Integrating Occupational Therapy Services in a Kindergarten Curriculum: A Look at the Outcomes

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KEY WORDS
• educational status
• motor skills
• occupational therapy
• outcome assessment (health care)
• psychomotor performance

PURPOSE. We measured fine motor and emergent literacy outcomes in kindergarteners enrolled in two integrated kindergarten classrooms. The students received fully integrated occupational therapy services. Most occupational therapy services focused on planning and teacher consultation versus direct intervention.

METHOD. A one-group pretest–posttest descriptive design was used to measure occupational therapy and emergent literacy outcomes in a convenience sample of 37 kindergarten-age children with and without disabilities. Four fine motor and two emergent literacy assessments were administered at the beginning and end of the school year. Data on the amount and type of occupational therapy services were documented over 7 months.

RESULTS. Children without disabilities made statistically significant changes in all areas. Children with disabilities made significant changes in two of the fine motor and three of the emergent literacy assessments.

CONCLUSION. Findings demonstrated that for this sample of children, significant improvements in fine motor and emergent literacy function were made.

Each reauthorization of the Education for All Handicapped Children Act of 1975 (Pub. L. 94–142) has promoted reflection and a reevaluation of educational services, which in turn have brought about important shifts in the delivery of special education and related services (Argabrite Grove, 2002). The 1997 reauthorization of the Individuals With Disabilities Education Act (IDEA; Pub. L. 105–17), for example, placed greater emphasis on delivering related services to children with disabilities within the context of the student’s curriculum and general education environment (Muhlenhaupt, Miller, Sanders, & Swinth, 1998; Nolan, Mannato, & Wilding, 2004). As a result, occupational therapy service delivery has shifted from traditional “pull-out” approaches to the integration of services into the student’s classroom and other school environments (lunchroom, playground, restroom; Swinth & Hanft, 2002). This shift has required occupational therapists to become knowledgeable about the curricula adopted in specific classrooms and within their school districts so they can better specify how a student’s disability affects functioning within the educational environment and develop relevant intervention strategies. Understanding the teacher’s educational philosophy is also critical for effectively suggesting intervention strategies compatible with that teacher’s focus.

The aim of this study was to describe what full integration of occupational therapy services would look like in an emergent literacy kindergarten curriculum and to document fine motor and emergent literacy outcomes for children with and without disabilities.
**Early Childhood Educator’s Perspective: Emphasis on Emergent Literacy**

Emergent literacy theory has influenced preschool and kindergarten curricula and is widely embraced by many early childhood educators (International Reading Association & National Association for the Education of Young Children, 1998; Katims, 1996; Nielsen & Monson, 1996; Teale, 1988). “Emergent literacy is concerned with the earliest phases of literacy development, the period between birth and the time when children read and write conventionally” (Sulzby & Teale, 1991, p. 728, italics added). Literacy development is multidimensional and is linked to the child’s reading and writing experiences in the home and at school. Emergent literacy theory proposes that listening, speaking, reading, and writing abilities develop concurrently and interrelatedly rather than sequentially. For example, writing experiences improve a child’s reading skills and vice versa (Teale & Sulzby, 1989). Children are immersed in authentic and natural literacy-rich classroom environments that offer opportunities to read and write linked with ongoing classroom activities (Lawhon & Cobb, 2002; Lesiak, 1997). For instance, a daily routine might involve having the children sign in for the day. Print-rich materials are also carefully embedded throughout the classroom (e.g., books, signs, recipe cards, calendars). Neuman and Roskos (1990) found that a literacy-enriched play environment resulted in more purposeful, connected reading and writing behaviors in two racially mixed preschool classrooms.

Proponents of emergent literacy theory encourage children to “write” for the purpose of relating thoughts and experiences and developing a self-image of a “writer” (Lesiak, 1997). “At kindergarten, most children are still using emergent forms of writing such as scribble, drawing, nonphonetic strings of letters, or phonetic (‘invented’ or ‘creative’) spelling, and few have made the transition to conventional writing as their preferred writing form” (Sulzby, 1992, p. 290). Early childhood educators who embrace emergent literacy theory believe that children can write (i.e., compose) even if they have not mastered all of the mechanics of handwriting (Martinez & Teale, 1987). The focus is on purposeful writing to communicate versus writing drills to learn printing skills (Sulzby, 1992).

**Occupational Therapist’s Perspective**

During the preschool years, children make important gains in hand skills that lay the foundation for success in many areas of school function, including handwriting, cutting with scissors, manipulating small play objects, and self-care tasks (e.g., managing one’s clothes, using a fork; Case-Smith et al., 1998; Meyers, 2006). Developmental delay in preschool children often manifests itself as an incomplete mastery of the fine motor skills needed to begin handwriting, which is one of the most frequent reasons for referral to occupational therapy (Case-Smith, 1995; Oliver, 1989; Reisman, 1991; Wehrmann, Chiu, Reid, & Sinclair, 2006). Typically developing children from low socioeconomic status urban communities may also demonstrate delays in fine motor skills and handwriting development because of limited access to drawing and writing utensils in their home (e.g., crayons, chalk, pencils; Peterson & Nelson, 2003; Purcell-Gates, L’Allier, & Smith, 1995).

