

EFFECTIVE OCCUPATIONAL THERAPY INTERVENTION FOR  
HANDWRITING/FINE MOTOR DIFFICULTIES

by

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## ABSTRACT

### EFFECTIVE OCCUPATIONAL THERAPY INTERVENTION FOR HANDWRITING/FINE MOTOR DIFFICULTIES

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Handwriting/fine motor difficulties are well documented as serious hindrances to academic learning for kindergarten and elementary school children. Intervention techniques to remediate these problems have been researched by educators and occupational therapists. Effective occupational therapy interventions have been found to include visual motor tasks, kinesthetic and dexterity training and motor planning/strengthening activities. Occupational therapists, mandated by the Individuals with Disabilities Education Act, work with these students in the school setting to enhance handwriting/fine motor skills to meet classroom curriculum demands. Humboldt County teachers have reported a high incidence of students with these deficits in their classrooms yet reported a low frequency of referral to occupational therapists for intervention. Funding and a lack of general knowledge about the role of therapists' in the school setting appear to be barriers to implementation of therapy services for students. These same teachers indicated a strong interest in continuing education on remediation techniques. An educational module designed for staff development for teachers in Humboldt County on handwriting/fine motor intervention strategies appears to be needed. Curriculum for students is rigorous with many academic topics to cover. Imbedding fine motor remediation techniques into another discipline seems advantageous. Food related activities naturally lend themselves to fine motor

involvement. Staff training encouraging vegetable awareness and handwriting skill acquisition is an effective way to impact student learning in two specialty areas. Linking fine motor intervention with nutrition education will be a cost effective, compelling, and creative solution to meet teacher and ultimately student needs in Humboldt County.

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## CHAPTER ONE INTRODUCTION

Fine motor/handwriting problems are serious and can result in school failure (Berninger & Rutberg, 1992; Levine, Oberklaid & Metzler, 1981). Handwriting is a significant part of the classroom day for early elementary students (McHale & Cermak, 1992). Good handwriting ability is linked to written composition success (Graham, Harris & Fink, 2000). Handwriting problems are not perceived as critical by educators although identification and remediation of these problems greatly benefit students' academic success and self esteem (Beringer, Mizokawa & Bragg, 1991; Levine, Oberklaid & Metzler, 1981;). Critical performance components of handwriting include adequate visual motor integration, fine motor dexterity, and complex motor planning ( Levine, Oberklaid & Meltzer, 1981; Sovik, 1984; Tseng & Murray, 1994; Weintraub & Graham, 2000). Occupational therapy remediation has been shown to be an effective intervention for these students (Case-Smith, 2002; Oliver, 1990). Therapists address the foundational visual motor skills necessary for handwriting (Amundson, 2001; California Department of Education, 1996; The American Occupational Therapy Association, Inc., 1999).

Based on informal surveys of administrators and teachers in a Northern California county, early elementary school teachers indicated a strong interest in further education pertaining to fine motor/handwriting interventions for their students. The majority of teachers identified more than six students in their classrooms with fine motor/handwriting difficulties and reported an increase in these difficulties possibly due to content standard rigor. These same teachers reported they were not seeking occupational therapy

intervention for these students. Funding limitations and a lack of knowledge about schoolbased occupational therapy services appeared to be a hindrance for students needing therapist intervention. Occupational therapists are rehabilitation professionals with a specialized background to provide intervention for children with disabilities. Currently, no occupational therapists are employed in schools within this county.

The idea to blend nutrition education with fine motor handwriting interventions came about because vegetable play naturally lends itself to fine motor involvement, and funding is currently available for nutrition education. In response to teacher and student need a teacher training module was developed that includes a presentation that covers the following topics: the complexities of handwriting and the importance of remediation, anatomy and motor development, ergonomics, and pencil grasp. The module also includes activities that integrate vegetable play with fine motor/handwriting interventions with the purpose of enhancing vegetable consumption among young children as well as providing fun remediation techniques for students struggling with handwriting.

This project investigates the following research question: What would be the contents of a teacher training module that addresses intervention techniques for pre-school and kindergarten students struggling with fine motor/handwriting difficulties? This project will link fine motor interventions with nutrition education; food play with vegetables easily integrates fine motor involvement.

In the following chapters, I will address this question by analyzing the impact poor handwriting has on academic success, performance components necessary for good handwriting, successful remediation strategies for students struggling with handwriting,

and intervention programs established by teachers and occupational therapists for these students. The process that led to this research question and the decision to blend fine motor interventions with nutrition education will be explored. Next, a discussion of the planning and revision process of the teacher training module will follow. Chapter Four will provide the content of the training module, followed by conclusions and implications for future research.

## CHAPTER TWO LITERATURE REVIEW

The rationale to develop a teacher training module designed to help students with fine motor handwriting problems is based upon an in-depth understanding of the complexities involved in handwriting and the impact poor handwriting has on academic achievement. This next section will focus on the importance of handwriting mastery for students, the foundational skills necessary for handwriting, and intervention techniques for remediation of handwriting difficulties.

### *Importance of Handwriting Mastery*

Due to the increased use of word processors and computers, some people may regard the skill of handwriting as a skill of the past. Written expression remains, however, a very important part of the elementary school curricula (Berninger, Vaughn, Abbott, Rogan, Brooks, & et al., 1997; Graham, Harris, & Fink, 2000; McHale & Cermak, 1992). The use of handwriting is in fact the primary method by which elementary school students convey their knowledge to teachers about the extent to which they have mastered academics (Amundson, 2001).

Handwriting has been reported by many authors to be a complex process involving the synthesis of cognition, visual perception, motor skill, integration of memory, problem solving, organization, reading and language ability, ideation, and graphomotor function (Amundson, 2001; Berninger et al, 1997; Levine, 1994; van Galen, 1991; Weintraub & Graham, 2000). Writing is the last language skill to develop ontogenically, after comprehension, speech, and reading (Levine, 1994). The demand for

written performance is high in elementary classrooms, taking place as a predominant activity between 30 to 60% of the classroom day (McHale & Cermak, 1992). Nearly 10% of elementary school children experience fine motor/handwriting difficulties (McHale & Cermak, 1992). Thus, in a typical classroom, the average teacher will probably have at least two students each year who will need special intervention or services such as occupational therapy (McHale & Cermak, 1992). Furthermore, the State of California Department of Developmental Services shows that children with developmental disabilities are significantly increasing in number, especially those diagnosed with autism. Many of these children experience some form of fine motor impairment resulting from this diagnosis (California Health and Human Services Agency, 1999).

