

SCHOOL-BASED TELEREHABILITATION IN OCCUPATIONAL THERAPY: USING TELEREHABILITATION TECHNOLOGIES TO PROMOTE IMPROVEMENTS IN STUDENT PERFORMANCE

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ABSTRACT

This article discusses the use of telerehabilitation technologies in occupational therapy for school-based practice. Telerehabilitation, for the purpose of this program, included the implementation of occupational therapy services via two-way interactive videoconferencing technology. The subjects included in this pilot program were children, ages 6 to 11 years, who attended an online charter school and had difficulties in the areas of fine motor and/or visual motor skills which impacted success with handwriting. Each participant completed a virtual evaluation and six 30-minute intervention sessions. The Print Tool™ Assessment was used to determine progress pre- and post-program. A learning coach/student satisfaction survey was given at the end of the program to determine participant satisfaction. Outcomes revealed improvements in handwriting performance for most students who participated in the program and high satisfaction rates reported by all participants.

Key terms: Telehealth, telerehabilitation, pediatrics, occupational therapy, school-based practice

INTRODUCTION

Providing individualized quality education services to students with special needs is an essential goal of every educational institution. Online charter schools have been instrumental in developing alternative high quality programming that is individually designed to match the needs of each student. While the provision of related services through virtual education can be challenging, it is important to students with special needs in the virtual education environment.

Families are increasingly choosing educational programming for their students that provide learning opportunities using Internet-based methods. Despite the ability to access teacher support on-line, all students with special needs must still have access to appropriate special education services, including related services of speech therapy, occupational therapy, and/or physical therapy. Unfortunately, it can be a difficult task for virtual schools to access sufficient numbers of related services personnel (Muller, 2009). Locating related service providers for students scattered over a large geographic area amplifies this challenge (Muller & Ahearn, 2004). Currently, there are speech therapy programs that offer school-based services via Internet-based methods; however, there are very few other documented programs that offer any form of occupational therapy services using

these methods for children who need special supports as detailed in an Individualized Education Program (IEP) and/or Individualized Family Service Plan (Cason, 2009; Gallagher, 2004; Heimerl & Rasch, 2009; OSPI, 2010).

Occupational therapy services often require manual handling or “hands-on” intervention and this hands-on approach can make occupational therapy services provided via Internet-based methods difficult to imagine. However, providing occupational therapy direct and consultation services using telerehabilitation technologies could be a potential solution to satisfy a need for occupational therapy services for some students with special needs enrolled in virtual online charter schools. Direct occupational therapy services in the public school environment, typically consisting of 20-30 minutes per week, do not always result in the most ideal or effective outcomes if there is limited follow-through in the classroom or home environments during other times of the week. The most successful outcomes are often seen as a result of occupational therapy consultation services, in which the therapist provides strategies and solutions to teachers, staff, parents, and caregivers to use at school and at home with the student. The consultation model is becoming an increasingly used model of intervention for occupational therapists in the schools and, although

there is some conflicting evidence, several studies reveal positive outcomes, including functional outcomes and teacher perceptions, with its use (Bayona et al., 2006; Casillas, 2010; Dreiling & Bundy, 2003; Dunn, 1990).

The American Occupational Therapy Association (AOTA) acknowledges the use of telerehabilitation technologies as a recognized and acceptable method of service delivery for many practitioners within the field of health care, particularly for individuals in rural areas where demands for services may exceed the services available (American Occupational Therapy Association [AOTA], 2010). AOTA recognizes the “significant need for occupational therapy practitioners to document, research, and publish on the effectiveness of evaluation, consultation, intervention, and follow-up services provided via telerehabilitation technologies and to determine how to best integrate telerehabilitation technology into various practice settings and home environments” (AOTA, 2010, p. 7). With the call from occupational therapy’s national organization, and the increased demand for and decreased supply of related services in school-based virtual settings, the exploration of virtual-based occupational therapy programs is timely.

As part of the initial phase of program development for the occupational therapy school-based telerehabilitation program that will be discussed in this article, several sources of literature were reviewed in an effort to synthesize existing information that would support its development. To date, intervention using telerehabilitation technologies has been successfully implemented with various impairments and pathologies. After completing a systematic review of 146 articles in the area of telerehabilitation from 1998 through 2008, Rogante, Grigioni, Cordella, and Giacomozzi (2010) identified various impairments that have been treated through the use of telerehabilitation including hip and knee replacements, daily-living impairments, cognitive impairments, mobility impairments, upper and lower extremity impairments, speech impairments, and ulcer-related impairments. Various pathologies have been addressed through telerehabilitation including, but not limited to, joint replacement, stroke, spinal cord injury, traumatic brain injury, walking inability, ulcers and wounds, multiple sclerosis, Parkinson’s disease, carpal tunnel, cerebral palsy, congenital neurological disorders, and paraplegia.

