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Effects of Practical Life Materials on Kindergartners' Fine Motor Skills

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A pretest-posttest control group design was used to measure the effect of practical life materials on public school kindergarten children's fine motor skill development over a 6-month period. The dependent measure was a penny posting test. More than 50 different sets of activities were provided to the experimental group (n = 101). Teachers coached students in following specific steps to use tweezers, tongs, and spoons to manipulate a variety of objects. Students then employed the materials during center time in their classrooms. Although experimental and control group teachers reported equal amounts of fine motor activity in their classrooms, significant interaction effects were found indicating the experimental group outperformed the control on the posttest measure. An overall effect size of 0.74 indicates that the type of fine motor activity is important in children's development.

KEY WORDS: fine motor skills; early childhood education; kindergarten; Montessori; quasiexperimental.

INTRODUCTION

Children who have difficulty coordinating the small muscle groups in their hands have difficulty dressing, feeding themselves, and manipulating pencils, crayons, and scissors. This difficulty makes children dependent on others, opens them to peer ridicule, and prevents them from meeting the demands of school (Losse et al., 1991). In a longitudinal study of clumsy children, Losse et al. found "difficulties with handwriting, in art design and technology, in home economics and in practical science lessons" (p. 60). These children also exhibited more behavior problems and lower achievement, with some exhibiting "intense personal feelings of failure" and a "worrying amount of dissatisfaction with those whose job it was to teach them motor skills" (Losse et al., 1991, p. 62). Clumsy teenagers reported that throughout their education, schools showed little interest and provided little help. Perhaps of greatest importance was that many of these children did not outgrow their clumsiness.

Other research exploring the relationship between motor skills and academic achievement has focused on literacy. For example, Reno (1995) found a moderate correlation between fine motor ability in young children and early literacy performance, and Share, Jorm, Maclean, and Matthews (1984) found interdigital dexterity to be a strong predictor of reading achievement. Given the importance of these findings, it is troubling that little quantitative research is available exploring types of fine motor skill interventions and their effects over time.

This study was a pretest-posttest control group design with a test of pincer grip manual dexterity as the dependent measure. The treatment was inclusion of practical life curriculum materials promoting use of the pincer grip in experimental kindergarten classrooms. Control classrooms were not given the curriculum materials. The pincer grip test is similar to other penny posting/placing tests common to early childhood motor ability tests (e.g., Henderson & Sugden, 1992). In the test, children were asked to pick up pennies and place them in a slot in a can. Experimental classrooms received sets

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of practical life materials housed in plastic shoeboxes, which engaged students in using various implements (tongs, tweezers, spoons, etc.) to manipulate objects. These activities were grounded in Montessori practices and theory (Montessori, 1914/1965). The pincer grip was the focus, since it is so important in early school experiences (e.g., buttoning, tying shoes, writing, drawing).

The Pincer Grip

There are two main ways the hand can grip an object: a) by closing the four fingers around the object with or without the thumb, called the power grip; and b) by pinching the object between one or more fingers and the thumb, called the pincer grip (Gray, Williams, & Bannister, 1995). The pincer grip can be differentiated into two subtypes that represent ends of a continuum in which the fingers rotate to adjust to the held object. The precision or tip pinch grip stabilizes an object between the tips of the fingers and the thumb (e.g., holding writing instruments, spoons, needles, and tweezers). The lateral pinch grip is used to hold a larger object with the flatter fingerprint pads and may involve more fingers than the precision grip (e.g., holding keys, markers, books, and tongs). The grip used to post pennies falls near the middle of this continuum.

Description of Materials Used for Practicing Fine Motor Skills

Experimental classrooms received more than 50 different sets of activities during the 6-month treatment period. Manipulation of these objects required application of cognitive and fine motor skills. For example, the "Diamonds" box contains a royal blue satin-covered, gold-tasseled case, 12 faceted faux diamonds, a cobalt blue glass bowl, a decorated egg carton with blue velvet pillows glued into the bottoms of compartments, and a silver spoon. The student is instructed to carefully pour the diamonds into the bowl, use the spoon to transfer and position each jewel on a velvet pillow, and finally transfer them back to the bowl and box. (See Fig. 1 for another example.)

These activities are inspired by "practical life" materials common in Montessori schools. They are simple, dynamic, self-corrective, and attractive to children (Wentworth, 1998), and they align with the National Association for the Education of Young Children's guidelines for developmentally appropriate practice (1996).

