al., 2013) and social-focused self-management interventions (e.g., Agran et al., 2001).

Fourth, effective classroom instruction is critical to the achievement of all students including those with IDD. We found that the overall quality and quantity of instruction in these general education classrooms was limited for *all* students. Within the framework of a multi-tiered system of support (MTSS), Tier 1 emphasizes effective instruction and evaluation within the general education classroom. Most of the instruction we observed across classrooms involved lecture, notetaking in journals, and downtime. Students with teachers providing lower levels of downtime (i.e., no task to engage) were often academically engaged at higher rates (e.g., Gabriel, Lynnette, Jazmine). In contrast, students with teachers providing higher levels of downtime tended to be academically engaged at lower rates and/or not engaged (e.g., Jameela, Ben, Darien). For teachers with more than one focus student in their classes, we observed mixed levels of academic engagement across focus students. We observed this variance in content and task alignment, as well as social interactions. The differences in these variables across students suggest teachers have the ability to differentiate instruction across students' needs. Therefore, we see quality classroom instruction as a critical component in ensuring quality instruction for students with IDD.

Limitations

Several limitations of this study suggest future directions for research. First, our observations involved only 15 students with disabilities enrolled in a single urban school district. Such a sample constrains the generalizability of our findings. We found it challenging to identify adolescents with IDD who were enrolled in STEM classes. Consistent with national educational placement patterns (Brock, 2018; Kleinert et al., 2015), inclusion is quite limited at the secondary level and in core academic classes like science and math. Future researchers should replicate this study in different districts with a wider range of students.

Second, our measure of interaction partners did not differentiate between peers who did and did not have IDD. Relative to their classmates, peer interactions were significantly lower for the 15 focus students. Anecdotally, we noticed that many of the peer interactions involved other students with significant support needs enrolled in the same class and supported by a common paraprofessional. Although increasing these interactions can certainly be valuable, expanding the breadth of peers in a class who get to meet, work alongside, and develop relationships with students with IDD is also essential. Future studies should include a more fine-grained differentiation of conversational partners.

Third, we did not collect detailed information about the classroom teachers and the characteristics of their classes. Type of education, certifications, prior training, and past experience are all factors that may impact how general educators prepare for and lead their classes. In this study, we are uncertain how well-prepared teachers were to serve students with IDD. Additional interviews with each general educator could have enriched our understanding of their confidence and competence in serving diverse students.

Implications for Research and Practice

Findings from this descriptive study have several implications for researchers and practitioners. First, general educators need support in delivering engaging classroom lessons that bridge STEM content to real-world application. Students displayed only modest rates of academic engagement and nearly one fifth of intervals (17.6%) included no instruction. Kelley and Knowles (2016) provide a conceptual framework linking the scientific community of practice with critical STEM concepts. They recommend improvements in preparing new STEM teachers and providing opportunities for teachers to expand their use of STEM practices.

Second, general educators need effective practices in order to provide strong instruction to students with IDD in their classes. Kuntz and Carter (2019) identified a growing body of work highlighting practices upon which general educators can draw (i.e., peer support arrangements, systematic instruction, self-management, and peer-mediated communication). However, the best pathways for informing and equipping general educators to implement these interventions in their classrooms is unclear. Although introducing effective strategies within pre-service training programs is appealing, it is more likely that subsequent professional development provided by schools, districts, and other educational groups will reach these teachers. Recent reviews of effective professional development approaches emphasize promising approaches for training and coaching that could be extended to general educators (Brock et al., 2017; Brock & Carter, 2017).

Third, general and special educators should collaborate to develop meaningful adaptations that encourage active engagement for students with IDD (Ballard & Dymond, 2017; Olson et al., 2016). General educators provide expertise on content knowledge, the academic standards, and the planned classroom instruction. Special educators provide expertise on adaptations and instructional practices to make the content accessible for students with disabilities. Future research should assess prevailing collaborative models and evaluate new approaches for educators to work together to address the educational needs of all students.

