

Fine Motor Activities in Elementary School Children: A Replication Study

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Importance: The educational landscape is continually changing in response to legislation and the adoption of new standards, such as the Common Core. Currently, little is known about how these changes have influenced the school day.

Objective: To examine the motor and technology requirements of kindergarten, second-, and fourth-grade general education classrooms.

Design: For 6 full school days, we made unobtrusive observations of and took notes that described classroom activities throughout the day. Data were coded by a committee, allocating each minute of the day into 1 of 10 activity categories.

Setting: Kindergarten, second-, and fourth-grade classrooms.

Participants: Three general education classrooms with approximately 20 students in each class.

Results: Students spent between 37.1% and 60.2% of the school day performing fine motor activities, with handwriting accounting for 3.4%–18.0% of the day. Time spent using technology was relatively sparse in kindergarten (4.8%) and second grade (3.1%) compared with fourth grade (14.3%). Transitions between activities (18.9%–23.4% of time spent) exceeded time spent handwriting.

Conclusion and Relevance: This article provides an updated estimate of motor demands throughout the school day. Estimates of fine motor activities were consistent with previous research, but the focus on handwriting appears to have substantially diminished.

What This Article Adds: Within the context of their own school, occupational therapists may find transitions to be a good opportunity for providing services within the classroom. In addition, handwriting practice outside of school may be more necessary in the current educational climate than in previous years.

Occupational therapy practitioners working in school settings support children in fulfilling their roles as students through engagement in desired academic and nonacademic activities ([American Occupational Therapy Association \[AOTA\], 2016](#)). Although school-based occupational therapy practitioners address a variety of performance skills, the most common reason for referral to occupational therapy is fine motor difficulties, specifically paper-and-pencil tasks, including handwriting ([Schneck & Amundson, 2010](#)).

[McHale and Cermak \(1992\)](#) completed a series of classroom observations, recording activities on a minute-by-minute basis, to understand the daily fine motor demands of elementary school, a minimally studied topic at the time. Second-, fourth-, and sixth-grade students spent between 31% and 60% of the school day engaging in fine motor activities, with the majority of fine motor time spent performing paper-and-pencil tasks (85%), followed by manipulation tasks (15%), such as cutting or using the computer. McHale and Cermak concluded that fine motor activities were an integral part of the school day and suggested that students with fine motor deficits require modifications, alternative modes of learning, and careful monitoring.

Since 1992, several major federal and state legislative changes have altered the educational landscape in the United States. Of note, in 1994, Title III of the [Improving America's Schools Act \(Pub. L. 103-382\)](#) increased funding for educational technology, and technology has since become ubiquitous in the classroom (e.g., [Bausell, 2008](#)). In 2001, the [No Child Left Behind Act \(Pub. L. 107-110\)](#) required school progress reports and increased accountability at the

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school level, resulting in more annual testing for students. Similarly, the reauthorization of the [Individuals With Disabilities Education Improvement Act of 2004 \(Pub. L. 108-446\)](#) included provisions for Response to Intervention, which involves periodic testing for the early identification of at-risk students. The increased emphasis on testing potentially diverts classroom activities away from fine motor tasks.

Perhaps the most influential recent educational mandate is the Common Core State Standards Initiative ([National Governors Association Center for Best Practices, 2010](#)), which has been formally adopted by 42 states and provides educational standards for kindergarten through 12th grade. Of particular interest to occupational therapy practitioners, the Common Core State Standards mandate instruction for keyboarding but not handwriting. Not surprisingly, emerging evidence suggests that implementation of these standards has decreased the time spent on handwriting instruction in some elementary schools ([Collette et al., 2017](#)).

This changing educational landscape suggests that [McHale and Cermak's \(1992\)](#) estimates of fine motor demands may no longer be relevant. A follow-up study of fine motor demands in 2003 by [Marr and colleagues](#) included more observation days, but observations occurred only in Head Start and kindergarten classrooms. This study found similar percentages of fine motor activities in kindergarten (between 36% and 66%), with potentially less emphasis on paper-and-pencil tasks (42%; [McHale and Cermak](#) reported only the aggregate). However, the students were observed in the first half of the school year, when kindergarten students are less prepared to receive handwriting instruction (e.g., [Marr et al., 2001](#)), and computer training time was not observed or included. In addition, classroom technology was less prevalent in the early 2000s than it is now.