Kairy, Lehoux, Vincent, and Visintin (2009) completed a thorough literature review of 28 experimental and observational studies on telerehabilitation. Of 13 studies including a control group, eight of which involved randomization to comparison groups, none reported less efficacy for telerehabilitation when compared to in-person rehabilitation. Interestingly, six reported that telerehabilitation led to superior health outcomes when compared to in-person intervention. This literature review also stated that patients and therapists generally perceived that telerehabilitation was convenient and useful. It is important to note that many of the 28 studies,

including some that had control groups, had limitations of research design, including small sample size, lack of proper randomization, and subjective outcome measures which may have introduced the possibility of over-estimation of efficacy.

Although it is limited, there is evidence that the use of telerehabilitation technologies can be an effective method with the pediatric population. Cason (2009) examined the benefits of an early intervention telerehabilitation program and revealed that the families were highly satisfied with the telerehabilitation visits that supplemented their monthly traditional occupational therapy sessions. Heimerl and Rasch (2009) described a telerehabilitation program that has been successfully implemented by the University of New Mexico’s Center for Development and Disability with families of children ages birth through two years. Occupational, physical, and speech therapy, as well as psychology services were offered in the form of evaluation follow-up, direct intervention, and consultation for clients who had difficulty accessing the necessary health provider services. Gallagher (2004) described a federally funded program in Hawaii that allowed occupational therapy assistants to provide intervention for students in the school buildings under the remote supervision of occupational therapists.

At the time this program was being developed, only one other program was located that had implemented a direct intervention model of occupational therapy telerehabilitation in the public schools with individuals on Individualized Education Programs. The Office of the Superintendent of Public Instruction (OSPI) for the State of Washington piloted a program during the 2009-2010 school year which provided related services of speech and occupational therapy to students with disabilities in the public school system (OSPI, 2010). The outcomes of this program revealed that students made progress on their goals and objectives on IEPs using a virtual rehabilitation method.

THE SETTING

An occupational telerehabilitation program was developed for students that attended Connections Academy, an online charter school for school-aged (K-12) students. The school is a tuition-free and fully accredited public school that students attend from home or other locations outside of the traditional classroom. At the time of program implementation, Connections Academy was operating in 20 states throughout the United States. Specifically, participants that were included in this program were selected from Ohio, Michigan, and Indiana Connections Academy.

PARTICIPANTS

Students that participated in the occupational therapy telerehabilitation program ranged in age from six to eleven years old with grade levels of first through sixth grade. The students included in the program were identified with deficits in the areas of visual motor and/or fine motor skills that impacted performance with handwriting skills and required occupational therapy intervention as identified on an Individualized Education Program. The primary disabilities listed on the Individualized Education Program that qualified each child for special education included cognitive disability, specific learning disability, emotional impairment, autism spectrum disorder, and language impairment. Five males and three females participated in the program. Each student was very unique with different goals, interests, and motivations.

Although the students were the primary participants, the learning coaches were also an essential component of the telerehabilitation program. In the virtual education setting, the learning coach is responsible for directing and guiding the student to facilitate success with classroom assignments and responsibilities. The learning coach can be a parent or another individual identified by the parent. For all participating students, the learning coach was also the mother of the student.

The Print Tool™ (Olson & Knapton, 2008) appeared to be one that could be administered with the most ease in an online virtual setting. It was determined that the instructions could be given easily during online interaction and the web camera could be easily positioned for a full review of both the upper extremity and the assessment paper to gather the information required for the assessment. The Print Tool™ evaluates several aspects of handwriting, including memory, orientation, placement, size, start, sequence, and control.

Each student participated in six individual intervention sessions. During the intervention phase, eight students were seen individually in a virtual environment for approximately 30 minute sessions on a weekly basis. If a student missed a scheduled session, it was made up at another time during the week. Each student attended a total of six telerehabilitation sessions in addition to an evaluation and post-test session.

It was important that both the student and occupational therapist had access to essential supplies to make the sessions interactive, meaningful, and fun. For this reason, each student was sent an extensive tool kit that was aimed to facilitate improvements in fine motor development and handwriting. Table 1 lists the supplies included in the tool kits sent to students.