The most common reason for a student to be referred to school-based occupational therapy services is handwriting difficulties (Tait, 1998). Occupational therapists provide consultation to classroom teachers as well as individualized student intervention under guidelines from the Individual with Disabilities Education Act (IDEA) (The American Occupational Therapy Association, Inc., 1999). Therapists are responsible for standardized student testing to address performance related to visual perception, visuo-motor integration, gross and fine motor function, sensory processing, and bilateral coordination (California Department of Education, 1996).

The importance of remediation and detection of students with handwriting/fine motor impairments has been well documented (Beringer et al., 1997; Fox, 1998; Graham, 1999; Graham, Harris & Fink, 2000). Students with difficulty have been noted to suffer frustration and/or school failure in later years (Beringer & Rutberg, 1992; Levine,

Oberklaid, & Metzler, 1981). Handwriting acquisition and mastery have been linked to children's compositional success and fluency (Beringer, Mizokawa, & Bragg, 1991; Graham, 1995; Graham, Harris, & Fink, 2000). Children are labeled as lazy and defiant who have been found to have clumsiness or coordination difficulties (Levine, 1994; Levine, Oberklaid, & Meltzer, 1981). Specialists often do not diagnose children early, and they dismiss handwriting difficulties as unimportant (Fox, 1998).

Early detection and intervention are most advantageous for the student's academic success (Beringer, Mizokawa, & Bragg, 1991; Levine, Oberklaid, & Metzler, 1981) as well as the relief of the child's family (Fox, 1998). Children struggling with handwriting face serious academic obstacles (Levine, 1994).

Writing is hard to hide and, therefore, children who have difficulty with it often feel exceedingly vulnerable in school. They may be ashamed of the legibility and content of their writing. They notice their peers transcribing far faster and with greater efficiency than they seem capable of. If their writing appears terrible, then somehow the outside world may think they have a terrible mind. In addition, they may be accused of laziness and a poor attitude for problems that are largely out of their control. For these reasons, writing difficulties need to be managed with great sensitivity and caring. (Levine, 1994, pp. 195-196)

The research literature on handwriting difficulties has tended to fall into categories of related factors or patterns of dysfunction. Many descriptive articles and books written on remediation strategies exist. Prior to 2000, not many empirical studies existed that discussed the efficacy of specific interventions. A possible conceptual

framework can be provided by considering research findings related to good and poor handwriting, as well as intervention strategies currently utilized by educators and occupational therapists alike. This literature review will address research on factors contributing to handwriting dysfunction and important components for good handwriting. In addition, specific intervention strategies and the relationship to dysfunction patterns will be examined. The efficacy of intervention techniques will be considered in detail.

### *Foundational Skills*

Handwriting involves the synthesis of many skills including orthographic coding, finger function, visual motor integration, eye/hand coordination, and visual perception (Amundson, 2001; Berninger & Rutberg, 1992; Tseng & Murray, 1994). In a noted seminal study, Ellis (1982) proposed that motoric processes are first informed by the visual process by providing critical feedback on features such as letter formation, size, spatial orientation, and so forth. Visual feedback or visual perception is a critical performance component (Ellis, 1982). Children with handwriting disorders (dysgraphics), however, continue to make errors in writing even with their eyes closed (Ellis, 1982). The possibility of other feedback such as kinesthetic, from the fingers and the wrist, is touched on briefly, and the neuromuscular component and its involvement in the production of written work was not explored (van Galen, 1991). The sections to follow will discuss individual performance components required in handwriting and compare and contrast recent research that addresses the complexity of motor involvement.

*Visual motor integration and visual perception.*

Visual motor integration and perception link strongly to handwriting ability (Sovik, 1984;; Tseng & Murray, 1994; Weil & Amundson, 1994). For example, dysgraphic children in Scandinavia were found to have visual figure ground perceptual disorders or dysfunction in their visual perceptual skills (Sovik, 1984). Pre-testing data identified these children as having problems not only with perception but motor behavioral and visuo-motor difficulties as well (Sovik,1984).

Handwriting disorders may include some component of fine motor dyspraxia and perceptual disorder (Sandler, Footo, Coleman, & Hooper, 1992). Students in kindergarten have a concomitant increase in ability to copy forms on the test of visual motor integration, as well as increase their ability to copy alphabet letters (Weil & Amundson, 1994). Children with poor handwriting also have poor results on tests such as the Ayers Motor Accuracy test and the Visual Motor Integration test (Tseng & Murray, 1994) as well as lower scores than children with good handwriting on seven perceptual/motor tests (Tseng & Murray, 1994). The two tests above (Ayers Motor Accuracy and Visual Motor Integration) have the highest correlation for legibility of handwriting of all children tested (Tseng & Murray, 1994). Poor handwriters can be predicted by their low scores on the Finger Position Imitation Test which measures fine motor praxis or complex motor planning (Tseng & Murray, 1994). Poor handwriters do worse than good handwriters on fine motor/dexterity tasks measured by the Bruininks-Oseretsky Test of Motor Proficiency which highlights the need to evaluate complex finger motor planning when initially testing these children (Tseng & Cermak, 1993; Tseng & Murray, 1994).

Although dexterity, grip, and pinch strength are not correlated (Lee-Vlkov, Aaron, Eladoumikdachi, Thornby, & Netcher, 2003), a comparison of strength scores may shed light on a possible relationship between hand strength and handwriting performance.

Ergonomic factors such as pencil size and pressure with writing (kinesthetic input) as well as perceptual motor performance have an influence on handwriting (Tseng & Cermak, 1993). Kinesthesia, along with motor planning and visual motor integration, is also closely related to handwriting performance (Tseng & Cermak, 1993). The kinesthetic input may enhance writing by decreasing the amount of visual inspection of work needed by the child, thus improving speed and freeing the child to input other academic information (Tseng & Cermak, 1993). Adequate kinesthetic development and perceptual motor skills are the foundation for handwriting performance (Laszlo & Broderick, 1991). Kinesthesia is necessary for maintenance of posture, error detection, and correction and provides the necessary information from the hand and arm to memorize movement (Laszlo & Broderick, 1991). Children who have difficulty with this information, and hence cannot store it in their memory, will face a new handwriting task every time they repeat previous writing attempts (Laszlo & Broderick, 1991).

An area that is relatively unresearched is the relationship between sensory discrimination/stereognosis and handwriting ability. Stereognosis involves the interpretation of sensory information obtained from the hand during palpation of a surface or the manipulation of an object. None of the studies in this literature review evaluated this component of children's hand function related to good or poor

handwriting. Sensory perception may comprise a critical role in the process of handwriting.