When a young child is referred to occupational therapy because of fine motor concerns, the occupational therapist typically observes the child during the problem activity to identify the body structures and functions (e.g., in-hand manipulation, visuomotor integration, eye–hand coordination) or contextual demands (e.g., positioning) that interfere with participation in fine motor activities and written communication. Biomechanical, sensorimotor, or teaching–learning approaches may be applied during occupation-based activities to improve specific component function and to help the child generalize the skills needed to function in the classroom (Case-Smith, 1996; Cornhill & Case-Smith, 1996; Peterson & Nelson, 2003). A positive relationship between component function and hand skills has been documented in the literature (Case-Smith, 1996, 2000; Cornhill & Case-Smith, 1996; Tseng & Murray, 1994; Weil & Amundson, 1994). Cornhill and Case-Smith (1996), for example, reported a significant correlation between in-hand manipulation and handwriting skill. Visual–motor integration also has been identified as a strong predictor of handwriting skill (Tseng & Murray, 1994). In a study of the relationship between components and function, Case-Smith (2000) concluded, “The relationships expressed validate the performance components–skills–functional performance model used to evaluate the children and support the hierarchy of performance that links components to skills to function and roles” (p. 378).

In addition, numerous studies have documented the positive effects of occupational therapy intervention on fine motor outcomes in children (Case-Smith, 1995, 1996, 2000; Case-Smith et al., 1998). Specifically, significant gains in skill areas related to fine motor function (e.g., pencil grasp, scissors grasp, in-hand manipulation, motor accuracy) have consistently been found after occupational therapy intervention (Case-Smith, 1995, 1996, 2000; Case-Smith et al., 1998).
Integration of Occupational Therapy Within an Emergent Literacy Curriculum

Given this information, it is important to consider how early childhood educators and occupational therapists may be inclined to work from two different, but related, perspectives regarding the kindergartner’s writing experiences. The early childhood educator, working from an emergent literacy focus, may emphasize the kindergartner’s engagement in writing to communicate ideas and to begin to identify him- or herself as a writer. This emphasis on the experience of being a writer versus correct letter formation may differ from a traditional occupational therapy focus on the development of fine motor skills and hand function needed for successful handwriting. With the shift toward integrating related services into the child’s curriculum, it is important for occupational therapists to gain awareness of the inherent philosophical differences that may exist between the early childhood educator’s and occupational therapist’s view of writing. Committing to the development of a shared framework sets the stage for true collaboration (Giangreco, Prelock, Reid, Dennis, & Edelman, 2000). Occupational therapy services will need to vary depending on the kindergarten curriculum, the teacher’s priorities, and the child’s needs (Case-Smith et al., 1998).

Informal approaches to writing used by teachers to promote emergent literacy may be successful for most students without disabilities but might prove frustrating for those with developmental disabilities and fine motor delays who may have difficulty with tasks as basic as holding a writing utensil and copying a line. In these cases, occupational therapy services can combine consultation with the teacher to adapt writing utensils and activities to enhance success and embedded intervention strategies within the classroom to help the child practice needed hand skills for appropriate grasp and use of a writing utensil. With improved hand skills, the child is more likely to successfully participate in the meaningful “writing” activities.

Integrated Occupational Therapy Services

Traditionally, occupational therapists provided individualized pull-out services to children with disabilities in school settings (Reid, Chiu, Sinclair, Wehrmann, & Naseer, 2006; Swinth & Hanft, 2002). Using this service delivery model, students were removed from the classroom and taken to a therapy room with intervention focusing on discrete skill training. This model of service delivery does not reflect IDEA’s mandate for education of students with disabilities in the least restrictive environment (i.e., with peers without disabilities to the maximum extent possible). Over the past 2 decades, the emphasis of intervention has gradually shifted to integrating related services into the classroom and other natural school contexts (Case-Smith & Rogers, 2005; Nolan et al., 2004; Swinth & Hanft, 2002). Integrated services involve the provision of both education and therapeutic strategies within the child’s natural environment to assess, plan, and implement intervention on common goals (Giangreco, 1986). Although sometimes viewed simply as “treatment that takes place in the classroom,” integrated therapy is actually complex, requiring team collaboration and a combination of teacher education, consultation with various team members, and direct service that is skillfully embedded in the natural context (Nolan et al., 2004).

Although integrated service delivery is the preferred model for therapy provision, few empirical studies have been published comparing functional outcomes in children receiving integrated versus isolated services (Nolan et al., 2004). In a single-subject design, Karnish, Bruder, and Rainforth (1995) found greater improvements in walking speed and quality of walking when students received physical therapy in the natural classroom versus an isolated setting. In two separate comparison group studies, no difference in outcomes was found between the groups; however, classroom staff preferred the integrated service model (Cole, Harris, Eland, & Mills, 1989; Dunn, 1990).

Recent studies have also emphasized the importance of the therapist–teacher relationship as a component of integrated services. In a survey of 40 teachers, findings indicated that as the amount of collaborative teaming increased, so did the teacher’s perceptions of occupational therapy contributions to student skill development (Barnes & Turner, 2001). Similarly, in a recent outcome study of 91 school-age children who received occupational therapy for fine motor difficulties, results indicated that occupational performance scores increased with greater teacher awareness of student needs and teacher implementation of occupational therapy strategies (Reid et al., 2006). Educating teachers about fine motor difficulties and how to implement occupational therapy intervention strategies may be critical in enhancing fine motor function in children (Reid et al., 2006).