Fourth, future policy initiatives should focus on efforts to improve the quality of STEM classroom instruction for all students. One emphasis should be placed on incorporating science concepts such as inquiry-based rather than lecture-based lessons. As opposed to listening activities, lessons aligned more closely to the characterization of STEM education (e.g., building relationships, making connections) could improve outcomes beyond content mastery by developing real-world, functional skills. Further, educators should have the resources (e.g., staff, schedules) to develop collaborative models and implement universal design principles (i.e., multiple modes of engagement, representation, and expression). Staffing models varied across our classrooms. Thus, future research could guide policy on how to better utilize these models in creating quality inclusive classes.

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Table 1

Student Demographics and Classroom Information

Teacher	Student	Special education categories	IQ	Alternate assessment eligible	Sex	Race/ethnicity	Age	Grade	STEM class	Classroom staffing	Racial composition of schools			
											AA	C	H/L	A
Teacher 1	Gabriel	Intellectual disability	49	Yes	Male	Caucasian	10	5	General science	GE, CP	32%	56%	7%	5%
	Jacob	Other health impairment + language impairment	44	Yes	Male	Caucasian	11	5	General science	GE, CP				
Teacher 2	Nicholas	Intellectual disability + Autism	57	Yes	Male	Caucasian	12	6	General science	GE, CP				
	Lynnette	Intellectual disability + Speech impairment	72	Yes	Female	Caucasian	12	6	General science	GE, CP				
Teacher 3 Class A	Ben	Intellectual disability	69	Yes	Male	Caucasian	14	8	General science	GE, 1:1				
Class B	Ezra	Functional delay	55	Yes	Male	Caucasian	13	8	General science	GE, 1:1				
Teacher 4	Jazmine	Autism	59	Yes	Female	Hispanic	11	5	General math	GE, 1:1, SE	20%	37%	36%	7%
Teacher 5	Peyton	Intellectual disability	61	No	Male	African American	12	7	General science	GE	85%	8%	8%	0%
Teacher 6	Zahra	Intellectual disability	45	Yes	Female	African American	14	8	General science	GE				
Teacher 7	Beau	Functional delay + Orthopedic impairment	84	Yes	Male	Caucasian	13	7	General science	GE, 1:1, SE	31%	58%	6%	5%
	Forrest	—	—	—	Male	Caucasian	—	7	General science	GE, 1:1, SE				
Teacher 8	James	Intellectual disability	40	Yes	Male	African American	18	12	Collision repair	GE	38%	42%	16%	3%
Teacher 9 Class A	Darien	Autism	—	No	Male	African American	16	12	Digital design	GE	50%	18%	30%	2%
Class B	Jameela	Intellectual disability	<50	—	Female	African American	17	12	Digital design	GE, OP				
Class B	Jason	—	—	—	Male	Caucasian	—	12	Digital design	GE, OP				

Note: AA = African American, C = Caucasian, H/L = Hispanic/Latino, A = Asian, GE = General educator, CP = Classroom paraprofessional 1:1 = Paraprofessional assigned to student, OP = Paraprofessional in room but assigned to another student, SE = Special educator, — = Access to records not available.