Neural encoding of mechanoreceptors of the hand is exquisite, discrete, precise, and highly differentiated to ensure smooth, graded controlled movements. The activation and feedback from the somatosensory receptors from the skin, joints, and muscles provide the foundation of tactile perception, shaping the hand for object manipulation and enabling humans to execute complex, smooth, graded, individuated finger movements. (Byl, Leano, & Cheney, 2002, p. 315)

Somatosensory system feedback dysfunction results in degradation of fine motor control of the hand in adults diagnosed with hand problems (Byl, Leano, & Cheney, 2002). A strong correlation exists between accurate sensory discrimination and faster fine motor skills (Byl, Leano, & Cheney, 2002). Fine motor control improves with sensory training in adults, and future research into the role of somatosensory discrimination and handwriting performance in children is warranted (Byl, Leano, & Cheney, 2002).

*Orthographic performance.*

Orthographic coding, the ability to develop an intact representation of letters of the alphabet and accurately and rapidly reproduce them from memory was originally thought to have a significant role in the handwriting process (Berninger, Mizokawa, & Bragg, 1991; Ellis, 1982; Levine, 1994; van Galen, 1991), but one study demonstrated that orthographic ability was not a predictor of handwriting status for fifth grade students with handwriting difficulties (Weintraub & Graham, 2000). Furthermore, visual motor and finger function tests are stronger predictors of handwriting legibility than

orthographic tests (Sovik, 1984; Tseng & Murray, 1994; Weintraub & Graham, 2000). Children can be classified as poor handwriters if they score poorly on finger function tasks and visual motor tests (Weintraub & Graham, 2000). Finger function and complex finger motor planning contribute strongly to handwriting legibility (Case-Smith, 1996; Case-Smith, 2002; Cornhill & Case-Smith, 1996).

*Fine motor/hand function performance components.*

Recent investigations of hand and finger functions indicate a strong correlation between handwriting and in-hand manipulation (Cornhill & Casesmith, 1996). In-hand manipulation, eye-hand coordination, and visuo-motor integration scores strongly correlate to good or poor handwriting (Cornhill & Case-Smith 1996). When provided with occupational therapy interventions addressing visuo-motor and in-hand manipulation skills, students with fine motor delays improved their performance levels to that of their peers (Case-Smith, 1996). These findings were unexpected; usually when a student is identified as having a delay, their maturation rate is expected to be slower than their peers (Case-Smith, 1996). In-hand manipulation skills as well as eye hand coordination had a clear relationship to a student's ability to perform functional tasks such as holding a pencil (Case-Smith, 1996; Cornhill & Case-Smith, 1996). The early introduction of tool use (such as the use of chopsticks) may enhance in-hand manipulation and may positively impact pencil control for handwriting (Exner, 1990). Games and imaginative play with small manipulatives are identified as being the best way to practice in-hand manipulation (Case-Smith, 1995). Because writing involves the competent use of a tool, occupational therapists have theorized that the in-hand

manipulation skills involved in writing relate directly to the handwriting process (Cornhill & Case-Smith, 1996).

The ability to precisely manipulate and adjust objects in one's hands is linked with efficient, mature, and effective fine motor skills (Case-Smith, 2002; Cornhill & Case-Smith, 1996; Exner, 1990), and rapid manipulation of the pen or pencil depends on intrinsic and extrinsic muscles as well as sensory feedback (Amundson, 2001). Seminal work by van Galen (1991) reported that afferent control is an unnecessary element in the writing process, but this was not researched as a factor (van Galen, 1991).

Some researchers have divided handwriting disorders into subtypes grouped with various other childhood dysfunctions (Sandler et al., 1992). The largest number of children identified had a combination of fine motor deficits and visual spatial deficits (Sandler et al., 1992). This finding strongly correlates with the research discussed previously relating good/poor handwriting to fine motor function and visual motor integration (Sandler et al., 1992).

Poor academic productivity in late elementary school and junior high is linked to deficits in fine motor and handwriting abilities (Levine, Oberklaid, & Meltzer, 1981). As students progress towards junior high, learning undergoes an abrupt change from passive learning to emphasis on encoding (as in writing), and the volume of required written material abruptly increases (Levine, Oberklaid, & Meltzer, 1981). The term developmental output failure describes children who exhibit a sharp decline in work habits, motivation, interest in school, and self esteem (Levine, Oberklaid, & Meltzer, 1981). The most common deficits in these children are in pencil control, fine motor tasks,

and visual retrieval (Levine, Oberklaid, & Meltzer, 1981). In one study, finger agnosia (trouble using proprioceptive or kinesthetic feedback to locate one's digits in space) occurred in half of the students, and all students with identified finger agnosia had fine motor problems with many exhibiting an awkward pencil grip which may hinder adequate pencil control (Levine, Oberklaid & Meltzer, 1981). Research trends on handwriting disabilities have undergone a paradigm shift (Berninger, Mizokawa, & Bragg, 1991). The writing product was the initial focus of research. The shift to the process involved in writing and handwriting occurred in the mid to late 1980s. The foundational skills required in writing, such as the ability to hold a pencil, adequately maneuver a pencil, and have the wrist and hand strength necessary to produce the much talked about product were not focused upon (Berninger, Mizokawa, & Bragg, 1991; Graham, 1999; Levine, 1994; van Galen, 1991).

With the passage of the Individuals with Disabilities Education Act, occupational therapists became involved in the research process (Henderson & Pehoski, 1995; The American Occupational Therapy Association, 1999). Therapists add their knowledge to previous research and provide a background related to evaluation of motor performance, visual perceptual skills, and visuo-motor integration (Amundson, 2001; Henderson & Pehoski, 1995). Many studies have been completed on students with mental retardation or neurological disabilities with fine motor/ handwriting difficulties (Lockhart & Law, 1994; Oliver, 1989; Penso, 1991; Ziviani, Hayes, & Chant, 1990). Sovik (1984) appears to be one of the first to study dysgraphic students with normal intelligence. An understanding of the factors essential for handwriting is crucial for determining the

remediation process for all students needing intervention. The section to follow will compare and contrast techniques for remediation of hand writing difficulties.

### *Intervention Techniques*

Relatively few empirical studies exist documenting effective intervention strategies, thus several older studies will be examined in an effort to contrast, compare, and critique available research. Many articles and/or anecdotal accounts are available providing ideas for instructional strategies as well as curricular modifications.