Theoretical Base

Montessori's (1914/1965) method emphasizes the care and management of the environment as the primary means for children to refine their motor skills. The prepared environment provides opportunities to carry out real work with a practical objective. Moving or washing child-sized furniture, polishing shoes or silverware, and cutting foods are examples of tasks involving gross and fine motor skills. Other fine motor skill activities employ instruments from daily life (e.g., spoons, tongs, ladles, and tweezers). Each activity consists of a series of movements to be performed in a logical sequence.

Fig. 1. "Ladybug levels" fine motor skill activity in which ladybug erasers are positioned on images glued to leaf pedestals.

Montessori broke each exercise into specific points to which the child's attention is drawn. The teacher demonstrates and narrates each step of the operation in a logical, orderly sequence. As they repeat the sequence, children learn to focus their attention, become aware of their body movements, and learn to recognize and use feedback to improve.

Previous Work

Two previous studies examined motor development of children in Montessori environments. Pendergast (1969) evaluated eye-hand coordination and visual perception skills of upper-middle income children. Gains were significant when comparing children attending the Montessori school to the conventional nursery school, but not significant when comparing Montessori children to those who stayed at home. This was attributed to the "many manipulative experiences in the Montessori program" (Pendergast, 1969, p. 140). Stodolsky and Karlson (1972) studied low- and middle-income children in their first, second, and third years of attending a Montessori

preschool program. The curriculum appeared to be effective in nurturing development of visual-motor integration, matching and sorting skills, and psychomotor skills.

Research Hypothesis

Both of the above studies indicated that Montessori programs may be effective in developing children's fine motor skills. However, they did not describe in detail the specific materials used nor did they investigate whether Montessori practical life materials are efficacious in non-Montessori classrooms. Thus, the following hypothesis is posited: Materials that promote use of fine motor skills developed from Montessori's theory will improve children's fine motor skills in a public school kindergarten when compared to more traditional fine motor activities.

METHOD

Participants

Kindergarten students (n = 186) from 13 classrooms in four schools participated in the study. All classes were half-day, and all were located in a school district that enrolled students from rural and urban environments in the Pacific Northwest. Eight teachers participated. Three teachers responsible for five classes in three schools comprised the control condition (n = 85). Five teachers responsible for eight classes of students in four schools formed the experimental condition (n = 101). School socioeconomic level varied as measured by free or reduced price lunch statistics. The four schools with experimental classrooms had the following percentages of low-income students: 21%, 25%, 32%, 53%. Only three of these schools were represented in the control condition (21%, 25%, 53%).

Dependent Measure: Penny Posting Test

In the Penny Posting Test, the number of pennies are counted that a seated child can pick up one at a time with the dominant hand and place through a one-inch slot in a can within 30 seconds. Each student was presented with 50 pennies spread on a towel and was given a practice of depositing two pennies into the slot, then two 30-second trials. This same procedure was followed for pretest and posttest.

Procedure

Assignment of conditions to classrooms was not random. The first author met with the teachers, described the project, and negotiated roles. Teachers instructing both morning and afternoon sessions (five of the eight teachers) thought participation in the study would be easier to manage if both of their classes were the same condition. Three teachers felt they were so strong and experienced in implementing fine motor skill activities that they preferred to be in the control condition, thereby allowing others the opportunity to work with the new materials. The remaining teachers agreed to the experimental condition.

Teachers were asked to show students how to manipulate the materials and complete the activities. Each box had a step-by-step set of instructions and a materials list. The first author demonstrated proper operation of boxes to the teachers. Teachers received six new boxes of materials every 2 weeks throughout the study period. Students used the fine motor skill activities as an option during center time almost every day.

To ascertain how often the experimental materials were employed and to gauge the amount of fine motor activity in all of the classrooms, at the conclusion of the study teachers completed a survey asking the frequency of various fine motor activities.

RESULTS

Performance curves for the experimental and control groups are presented in Fig. 2. An ANOVA for repeated measures on the number of pennies successfully dropped by the two groups over four trials indicated no significant group effect ($F = 3.23$, $df = 1/184$, $p = .074$), a significant trials effect ($F = 63.50$, $df = 4/552$, $p < .001$), and, of most importance, a significant Group × Trials interaction ($F = 34.49$, $df = 3/552$, $p < .001$). The assumption of sphericity was met (Field, 2000). Analyses of 95% confidence intervals of means revealed that on the two trials prior to treatment (Trials 1 and 2), experimental and control conditions did not differ, but on the two trials after treatment (Trials 3 and 4), there were significant differences between groups (see Table I and Fig. 2). These differences resulted in a large average effect size of .74 (Shavelson, 1996) for the two trials of the posttest. Comparisons of male and female performance were nonsignificant.