Table 2

Academic Outcomes for Students with Disabilities and Comparison Peers

	Academic engagement				Content alignment				Task alignment			
Student	Active	Passive	Not engaged	No task	Same	Adapted	Alternate	No content	Same	Adapted	Alternate	No task
Gabriel	81.2 (85.7)	8.2 (6.0)	9.4 (8.3)	1.2 (0.0)	22.4 (96.4)	72.9 (1.2)	2.4 (0.0)	2.4 (2.4)	14.1 (98.8)	20.0 (1.2)	63.5 (0.0)	2.4 (0.0)
Jacob	87.5 (100.0)	4.2 (0.0)	8.3 (0.0)	0.0 (0.0)	10.2 (100.0)	32.7 (0.0)	53.1 (0.0)	2.0 (0.0)	10.2 (100.0)	0.0 (0.0)	85.7 (0.0)	2.0 (0.0)
Nicholas	68.3 (83.3)	13.3 (11.7)	15.0 (5.0)	3.3 (0.0)	98.3 (100.0)	0.0 (0.0)	0.0 (0.0)	1.7 (0.0)	80.0 (100.0)	16.7 (0.0)	0.0 (0.0)	3.3 (0.0)
Lynnette	36.7 (86.2)	26.7 (3.4)	35.0 (10.3)	0.0 (0.0)	98.3 (100.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	70.0 (100.0)	0.0 (0.0)	28.3 (0.0)	0.0 (0.0)
Ben	16.7 (50.8)	3.3 (10.2)	18.3 (30.5)	61.7 (8.5)	21.7 (91.5)	10.0 (0.0)	6.7 (0.0)	61.7 (8.5)	21.7 (91.5)	10.0 (0.0)	6.7 (0.0)	61.7 (8.5)
Ezra	77.6 (62.1)	5.2 (10.3)	12.1 (24.1)	5.2 (1.7)	10.3 (98.3)	0.0 (0.0)	86.2 (0.0)	3.4 (1.7)	10.3 (98.3)	8.6 (0.0)	75.9 (0.0)	5.2 (1.7)
Jazmine	96.7 (70.0)	1.6 (5.0)	1.6 (13.3)	0.0 (11.7)	0.0 (93.3)	0.0 (0.0)	100.0 (0.0)	0.0 (6.7)	0.0 (93.3)	0.0 (0.0)	100.0 (0.0)	0.0 (6.7)
Peyton	25.0 (50.0)	18.3 (10.0)	56.7 (40.0)	0.0 (0.0)	100.0 (100.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	100.0 (100.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Zahra	70.0 (65.3)	10.0 (4.1)	0.0 (30.6)	20.0 (0.0)	44.0 (87.8)	34.0 (0.0)	0.0 (0.0)	22.0 (12.2)	68.0 (100.0)	0.0 (0.0)	30.0 (0.0)	2.0 (0.0)
Beau	35.0 (88.3)	11.7 (8.3)	28.3 (1.7)	25.0 (1.7)	68.3 (95.0)	0.0 (0.0)	0.0 (0.0)	31.7 (5.0)	53.3 (95.0)	15.0 (0.0)	0.0 (0.0)	31.7 (5.0)
Forrest	31.9 (80.4)	8.5 (2.2)	53.2 (17.4)	6.4 (0.0)	93.6 (97.8)	0.0 (0.0)	4.3 (0.0)	0.0 (2.2)	93.6 (97.8)	0.0 (0.0)	4.3 (0.0)	0.0 (2.2)
James	44.4 (72.2)	18.5 (0.0)	29.6 (24.1)	7.4 (3.7)	77.8 (96.3)	18.5 (0.0)	0.0 (0.0)	3.7 (3.7)	77.8 (98.1)	18.5 (0.0)	0.0 (0.0)	3.7 (1.9)
Darien	19.2 (6.1)	0.0 (0.0)	24.2 (33.7)	56.6 (60.2)	40.4 (39.8)	0.0 (0.0)	0.0 (0.0)	59.6 (60.2)	40.4 (39.8)	0.0 (0.0)	0.0 (0.0)	59.6 (60.2)
Jameela	3.9 (6.5)	0.0 (0.0)	41.6 (40.3)	54.5 (53.2)	45.5 (46.8)	0.0 (0.0)	0.0 (0.0)	54.5 (53.2)	45.5 (46.8)	0.0 (0.0)	0.0 (0.0)	54.5 (53.2)
Jason	14.8 (29.6)	3.7 (11.1)	53.7 (33.3)	27.8 (25.9)	70.4 (72.2)	0.0 (0.0)	0.0 (0.0)	29.6 (27.8)	70.4 (72.2)	0.0 (0.0)	0.0 (0.0)	29.6 (27.8)
Average	**48.5 (64.4)**	**9.6 (5.5)**	**23.9 (19.2)**	**17.8 (10.9)**	**52.5 (87.9)**	**12.0 (0.1)**	**16.7 (0.0)**	**18.9 (12.3)**	**49.4 (88.6)**	**6.6 (0.1)**	**25.6 (0.0)**	**18.4 (19.9)**

Note. Peer comparison data are indicated in parentheses.

