
Fine Motor Activities in Elementary School: Preliminary Findings and Provisional Implications for Children With Fine Motor Problems

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This study was designed to obtain a detailed picture of the fine motor requirements in regular elementary school classrooms. This knowledge is critical for occupational therapists in working with children with fine motor and handwriting problems who are mainstreamed into regular classes. The allocation of time to fine motor activities and the types of fine motor tasks children are expected to perform in elementary school were investigated through the observation of six elementary school classrooms. A written minute-by-minute record of one whole day's activities in each classroom showed that 30% to 60% of the day was allocated to fine motor activities, with writing tasks predominating over other manipulative tasks. Implications for children with fine motor difficulties include the need for modifications to volume of work, types of tasks, and materials.

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Fine motor skills may be considered enabling behaviors and may affect the child in school in several ways. They may influence the quality and quantity of the child's learning and achievement in the classroom, the validity of assessments for instructional planning, educational placement and eligibility for services, and the development of the child's self-esteem and motivation (Cermak & Henderson, 1990; Levine, 1987).

For example, when a child with fine motor problems must copy math problems out of a textbook before even beginning to solve them, she may not physically be able to do enough problems to get the necessary practice, thus her achievement in math may be affected. Another child may not be able to demonstrate that he knows how to do long division if he cannot write legibly enough to read back to himself correctly the numbers he has written. This situation may lead the teacher to assume that the child does not know how to do long division, thus illustrating the effect of fine motor skills on assessment for instruction. A third child who writes very slowly may not be able to complete many math problems on the annual timed test that determines math group placement. He may then be placed in an inappropriate math group. Lastly, if a child with fine motor problems is graded in handwriting by the same standards as children without fine motor problems, the child's self-esteem may suffer.

The incidence of fine motor difficulties among children is not readily available because fine motor difficulties is not one of the standard reporting categories for federal, state, or local records. However, available research shows that between 90% (Tarnopol & Tarnopol, 1977) and 98% (Clements, 1966) of children with learning disabilities or minimal brain damage demonstrate either fine motor difficulties or poor, slow, and labored handwriting. Although the federal government reports that about 5% of the school-aged population receives services for learning disabilities (U.S. Department of Education, 1987), in practice, the number of children receiving such services is often considerably higher. For example, in Massachusetts in 1988, 16.4% of the school-aged population received services for learning disabilities (Massachusetts Department of Education, personal communication, February 10, 1989). In fact, estimates of the number of children with learning disabilities have ranged as high as 30% of the student population (Cermak & Henderson, 1990). On the basis of Tarnopol and Tarnopol's (1977) finding that 90% of children with learning disabilities have fine motor or handwriting difficulties as well, one may estimate that at least 4.5% of school-aged children (90% of the Department of Education's 5% figure cited above) will have serious fine motor problems in connection with their learning disabilities. Fine motor difficulties greatly affect children's performance in the classroom. Younes, Rosner, and Webb (1983) reported that of the 199 children with learning disabilities they studied, 47% were initially referred for handwriting problems.

Many other students may have fine motor problems that are due primarily to a physical disability, such as cerebral palsy, muscular dystrophy, juvenile arthritis, or spina bifida. Andrews and Elkins (1981) reported the results of a survey in Australia of regular classroom teachers of children with spina bifida and hydrocephalus. Thirty-nine percent of the students were perceived as experiencing some degree of difficulty with fine motor tasks, including writing, drawing, using an eraser, ruling lines, steadying papers, taking books from the desk, turning pages, using scissors, and doing craft activities.

Children who have attention deficit disorders with or without learning disabilities may also have difficulty with fine motor tasks (Denckla, Rudel, Chapman, & Krieger, 1985). Lastly, Gubbay (1985) found that 5% of children without learning disabilities nevertheless have major problems because of clumsiness.