An individualized training program using tracing, tracking, and copying resulted in improved handwriting quality among dysgraphic students, but overall progress was not statistically significant (Sovik, 1984). Sovik states, “It seemed reasonable to believe that the psychomotor handicaps which these subjects were likely to have, compared to other children on entering school, had been augmented during their first years of school attendance because of inadequate writing instructions practiced in class [difficulties would have been eliminated or greatly lessened]” (1984, p. 146). Traditional handwriting instruction may not meet the individual needs of all students, especially those disposed toward dysgraphia (Sovik, 1984). An individualized or modified curriculum is suggested as being beneficial (Sovik, 1984).

Special education students involved in a sensorimotor program using multisensory stimulation as well as gross, fine, and visual motor strengthening activities responded with greater improvements in handwriting readiness skills than children of normal intelligence (Oliver, 1989). The largest developmental gain occurred in children who had discrepancies between verbal and performance IQs on the Wechsler Intelligence

Scale for Children-Revised validating the benefit of individualized instruction emphasizing multisensory activities (Oliver, 1989). Thus, adequate sensorimotor development may be a key foundation for handwriting acquisition, and children with insufficient sensorimotor development may become “frustrated with the seatwork commonly done in kindergarten” (Oliver, 1989, p.115).

A need existed for research that would help to identify the effects of occupational therapy intervention on students with handwriting/fine motor disabilities (Fox, 1998; Graham, 1999). Learning disabled students identified as poor handwriters made significant gains in handwriting legibility through occupational therapy interventions specific to identified problem areas with emphasis on visual motor skill development and handwriting practice (Case-Smith, 2002). Activities for remediation also included proprioceptive input, in-hand manipulation, and activities to improve arm strength and stability (Case-Smith, 2002). Communication with teachers was a critical element for carry-over of intervention strategies to facilitate student success (Case-Smith, 2002). Case-Smith (2002) and Cornhill & Case-Smith (1996) show positive implications as to the benefit of therapist intervention that addresses the development of foundational visual motor skills in these students.

Among young children at risk for handwriting problems, the treatments associated with the most successful result are visual cues and memory retrieval (Berninger et al., 1997). Two variables predict handwriting outcomes: finger succession and total finger score at pre-test (children’s accuracy on finger lifting, spreading, localization, and recognition were summed to give a total finger score) (Berninger et al., 1997). There is a

strong correlation between complex finger motor planning and finger function and the ability to evaluate handwriting skills (Berninger & Rutberg, 1992; Weintraub & Graham, 2000). Visual motor integration skills were a strong predictor for handwriting success (Berninger et al., 1997). The use of the visual cues and memory retrieval as a treatment intervention may have in fact provided children with a boost to their visual perception skills which enhanced their handwriting performance.

Recent articles by teachers note a shift in the instructional process to include a multi-sensory/occupational therapy design in their approach to handwriting instruction (Keller, 2001; Naus, 2002; Woods, 2001). A handwriting group that reported success worked on improving elementary students' handwriting problems and utilized sensory integration strategies including strengthening, coordination and visual motor activities (Keller, 2001). Students who took part in the program met the goals that were established for them and gained confidence in their writing abilities (Keller, 2001). This approach is similar to the intervention techniques by Case-Smith (2002). Many of the activities were related to hand and finger strength as well as visual motor integration, and they proved to be effective strategies for remediation of handwriting difficulties in elementary students (Case-Smith, 2002).

A Montessori approach has also been described as an effective intervention to improve and facilitate handwriting performance (Woods, 2001). Handwriting acquisition and development are established as very important, and curricula are designed to facilitate the hierarchy of skills necessary for learning (Woods, 2000). Montessori ideas of teaching emphasize foundational motor development including tactile and kinesthetic

components, as well as basic tripod grip strengthening activities. Children in Taiwan develop a tripod grip for pencil use at an earlier age than children in England and the U.S., and this skill development is attributed to their use of chopsticks while eating (Tseng, 1998). Chopsticks use a similar tripod grip that is required in writing, and the use of chopsticks may positively impact muscle development and coordination enhancing children's ability to correctly hold their pencil or crayon (Schneck & Henderson, 1999; Tseng, 1998). Awkward pencil grip (inadequate tripod grip development) has been linked to handwriting difficulties (Levine, Oberklaid, & Meltzer, 1981). Fine and dexterous movements are foundational motor skills necessary for handwriting (Case-Smith, 2002; Cornhill & Case-Smith, 1996; Oliver 1989; Weintraub & Graham, 2002) and are also required for effective use of chopsticks (Schneck & Henderson, 1999). Tool experimentation through creative play is thought to be linked to developing the foundation of hand function in children (DeGangi, Wietlisbach, Goodin, & Scheiner, 1993). The Montessori approach touches on basic themes that other researchers have pointed out: Motor foundation skills are the basis for handwriting acquisition and must be in place for students to progress (Case-Smith 2002; Case-Smith et al., 1998; Cornhill & Case-Smith 1996; Oliver, 1989; Weintraub & Graham, 2002).

Another more recent handwriting approach utilizes principles of visual-motor development and examines the predictive relationships between hand skill and handwriting success (Naus, 2000). Activities to encourage development of hand muscles or foundational skills for handwriting are practiced as hand readiness strategies (Naus,

2000). Prerequisites of handwriting discussed are a notable change from older literature (Naus, 2000).

### *Conclusion*

The purpose of this literature review was to investigate performance components related to handwriting and effective intervention strategies, as well as establish any causal relationship between the two findings. A clear and strong relationship emerged between foundational motor skills and handwriting ability. Foundational motor skills include adequate in-hand manipulation, tripod grip, and finger control to guide a pencil. Finger agnosia was aptly used to describe the motor planning deficits in poor handwriters. Basic proprioceptive and kinesthetic feedback appears inadequately developed in these children. Initial research reviewed failed to take into account the motor processes involved in writing and instead placed the majority of emphasis on orthographic coding and perceptual skills. Specific performance components established as predictors for good handwriting revealed finger function, visuo-motor integration, motor planning, and kinesthesia to be essential factors. Furthermore, an underlying theme that established itself during this literature review is the predictability of low child scores in complex finger motor planning, kinesthetic finger awareness, dexterity and poor handwriting. Another important point revealed was the need to initially evaluate fine motor dexterity and complex finger motor planning in children with handwriting problems. Remediation strategies that addressed these components were shown to be the most effective. Research by Case-Smith on occupational therapy intervention was the only statistically significant, current study that used a blend of these established handwriting performance components

in the remediation process to enhance the skills of established poor hand writers with learning disabilities. Other research studies reviewed either were not statistically significant, or the participants were not identified initially as poor handwriters. Of interest to this review is the study by Sovik (1984) and his conclusion that students struggling with writing may not respond to the traditional method of teaching and may need a modified, individualized curriculum based on an evaluation of their deficits. This, in fact, is what therapist intervention provided in the research by Case-Smith (2002). The occupational therapists modified the remediation process for each student depending on initial evaluation performance areas of weakness.