PROGRAM IMPLEMENTATION

Intervention implementation included one virtual evaluation, six intervention sessions, and a post-test session. The virtual evaluation was about an hour in length. The intervention sessions and post-test sessions each lasted approximately 30-40 minutes.

Informal observation of fine motor skills was completed with each student. A formal handwriting assessment was also completed as part of the evaluation process. Several published handwriting assessments were considered; however,

Table 1: Occupational Therapy Tool Kit

Materials	Potential Use
Handwriting Book	Assigned OT homework.
Slate Chalkboard, Chalk, and Sponges	Wet, Dry, Try Handwriting Without Tears method.
Handwriting Without Tears Notebook Paper	Facilitate improvements with letter size and placement.
Finger Spacer	Encourage appropriate spacing between words.
Therapy Putty	Handwriting warm up exercise, hand strengthening activity, and building and finger tracing letters and numbers.
Therapy Band	Handwriting warm up exercise and arm strengthening activity.
Tennis Buddy and Small Manipulatives	In-hand manipulation (when "feeding" tennis buddy), hand strengthening to help tennis buddy "chew" by opening and closing the mouth of the tennis ball/ handwriting warm up exercise.
Wikki Stix	Building and finger tracing letters and numbers.
Playdoh	Building and finger tracing letters and numbers.
"Just Right" Pressure Kit	Practice adjusting the pressure used when writing with a pencil (various materials included foil, carbon paper, paper towels, bubble wrap, and "just right" index card).
Pencil Grip	Encourage proper pencil grasp.
Pencils for Little Hands	Encourage proper pencil grasp for students with small hands.
Animal Tong & Pompom Balls	Practice using a tripod grasp in an alternative fun manner.
Handwriting Without Tears Stamp and See Screen	Practice building letters and numbers with magnetic lines and curves and trace letters and numbers with magnetic writing tool
Colored Sand	Practice tracing and drawing letters and numbers.

Scheduled “live” sessions via web camera included a variety of interactive activities that were client-centered and meaningful to the student. The use of a combination of intervention approaches has been found to be effective in improving handwriting performance (Peterson & Nelson, 2003); therefore, each session was comprised of a variety of approaches that included biomechanical, kinesthetic, or multisensory methods. The sessions were guided by individualized PowerPoint files which were uploaded into an Adobe Acrobat Connect live lesson room. A live video stream of the student and therapist was in the live lesson room and could be enlarged as needed for better viewing by the student or therapist. Whiteboard tools (e.g., interactive marker, pencil, arrow, eraser, stamp) were used for the student to click and select desired activities, as well as to draw on screen to complete interactive games and other activities (e.g., mazes, connect the dots, drawing, writing). Additional activities that were involved in each session included fine motor enhancement activities, handwriting and seatwork warm-up activities, and subsequent handwriting instruction.

Fine motor enhancement activities were explained and/or demonstrated by the occupational therapist via web camera and were selected on an individualized basis as per the specific needs of the student. These activities included the use of fine motor manipulatives to complete tasks such as finding treasures in therapy putty, feeding “tennis buddy,” and playing frog jump races using finger isolation to make plastic frogs bounce across the table. Handwriting and seatwork warm-up activities included fine motor strengthening, upper extremity stretching, and/or gross motor activities that prepared the student for seat work. Sample activities included “boxing” or “archery” using therapy band, treasure find using therapy putty, and brain gym exercises. Monitored handwriting instruction included implementing methods described in the Handwriting Without Tears program based upon the specific needs of the student (Olsen & Knapp, 2008). Multisensory Handwriting Without Tears suggested methods were used to reinforce learning including use of the Stamp-and-See Screen, as well as the Wet-Dry-Try Method using sponges, chalk, and chalkboard. Multisensory handwriting practice using other manipulatives was also emphasized. For example, the student built and traced letters using manipulatives such as Wikki Stix, Playdoh, or therapy putty. The whiteboard tools on the PowerPoint screen were also utilized to trace or draw colorful letters as additional strategies to aid with motor memory for letter formation. Other kinesthetic strategies included air writing and palm writing with eyes open and closed, as well as the Handwriting Without Tears methods of imaginary writing and Letter Size and Place word building using hands. Visual charts and/or checklists were also used to encourage the students to evaluate their written work.