The purpose of the current study is to replicate the [McHale and Cermak \(1992\)](#) study in the current educational context. We ask a broader research question: What are the motor and technology demands of elementary school? With improved understanding of the requirements of the school day, we aim to provide up-to-date implications for children with motor and other difficulties in general education classrooms. We hypothesize that the increased emphasis on testing ultimately reduces the number of minutes spent on fine motor activities during the school day and that within fine motor activities, technology plays a principal role at the expense of paper-and-pencil tasks.

Our study improves on the studies of [Marr et al. \(2003\)](#) and [McHale and Cermak \(1992\)](#) by quantifying all of the activities that occur throughout the school day, rather than focusing only on fine motor demands. In addition, our classroom observers were trained in ethnographic methods and typed detailed notes about classroom activities and student behaviors throughout the day. All data were coded by a committee, allowing for in-depth discussions among all four authors about how to code complex activities.

Method

Research Design and Participants

We conducted an observational study of 3 elementary school classrooms (i.e., 1 kindergarten, 1 second grade, and 1 fourth grade), with about 20 students per classroom, in a small college town (population approximately 15,000) in upstate New York. Each classroom was observed in the second half of the school year for 2 full school days (8:30 a.m.–3:00 p.m.) by the first two authors ([Caramia and Gill](#)), resulting in 6 observation days in total. [Caramia and Gill](#) each observed the kindergarten classroom for 1 day, [Caramia](#) observed the second-grade classroom for 2 days, and [Gill](#) observed the fourth-grade classroom for 2 days.

Procedure and Data Collection

The study was approved by the Clarkson University (Potsdam, NY) institutional review board. The elementary school principal and superintendent provided permission for the study before its onset, and parents were notified in the school newsletter the next week about classroom observations. Classroom teachers were also informed about the study via

email. One teacher from each grade agreed to participate in the study. Observation days were identified by the teachers as being typical school days (i.e., no special programming or classroom parties occurred on observation days).

Before making observations, authors Caramia and Gill were trained by the fourth author (Schelly) in ethnographic methods, including the practice of conducting participant observation. Caramia and Gill practiced note taking in an educational setting by watching several hours of video footage of real elementary school classrooms. They focused on noticing students' movements and activities and attempted to describe the classroom environment in an unmotivated way, through activity- and child-focused stream of consciousness. The aims were to avoid categorizing activities and to provide sufficient details to trigger memories in later coding discussions. Notes were then compared and discussed among all four study authors, with a focus on how to take descriptive notes in general and on specific circumstances in which additional details would be needed, such as when multiple activities were performed at the same time. At the end of their training, Caramia and Gill were consistently writing similar observation notes of the same video footage.

On observation days, Caramia and Gill sat in unobtrusive locations in their respective classrooms. They took notes on laptop computers in Microsoft Word (Microsoft Corporation, Redmond, WA). They noted the time at which each classroom activity began and stopped along with a detailed description of the students' behaviors. Following [McHale and Cermak \(1992\)](#), they focused their observation notes on the entire classroom rather than on a specific child. Because multiple activities often happened at the same time, notes were taken on what each group of children was doing. They noted when 1 or 2 children did something unique or disruptive, but these observations were not included in the coding, which attempted to capture large patterns of activity within the classroom.

Data Analysis

A coding scheme was developed by all four authors before data collection. The coding scheme was based on previous research (i.e., [Marr et al., 2003](#); [McHale & Cermak, 1992](#)) and the third author's (Ohl's) experience working in the public education sector. The scheme was altered slightly during the coding process, leading to 10 activity categories based on the classroom observations ([Figure 1](#)). All observation notes were coded by committee over three sessions soon after the observations were completed, with full consensus required for each minute of the school day. In cases of disagreement, the author who conducted the observation was typically able to recall additional details, which then led to agreement. Coding consistency was maintained between coding sessions by keeping detailed notes about coding decisions that required discussion.

The average number of minutes and percentage of time dedicated to each type of activity per observation day were calculated using Microsoft Excel. The average time spent performing each category was based on the 2 observation days for each grade. A fine motor composite was calculated by adding the average time allocation for the following categories:

- Fine motor, nonacademic content
- Fine motor, academic content
- Computer or other technology use by students for leisure or academic purposes
- Handwriting
- Dining
- Transition time (25%).

We included 25% of the transition time after estimating that transition time consisted of approximately 25% fine motor tasks (e.g., closing books, picking up items) and 75% gross motor tasks (e.g., walking between classrooms). A gross motor composite was calculated by adding the average time allocation for the following categories: unstructured gross motor activity, structured gross motor activity, and 75% of the transition time.