This study, although similar to previous studies of fine motor outcomes in preschoolers, is unique in that the occupational therapy services were explicitly linked to the emergent literacy curriculum and were fully integrated into the classroom. The purpose of this study was to document and describe integrated occupational therapy services and to measure fine motor and emergent literacy outcomes in kindergartner children with and without disabilities who received 7 months of occupational therapy services that were fully embedded into the classroom curriculum.
Method

A one-group pretest–posttest descriptive design was used to measure fine motor and emergent literacy outcomes in a convenience sample of kindergarten-age children attending an inner city urban school who received fully integrated occupational therapy services. For ethical and service delivery reasons, a control group was not obtained. Consequently, this was an outcome study rather than a clinical trial. A research team of three occupational therapists and three early childhood teachers performed the pretesting and posttesting of fine motor and emergent literacy skills at the beginning and end of 1 academic year. After training, an intrarater reliability of .95 or higher was established in test administration before pretesting.

Participants

Students with and without disabilities enrolled in two integrated kindergarten classrooms with fully integrated occupational therapy services were invited to participate in this study. After institutional review board approval, written parental consent and the students’ written assent were obtained from all of the invited participants.

Curriculum

Each kindergarten class followed the school district’s core classroom curriculum for literacy, mathematics, science, and social studies. In addition, the individualized education plan (IEP) goals for the children with disabilities were integrated into the classroom activities. The curriculum applied an emergent literacy framework using thematic webs as a structure for planning learning activities to teach the interrelationship among reading, doing, speaking, listening, and writing.

Integrated Occupational Therapy Services

One occupational therapist, with more than 20 years of pediatric experience, provided services 2 days per week in the two kindergarten classrooms. Occupational therapy services were fully integrated into the classroom curriculum and consisted of a range of indirect and direct services. Indirect services included learning about the curriculum; making classroom observations; engaging in collaborative consultation with teachers, parents, and other service providers; and undertaking preparation activities. Direct services included both group and individual assessment and intervention fully embedded in the classroom curriculum.

Indirect Services. To successfully embed services within the kindergarten classroom, the occupational therapist spent time learning about the emergent literacy curriculum in the beginning of the school year. Specifically, time was spent observing class routines and activities, following individual students through centers, attending teacher in-services on the emergent literacy curriculum, and reading teachers’ weekly newsletter to parents. Understanding the curriculum was considered an essential first step in developing intervention activities that could be naturally embedded into the classroom.

Several other strategies were applied to enhance collaboration with the teachers so that services could be successfully integrated. First, the occupational therapist learned about the unique classroom culture by identifying each of the teacher’s priorities and concerns related to individual students and the class as a whole. For example, one teacher preferred physical education and music therapy to be combined, whereas the other preferred them to be separate activities. These preferences influenced how the occupational therapist collaborated with service providers for each classroom. The size and layout of each class varied as well, which influenced how specific plans were made for small group work. Both teachers were similar in their needs for occupational therapy—requesting strategies for enhancing pencil grip, prewriting skills, fine motor skills, and sensory processing strategies related to focusing and attending.

Second, time was spent providing in-services for the teachers and support staff covering occupational therapy’s role in fostering participation in kindergarten activities, including meaningful writing by addressing the fine motor, visual–motor, and sensory-processing performance skills related to classroom function.

Third, classroom materials that could be used to promote success in fine motor and writing activities were ordered and incorporated into the classroom for all students to use (e.g., multiple opportunities to work on vertical surfaces, including easels, dry erase boards, and slantboards).

Fourth, therapeutic materials to address individual student needs were selected and placed in the classroom (e.g., special “tools” such as tongs, spray bottles, scissors, and vibrating pens or developmentally appropriate games). This was done in collaboration with the teacher so that the materials were stored and made available on the basis of the teacher’s preferences.

Fifth, consultation with the teacher and other team members took place weekly to arrange opportunities to evaluate students, develop home programs, organize informal and formal teaming times, and create classroom programs. Sixth, time was spent planning transdisciplinary interventions such as co-led groups with art therapy, music therapy, and adapted physical education.

The occupational therapist intentionally interacted with the teachers in ways that encouraged them to become more competent over time in applying occupational therapy strategies to enhance fine motor function with their students. For example, collaborative consultation progressed from a more
directive (directing, demonstrating) to nondirective (problem solving, listening) interactive approach. In addition, the therapist’s interactions progressed from high to low degrees of control.