Consultation with the learning coaches regarding strategies to use at home to enhance fine motor and

handwriting skills was an important part of each session. Consultation during the first session included any recommendations for environmental modifications based upon parent report and clinical observations in the evaluation. For example, use of a pencil grip, modified paper style or a change in paper position (e.g., slant of paper on desk, use of easel) were recommended for some students. In the initial session, as well as subsequent sessions, consultation occurred throughout the session as the learning coach observed and asked questions. There was a scheduled time at the end of each session devoted to offering suggestions to the learning coach and answering any questions.

Learning coaches were asked to follow-up and implement the suggestions offered by the occupational therapist throughout the week. In order to enhance the content of the live session each week, learning coaches were asked to assist students with assigned OT homework given weekly. Although there were handwriting worksheets assigned to practice each week, the bulk of the homework was designed to provide meaningful and fun interaction between the learning coach and student, while simultaneously working on the handwriting skills learned each week.

RESULTS

Assessment for the pilot program took place at the conclusion of six live sessions with the student and learning coaches. The Print Tool™ was readministered with each student. Additionally, the learning coach and student completed a satisfaction questionnaire that was created to determine the level of success of the program based upon client perception.

HANDWRITING PERFORMANCE

Quantitative results for handwriting performance were obtained using The Print Tool™ which was administered to each student prior to the intervention sessions and again following the six intervention sessions. Scores are presented in a percentage format revealing the percentage correct for each component of the assessment; therefore, a score of 100 would be the maximum possible score. Figure 1 illustrates the improvements that were made by each student for the total overall assessment score in which all upper case, lowercase, and number scores, including memory, orientation, placement, size, and control, were combined to reveal an overall improvement score for the printing assessment. Although three out of eight students who were assessed on The Print Tool™ received scores that remained relatively unchanged (within two percent for pre- and post- assessment), five out of eight students had scores that were at least a 5% increase from pre- to

post-test. The average percentage increase was greater than 6% for students overall; however, three out of eight students had post-test scores that were 11% or greater improvement.

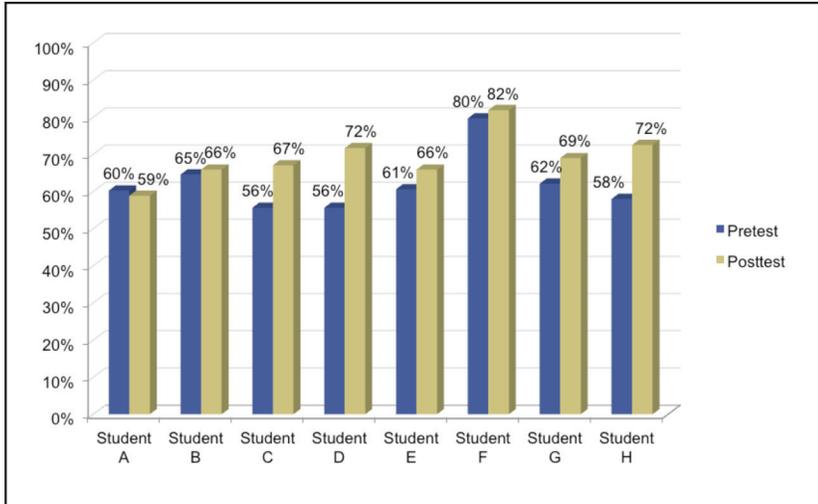


Figure 1: Pre- and Post- The Print Tool™ Overall Percentage Scores

In order to further analyze the results of the intervention process in regard to handwriting performance, student subtest scores were combined and averaged in an effort to get a sense of the overall improvements made with all the students in aggregate. For example, each student’s memory scores were added together and divided by the total possible points from all students to get an average memory score for all of the students combined. Figure 2 provides a visual picture of overall improvements that were made by the students as a whole.

