

A Field Study of Telepractice for School Intervention Using the ASHA NOMS K-12 Database

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Abstract

The purpose of this article is to describe the characteristics and effectiveness of a telepractice speech-language therapy program for school-age children. Outcome data related to the caseload, type and amount of intervention, and student progress from a school-based telepractice therapy program were compared with the K-12 Schools National Outcomes Measurement System (NOMS) of the American Speech-Language-Hearing Association. NOMS provides data for students receiving intervention through direct, in-person service delivery models. The findings suggest many similarities between the characteristics of the telepractice and direct, in-person service delivery models. The telepractice service delivery model was effective for most students included in the study. Results of this study support the described telepractice service delivery model as a viable option for speech-language therapy services delivered to public school students with communication impairments. Limitations of this study are discussed with guidance provided for future research studies exploring the efficacy of speech-language therapy delivered via telepractice.

Keywords

elementary school age, middle school age, evidence-based practices, applied research, service delivery, speech-language pathology, technology

Technological advancements have led to the use of telepractice to provide speech-language services. “Telepractice is the application of telecommunications technology for delivery of professional services at a distance by linking clinician to client, or clinician to clinician, for assessment, intervention, and/or consultation” (American Speech-Language-Hearing Association [ASHA], 2005). Many disciplines within health care utilize telepractice to deliver services, and a variety of terms have been used to describe this service delivery model (e.g., telerehabilitation and telehealth). As usage has increased, acceptance of the service delivery model has grown, as it enables speech-language pathologists (SLPs) to collaborate with other professionals from great distances and provide services to under-served geographical areas. Early studies (ASHA, 2005; Forducey, 2006; Houn & Trottier, 2006; Juenger, 2009; Polovoy, 2008) have also demonstrated that this type of service may improve student learning. Theodoros (2008) suggested that telepractice has the potential to optimize functional outcomes by facilitating generalization of treatment gains and by enabling SLPs to monitor communication and swallowing behaviors. During the past decade, a growing database has supported the efficacy of telepractice services with pediatric and school-age children. Examples include the use

of telepractice to deliver services to preschoolers who stutter (Lewis, Packman, Onslow, Simpson, & Jones, 2008; Wilson, Onslow, & Lincoln, 2004), as well as to school-age children who stutter (Sicotte, Lehoux, Fortier-Blanc, & Leblanc, 2003).

Initial exploration of the use of telepractice to assess children with speech and language delays and disorders has also been conducted. M. C. Waite, Cahill, Theodoros, Busuttin, and Russell (2006) found high levels of agreement between assessments of children with speech sound disorders made by SLPs on-site and those made by SLPs using telepractice. These levels of agreement were consistent across measures of speech intelligibility, single word articulation, and oral motor tasks. In a related study, M. Waite,

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Theodoros, Russell, and Cahill (2009) investigated whether subtests of the fourth edition of the *Clinical Evaluation of Language Fundamentals* (CELF-4; Semel, Wiig, & Secord, 2003) could be administered successfully using telepractice. For this study, typically developing children aged 5 to 9 years with suspected language impairment were assessed by clinicians through telepractice using four subtests of the CELF-4. The researchers concluded that the use of telepractice to present the CELF-4 was a valid method of administering the subtests. In a follow-up study, M. C. Waite, Theodoros, Russell, and Cahill (2010) also found that assessment of children aged 5 to 9 years with identified language impairment using the CELF-4 was effectively conducted via telepractice.

A few Phase I treatment studies have explored the use of telepractice as a service delivery model for children in public school systems. Phase I studies are generally considered to be preliminary research, often lacking a control group, random assignment, and other types of constraints. The goals of these types of studies are to explore issues related to the feasibility of a therapy program, to identify problems related to treatment design, and to gather preliminary data to support a Phase II treatment study. Grogan-Johnson, Alvares, Rowan, and Creaghead (2010) explored the feasibility and outcome of interventions using telepractice in rural public schools in Ohio for students with articulation, language, and/or fluency disorders. Thirty-four participants received speech-language intervention through a telepractice service delivery model and a direct side-by-side model in which the students received small-group intervention conducted by an SLP. In this study, 17 children were randomly assigned to receive telepractice intervention for 4 months and then side-by-side intervention for 4 months, while the remaining 17 children received side-by-side intervention first, followed by 4 months of telepractice intervention. Change in performance was measured by progress-monitoring tools, including standardized assessments, data collection and quarterly progress reports, which are typically utilized in the public school setting. Results indicated that students made progress in both service delivery models and that the gains were similar regardless of the model used. In a follow-up study (Grogan-Johnson et al., 2011), 13 school-age students received speech sound intervention using computer-based speech sound intervention materials provided through either telepractice or a direct, in-person intervention service delivery model. Improvement was measured by results on standardized assessments, data collection, and progress made toward achieving intervention goals on students' Individual Education Programs (IEPs). These are typical methods of progress monitoring utilized in the public schools. Students in both service delivery models made significant improvements in speech sound production, suggesting that telepractice may be an effective service delivery model for use with public school-age students with speech sound disorders.