Further research is needed in this area to identify specific handwriting interventions that are most advantageous as well as time and cost effective. In addition, more research is needed to find interventions that improve writing speed and not just legibility. Future research will help educators and therapists to better meet the needs of these students and, ultimately, enhance their academic success.

This project investigates the following research question: What would be the content of a teacher training module that addresses intervention techniques for pre-school and kindergarten students struggling with fine motor/handwriting difficulties?

## CHAPTER THREE METHODOLOGY

In this chapter, I will introduce the process by which we developed the teaching module that will be presented in Chapter Four. Information gathered from four informal surveys will be discussed, and I will conclude with an explanation of the reasoning behind the synthesis of nutrition and occupational therapy, as well as the creation, assessment, and revision process involved in the module design. This process will be placed in the context of the previously examined literature.

### *Chronological History of the Project Idea*

#### *Initial work with children and schools.*

I began working with children with physical disabilities at a private, non profit rehabilitation clinic in rural northern California. My initial interest and focus were in rehabilitation of the upper extremities, and I planned to obtain enough hours and experience in this area to sit for the exam and become a board certified hand therapist. My interest in children expanded and grew when I continued to encounter, as part of my case load, children who had fine motor and handwriting difficulties. I was frustrated, however, by untimely referrals which I believed resulted in the development of inefficient handwriting skills. I also noticed that these children (mostly boys) were unenthusiastic about writing, had poor self esteem around handwriting, and had muscle weakness which hindered their performance. Furthermore, it was upsetting when some parents reported that their child's handwriting problems were not taken seriously by school staff. Some parents noted they were told, "Don't worry; he will outgrow it" or

“He is a boy, and all boys have problems writing.” In addition, I was removed from the educational setting where I felt I could make the most impact on the child’s performance. I called the local County Office of Education to inquire about school-based occupational therapists for possible collaboration regarding these referrals. I discovered that no therapists were on staff. I was shocked, as federal mandates and state guidelines are in place for these services. If therapists were employed in the school setting, perhaps these children’s problems could have been prevented or lessened in severity. I discussed this issue with several other therapists working in pediatrics. They identified insufficient funds for these services as the major reason behind the lack of occupational therapy. In questioning one retired teacher who is a friend of mine she reported that school administration told her, “Don’t recommend OT, we don’t want to pay for it.” Also, parents have stated that when they have requested an OT evaluation for their child they have been told, “We don’t provide those services at this school.” Furthermore, one parent confided in me a school psychologist told her that she wanted to recommend OT for the parent’s child but was afraid she would lose her job if she did. As a result, I expanded my expertise by researching articles and attending conferences on handwriting/ fine motor difficulties.

In fall 2001, I entered Humboldt State University (HSU) to pursue an M.A. in Education. From the beginning, my focus in class projects was around fine motor handwriting problems and therapy services for these students. Also, because local educationally-based therapy services were not available for students, I investigated how services were established in other areas, especially rural County Offices of Education.

I believed that funding was a major part of the problem but perceived that other reasons might exist as well.

*Inquiry on teacher education about occupational therapy.*

I completed an education inquiry project during my first semester at HSU that investigated how elementary teachers learn about school-based occupational therapy services for children. During this inquiry, I interviewed several professors of occupational therapy at San Jose State University and two professors in special education at HSU. Data revealed that no information is presented about occupational therapy to special educators due to the heavily impacted curriculum mandated by the California Commission on Teacher Credentialing. Special educators are provided with a packet of information about rehabilitation services (speech therapy, physical therapy, and occupational therapy) to review on their own. Teachers in regular education received no formal information in their curriculum. In my inquiry summary, I concluded that workshop or in-service education would probably be the best way to increase elementary school teachers' awareness about what services OT can provide for their students.

*Qualitative study: Establishment of occupational therapy in a rural county.*

During another class project, I conducted a qualitative study that investigated how an occupational therapy program became established at a rural County Office of Education in Central California. Interviews with four school-based occupational therapists revealed that education to teachers and administrators was an integral part of the development of their program, in-service education being the most commonly

mentioned strategy in program development. The therapists wrote grants to help fund the initial program start up. A major theme that was revealed by the therapists was that they provided frequent teacher education to share occupational therapists' expertise. As one therapist reported, "We have provided and continue to provide lots of in-service training to teachers and school districts concerning the scope of OT (occupational therapy)." Another therapist stated, "We had to educate the world out there, along with the staff and administrators of the schools, and even our boss, on what OT is, what our department needs and what the students need." This information led me to believe that one of the problems in establishing occupational therapy was a general lack of awareness about its uses and benefits.

*Survey to school administrators on their knowledge about OT.*

Next, I conducted an informal, quantitative survey of 19 northern California county school administrators. I found a positive relationship between the knowledge and attitudes of administrators about occupational therapy and the use of these services in their districts. Data also revealed that the majority of these administrators lacked knowledge of occupational therapy. Some of the administrators cited inadequate funding as a difficulty in providing these services. Several administrators indicated they may be interested in obtaining grant funding to help with providing such services for students. Results of the survey also confirmed that the provision of occupational therapy services for children in this rural northern county is extremely low. Administrators, who are

frequently unfamiliar with occupational therapy, make decisions concerning the provision of these services (Bloom, 1988; Szabo,2000).

*Literature investigation on fine motor/handwriting difficulties.*

The idea to investigate literature surrounding fine motor/handwriting interventions which were most effective arose from my motivation as a therapist to provide the best possible treatment for the students with whom I work. The intervention strategies that were found to be most effective were interventions that involved using visual motor activities, strengthening the muscles of the hand, and improving dexterity. Furthermore, performance components that were noted to be indicators of poor handwriting were revealed as finger agnosia, poor motor planning, and poor kinesthetic awareness. The research revealed that many of these problems could be remedied when students were engaged in activities that targeted these specific skill areas. I envisioned activities that address the necessary performance components for the handwriting that could be frequently provided to students. From this idea, the thesis project teacher training module was established. I determined that a training module designed for preschool and kindergarten teachers could be helpful in introducing these teachers to the role of occupational therapy in the education setting, anatomy and muscle development in children, and the importance of remediation for students with fine motor and handwriting problems. The module provides indicators for students who may be appropriate for an evaluation by an occupational therapist (California State Department of Education, 1996).