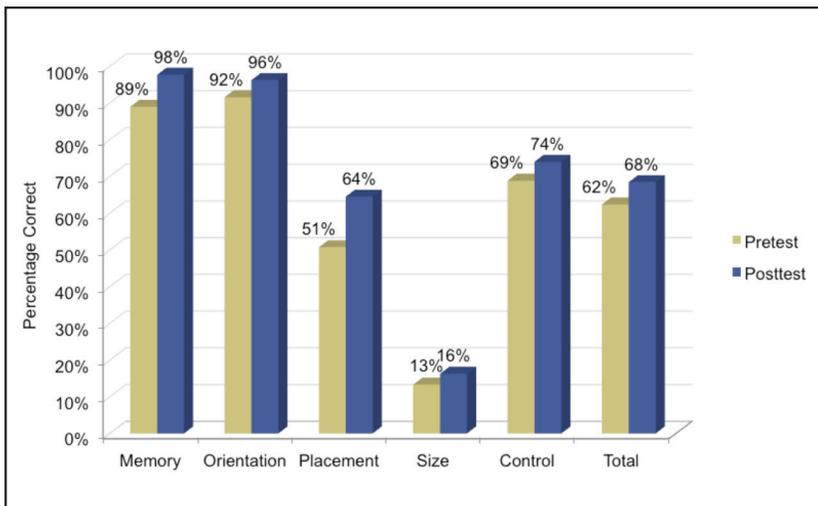


Figure 2: Aggregate Comparison of Pre- and Post- Printing Assessment

The outcomes of this program complement the existing literature that reveals that the use of telerehabilitation technologies can be therapeutically effective. Specifically for this program, students showed improvements in the occupation of handwriting after the implementation of only six sessions that emphasized kinesthetic, multisensory, and biomechanical approaches during occupational therapy intervention. Figure 2 reveals that there were score increases for all handwriting components assessed following the six week intervention. The most significant improvements appeared to be in the areas of memory and letter placement; however, there also appeared to be positive effects of the intervention in the area of orientation as several students showed decreases in the number of reversals.

Although, in most cases, there were component score increases for each student, there were some component scores that actually decreased at the post-test. It is important to note that two students, specifically students A and C, were noticeably frustrated and did not appear motivated to do their best on the post-test as noted by their facial expression and verbal comments. Therefore, the scores that these students received may not be a good indication of their true abilities. This may be attributed to the fact that the students, who were two of the youngest students, had become accustomed to doing “fun” things during occupational therapy sessions and were anticipating that those “fun” activities would be part of the session designated for the post-test as well. Decreased effort by these students may have had an impact on the overall The Print Tool™ percentage scores of the group as a whole.

PARTICIPANT SATISFACTION

In addition to evaluating handwriting performance, an evaluation of student and learning coach perspectives was important in determining the overall success of the program. To gather information about the virtual intervention process from the client’s perspective, a satisfaction measure was created for use at the end of six weeks of intervention. The satisfaction survey addressed several aspects of the telerehabilitation process, including measures of quality and preferences, improvements over time, benefits and challenges of the process, and suggestions. The learning coach and the student completed different sections of the survey. In addition to open-ended questions, a Likert scale was developed for both learning coach and

student sections, with visual figures added to the student Likert scale to facilitate student understanding of the rating scale.

Results of the survey's Likert scales, summarized by averaging all the participant scores, are

presented in Table 2 for the learning coach's perspective and Table 3 for the student's perspective. It is important to note that a score of 5 revealed the participant's strong agreement with the statement listed; whereas, a score of 1 revealed strong disagreement with the statement.

Table 3: Student Satisfaction Levels – Mean Scores

Questions for the Student (N=9)	Mean Score
1. I had fun during occupational therapy sessions.	4.44
2. I think I can do a good job remembering to do the things that I have learned in occupational therapy.	4.22
3. I am happy that occupational therapy was on the Internet!	4.22
4. I learned new things in occupational therapy that can help me in school.	4.33

Note. The rating scale identified for the student was presented with a visual Likert scale that resembled different emotions on drawn face. Scores of 5 = Big smile; 4 = Smile; 3 = Straight face; 2 = Frown; 1 = Half happy/Half frown to indicate "I'm not sure."

Table 2: Learning Coach Satisfaction Levels- Mean Scores

Questions for the Learning Coach (N=8)	Mean Score
1. I was able to navigate the Live Lesson room with my student with ease during occupational therapy sessions.	4.88
2. The sound quality during the virtual sessions was good.	4.75
3. The video quality during the virtual sessions was good.	4.75
4. I am satisfied with the overall quality of Virtual OT services that were offered to my student weekly.	5.00
5. I am happy with the level of consultation and suggestions that I received from the occupational therapist to help my student advance with his/her IEP goals.	5.00
6. I feel confident that I have the ability to implement the suggestions that the occupational therapist offered during the intervention process.	4.75
7. I have noticed improvements in my student's school performance related to his/her IEP goals as a result of occupational therapy services.	4.75
8. I am satisfied with the variety of strategies used by the occupational therapist with my student during sessions.	5.00
9. I am happy that occupational therapy services are offered in an online virtual format.	4.75
10. I would prefer that occupational therapy services take place in a clinic instead of virtually.	1.75

Note. The rating scale identified for the learning coach is as follows: 5 = strongly agree; 4 = agree; 3 = neutral; 2 = disagree; 1 = strongly disagree.