These published results report generally positive outcomes from using telepractice for the provision of assessment and intervention services to school-age children. However, telepractice is a relatively new service delivery model for school-based speech-language pathology. In addition to a lack of empirical evidence (Hill & Theodoros, 2002), there is not sufficient published information regarding the nature, scope, and description of this methodology. The purpose of the present study was to compare descriptive and outcome data from a sample of school-age students receiving speech-language intervention by telepractice with direct, in-person service delivery model data available from the ASHA K-12 Schools National Outcomes Measurement System (NOMS; ASHA, 2003).

The NOMS is a voluntary data collection system. SLPs can register their school system to participate and in exchange for participation can compare data from their school district against the national data contained in the system. The NOMS database reports descriptive information on students receiving speech-language intervention as well as measurements of student progress during a documented intervention period through the use of Functional Communication Measures (FCMs). FCMs quantify changes in functional communication and swallowing over time instead of measuring specific goals of treatment or the specific outcomes of therapy techniques (Jacoby, Lee, Kummer, Levin, & Creaghead, 2002; Mullen & Schooling, 2010). An FCM is a disorder-specific, seven-point rating scale designed to describe change in 12 functional communication areas:

1. speech sound production,
2. spoken language comprehension,
3. spoken language production,
4. intelligibility,
5. fluency,
6. pragmatics,
7. voice,
8. written composition,
9. emergent literacy,
10. reading comprehension,
11. word recognition, and
12. writing accuracy (ASHA, 2003).

A certified SLP selects FCMs based on a child's IEP and scores the student on the selected FCMs at the beginning, and again at the end, of the documented intervention period. In addition to scoring the FCMs, the SLP also provides descriptive client characteristics (e.g., age, grade, frequency, and amount of intervention; ASHA, 2003). An example of an FCM is provided in the appendix.

The NOMS has not been identified as an outcome measurement tool for speech-language therapy services delivered by telepractice. The NOMS database could be a useful measure for comparing school-age students with

communication impairments who receive services through telepractice with students who receive speech-language intervention services through a direct, in-person service delivery model. Use of the NOMS database would permit direct comparison of the descriptive caseload characteristics, and the results of intervention provided by the two service delivery models. It was hypothesized, (a) that there would be similar caseload characteristics for both service delivery models and (b) that children in the telepractice program would make positive changes in their assigned NOMS FCMs and that these changes would be similar to changes made by children who received services in a direct, in-person service delivery model.

Method

Participants

Students were identified for this study from a larger school-age telepractice pilot project of approximately 200 students being conducted in three Ohio public school districts by researchers from Bowling Green State University (BGSU) and Kent State University (KSU). The ASHA K-12 NOMS database permitted entering data for school-age students in kindergarten through Grade 12 who were identified under the Individuals With Disabilities Education Improvement Act of 2004 (IDEA, 2004) as having either a speech or language impairment or a specific learning disability (SLD) with a co-occurring speech and/or language impairment, and who were currently receiving speech-language intervention services. Students who received speech and language intervention services but were identified under other IDEA 2004 categories (e.g., autism, cognitive impairment, cerebral palsy, cleft lip/palate, neurological impairment) were not selected as they did not meet the established criteria of the NOMS database (ASHA, 2003). Based on these entrance requirements, 71 students (aged 5–15 years) participated in the project. Also, the participants did not exhibit significant hearing or vision loss and English was their primary language. These students represented 30% to 50% of the children from each district's caseload, with caseload size ranging from 50 to 75 students. The students' parents gave written consent to participate in this project and, in addition, each student agreed to participate which was a requirement of the Institutional Review Boards of BGSU and KSU in approving this project.

Procedure

Speech-language pathologists. Three SLPs provided speech-language intervention services to the participants using a telepractice service delivery model. Two of the SLPs held master's degrees and one held a PhD in speech-language pathology. All the SLPs held the ASHA Certificate of Clinical Competence (CCC), had at least 10 years of experience

providing intervention for children with communication impairment, and at least 3 years of experience providing speech-language intervention in the public school setting. Two of the SLPs were employed and located at KSU; the third SLP was employed and located at BGSU. Intervention was provided based on each individual student's IEP. As a result, intervention goals, objectives, and procedures differed among the participants, as did the number and length of intervention sessions.