**Direct Services.** Direct services consisted of both individual and group intervention strategies designed to be embedded into the emergent literacy curriculum and daily classroom schedule. Occupational therapy focused on successful participation in classroom activities (e.g., group activities, center activities, social interaction, meaningful writing activities, activities of daily living, transitions) and the development of related performance skills (e.g., fine motor skills, sensory processing, social skills). Biomechanical, sensorimotor, or teaching–learning approaches were applied during occupation-based activities to improve specific component function and to help the child generalize the skills needed to function in the classroom. Although the occupational therapist focused intervention on meeting the needs of the children receiving special education, typically developing peers also received services because intervention was fully integrated into classroom. For example, occupational therapy group participants typically involved two to three children on IEPs and two typically developing classroom peers. For one particular art group, the occupational therapist read a book to four to six students and led them in an art project using adapted tools related to the book. In another group, each child made a leather book marker using leather stamping tools. Group activities were specifically designed to foster fine motor skills in tandem with emergent literacy curriculum and the IEP goals.

**Documentation of Occupational Therapy Services**

The occupational therapist documented the amount and type of her services from October to May (7 months) on a detailed data sheet. All of the therapist’s direct and indirect services were documented for the two kindergarten classrooms. Time spent (in minutes) in direct intervention including both group and individual was documented for each child with and without disabilities. In addition, the types of services were specified in the areas of fine motor, sensory process, social participation, gross motor, and self-care. Time spent in indirect intervention activities was also documented and included teacher education, collaboration time with the teachers, and related service providers and activity planning times.

**Instruments**

The study’s instruments measured developmental function in two areas: fine motor performance related to writing and emergent literacy skills. A battery of six assessments was administered by the research team to all participants during a 2-week period at the beginning (September) and end (May) of the school year. After informed consent, the participants were tested in a quiet room at school during two sessions.

**Fine Motor Performance.** Assessments that measure fine motor skills and performance in areas related to handwriting were selected for this study. Studies have consistently correlated visual–motor skills (Cornhill & Case-Smith, 1996; Daly, Kelley, & Krauss, 2003; Tseng & Murray, 1994; Weil & Amundson, 1994) and in-hand manipulation (Cornhill & Case-Smith, 1996) to handwriting skill. Pencil grasp was also assessed. In a study by Parush, Levanon-Erez, and Weintraub (1998), inferior pencil positioning was associated with poor handwriting. In addition, the kindergarten teachers involved in this study noted frequent problems with prehension of classroom tools. This finding may be linked to the tendency for children living in low-income urban environments to have limited access to drawing and writing utensils in their homes (Purcell-Gates et al., 1995).

Fine motor performance was measured by the Fine Motor (FM) scale of the Peabody Developmental Motor Scales–2 (PDMS–2), a norm-reference standardized test for children birth through 72 months (Folio & Fewell, 2000). The Fine Motor Quotient includes subtest scores from Grasping and Visual–Motor Integration that measure hand use, eye–hand coordination, and manual dexterity. Test–retest reliability for the PDMS–2 (FM) is excellent ($r = .93$), as is interrater reliability ($r = .98$; Folio & Fewell, 2000). Standard scores and age equivalents were used in data analysis.

Visual–motor skills were measured using the Visual–Motor Integration test (VMI; Beery & Buktenica, 1997). The VMI, a norm-referenced standardized test for children 3 through 17 years, requires the child to draw a developmental sequence of 24 geometric forms using paper and pencil. This test has sound psychometric qualities, with test–retest reliability at .87 and interrater reliability at .94 (Beery & Buktenica, 1997). Standard scores and age equivalents were used in data analysis. The supplemental tests assessing visual perception and motor coordination were not administered.

In-hand manipulation was measured using five small pegs from a nine-hole pegboard. Translation and rotation speed were recorded for each hand using the administration and scoring procedures developed by Case-Smith (1995, 1996, 2002; Case-Smith et al., 1998) and reported in numerous studies. In the translation test, the child picks up two, three, four, and then five pegs using one hand, moves them into the palm and then back to the fingertips, and puts them in the pegboard. The number of drops and seconds to complete each task are recorded. A composite score of the mean time and number of drops was used in the data analysis. To
measure rotation, the child picks up a peg from the pegboard and rotates it 180 degrees with the fingertips before returning it to the pegboard. The length of time it takes to rotate five pegs is documented. The number of drops and amount of times the hand was stabilized on the surface is also recorded for each hand. A composite score based on the means for time and number of drops and stabilizations was used for data analysis (Case-Smith, 2002).

Last, pencil grasp was assessed using the developmental sequence described by Schneck (1991) and Schneck and Henderson (1990). Pencil grasp was observed during the VMI testing and rated based on this 10-point hierarchy.

Emergent Literacy. Two assessments were used to measure emergent literacy. Three subtests of Clay’s (1993) Observation Survey of Early Literacy Achievement (OSELA) were used. Since the 1960s, Clay has engaged in in-depth research and analysis of literacy development. “The research methods she used produced assessment tools that have high construct and face validity and high reliability measured in large-scale studies” (Reading Recovery Council of North America, Inc., 2002, p. 43). According to Clay (1993), these controlled observation measures permit more detailed recording of individual responses than normative tests. “The Observation Survey adheres to characteristics of good measurement instruments, namely, a standard task, a standard way of administering the task, ways of knowing about reliability of observations, and a real-world task that establishes validity of the observation” (Reading Recovery Council of North America, 2002, p. 44).