Table 3

Percentage Active Engagement by Level of Content and Task Alignment for Students with Disabilities

Student	Content alignment			Task alignment		
	Same	Adapted	Alternate	Same	Adapted	Alternate
Gabriel	84.2	82.3	100.0	75.0	100.0	79.6
Jacob	100.0	100.0	76.9	100.0	—	85.7
Nicholas	37.3	—	—	40.5	—	29.4
Lynnette	70.7	—	—	72.3	70.0	—
Ben	23.1	83.3	50.0	23.1	83.3	50.0
Ezra	33.3	—	87.8	33.3	100.0	86.4
Jazmine	—	—	96.7	—	—	96.7
Peyton	25.0	—	—	25.0	—	—
Zahra	59.1	100.0	—	73.5	—	100.0
Beau	47.5	—	—	45.2	55.6	—
Forrest	34.1	—	0.0	34.1	—	0.0
James	86.4	20.0	—	86.4	20.0	—
Darien	40.0	—	—	40.0	—	—
Jameela	8.6	—	—	8.6	—	—
Jason	21.1	—	—	21.1	—	—
Average	40.7	80.6	89.2	41.1	72.3	85.4

Note. Dashes indicate no intervals with the indicated alignment.

Table 4

Social Outcomes for Students with Disabilities and Comparison Peers

	Interaction type												Interaction partner									
Student	Academic		Behavioral		Social		Attempted		Unintelligible		No interaction		General educator		Para-professional		Peer		Other adult		Not applicable	
Gabriel	38.8	(4.8)	14.1	(2.4)	3.5	(2.4)	0.0	(2.4)	3.5	(7.1)	43.5	(82.1)	8.2	(4.8)	51.8	(0.0)	0.0	(10.7)	0.0	(0.0)	41.2	(86.9)
Jacob	27.1	(2.1)	6.3	(4.2)	8.3	(0.0)	0.0	(10.4)	0.0	(0.0)	58.3	(83.3)	0.0	(4.2)	37.5	(0.0)	0.0	(6.3)	0.0	(0.0)	62.5	(93.8)
Nicholas	25.0	(23.3)	11.7	(0.0)	1.7	(1.7)	1.7	(1.7)	1.7	(3.3)	58.3	(70.0)	5.0	(5.0)	21.7	(0.0)	15.0	(23.3)	1.7	(1.7)	58.3	(66.7)
Lynnette	20.3	(13.8)	3.4	(1.7)	0.0	(12.1)	0.0	(1.7)	1.7	(3.4)	76.3	(69.0)	6.8	(8.6)	15.3	(0.0)	1.7	(22.4)	0.0	(0.0)	79.7	(70.7)
Ben	18.3	(5.1)	16.7	(1.7)	15.0	(10.2)	0.0	(1.7)	3.3	(8.5)	50.0	(74.6)	3.3	(5.1)	31.7	(0.0)	20.0	(22.0)	0.0	(0.0)	50.0	(74.6)
Ezra	24.1	(5.2)	12.1	(1.7)	1.7	(15.5)	0.0	(1.7)	1.7	(12.1)	65.5	(63.8)	1.7	(6.9)	32.8	(0.0)	0.0	(25.9)	0.0	(1.7)	65.5	(67.2)
Jazmine	80.3	(6.7)	26.2	(1.7)	1.6	(5.0)	0.0	(0.0)	1.6	(1.7)	1.6	(85.0)	0.0	(6.7)	31.1	(1.7)	82.0	(6.7)	0.0	(0.0)	1.6	(85.0)
Peyton	6.7	(8.3)	18.3	(6.7)	43.3	(28.3)	5.0	(1.7)	13.3	(20.0)	26.7	(40.0)	21.7	(10.0)	0.0	(0.0)	56.7	(51.7)	0.0	(0.0)	31.7	(43.3)
Zahra	6.0	(16.3)	10.0	(6.1)	0.0	(12.2)	2.0	(0.0)	0.0	(16.3)	84.0	(49.0)	14.0	(10.2)	0.0	(0.0)	2.0	(40.8)	0.0	(0.0)	86.0	(49.0)
Beau	13.3	(3.3)	10.0	(0.0)	0.0	(0.0)	1.7	(0.0)	0.0	(0.0)	76.7	(96.7)	1.7	(0.0)	13.3	(0.0)	0.0	(3.3)	1.7	(0.0)	76.7	(96.7)
Forrest	12.8	(34.8)	27.7	(6.5)	0.0	(4.3)	2.1	(0.0)	4.3	(0.0)	57.4	(60.9)	0.0	(2.2)	29.8	(2.2)	14.9	(37.0)	0.0	(0.0)	57.4	(60.9)
James	5.9	(14.8)	0.0	(2.9)	0.0	(0.0)	0.0	(0.0)	5.9	(11.8)	88.2	(73.5)	8.8	(11.8)	0.0	(0.0)	2.9	(14.7)	0.0	(0.0)	88.2	(73.5)
Darien	5.1	(2.0)	2.0	(1.0)	7.1	(19.4)	0.0	(0.0)	1.0	(16.3)	84.8	(62.2)	4.0	(3.1)	4.0	(0.0)	7.1	(35.7)	0.0	(0.0)	84.8	(62.2)
Jameela	1.3	(5.2)	0.0	(0.0)	6.5	(1.3)	0.0	(0.0)	0.0	(0.0)	92.2	(93.5)	3.9	(6.5)	0.0	(0.0)	3.9	(0.0)	0.0	(0.0)	92.2	(93.5)
Jason	14.8	(13.0)	1.9	(0.0)	5.6	(13.0)	0.0	(0.0)	3.7	(18.5)	74.1	(55.6)	3.7	(16.7)	0.0	(0.0)	22.2	(29.6)	0.0	(0.0)	74.1	(55.6)
Average	**20.0**	**(10.4)**	**10.7**	**(2.4)**	**6.3**	**(8.4)**	**0.8**	**(1.4)**	**2.8**	**(7.9)**	**62.5**	**(70.6)**	**5.5**	**(6.8)**	**17.9**	**(0.3)**	**15.2**	**(22.0)**	**0.2**	**(0.2)**	**63.3**	**(72.0)**