Figure 1. Activity Categories and Examples

Activity Category	Example
1. Fine motor, nonacademic content	Doing unstructured art Playing with a sand table Playing with building blocks or play dough
2. Fine motor, academic content	Coloring or drawing on paper Using manipulatives for math Reading or looking at books
3. Academic content, no fine or gross motor involvement	Spelling orally Counting without pointing Being instructed by the teacher
4. Nonacademic content, no fine or gross motor involvement	Singing Resting Watching a video
5. Computer or other technology use by student for leisure or academic purposes	Using a tablet, computer, or Smartboard during free time or a lesson
6. Unstructured gross motor activity	Playing during recess Dancing during free time Running during free time
7. Structured gross motor activity	Participating in physical education class Participating in full-body classroom sing-alongs
8. Handwriting	Writing on a worksheet Writing on the board
9. Transition	Moving between classrooms Moving from activity to activity within the classroom
10. Dining	Setting up for a new activity Eating during lunch Eating during snack time

For comparisons with [McHale and Cermak \(1992\)](#), we further categorized the fine motor composite into two new categories: paper-and-pencil tasks and manipulation tasks. Paper-and-pencil tasks included handwriting and coloring or drawing on paper (whereas writing on a Smartboard was considered technology use), and manipulation tasks included the remainder of the fine motor composite.

Results

We calculated the average number of minutes and the percentage of the school day that participants spent performing fine motor and gross motor tasks, using technology, writing, transitioning from class to class and within the classroom, and dining ([Table 1](#)). The fine motor composite (see [Table 1](#)) indicates that on average the fine motor demands of the school day increase by 13 percentage

points as children age from kindergarten (37.1% of the school day) to second grade (50.1% of the school day) and increase by another 10.1 percentage points as they age from second grade to fourth grade (60.2% of the school day). The gross motor composite (see [Table 1](#)) is consistent across the grades, ranging from 25.0% to 28.8% of the school day. Technology use was limited in kindergarten (4.8%) and second grade (3.1%) but increased substantially in fourth grade (14.3%). Transition time, which was similar across grades, accounted for a large percentage of the day (18.9%–23.4%).

On the basis of the fine motor composite, we calculated the number of minutes and the percentage of time that participants spent performing the fine motor activities of paper-and-pencil tasks versus manipulation tasks ([Table 2](#)). Kindergarten students performed relatively few paper-and-pencil tasks, which composed only 17.8% of their fine motor activities. However, by second grade, the amount of time spent on paper-and-pencil tasks increased substantially (35.8% of fine motor activities) and then remained similar in fourth grade (37.4% of fine motor activities).

Discussion

We observed kindergarten, second-grade, and fourth-grade students in three classrooms over 6 days to examine the motor and technology demands of elementary school. Our findings on the average fine motor requirements of the school day were strikingly similar to those of [Marr et al. \(2003\)](#) and [McHale and Cermak \(1992\)](#), despite a 15- and 25-yr time difference, respectively, between those studies and the current study. We found that students spent between 37.1% and 60.2% of the school day performing fine motor activities, with fine motor demands increasing with each grade. This result provides some evidence that opposes our hypothesis that current fine motor demands would be less than demands found in the earlier studies and suggests that fine motor demands are consistent across multiple samples and over time.

Table 1. Classroom Performance of Each Activity Category and Fine and Gross Motor Composites

Activity Category	Proportion of the School Day, <i>M</i> min (% of school day)		
	Kindergarten	Second Grade	Fourth Grade
1. Fine motor, nonacademic content	10.0 (2.5)	26.0 (6.6)	4.5 (1.2)
2. Fine motor, academic content	41.5 (10.6)	27.5 (7.0)	50.5 (12.9)
3. Academic content, no fine or gross motor involvement	92.0 (23.4)	85.5 (21.8)	54.0 (13.8)
4. Nonacademic content, no fine or gross motor involvement	42.0 (10.7)	10.5 (2.7)	1.0 (0.26)
5. Computer or other technology use by students (leisure or academic)	19.0 (4.8)	12.0 (3.1)	56.0 (14.3)
6. Unstructured gross motor activity	38.5 (9.8)	13.0 (3.3)	16.5 (4.2)
7. Structured gross motor activity	11.0 (2.8)	16.0 (4.1)	28.5 (7.3)
8. Handwriting	13.5 (3.4)	70.0 (17.8)	70.5 (18.0)
9. Transition	85.0 (21.6)	92.0 (23.4)	74.0 (18.9)
10. Dining	40.5 (10.3)	40.0 (10.2)	35.5 (9.1)
Fine motor composite	145.8 (37.1)	198.5 (50.1)	235.5 (60.2)
Gross motor composite	113.3 (28.8)	98.0 (25.0)	100.5 (25.7)

Note. Number of minutes and percentage of the school day are averages of the 2 observation days per grade. *M* = mean.

estimates. Curricular changes over time, such as the implementation of the Common Core State Standards, may explain the decreased emphasis on these tasks, but further study is needed.