The Letter Identification subtest of the OSELA is an individually administered, 54-item assessment that measures the child’s ability to identify the upper- and lowercase letters of the alphabet. Students are given 1 point for each letter identified by name or sound. Concepts About Print assesses the child’s understanding of how to handle a book and the conventions of printed language while being read a book (e.g., identifying the front and back of the book, the differences between a letter and a word) and can yield a total score of 24. Hearing and Recording Sounds evaluates phonemic awareness by having the child write two sentences that are dictated orally. One point is given for each correct letter sound representation, for a total of 37 (Clay, 1993). The standard procedures as described by Clay (1993) were used for these OSELA subtests.

The second assessment, Approximations to Text (Pappas, 1993), assesses children’s behaviors during a simple story reading by an adult and their ability to “reread” the story immediately afterward. This test was administered in a quiet room and videotaped. Each tape was scored on a 35-point scale by the examiner and a second rater to ensure reliability.

Data Analysis

All testing data were entered into the Statistical Package for Social Sciences program, version 12 (SPSS, Inc., Chicago). To measure fine motor and emergent literacy outcomes in kindergarten children with and without disabilities who received 7 months of occupational therapy services that were fully integrated into an emergent literacy curriculum, pretest and posttest scores were computed using two-way analyses of variance (ANOVAs). Standard scores were computed and used in analysis for the PDMS–2 (FM) (mean of 50, standard deviation of 10) and the VMI (mean of 100, standard deviation of 15). Raw scores were used for all of the other tests.

To determine clinical significance, the Proportional Change Index (PCI) was calculated for tests yielding age equivalent scores (PDMS–2 [FM] and VMI). Kadzin and Wilson (1978, as cited in Ottenbacher, Johnson, & Hojem, 1988) argued that there are limitations to traditional studies relying on statistical comparisons between average improvements in groups because individual performance is not considered. The PCI is one of several procedures designed to measure developmental improvements in any domain (Ottenbacher et al., 2000; Wolery, 1983). “The PCI provides an easy-to-compute numerical index of the relationship between the estimated rate of preintervention development and the rate of development during treatment” (Ottenbacher et al., 1988, p. 159). To calculate the PCI, the rate of development at pretest (developmental age divided by chronological age) is compared with the rate of development during intervention (amount of developmental gain divided by the time of intervention). Scores greater than 1.0 indicate that the child demonstrated accelerated development during the intervention period.

Descriptive data were compiled to document the amount and type of occupational therapy services provided to kindergarten children with and without disabilities during one academic school year. Mean scores for intervention time and type of services provided were obtained from the data sheets and calculated. Percentages of the type of intervention provided were also computed.

Results

Participants

A convenience sample of 37 children, with and without disabilities, from two integrated kindergarten classrooms participated in this study. The age range of the sample at the beginning of the study was 60 to 83 months, with a mean age of 71.5 months. Twelve children had identified disabilities (6 in each class) and received special education,
occupational therapy, speech–language pathology, adapted physical education, music therapy, and physical therapy, as needed. Children with disabilities all qualified for special education and presented with a variety of developmental disabilities, including Down Syndrome (n = 3), cerebral palsy (n = 1), mental retardation (n = 4), and undiagnosed developmental delays (n = 4). Only one of the children with disabilities was nonambulatory and used a wheelchair. Although the remaining 25 children were identified as typically developing peers, many were at risk of fine motor and academic delays because of their low-income urban status (Lee-Corbin & Evans, 1996). For example, on the basis of the pretest scores, the typically developing peers demonstrated an average of 18 months of delay in visual–motor skills based on the VMI.

**Description of Occupational Therapy Services**

The amount and type of occupational therapy services provided in the two kindergarten classrooms are presented in Table 1. The children with disabilities (n = 12) received an average of 28 sessions (range of 23–42) over 7 months. Because occupational therapy services were embedded within the classroom, the children without identified disabilities (n = 25) also received services with a mean of 18 sessions (range of 12–28). The total amount of service provided to the children with disabilities ranged from 805 to 1,180 min with a mean of 942 min (15.7 hr or approximately 2 hr per month). Children without disabilities received a mean of 567 min (range of 335–885) of occupational therapy over 7 months (more than 1 hr per month). The participating therapist spent most of her time in indirect (64%) versus direct (36%) services for the children with disabilities, representing a 2:1 ratio. Indirect services included teacher consultation (55%), preparation and planning (50%), and parent consultation (6%). Some of the teacher consultation time overlapped with preparation and planning. A bulk of the planning sessions focused on developing group activities relevant to the thematic web being addressed in the curriculum. For example, the leather stamping project was planned during a thematic web focusing on “tools” and required the children to use a wooden mallet and leather stamping tools.

The majority of direct service was provided in group format (78%) with approximately half the sessions being co-treated with another service provider (art teacher or music therapist). Groups were made up of children both with and without disabilities, which allowed those without disabilities, but at risk of delays, to receive occupational therapy intervention as a typically developing peer in the group. The majority of direct service focused on fine motor development (63%) followed by sensory processing (24%) and social function (13%).