Note. Peer comparison data are indicated in parentheses.

Table 5

Contextual Factors for Students with Disabilities and Comparison Peers

	Physical arrangement				Instructional grouping					
Student	Tables	Lab tables	Individual desks	Other	Whole class	Large group	Small group	Paired group	Independent	1:1
Gabriel	0.0 (0.0)	100.0 (89.3)	0.0 (0.0)	0.0 (10.7)	22.4 (34.3)	0.0 (0.0)	67.1 (2.4)	0.0 (4.8)	10.6 (51.2)	0.0 (0.0)
Jacob	0.0 (0.0)	100.0 (89.6)	0.0 (10.4)	0.0 (0.0)	10.4 (100.0)	0.0 (0.0)	89.6 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Nicholas	60.0 (58.3)	33.3 (33.3)	0.0 (0.0)	6.7 (8.3)	73.3 (71.7)	11.7 (13.3)	15.0 (15.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Lynnette	86.4 (86.2)	0.0 (0.0)	0.0 (0.0)	13.6 (13.8)	55.9 (63.8)	0.0 (0.0)	30.5 (1.7)	0.0 (0.0)	13.6 (34.5)	0.0 (0.0)
Ben	0.0 (0.0)	96.7 (93.2)	0.0 (0.0)	3.3 (3.4)	56.7 (64.4)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	40.0 (35.6)	3.3 (0.0)
Ezra	0.0 (0.0)	100.0 (98.3)	0.0 (0.0)	0.0 (1.7)	10.3 (67.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	48.3 (32.8)	41.4 (0.0)
Jazmine	100.0 (98.3)	0.0 (0.0)	0.0 (0.0)	0.0 (1.7)	0.0 (51.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (48.3)	100.0 (0.0)
Peyton	100.0 (100.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	46.7 (46.7)	0.0 (0.0)	0.0 (0.0)	23.3 (15.0)	30.0 (38.3)	0.0 (0.0)
Zahra	0.0 (0.0)	80.0 (98.0)	0.0 (0.0)	20.0 (2.0)	36.0 (46.9)	0.0 (0.0)	0.0 (0.0)	22.0 (28.6)	42.0 (24.5)	0.0 (0.0)
Beau	0.0 (0.0)	31.7 (98.3)	66.7 (0.0)	1.7 (1.7)	75.0 (75.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	15.0 (25.0)	10.0 (0.0)
Forrest	83.0 (82.6)	0.0 (15.2)	14.9 (0.0)	0.0 (2.2)	38.3 (41.3)	0.0 (0.0)	55.3 (56.5)	0.0 (0.0)	2.1 (2.2)	2.1 (0.0)
James	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	100.0 (100.0)	41.2 (41.2)	0.0 (0.0)	29.4 (29.4)	0.0 (0.0)	29.4 (29.4)	0.0 (0.0)
Darien	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	100.0 (100.0)	3.0 (0.0)	0.0 (0.0)	0.0 (5.1)	0.0 (0.0)	97.0 (94.9)	0.0 (0.0)
Jameela	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	100.0 (100.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	100.0 (100.0)	0.0 (0.0)
Jason	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	100.0 (100.0)	13.0 (11.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	87.0 (88.9)	0.0 (0.0)
Average	**28.6 (28.4)**	**36.1 (41.0)**	**5.4 (0.7)**	**29.7 (29.7)**	**32.1 (47.7)**	**0.8 (0.9)**	**19.1 (7.3)**	**3.0 (3.2)**	**34.3 (40.4)**	**10.5 (0.0)**