It seems that, at a minimum, nearly 10% of elementary school-aged children may experience major difficulty with fine motor tasks. We derived this figure by combining the estimated minimum of 4.5% of children who have both learning disabilities and fine motor difficulties (Tarnopol & Tarnopol, 1977; U.S. Department of Education, 1987) and the finding of 5% of children without learning disabilities who have major problems with fine motor tasks (Gubbay, 1985). Figures on the incidence of fine motor difficulties among all children with physical disabilities and attention deficits were not available, but would probably increase this figure even after overlap between categories is taken into consideration. In a typical classroom, then, the average teacher will probably have at least two students each year whose fine motor difficulties are serious enough to require special education or other services.

Although it is uniformly recognized that elementary school work requires fine motor tasks, there is little documentation about either the percentage of time spent on such tasks or the specific types of tasks with fine motor requirements that children are expected to perform. This knowledge is critical for occupational therapists because most referrals for occupational therapy for children in schools involve problems in handwriting and fine motor skills (Cermak, 1991). To obtain a detailed picture of the fine motor requirements of work in regular elementary school classrooms, the first author conducted day-long observations in six classrooms across the different years of elementary school. The method and findings from this study (McHale, 1987) are presented, followed by a discussion of some of the implications for children with fine motor problems who are in regular classrooms.

Method

Subjects

Six classes from two middle-income suburban public school districts in New England served as observation

sites for this study. The six classes consisted of two classes each from Grades 2, 4, and 6. Two of the six classes observed were split grades, one a split first and second grade, the other a split fifth and sixth grade. Where a school system offered a choice of classes within a grade level and the classes had been grouped by ability, the class representing a middle academic group was selected for observation. Where more than two such classes at a grade level were available for observation, the participating class was chosen randomly. The inclusion of split-grade classrooms was not part of the design of the study, but rather reflects the frequency with which one of the school districts uses split-grade classrooms.

Procedure

A written record of activities on a minute-by-minute basis was made for one whole academic day in each of the six classrooms. The major indicators of fine motor requirements were allocation of time to fine motor tasks and the types of tasks children were expected to perform. All classroom observations and coding were done by the first author.

During observations, the time at which a particular task or activity began was recorded on an observation data sheet, and that task was described. When the task or activity changed, the time of the change and the nature of the new activity were recorded. All observations began or ended at the time that a school administrator had identified as the beginning or ending of the school day. Lunchtime, which was 45 min, was not included in the observations or calculations. Thus each class was observed for 5 hr 15 min.

In one of the second-grade and one of the fourth-grade classes, some of the students changed teachers for particular subjects. For example, in one fourth-grade class, 9 students left to receive their math instruction in a different classroom. Because some students stayed in the original classroom, the observation continued in the original classroom. However, in one sixth-grade class, all of the students moved as a group to different teachers for math and social studies. In that case, the observations took place in three different classrooms as the students moved from teacher to teacher. When instructional groups within a class participated in separate activities, time allocations and tasks were recorded separately for each group.

After each observation was completed, all tasks were assigned to one of four categories: fine motor tasks, integrated fine motor tasks, other academic tasks, and non-academic activities. *Fine motor tasks* were those for which performance required a major use of one's hands, such as writing with a pencil, using scissors, and using a computer keyboard. *Integrated fine motor tasks* included activities in which fine motor and other academic tasks occurred simultaneously. For example, sometimes a

teacher instructed orally while children completed work sheets. The category of *other academic tasks* included tasks for which performance did not require frequent use of one's hands, such as reading or group discussion. *Non-academic activities* included those activities that seemed to be either functional (e.g., the collecting of lunch money) or transitional (e.g., moving from one classroom to another) rather than instructional.

Interrater reliability within these six classrooms was not calculated; however, at a later date, four 1-hr classroom observations were videotaped and independently scored by both the first author and another trained rater. Results indicated interrater agreement of more than 95% on the coding of both fine motor and integrated fine motor activities for time allocation and type of task.

The key factor in selecting a category for the activities during a particular span of time was always the teacher's instructions to the class or group as a whole, rather than the activities of particular children within the group. For example, if the teacher assigned the task of writing sentences from vocabulary words, the task was categorized as a fine motor task from the time the teacher indicated that students should begin work until the teacher gave instructions for all students to begin some other type of activity. In some classes, children who had finished a particular academic task were allowed to determine how they would use their remaining free time. Thus, in one class, children who finished writing their spelling words might listen to tapes, whereas in another class, children who finished a small group discussion might do their math homework. In this study, however, all activities were categorized according to the teacher's instructions and the time the teacher allowed for task completion, not according to how particular children used the time.