A composite score for each teacher was derived from the questionnaire. These composite scores were analyzed using a t test for independent samples with equal variances assumed. The analysis showed no significant differences between experimental and control group teachers in the amount of fine motor activity they reported in their classrooms, Exp. Mean = 47.8 (6.76); Con. Mean = 46.3 (8.39); $t = .274$, $df = 6$, $p = .79$. Thus, the object boxes were a substitute for fine motor activities typically present.

Table I. Pretest and Posttest Results for Control and Experimental Groups

Group	Test	Mean number of pennies	Standard Deviation	95% Confidence interval	
				Lower bound	Upper bound
Control $n = 85$	Pretest 1	16.9	2.8	16.3	17.5
	Pretest 2	17.6	3.0	16.9	18.2
	Posttest 1	17.5	2.7	16.9	18.1
	Posttest 2	17.8	2.8	17.2	18.4
Experimental $n = 101$	Pretest 1	16.3	2.7	15.7	16.8
	Pretest 2	16.7	2.9	16.2	17.3
	Posttest 1	19.4	2.6	18.9	19.9
	Posttest 2	19.9	2.8	19.3	20.4

DISCUSSION

The hypothesis was supported. Since all teachers reported equivalent amounts of fine motor activity in their classrooms, the differences may be more confidently attributed to students' use of the study materials. It was the nature of the fine motor activity, not the amount of activity, that resulted in increased performance.

After the posttest, experimental group students were asked to comment on the materials. Most children spoke enthusiastically of the activities, commenting that the activities sparked their imaginations and challenged their motor skills. Teachers mentioned how students enjoyed the activities because of the attractive items and themes. Activities that teachers described as most valuable were those that incorporated cognitive skills such as finding likenesses and differences, matching and sorting, or science content such as learning about animals.

Although most kindergarten classrooms are rich with fine motor activities, results underscore the need for carefully constructed and coached activities. The nature of the activities and how children are instructed in completing them appear to be important factors. Perhaps teachers should begin to include activities like those employed in this study, since effective instructional environments are absolutely essential given the high-stakes nature of schooling.

Research has revealed that clumsy children find academic tasks such as handwriting and manipulating science equipment difficult (Graham & Weintraub, 1996; Losse et al., 1991), and handwriting legibility influences teachers' perceptions of students' academic competence (Sweedler-Brown, 1992). Thus, it is important that teachers at all levels help these children develop adequate skills. Our findings reveal that practical, engaging activities focusing on fine motor skill development and practice do help. Future research is needed to track the longevity of the treatment effects along with a particular focus on those children who struggle the most, for it is these children who appear to be at risk during later stages of their growth and development.

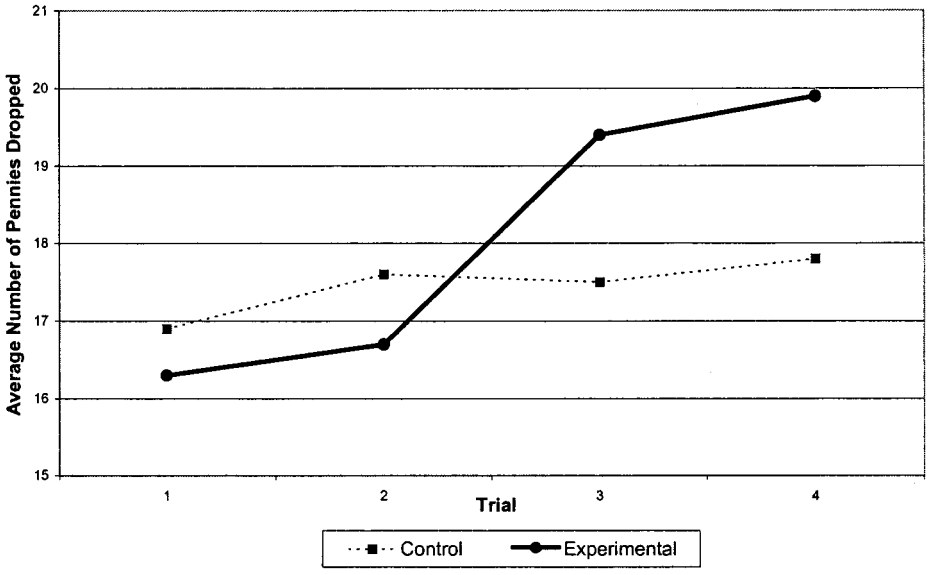

Fig. 2. Performance curves.

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