**Comparison of Pretest and Posttest Fine Motor Performance and Emergent Literacy**

Pretest and posttest scores are reported in Tables 2, 3, and 4. Standard scores were calculated and compared for the PDMS–2 (FM) and the VMI; raw scores were used for the remaining tests. Comparisons using two-way ANOVAs indicated that each class as a whole (n = 37) made statistically significant changes at the p < .05 level in all of the fine motor and emergent literacy measures. In addition, the children without disabilities made statistically significant changes in all eight measures. The children with disabilities (n = 12) made significant changes in two of the fine motor assessments (PDMS–2 [FM] and pencil grip) and three of the emergent literacy tests (Concepts About Print, Letter Identification, and Approximation to Text). The VMI and in-hand manipulation assess more refined hand skills than the PDMS–2 and pencil grip. Less change was noted in these areas for the children with disabilities. Similarly, the Hearing and Recording Sounds required the greatest amount of visual–motor and fine motor control in the emergent literacy tests. Students with disabilities did not make significant changes in this assessment.

In addition to levels of statistical significance, effect sizes were reported using eta-squared (η²) to indicate the difference between mean scores for the children with and without disabilities. A squared effect size of .64 is considered large, and .25 is considered medium (Ottenbacher & Barrett,
Medium or larger effect sizes were found for the children with disabilities for the PDMS–2 (FM), pencil grip, and letter identification scores indicating large changes between pretesting and posttesting. The children without disabilities made greater changes at posttest in some of the emergent literacy tests (Letter Identification, Concepts About Print) compared with the children with disabilities.

**Improvement Beyond Maturation**

The mean PCI score for the children with disabilities was 4.0 for the PDMS–2 (FM) Visual–Motor subtest, 9.5 for the PDMS–2 (FM) Grasping subtest, and 2.3 for the VMI, indicating improvement well beyond that expected because of maturation. Similarly, mean PCI scores were greater than 1.0 for the class as a whole in all three areas. The children without disabilities obtained PCI scores greater than 1.0 in the PDMS–2 (FM) Visual–Motor subtest and the VMI.

**Discussion**

We found statistically significant improvements in fine motor and emergent literacy outcomes in children with and without disabilities after 7 months of participation in an emergent literacy kindergarten curriculum with fully integrated occupational therapy services. PCI scores indicated change beyond that expected because of maturation. Without a control group, however, it is not possible to infer causality—that the interventions were responsible for changes in

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**Table 2. Fine Motor Pretest and Posttest Scores**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Pretest</th>
<th>Posttest</th>
<th>p</th>
<th>Effect Size</th>
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<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
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<tr>
<td>PDMS–2 (FM) Sum SS</td>
<td></td>
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</tr>
<tr>
<td>Whole class (n = 37)</td>
<td>17.6 (6.1)</td>
<td>20.1 (4.9)</td>
<td>.000**</td>
<td>.410</td>
</tr>
<tr>
<td>With disabilities (n = 12)</td>
<td>11.2 (5.2)</td>
<td>15.5 (5.9)</td>
<td>.003**</td>
<td>.578</td>
</tr>
<tr>
<td>Without disabilities (n = 25)</td>
<td>20.7 (3.6)</td>
<td>22.3 (2.2)</td>
<td>.021*</td>
<td>.202</td>
</tr>
<tr>
<td>VMI SS</td>
<td></td>
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<td></td>
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<tr>
<td>Whole class (n = 37)</td>
<td>73.9 (18.8)</td>
<td>77.9 (18.2)</td>
<td>.022*</td>
<td>.142</td>
</tr>
<tr>
<td>With disabilities (n = 12)</td>
<td>60.7 (23.9)</td>
<td>65.2 (24.9)</td>
<td>.262</td>
<td>.113</td>
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<tr>
<td>Without disabilities (n = 25)</td>
<td>80.3 (11.9)</td>
<td>83.9 (9.9)</td>
<td>.023*</td>
<td>.198</td>
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<tr>
<td>In-Hand Manipulation</td>
<td></td>
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<tr>
<td>Whole class (n = 37)</td>
<td>33.6 (12.8)</td>
<td>31.0 (14.5)</td>
<td>.003**</td>
<td>.282</td>
</tr>
<tr>
<td>With disabilities (n = 12)</td>
<td>45.2 (22.1)</td>
<td>44.0 (19.4)</td>
<td>.179</td>
<td>.398</td>
</tr>
<tr>
<td>Without disabilities (n = 25)</td>
<td>31.2 (8.9)</td>
<td>25.8 (7.6)</td>
<td>.002**</td>
<td>.345</td>
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<tr>
<td>Pencil Grip</td>
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<tr>
<td>Whole class (n = 37)</td>
<td>3.9 (0.9)</td>
<td>4.7 (0.9)</td>
<td>.000**</td>
<td>.557</td>
</tr>
<tr>
<td>With disabilities (n = 12)</td>
<td>3.4 (1.3)</td>
<td>4.3 (1.5)</td>
<td>.003**</td>
<td>.565</td>
</tr>
<tr>
<td>Without disabilities (n = 25)</td>
<td>4.2 (0.4)</td>
<td>4.9 (0.3)</td>
<td>.000**</td>
<td>.569</td>
</tr>
</tbody>
</table>

**Note.** M = mean; PDMS–2 (FM) = Peabody Developmental Motor Scales–2 (Fine Motor scale); SD = standard deviation; SS = standard score; VMI = Visual–Motor Integration test. For PDMS–2, VMI, and Pencil Grip, higher scores are indicative of improvement. *p < .05. **p < .01. ***large effect size.