All tasks that met the definition of *fine motor*, that is, that required major use of one's hands, were identified and described in detail on the observation data sheets. The academic subject, the precise task, and the materials used were recorded. For example, rather than just describing a task as *writing*, the first author described it as copying sentences from a textbook onto paper with a pencil.

After the observations were completed, the duration of time spent on each of the four categories of tasks was calculated with the data from the observation data sheets. The percentages of time allocated to fine motor and integrated fine motor tasks were then calculated. A list of all tasks assigned was then developed, and tasks were grouped together for reporting purposes.

Results

Findings regarding actual time and the percentage of the day spent on fine motor tasks and integrated fine motor tasks are shown in Table 1. Where classes contained sepa-

Table 1
Time Allocated to Tasks in Regular Classrooms

Grade	Time on Tasks (min)				Total Time Allocated to Fine Motor and Integrated Fine Motor Tasks (%) ^c
	Fine Motor ^a	Integrated Fine Motor ^b	Other Academic ^c	Non-academic ^d	
2	128	15	89	83	45
2 (Split)	166	6	86	57	55
4	70	28	145	72	31
4	80	17	147	71	31
6	90	14	137	74	33
6 (Split)	180	9	65	61	60

^a $M = 119, SD = 42$. ^b $M = 15, SD = 7$. ^c $M = 112, SD = 33$. ^d $M = 70, SD = 9$. ^e $M = 43, SD = 12$.

rate instructional groups, the results reflect an average of the time allocations for the different groups. However, in split-grade classes, only the results for the grade actually being observed are reported.

The types of fine motor tasks that occurred in the classrooms are shown below. Only tasks actually observed in the six classrooms were included. For reporting purposes, tasks were grouped under two major headings: paper-and-pencil tasks and manipulative tasks. The category of paper-and-pencil tasks, which included all tasks requiring the use of pencil, pen, crayon, or marker on paper, contained the following:

- Copying from text or the board
- Doing repetitive writing
- Writing headings on paper
- Writing from dictation
- Taking notes
- Completing commercial work sheets, workbooks, or tests
- Correcting work rapidly
- Answering questions from text
- Doing creative writing
- Drawing.

The category of manipulative tasks, which includes tasks that require manipulating objects rather than writing with an implement, contained the following:

- Folding paper to make margins and dividing lines
- Cutting or pasting or both
- Using a computer
- Manipulating objects such as seeds or plants.

For all fine motor activities for the six classrooms, 85% of the time was spent on paper-and-pencil tasks and 15% was spent on manipulative tasks. Subheadings under each major category of task also reflect groupings of similar tasks. For example, in the category of paper-and-pencil tasks, the subheading of repetitive writing includes the specific tasks of the repetitive writing of spelling words,

handwriting practice, and the repetitive writing of vocabulary definitions.

Discussion

Allocation of Time

There was a considerable range in the length of time and percentage of the day allocated to all types of fine motor tasks in the classrooms observed (see Table 1). The range extended from 31% to 60% of the academic day. This finding indicates that different classrooms may have different levels of fine motor demands. The variations may result from factors such as teacher style, classroom and school organization, and curriculum decisions. Results from the small sample of six classrooms did not indicate a relation between increasing grade level and increasing percentage of time allocated to tasks with fine motor demands. Rather, it seemed that in some elementary school classrooms, the primary learning modality was fine motor activity, whereas in other classrooms, fine motor activity played less of a role in learning because group discussion or oral instruction predominated.

Equally important, however, is the finding that in all the classrooms observed, a substantial part of the day was spent on fine motor tasks. Thus, it seems that regardless of the differences between classrooms in the degree of emphasis on fine motor tasks, all the classrooms observed had a high level of fine motor demands. It should be emphasized that these observations were made in only one day in each of the six classrooms. Therefore, broad conclusions about elementary school classrooms in general would not be warranted.