*Linking nutrition and occupational therapy.*

The rationale to blend nutrition with fine motor/hand writing development came from numerous discussions with Linda Prescott, a nutritionist for the local County Office of Education. It is difficult for teachers to include nutrition education and fine motor development in the classroom due to time constraints. As a result of content standard demands, children are asked to write at an earlier age when motor performance may be inadequate. The lack of funding available for children with motor deficits (occupational therapy not being sought out for students who may be struggling), and a possible lack of knowledge of what occupational therapy can provide for these students led to the decision to combine both our specialties. Currently, grant funding is available for nutrition education for students. Nutrition activities can be incorporated in a creative manner to include a strong fine motor component. These activities could be provided at no additional cost to teachers or school districts. Teachers may be inclined to utilize these activities if the opportunity to enhance both eating habits and fine motor skills was presented. The module idea was envisioned to be a preventative/school readiness package or remediation tool.

*Informal needs assessment: Survey of teachers  
in a northern county.*

To test the need for, interest in, and usefulness of this project idea, I conducted a needs assessment. A two part survey was developed focusing on occupational therapy and children's fine motor/handwriting difficulties as well as nutrition education. I developed the survey with nutritionist Linda Prescott with each of us developing questions related to our own areas of expertise. We formulated two questions that

pertained to teacher interest in activities that combined both nutrition and fine motor activities. A total of 48 elementary school teachers completed the survey, and the resulting data were striking. Of the 48 participants, 56% reported that they had more than six students in their classrooms who struggled with fine motor/handwriting skills. Only 8% of these teachers reported 1 to 2 students with difficulties while 26% reported 3 to 6 students struggling with fine motor/handwriting difficulties. In addition, 63% of these teachers noted an increase in fine motor/handwriting problems in their students with the increased rigor of California Content Standards. The number of students reported by participants to be struggling with fine motor handwriting was far greater than I expected. Review of literature revealed only 2 students per classroom with fine motor/handwriting difficulties (McHale & Cermack, 1992)

I also developed survey questions that investigated the frequency in which teachers refer students for an occupational therapy evaluation. Of the 48 teacher participants surveyed, only 10% reported that they sought occupational therapy intervention on a frequent basis for their students. This was the case despite 100% of the teacher respondents acknowledging that handwriting/fine motor difficulties significantly hindered the academic success of their students. The majority of respondents (61%) reported that occupational therapy intervention or assistance was never sought for these students. One respondent wrote on her survey that it had “never occurred to her” to seek an occupational therapy evaluation. This coincides with research by Szabo (2000, p. 26) who states, “Misconceptions exist about what services therapists can provide in a school environment.” She also points out that “educationally relevant services may be different

from services provided under a more traditional model,” which can further lead to misunderstandings about the role of occupational therapy (Szabo, 2000, p. 26). Current employment of occupational therapists in rural northern California does not match employment in other counties/schools throughout the United States. Occupational therapists working in the educational setting account for the majority of the jobs held by therapists in the United States (The American Occupational Therapy Association, Inc., 1999). Children in this rural area are not getting the benefit of occupational therapists’ expertise. The design of a teacher training module that acquaints teachers to occupational therapy and provides children with access to activities designed by an occupational therapist could be beneficial for students in this area.

Information obtained about teacher interest in a combined nutrition and fine motor professional development program was positive. The majority of respondents (93%) reported they would be interested in professional development on nutrition education that incorporated fine motor/pre-writing development. All 48 respondents (100%) stated that they would be interested in professional development for student intervention techniques for fine motor/handwriting difficulties.

#### *Vegetable Play Lesson Plan*

The vegetable play activities were selected with careful consideration of the previous literature review findings, content standards for kindergarten, and the ability to access and prepare these items with ease and cost effectiveness. Activities that encouraged and possibly enhanced playful behaviors in children were chosen (Kielhofner & Vandenberg, 1982). Developmentally appropriate activities were also integral to the

selection process. Four vegetables were chosen to be utilized in the lesson plans: peas, carrots, spinach and jicama. Two activities were developed for each vegetable. Refer to the content section for the PowerPoint presentation of the activities and pictures of tools and materials utilized.

The vegetable lesson plans are designed to help students develop a dynamic tripod pencil grip, in-hand manipulation, and scissor skills. The activities also strengthen the thumb, hand and wrist; encourage arching of the hand; and aim to help children establish hand dominance. Chopsticks are incorporated into the vegetable play activities to enhance tripod grip acquisition. Tool experimentation through creative play is thought to be linked to developing the foundation of hand function in children (DeGangi, Wietlisbach, Goodin & Scheiner, 1993).

Linda Prescott and I completed a pilot of all of the activities during my work as an occupational therapist. I had two students with whom I normally work with complete the activities. Linda and I also met for a total of approximately 25 hours to discuss the activities and modify the tools and materials used. The tools that we utilized were customized to increase the ease of use for the children. In addition, we chose to use fresh vegetables versus frozen or canned vegetables as student success with the fresh vegetables was improved. Also, the activities were changed in several instances to improve peer interaction, attention, and participation among the children.

*Peas Lesson Plan.*

*Activity # 1*

The first activity in the lesson plan is introduced by reading the children's book *Little Pea*. After the story is read, the teacher will ask the children questions about peas to stimulate discussion and children interaction. A vegetable photo card of a pea pod will be shown to the students, and the teacher will point out the characteristics of the pod and the vine. Fresh pea pods will then be introduced to the children for touching and comparison of size. The teacher will hold up a large pea pod and a small pea pod and ask the children if they think each pod has the same number of peas inside. Following the reading of the story and discussion about the peas, the teacher will introduce the chopsticks to the students. Correct finger and wrist placement will be emphasized and demonstrated to the children. The teacher will open up the large pea pod and demonstrate how to remove a pea from the pod using the chopsticks. Next, the teacher will hold the large pea pod, and each child will take turns removing a pea from the pod and placing them on a felt square as everyone counts the number of peas that are removed. The process will be repeated with the smaller pea pod. When all the peas have been counted and laid out on the felt the teacher will ask the children questions comparing the number of peas in each pod.