Note. Peer comparison data are indicated in parentheses.

Figure 1

Observational Measures, Codes, and Brief Definitions

Academic engagement	
Actively engaged	Physical orientation toward the task and physically responding to directions and the task
Passively engaged	Physical orientation to the task but not physically responding to directions and the task
Not engaged	Physical orientation to other events or people in the class not related to the presented task
No task to engage	Student was not provided with a task in which to engage
Content Alignment	
Same/	Content matched the class content in topic and presentation
Adapted	Content matched the class content in topic or presentation
Alternate	Content differed from the class content in topic and presentation
No content	No academic content presented
Task alignment	
Same	Task matched the class task in format with no variation
Adapted	Task matched the class task in format with variation on at least one dimension (e.g., mode of expression)
Alternate	Task differed from the class task in format
No task	No task presented
Interaction type	
Academic	Communication regarding academic content and the assigned instructional task
Behavioral	Communication regarding a behavioral direction (e.g., dismissal from class)
Social	Communication regarding topics outside of the classroom activities and other non-academic content
Unintelligible	Communication that observers could see or hear but not understand the intent of the message
Attempted	Communication where a student made an effort to convey a message to a partner that went unreceived, unnoticed, or unreciprocated (e.g., raising a hand and not being called on)
Other	Communication with or by the student not aligned to any other type of interaction
No interaction	No observed communication
Interaction partner	
General educator	The primary instructor of the class
Paraprofessional	The support staff present in the classroom to assist students with disabilities
Peer	Another student enrolled in the class with or without disabilities
Other adult	Other adults in the classroom such as the special education teacher or administrator
Not applicable	No observed interaction or his/her attempted interaction went unreceived

Class task	
Textbook/reading	Reading from a textbook or other bound material
Workbook	Reading and writing in a bound workbook
Worksheet	Writing on a printed worksheet or in a notebook/journal including when paired with teacher lecture
Quiz/test	Completing an informal or formal written assessment
Listen/lecture	Orienting toward a speaker in order to receive the presented information without responding verbally or physically
Discussion	Orienting toward a speaker in order to receive the information with the expectation to respond
Electronics	Orienting toward an electronic device such as tablet or computer for instructional purposes
Hands-on	Manipulating physical materials as the instructional activity (e.g., dice, building materials)
Other	Tasks not categorized by the previous codes
No task	No instructional task was presented including transitions and down time
Physical arrangement	
Tables	Sitting at a table or individual desk clustered with one or more other individual desks to form a table
Lab table	Sitting at a stationary, lab table designed for two students sitting side-by-side
Individual desk	Sitting at a desk intended for one students and independent of other desks or tables
Other	Sitting in an arrangement not categorized by the previous codes (e.g., sitting on a bean bag chair or computer table)
Instructional grouping	
Whole class	Working with all other students
Large group	Working with more than seven other students but fewer than all students
Small group	Working in a group of two to six other students
Paired group	Working with one other student
Independent	Working alone without assistance from others
One-on-one	Receiving instruction directly from an adult