A third finding relates to the time allocated to integrated fine motor tasks. Integrated tasks may present increased difficulties for the child who must concentrate on the physical act of writing or using hands while also focusing on the content of the oral instruction being presented. Fine motor activities were classified as integrated tasks only when fine motor and other academic tasks occurred simultaneously. If the teacher's instructions to the class created a boundary between types of tasks, the tasks were not considered to be occurring simultaneously. For example, if the teacher said, "I want you to put your pencils down and listen for a minute," that statement created a clear demarcation between time spent on fine motor tasks and time spent attending to oral instruction.

In general, the classes observed did not seem to spend large percentages of the day engaged in integrated tasks. With the exception of one fourth-grade class, no class spent more than 5% of the day on integrated tasks. In the fourth-grade class in which 9% of the day was spent on integrated tasks, most of the integrated time occurred while the children were preparing a science project. As they worked on a plant booklet, the teacher continued oral instruction about their plants. It may be that high allocations of time to integrated tasks are not evident

until junior high school or high school when there is more emphasis on such tasks as taking notes during oral instruction.

An interesting finding emerged when data from the classrooms were examined. Although only two split-grade classrooms were observed, the two highest percentages of time allocated to fine motor tasks were in these classes. In the two split grades observed, teachers organized the students into many separate small instructional groups. In the first- and second-grade classroom there were four separate groups, two for reading and two for math. In the fifth- and sixth-grade classroom there were five separate groups, three for reading and two for math. The high percentages of time on fine motor tasks resulted from the need to keep students in some groups involved in seat work while the teacher conducted oral instruction with other groups.

Types of Tasks

Paper-and-pencil tasks are listed according to the degree of student control over the volume and content of task performance as determined by task analysis done by the authors. The list begins with tasks that offer little student control in these areas, such as copying from a textbook or writing spelling words repeatedly. Creative writing and drawing, tasks with the highest degree of student definition of the task, are listed near the end of paper-and-pencil tasks. The manipulative tasks listed require high fine motor skills but do not involve the use of a writing implement on paper. They focus on working with materials or tools. For example, in one fourth-grade class, the students prepared a science project that involved cutting a seed in half, gluing it to a piece of paper, and covering the seed with a piece of adhesive-backed transparent plastic.

Several patterns related to types of fine motor activities were identified during the observations. Most time spent on fine motor tasks involved some kind of writing with paper and pencil rather than manipulating other types of materials or tools or using markers or crayons. Two types of fine motor activities occurred in every regular classroom observed. First, children were instructed to fold paper to make margins or dividing lines before doing their work. Second, reading workbooks or work sheets were used in all classes. The fine motor demands of the reading workbooks could be described as minimal. Except for comprehension questions, the tasks in the reading workbooks involved either circling numbers for multiple-choice questions or writing single letters or words.

In five out of six classrooms, children were expected to copy from textbooks and do repetitive writing for such tasks as copying spelling words or vocabulary definitions. Creative writing and answering questions in sentences, tasks in which the child does have a great degree of

control over the volume and content of writing, occurred in four out of six classrooms.

Implications for Children With Fine Motor Difficulties

The findings regarding the amount of time allocated to fine motor tasks and the types of tasks that children are expected to perform raise important issues about providing appropriate education for children with fine motor difficulties in the regular classroom. In all classrooms observed, at least one third of the day was allocated to fine motor activity, and in two out of six of the classrooms observed, at least 55% of the day was allocated to fine motor tasks, thus it seems that fine motor tasks are an integral part of elementary school education. Providing an appropriate education for a child with known fine motor problems in regular classes may therefore require a teacher to make needed modifications, provide alternative modes of response and learning, or reduce the volume of written work while ensuring that adequate practice for learning new tasks has been provided. Careful monitoring of the child's work and learning is required to ensure that an appropriate match between fine motor demands, environmental adaptations, and the child's ability is occurring.

Given that a range in fine motor requirements was observed within the same grade level, placing the child in a class in which the requirements lie at the lower end of the range may be the preferred course of action when a choice of classes exists. However, in the present study we examined only time allocated to fine motor tasks and did not consider the volume of work to be done in the time allocated. In making decisions about a child's education, we would also need to consider this factor.