*Activity # 2*

The teacher will hold up several pea pods for the students to see. The teacher will invite discussion about the pea pod, number of peas inside the pod, and demonstrate how to remove peas from the pod using chopsticks. Correct use of the chopsticks by the students will be emphasized and monitored by the teacher. Students will be instructed to

pair up with each other and will use chopsticks to remove peas from the pod. One student will hold the pea pod while the other student will remove the peas with the chopsticks. The teacher will demonstrate to the children how to open a pea pod. Children will place the peas removed from the pod into a small cup. The children will then be instructed to switch roles and repeat the process with another pod. Once both pea pods have been opened and each child has a cup of peas, using their chopsticks the children will remove their peas from the cup one at a time and place them on a felt cloth. The teacher will then instruct each child to count the number of peas that they have and write the number on their sentence strip. Next, the children will be encouraged to eat the peas on the felt strip using their chopsticks. The teacher will then pose questions to the children regarding who had the fewest or most peas.

*Carrot Lesson Plan.*

*Activity # 1*

The teacher will hold up the book *Rabbit Food* for the students to see and share with them that the book is about a young rabbit who does not like to eat carrots. Next, the teacher will explain that the group will play a game called “feeding the rabbit.” Students will be instructed to pair up with one another. The teacher will then demonstrate to the students the correct way to use the tools for the game. The tools will be distributed to the student pairs; one child will be given chopsticks and the other the rabbit puppet. One child will hold the chopsticks and feed the puppet a carrot using the chopsticks. The teacher will demonstrate how this is done. The teacher will read the book to the students and instruct them to listen for the word “eat” as the book is read. Each time the word eat

is heard in the story the students with chopsticks will remove a carrot from the bowl on the table and feed it to the rabbit puppet. The children holding the rabbit puppet can pretend to be munching on the carrot by opening and closing the rabbit puppet's mouth. This process will be repeated each time the word eat is read in the storybook. When the book has been finished, the students will return the carrots to the bowls and will be encouraged to use chopsticks to eat the carrots.

#### *Activity # 2*

The teacher will play the song *Ten Crunchy Carrots* to the group of students. Next, the teacher will distribute paper, scissors, and a piece of crayon to each student. A small one inch piece of crayon is utilized to encourage a dynamic tripod grip and prevent an inefficient thumb adduction grip. The teacher will demonstrate to the students how to fold the paper in half and instruct the students to do this. Next, the teacher will instruct the students to cut the paper. The teacher will model the correct way to hold the piece of crayon and will demonstrate to the students how to trace their hand. Emphasis will be placed on teaching students the names of their fingers. Using one half of the paper the students will be told to trace their non-dominant hand with the piece of crayon. The teacher will instruct students to pair up and trace their partner's dominant hand on the second sheet of paper. After this is completed, students will each be presented with a small bowl of carrots. The teacher will demonstrate to the students how to hold carrots in their dominant hand and using in hand manipulation place carrots one at a time on the hand outline, one carrot for each finger. The teacher will name each finger as a carrot is placed on it. Students will be told to keep their other hand in their lap and try not to use it

to help their dominant hand. Once students have placed the ten carrots on their finger patterns, they will be instructed to use each hand one at a time to pick up the carrots and hide them in their hand. The teacher will demonstrate this for the students. The students will be cued to try to only use one hand to pick up the carrots. This will encourage in-hand manipulation skills. The teacher will carefully monitor the students as they complete the activity and correct students as needed. Once the students have “squirreled” all the carrots in each hand they will be told to place them in their bowl. Finally, students will be encouraged to eat the carrots that they have in their individual bowls.

*Jicama Lesson Plan.*

*Activity # 1*

The teacher will hold up a photo card of a whole jicama and encourage dialog among the children about jicama including how it grows and who has ever eaten it. Each child will be given a pair of chopsticks and a placemat. The teacher will place several large bowls of jicama sticks on the table and then will demonstrate to the children how to use the chopsticks to pick up the jicama sticks. Children will be instructed to use chopsticks to count out eight jicama sticks onto their place mat. Next, the teacher will demonstrate to the children how to use in hand manipulation to pick up the jicama. Children use in hand manipulation skills to shift sticks into their dominant hand (4) and (4) in their non dominant hand while the teacher monitors to make sure the correct technique is used. The teacher demonstrates to the students how to pass the jicama from hand to hand to enhance arching of the hand. Finally, the children will be encouraged to eat the jicama.

*Activity # 2*

The teacher will present to the students a photo card showing a whole jicama. Students will be encouraged to answer simple questions about the jicama. The teacher will demonstrate to the students how to hold the jicama stick like a pencil. The teacher will place a bowl of jicama sticks on the table, and the students will pick up one stick with their dominant hand and hold it like a pencil. The teacher will check in with the students to make sure that their grip is correct. Next, the teacher will demonstrate how to hold the jicama stick with the thumb and each finger one at a time and will encourage the students to do the same with their jicama stick. Students will put their jicama stick on their placemat. The teacher will distribute guacamole in small containers to each student and model to the students how to twirl the guacamole container with the fingertips of the dominant hand without the aid of their other hand. The children then will pick up their guacamole container and try to twirl it as demonstrated while the teacher monitors students for correct technique. Next, the teacher will demonstrate to the students how to hold the jicama stick like a pencil and encourage students to remove the lid on their guacamole cup and dip their sticks into the guacamole and eat. The teacher will encourage a dialog about the taste of the jicama and guacamole.

*Spinach Lesson Plan.**Activity # 1*

The first spinach activity will be introduced by reading to children the book *Growing Vegetable Soup* by Lois Elhert. To help increase knowledge and familiarity with the vegetables the teacher will facilitate a discussion about the different vegetables in the

book. Once the book is finished, the children will make a pretend vegetable soup using a large pot and felt vegetable pieces (spinach, carrot, tomato, bell pepper, eggplant, onion, pea pod). The teacher will introduce the chopsticks and models how to hold them correctly. Next, the teacher will demonstrate how to pick up one felt vegetable and pass it to the student on the left and the student will pass it to the child to her/his left and so on. The last child in the circle will place the felt vegetable in the soup pot. The process is repeated until all the felt vegetables are in the pretend soup pot. The teacher will monitor the students for correct use of the chopsticks. Finally, the soup pot will be passed from student to student, and they will use their chopsticks to stir the vegetables in the soup pot.