Our hypothesis that increased technology use would lead to decreased handwriting is not supported by our findings. Technology was omnipresent in the classroom, but student technology use was, surprisingly, limited. Even in the fourth grade, less than 15% of the day was spent using technology; second grade and kindergarten students used it substantially less. Possible explanations may include that teachers in the current study consciously avoided technology adoption or that technology use occurs naturally in spurts and our observation days were days during which use was limited.

We found that fine motor skills were integrated into tasks throughout the day, including transitions to and from the classroom and between activities (e.g., unzipping a backpack to get out paperwork for the teacher; gathering items, such as pencils and markers, to transition to a new activity), activities of daily living (e.g., zipping and buttoning jackets for recess), and technology use (e.g., using a finger to complete a maze on the Smartboard). Therefore, students who struggle with fine motor skills will likely struggle throughout the day.

Finally, transition time accounted for a much larger percentage of the day than we expected, ranging from 18.9% to 23.4% of the school day. Education researchers have long known that transitions pose classroom management problems (e.g., Arlin, 1979), and transitions are especially difficult for some students who receive occupational therapy

(e.g., children with autism spectrum disorder; see American Psychiatric Association, 2013). The ubiquity of transitions throughout the school day suggests future directions for occupational therapy researchers.

Table 2. Classroom Performance of Fine Motor Activities: Paper-and-Pencil Versus Manipulation Tasks

Fine Motor Activity	No. Minutes (% Fine Motor Composite)		
	Kindergarten	Second Grade	Fourth Grade
Paper-and-pencil tasks	26.0 (17.8)	71.0 (35.8)	88.0 (37.4)
Manipulation tasks	119.8 (82.2)	127.5 (64.2)	147.5 (62.6)

Note. Number of minutes and percentage of the school day are averages of the 2 observation days per grade.

Limitations and Future Directions

Some aspects of this study may not be generalizable because we used a convenience sample in upstate

New York and relied on only 2 school days per grade. In addition, we may have underestimated technology use. A survey of urban and rural U.S. schools showed higher estimates of student computer use than those found in the current study (Gray et al., 2010). Therefore, additional estimates are needed.

The use of coding by committee promotes discussion about gray areas between codes, but in choosing this method, we did not formally calculate point-by-point agreement in notetaking procedures before the observation days. On the one hand, this approach gives observers substantial independence in how they describe a classroom scene, potentially making it easier for them to recall that scene during committee discussions. On the other hand, this method eschews estimating how consistent multiple observers are in their notes. It is possible that our observers attended to slightly different details in the classroom, which could create discrepancies, especially in the coding of activities that fall into a gray area. A related limitation is that one observer observed both second-grade classrooms and the other observed both fourth-grade classrooms; therefore, notetaking discrepancies could have affected the global estimates for the second and fourth grades.

Further study examining how children with behavioral or sensory difficulties, or both, experience transitions both within and outside of the classroom may assist occupational therapy practitioners in the planning and implementation of strategies throughout the school day. The relationship between transition time and type and behavioral problems is unknown.

Implications for Occupational Therapy Practice

The results of this study have the following implications for occupational therapy practice:

- Children who struggle with fine motor skills may require support throughout the day, rather than only during activities that are predominantly fine motor in nature.
- The focus on handwriting appears to have substantially diminished since McHale and Cermak's (1992) study. If there are indeed fewer opportunities for handwriting practice in the classroom, students who struggle with handwriting may need more practice outside of school.
- Even though it is ubiquitous at school, technology may play an understated role in the classroom.

Conclusion

This observational study provides updated evidence about the motor and technology demands in elementary school. Although more than 25 yr have passed since the seminal study we replicated (McHale & Cermak, 1992), the proportion of the school day spent performing fine motor activities is almost identical. However, the type of fine motor activity is drastically different. Whereas McHale and Cermak (1992) found that a significant proportion of fine motor time was spent performing paper-and-pencil tasks, we found that students performed more manipulative tasks. Interestingly, there was a fine motor component to most activities throughout the school day, including those that were primarily gross motor in nature. We observed less technology use than expected and more time spent in transition. Occupational therapy practitioners should consider these findings within the broader context of their own schools. ■

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