As mentioned earlier, a substantial amount of time allocated to integrated tasks can present a problem for the child who has difficulty thinking while writing. However, these six observations do not indicate that a substantial amount of time is allocated to integrated tasks in elementary school. It should be noted that our operational definition of integrated fine motor tasks influenced these findings. We defined *integrated fine motor tasks* as simultaneous occurrence of fine motor activities and oral instruction by the teacher. Many of the activities that we defined as fine motor activities, such as writing sentences with vocabulary words, also demanded thinking while writing.

Split-grade classes are often viewed as advantageous for the child with special needs because a greater spread of ability is present to enable the child's needs to be met. However, this type of class might not be an optimal choice for a child with fine motor problems because of the high percentage of time spent on fine motor activities. The organization of classroom activities in a split-grade classroom must be examined carefully before a

child with fine motor problems is placed in that class. The effect on fine motor demands of so many instructional groups can be reduced. For example, in the first- and second-grade classroom observed for this study, an aide took 9 students into a separate room for computer instruction while another group was instructed in math in the classroom by the teacher. Thus, the fine motor activity of those 9 children was of a different intensity than it would have been if they had been assigned the more usual type of seat work while the other group was receiving direct instruction.

The types of tasks assigned affect the child with fine motor difficulties, because tasks themselves may present different requirements relating to the amount, size, legibility, and spacing of writing or to the complexity and difficulty of work with particular materials. For example, a math ditto with answer spaces designed for a child with handwriting of average size may not offer enough work space for a child whose handwriting is larger than average. Different tasks also may offer the child different levels of control over the volume and content of writing. For example, assigning a child the task of writing a story with spelling words allows far more latitude in volume of writing than does assigning the task of copying five paragraphs from a social studies text. Thus, the type of tasks assigned may increase or decrease the need for modifications to work.

A particular issue is the frequency with which repetitive writing tasks were assigned to children. The educational value of such tasks for children who have difficulty thinking while focusing on handwriting must be carefully considered. Spelling pretests or oral vocabulary pretests could eliminate the need to have students copy entire spelling or vocabulary lists over and over. In math, requiring students to copy a number of complex math problems onto another piece of paper before they begin to solve the problems could be eliminated through the use of a photocopying enlarging machine. As an alternative, the student could use the workbook version of the textbook if that is available.

The practice of having children fold paper to make margins and dividing lines on their papers, which occurred in every classroom, is a frequently recommended modification for children with handwriting problems. The use of reading workbooks with minimal fine motor demands is also helpful for the integration of children with fine motor problems into regular classrooms.

Simple modifications for handling more lengthy assignments in reading workbooks could include allowing the child to remove the page from the workbook and to use a typewriter to type answers directly onto the page. In one sixth-grade classroom observed, a typewriter was used for this purpose by several students, none of whom had known fine motor difficulties.

In summary, the results of this study are exciting but must be viewed as preliminary. Knowledge of the heavy

fine motor demands of regular classrooms should assist occupational therapists working in the schools in providing more appropriate consultation. However, this study is based on limited observations. The sample was small—only six different classrooms and only two split-grade classrooms were observed. Moreover, each class was observed for only one day. Although we attempted to select typical days, with such a short observation an atypical day would have skewed the results. In addition, the issue of interrater reliability of coding was not fully addressed in this study in that on-site interrater reliability was not calculated. It is possible that rating from a videotape results in higher (or lower) interrater reliability of coding compared with rating from on-site observation. This study should be replicated with a larger sample with wider geographic representation and over a longer period of time, and on-site reliability must be examined.

Direct observation of the classroom provides helpful information about classroom organization, the use of time for academic activities, and the tasks that children will be expected to perform. Classroom observation provides invaluable information to the therapist consulting with the teacher and can help to identify potential problem areas for a child with fine motor problems. Appropriate modifications and personalized instruction can then be anticipated. Necessary plans can be implemented before or during the performance of academic tasks, rather than after the child has experienced failure at a particular task. When combined with careful monitoring of the child's work and learning, knowledge and anticipation of potential problem areas will help ensure that the child receives an appropriate education in the regular classroom. ▲

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