#### *Activity # 2*

The teacher will begin the activity by showing the students a photo of fresh spinach. The teacher will encourage a discussion about spinach by asking students questions. The teacher will pass out small cutting boards to each student and 4 to 5 large spinach leaves. The teacher will demonstrate to the students how to tear the spinach leaves in half. The teacher will instruct the students to tear their own spinach leaves using their index, thumb and middle fingers in a palmer pinch grip. Once the students have torn all their leaves in half, the teacher will demonstrate threading the spinach pieces onto a wooden skewer. The teacher will distribute a wooden skewer to each student and instructs them to thread the leaves onto the skewer. Next, the teacher will cue the students to pair up. One set of chopsticks and one bubble tong will be given to each pair of students. The teacher will demonstrate with a student how to hold the skewer with the non dominant hand and with the dominant hand use chopsticks to pull the spinach piece

off the skewer. The teacher will also demonstrate how to place the spinach piece with chopsticks into the partner's bubble tongs. The partner will hold the bubble tongs open, and the student will place the spinach pieces one at a time into the tongs. When the skewer is empty, the student with the tongs will empty them on the other student's cutting board. The students will be instructed to switch tools and repeat this process. The teacher will monitor students to make sure correct tool use is being utilized by all the students. When all the students have completed the activity, students will be encouraged to eat the spinach pieces on their cutting board.

*Pilot Presentation of the Training Module to Early Childhood Educators*

An abbreviated presentation of this training module was presented to a group of 21 early childhood educators. This included a Power Point presentation and modeling of the pea and jicama activity. The jicama activity was completed by the participants following the demonstration. A written surveys was presented to participants for feedback about the training module. A total of 16 surveys were returned, and results revealed that the educators were very interested in the knowledge and the activities. Several educators were especially interested in tripod grip acquisition and pre-writing development. In addition, participants requested handouts including pictures of the activities. The majority of the participants noted that the activities appeared to be easy to implement and that they were fun. Most importantly, the connection between nutrition and fine motor skills was found by participants to be very valuable.

The rationale for this project came about after careful consideration of the multiple dilemmas just discussed. This project utilized in-service/workshop training for rural northern California teachers to introduce them to occupational therapy and fine motor/handwriting interventions for student. The training module includes small group or whole classroom activities that teachers or teacher assistants are able to easily complete with children. Fine motor interventions are linked with nutrition education to enhance academics in two areas. In an era of cost containment, the blending of two specialties (nutrition and occupational therapy) can provide a new, creative contribution to schools. Ultimately, the goal of this project is to positively impact students' eating habits and handwriting/fine motor skill acquisition.

CHAPTER FOUR  
CONTENT

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## CHAPTER FIVE CONCLUSION

The goal of this project was to develop a cross curricular training module designed to introduce early childhood educators to handwriting/fine motor intervention strategies and activities. The training module includes a PowerPoint presentation, lesson plans, and supporting materials. One of the strengths of this training module is that it is the first program to integrate nutrition education with fine motor/handwriting interventions. This program's innovative linking of these two specialty areas may positively impact a teacher's ability to maximize curricular space and time.

The original plans were to pilot the training module in the Nutrition for Young Children course offered through the local County Office of Education. Unfortunately, this course was cancelled because of low enrollment. However, a short PowerPoint presentation from the training module and the jicama vegetable lesson plan was presented to early childhood educators during one of their monthly meetings. Feedback obtained from an anonymous evaluation form was very positive with the majority of participants wanting more information and clearly enthusiastic about the activities. Several participants expressed a need for more training in the area of fine motor/ pre-writing development.

The vegetable lesson plans were jointly piloted by myself and Linda Prescott, and modifications were made and effectiveness for students determined based on our observations, discussions and self critiquing. Overall, the activities engaged the students, all students were able to complete the activities with ease, and almost all students were

willing to try the vegetables during the play sessions. Students were eager to participate in the activities and appeared to enjoy learning about vegetables as well as experimenting with the new tools.

Ease of implementation was an important factor in the development of this project. Preparation time, cost, and clean up were essential factors in the selection of vegetable activities. In the one classroom in which Linda and I piloted the activities, the teacher was excited and very positive when listening to our description of the vegetable games that were utilized with her students. Also, Linda and I noted that the activities were easy to prepare, and clean up was quick and minimal. Feedback obtained about ease of implementation from the pilot to early childhood educators was also very positive.

#### *Limitations*

One limitation to this training module was a lack of parent involvement. This is important for nutrition as parents are responsible for mealtime at home which contributes greatly to eating patterns and behavioral changes. In addition, parent awareness and follow through in the area of fine motor skill development would also be helpful. This is an area that needs further development. Linda and I envision adding a parent education component to this module that could take the form of a newsletter and include parent instructions for completing these activities with their child at home. Also, providing reproducible handouts for teachers to give to parents as part of their training module would be advantageous. Nutritious recipes, fine motor development information, and home program activities may be very helpful. Also, a parent kit may help improve carry over of vegetable awareness and handwriting skills in the home environment. Tools used

by the teachers could be provided to the parents at a nominal cost. A list of children's books about vegetables and healthy eating could also be included in the parent kit.

#### *Implications for Further Research*

A next step for this project will be to pilot the complete training module with teachers and teacher aids, utilizing an anonymous course evaluation and focus groups. Feedback would be given regarding the activities that the teachers and aides participated in as part of the presentation, as well as thoughts on the other activities in the module. As the teachers will not have completed all the activities during the presentation, the information gathered on non-completed activities would only be speculative. The final step in the process will be to interview teachers after they have implemented all the lesson plans/activities in their classrooms with students.

The effectiveness of the lesson plans/activities for improving handwriting/fine motor skills and nutrition in students has yet to be determined. Conducting a pilot study comparing students who received these intervention activities on handwriting skills and nutrition habits to a control group could be useful. The information gathered could provide valuable insights as to the utility of the module. However, this was not in the scope of this project.

In the future, Linda and I plan to obtain grant funding to pilot these activities with more students. Information obtained for this project about the activities was gathered on kindergarten students only. Piloting the activities on pre-school children will be necessary to ascertain the appropriateness of the activities for this younger age group.

Designing more playful props (such as puppets that look like vegetables) and tools that are more child-friendly is a future component. The development of songs that are relative to vegetables and hand strengthening is envisioned to compliment the activities.

### *Conclusion*

This project was developed to improve teacher knowledge and awareness about both nutrition and fine motor/handwriting skill development for early elementary students. A training module was designed to provide teachers with simple activities they could complete with students that blended both these areas and thus possibly provided positive reinforcement for eating habits and handwriting acquisition in their students. Ultimately, our goal is to benefit early elementary students in both their knowledge of healthy eating habits and their fine motor skill development.

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