Based upon the Likert Scale, multiple choice questions, and open-ended responses on the survey, it appeared as if the learning coaches and students were highly satisfied with the occupational therapy telerehabilitation program. Existing telerehabilitation literature suggests that clients typically embrace the opportunity to receive services via telerehabilitation and are generally satisfied with the outcomes (Crutchely & Campbell, 2010; Kairy et al., 2009; Lai, Woo, Hui, & Chan, 2004; Russell, Buttrum, Wootton, & Jull, 2010; Wu & Keyes, 2006). The learning coaches and students involved in this program were no exception as they revealed 100% satisfaction with the overall quality of the program. Eighty-six percent of respondents also noted that they observed improvements in the students' school performance related to the IEP goals as a result of occupational therapy services. Interestingly, 71% disagreed with the statement, "I would prefer that occupational therapy services take place in a clinic instead of virtually." The remaining respondents reported neutral feelings to this statement. In fact, 86% of the learning coaches (all but one who checked the neutral response) revealed that they were happy that the services were provided in an online format. One parent, who rated this question as neutral, clarified her stance in the survey. She expressed that she did not see any disadvantages to providing occupational therapy services in a virtual format and did not truly have a preference between in-person and virtual methods. She also revealed that the developed program was far more than she expected it would be.

LIMITATIONS

Although the overall results for handwriting performance and satisfaction levels were promising, there were some limitations that may have influenced the outcomes of this particular program assessment. First, the program implementation was very short at only six weeks. For many students, more than six sessions may be necessary for significant improvement to occur. Additionally, the small sample size (eight students) for the pilot program may have an impact on the interpretation of the change in student handwriting assessment scores. With a small sample size, the percentage change from pre- to post-test may need to be much greater to reveal significant results.

RECOMMENDATIONS FOR PRACTICE

This program has the potential to be expanded in numerous ways, specifically in the school-based practice setting. This particular program focused on occupational therapy intervention for students with deficits in the area of fine motor or visual motor skills that affected handwriting performance. Telerehabilitation intervention could certainly be expanded to include other areas of occupation in addition to handwriting performance. Certainly, students who have deficits in the areas of fine motor and visual motor difficulties have challenges in other areas that are important for success in school. In addition to working with students to facilitate improvements in the handwriting process, consultation and direct service might include strategies to facilitate improvements for several areas of performance skills (e.g., posture, coordination, strength, coping and behavior regulation), performance patterns (e.g., habits, routines, roles), and client factors (e.g., sensory, motor, and movement functions) (American Occupational Therapy Association, 2008). Other specific areas of occupation important for success in school might be addressed including areas such as keyboarding and self-help skills that are essential for success in school.

Alternatively, the occupational therapist could serve as a consultant for students who experience challenges independently accessing tools in the learning environment. For example, when a student in the virtual education setting has difficulty independently using the keyboard or computer mouse effectively because of fine motor difficulties, the occupational therapist could assist the caregiver or teacher with changing the Ease of Access settings in the student's computer control panel. The occupational therapist may discuss options such as enabling the ClickLock function so the student can highlight or drag items without holding down the mouse button, or slowing down the keyboard repeat rates so the computer will ignore any accidental repeated keystrokes made by a student with poor fine motor control.

Although the information gathered from this program provides some initial documentation that telerehabilitation in school-based practice has the potential to be an effective intervention approach, future research is required to validate its use in the school environment. Suggestions for future research include survey research to examine satisfaction levels of caregivers, teachers, and/or students for telerehabilitation intervention in the school-based environment, randomized controlled trial research to compare the effectiveness of in-person intervention and telerehabilitation intervention in school practice, and comparative studies that examine existing data regarding student progress on IEP goals for students receiving in-person intervention and those who received telerehabilitation intervention. A meta-analysis is also needed that updates the literature, and weighs studies objectively in terms of quality, so that a single overall effect size of telerehabilitation can be computed.

ACKNOWLEDGEMENT

This work was supported in part by the author's private practice, Community Therapy Services, LLC, as well as Connections Academy, Baltimore, MD. The research contained therein was conducted in partial fulfillment of the requirements for the Occupational Therapy Doctoral (OTD) degree, Chatham University, Pittsburgh, PA.

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