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**Table 3. Emergent Literacy Pretest and Posttest Scores**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Pretest</th>
<th>Posttest</th>
<th>p</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hearing and Recording Sounds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole class (N = 37)</td>
<td>0.86 (2.0)</td>
<td>8.8 (11.6)</td>
<td>.001**</td>
<td>.336</td>
</tr>
<tr>
<td>With disabilities (n = 12)</td>
<td>0 (0)</td>
<td>0.9 (2.9)</td>
<td>.300</td>
<td>.100</td>
</tr>
<tr>
<td>Without disabilities (n = 25)</td>
<td>1.08 (2.0)</td>
<td>11.9 (10.2)</td>
<td>.000**</td>
<td>.580</td>
</tr>
<tr>
<td>Concepts About Print</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole class (N = 37)</td>
<td>3.5 (4.9)</td>
<td>9.6 (4.9)</td>
<td>.000**</td>
<td>.662***</td>
</tr>
<tr>
<td>With disabilities (n = 12)</td>
<td>1.5 (1.7)</td>
<td>4.2 (3.5)</td>
<td>.009**</td>
<td>.479</td>
</tr>
<tr>
<td>Without disabilities (n = 25)</td>
<td>4.5 (2.7)</td>
<td>12.2 (3.1)</td>
<td>.000*</td>
<td>.808***</td>
</tr>
<tr>
<td>Letter Identification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole class (N = 37)</td>
<td>6.7 (11.4)</td>
<td>33.3 (18.4)</td>
<td>.000**</td>
<td>.606***</td>
</tr>
<tr>
<td>With disabilities (n = 12)</td>
<td>2.9 (5.9)</td>
<td>21.5 (20.1)</td>
<td>.013*</td>
<td>.567</td>
</tr>
<tr>
<td>Without disabilities (n = 25)</td>
<td>8.6 (13.1)</td>
<td>38.9 (14.9)</td>
<td>.000**</td>
<td>.812***</td>
</tr>
<tr>
<td>Approximation to Text</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole class (N = 37)</td>
<td>10.9 (2.8)</td>
<td>12.6 (2.8)</td>
<td>.000**</td>
<td>.342</td>
</tr>
<tr>
<td>With disabilities (n = 12)</td>
<td>10.4 (2.6)</td>
<td>11.7 (2.8)</td>
<td>.013*</td>
<td>.477</td>
</tr>
<tr>
<td>Without disabilities (n = 25)</td>
<td>11.8 (3.0)</td>
<td>14.6 (1.6)</td>
<td>.047*</td>
<td>.183</td>
</tr>
</tbody>
</table>

**Note.** M = mean; SD = standard deviation. Higher scores are indicative of improvement for all assessments. *p < .05. **p < .01. ***large effect size.
Students with disabilities demonstrated statistically significant improvements in fine motor skills as measured in the PDMS–2 (FM) and in the pencil grasp assessment. Although changes in VMI scores were not statistically significant, the PCI was greater than 1.0, indicating improvement beyond expected maturation. Students with disabilities also made significant progress in all measures of emergent literacy except Hearing and Recording Sounds (writing a dictated sentence). Although the students with disabilities made gains in fine motor skills, visual–motor (as measured in the VMI and Hearing and Recording Sounds) and in-hand manipulation scores were well below those of their typical peers. These skills require the use of a higher level of hand skills. PCI scores for the class as a whole indicated that fine motor changes were accelerated during the intervention period with greater acceleration noted in the group with disabilities. By contrast, effect size scores were greater for the children without disabilities in several of the emergent literacy tests (Hearing and Recording Sounds, Concepts About Print, and Letter Identification).

In addition, study outcomes suggest that children without identified disabilities but at risk may benefit from occupational therapy services that are integrated into the classroom. In this study, although the children without disabilities were officially considered typically developing peers, all were from low-income families and demonstrated fine motor and emergent literacy delays in pretest scores. Changes between pretesting and posttesting indicated that the students without disabilities made significant gains in all of the fine motor and emergent literacy measures. The school principal expressed delight in these results, indicating that she was getting the “biggest bang out of her therapy buck.”

There is growing national support for providing early identification and intervention for all students in need. For example, the response to intervention approach is being promoted in an effort to provide immediate intervention for children falling behind in the general education curriculum (American Occupational Therapy Association, 2007). According to a 2002 Report of the President’s Commission on Excellence in Special Education, local education agencies and states are encouraged to provide preidentification services to children at risk of being identified as needing special education (National Rehabilitation Association, 2002). Some children may make enough change with early short-term therapy to prevent the need for long-term special education. In a recent randomized control study, Peterson and Nelson (2003) found significant improvements in printing in low-income urban first graders who received 10 weeks of occupational therapy compared with a control group. The embedded intervention described in this study offers a viable model for how occupational therapists can concurrently

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**Table 4. Fine Motor Proportional Change Index (PCI)**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Pretest Age Equivalent (SD)</th>
<th>Posttest Age Equivalent (SD)</th>
<th>PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDMS–2 (FM) visual motor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole class (n = 37)</td>
<td>52.9 (17.8)</td>
<td>61.4** (14.5)</td>
<td>2.3</td>
</tr>
<tr>
<td>With disabilities (n = 12)</td>
<td>35.4 (18.4)</td>
<td>46.8* (17.2)</td>
<td>4.0</td>
</tr>
<tr>
<td>Without disabilities (n = 25)</td>
<td>61.4 (13.2)</td>
<td>67.6* (6.3)</td>
<td>1.5</td>
</tr>
<tr>
<td>PDMS–2 (FM) grasp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole class (n = 37)</td>
<td>60.2 (18.3)</td>
<td>66.3** (11.7)</td>
<td>3.4</td>
</tr>
<tr>
<td>With disabilities (n = 12)</td>
<td>43.2 (23.5)</td>
<td>56.5* (17.2)</td>
<td>9.5</td>
</tr>
<tr>
<td>Without disabilities (n = 25)</td>
<td>68.4 (6.3)</td>
<td>71.0* (0)</td>
<td>0.5</td>
</tr>
<tr>
<td>VMI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole class (n = 37)</td>
<td>48.5 (18.3)</td>
<td>55.9** (13.9)</td>
<td>1.6</td>
</tr>
<tr>
<td>With disabilities (n = 12)</td>
<td>38.3 (9.3)</td>
<td>47.1** (11.7)</td>
<td>2.3</td>
</tr>
<tr>
<td>Without disabilities (n = 25)</td>
<td>55.4 (10.1)</td>
<td>60.1** (13.2)</td>
<td>1.3</td>
</tr>
</tbody>
</table>

*Note. M = mean; PDMS–2 (FM) = Peabody Developmental Motor Scales–2 (Fine Motor scale); SD = standard deviation; VMI = Visual–Motor Integration test. **p < .05. *p < .01.
address the needs of children with and without disabilities, promoting cost-effectiveness.

This study also provides a detailed breakdown of one occupational therapist’s use of time and type of service delivery provided within an integrated practice model. To begin with, the majority of her time was spent providing indirect (64%) versus direct services (36%). Approximately half of the time spent in indirect service was providing teacher and parent consultation, and half was spent in preparation and planning for embedded services. The importance of teacher consultation, specifically education, was also found in a recent outcome study conducted in Canada (Reid et al., 2006). Applying the occupational therapy school-based consultation model, therapists spent the majority of their time educating teachers in how to apply occupational therapy intervention strategies in the classroom. Reid et al. (2006) found a relationship between a teacher’s knowledge of occupational therapy strategies, implementation of intervention strategies, and positive changes in occupational performance.

Although a strong case is being made to support time spent in teacher education and consultation, therapists’ time spent in planning for embedded services is often unaccounted for and may not be viewed as a legitimate part of occupational therapy service. The results of this study validate a therapist’s time needed to plan for direct services embedded in the curriculum because of the complexity of integrated therapy. The occupational therapist in this study spent planning time meeting with teachers and other personnel to develop co-led groups and prepare needed materials. Careful planning services of this kind may prevent integrated therapy from looking simply like “treatment that takes place in the classroom.”

Of the time spent in direct services (36%), most of the therapist’s time was spent providing group (78%) versus individual intervention. The benefit of using group intervention is that it meets the needs of both groups of children—those with and those without disabilities. Group intervention allows the children with disabilities to be educated with peers without disabilities and provides early intervention for children without identified disabilities who may be demonstrating delays.

Limitations of This Study

A significant limitation of this study is that it was not possible to use a control group or random assignment because of ethical and service delivery reasons. This issue prevents the ability to infer causality, that is, that the interventions were responsible for changes in performance. The provision of pull-out therapy services for one of the classrooms was not an option because both teachers preferred embedded inter-

vention. Another limitation is that the intervention (independent variable) consisted of a combination of strategies (direct and indirect) based on multiple theoretical principles (biomechanical, sensorimotor, or teaching-learning), making it difficult to determine what intervention may have had the greatest influence.

Summary

This outcome study demonstrates that significant progress was made over 1 academic year in both fine motor and emergent literacy skills in kindergarteners with and without disabilities participating in an emergent literacy curriculum with embedded occupational therapy services. Systematically measuring outcomes related to classroom function assists practitioners in evaluating the success of particular practice models and types of intervention. Findings also illustrate an occupational therapist’s use of time when providing integrated services. Time spent collaborating with the teacher and other personnel outweighed time spent in direct intervention by a 2:1 ratio. Educating teachers about occupational therapy strategies may play an important role in student outcomes (Reid et al., 2006). The ability to develop a shared framework may be especially critical when teachers and therapists approach children’s learning needs from two different perspectives, as in the case of early writing. As the focus of occupational therapy shifts from pull-out to embedded services, therapists may need to make a case for time spent in planning as a legitimate part of service because of the complexity of integrated therapy.

Finally, our results demonstrate how integrated occupational therapy can concurrently address the occupational performance needs of children with disabilities and those at risk of delay. The blending of teacher education, collaborative planning, and embedded direct intervention as described in this study provides a natural way for occupational therapists to contribute discipline-specific information and strategies needed to enhance particular areas of function that are not a part of the teacher’s expertise. ▲

References