ASHA K-12 schools NOMS data collection. The NOMS system was utilized to record student descriptive data and to report progress. The NOMS database contains descriptive information for more than 14,000 school-age children (Mullen & Schooling, 2010) and permits the user to compare the results of students receiving services in a specific district with those of all the students in the national database (Mullen & Schooling, 2010). The data contained in the NOMS system were collected from SLPs using a direct, in-person service delivery model. To utilize the database, the authors requested a special enrollment in the system so that the students from the present study, who were receiving services through telepractice, would be considered a unique school district. This exception allowed direct comparison between the students in the telepractice service delivery model with the students in the national database.

To use the NOMS database, SLPs must hold at least a master's degree in speech-language pathology, have the ASHA CCC, and pass a rater reliability test. All of the SLPs providing direct intervention—as well as the principal investigators—completed the self-guided practice and passed the user reliability test for the NOMS. Students were then entered into the NOMS system based on the specific instructions provided by the system (ASHA, 2003). Typically, students enrolled in the system have an initial FCM assigned at the start of the school year and a final FCM assigned at the annual IEP review date. Following this IEP review, the student is reentered into the system and the final FCM reported at the annual review date becomes the new "initial" FCM for the next reporting period. However, the current study was designed to last for only one academic year, so FCMs were assigned at the beginning of the school year and then again at the end of the same academic school year, per the NOMS data system. For many, but not all, of the students in the current project, this date coincided with their annual IEP review date.

Each of the 12 FCM scales identified previously is measured on a 7-point rating scale ranging from 1 (*nonfunctional*) to 7 (*normal functioning*; see appendix). It is important to note that the FCMs relate to overall functional communication skills rather than progress toward any one specific goal (Mullen & Schooling, 2010). A gain of one number (e.g., moving from a rating of 3 to a rating of 4 on the speech intelligibility FCM) suggests a significant functional change in communication skills. It should also be

noted that some students were seen for speech services only, others for language services only, and still others for a combination of speech and language services. Multiple FCMs were completed for students receiving services for multiple speech and language goals.

In addition to the FCM scores reported for the participants, improvement in communicative functioning was also reported through quarterly progress reports and annual reviews of IEPs. These data are not reported here because each school district used different methodologies in establishing goals for students, and as a result, the quarterly progress reports and annual IEP reviews were not consistent among the SLPs, each of whom worked with a different school district.

Telepractice Assistants

The participants in the study received speech-language therapy services through live, interactive videoconferencing delivered over the Internet using desktop computers. To assist with the service delivery, each school employed a staff member who met the district's requirements for an instructional aide. This individual was present during all therapy sessions to troubleshoot any equipment or technology malfunctions, provide an adult presence in the therapy room, and escort the students to and from therapy sessions. The telepractice assistant did not participate in the therapy session or in any way provide intervention services. Each telepractice assistant was trained by one of the authors on the use of the software and equipment, responsibilities related to scheduling, and all guidelines related to confidentiality.

Equipment

Identical equipment was used at the three school districts: a Dell Inspiron XPS 410 desktop computer with the Microsoft Windows XP operating system, a 19" widescreen flat panel display, a Logitech Quick Cam Orbit MP Color Web Camera with built-in microphone, and a student headset. To allow the telepractice assistant to listen to the sessions, an additional headset and an audio splitter were available. The equipment at KSU and BGSU included a Dell Optiplex 755 desktop computer with the Windows XP operating system, a 22" flat panel display, and a Logitech Quick Cam Orbit MP Color Web camera with built-in microphone and accompanying headset.

The Internet connection between the universities and the school districts was facilitated through each university's networks and the Optical Connection-3 to the Ohio Academic Resources Network (OARnet) to reach the T1 connection at each K-12 school. The OARnet is a technology infrastructure that provides support and services to all academic institutions in Ohio, including higher education and K-12 schools. Student privacy was maintained through

128-bit Advanced Encryption Standard (AES) Internet signal encryption, which meets Federal Information Processing Standards (FIPS) and is Health Information Portability and Accessibility Act (HIPAA) compliant. In addition to ensuring the privacy of the students' educational performance, the connection and equipment allowed for consistent access to therapy, with fewer than 2% of sessions cancelled due to difficulties with Internet connection.

The videoconferencing software used for all therapy services was Polycom PVX (8.0.2). This software was downloaded on each computer at universities and all three schools. It allowed for direct computer-to-computer communication. As with the infrastructure, the student's privacy was protected by a 128-bit AES Internet signal encryption. The software allowed for clear audio and video communication between therapists and students. In addition, the software allowed the therapist to share applications from the university computer with the student's computer, which permitted a variety of activities to be completed collaboratively. For example, the student and SLP could jointly complete an Internet-based game or write and illustrate using an onscreen white board.

Results

Demographics

A summary report comparing the results obtained by the 71 participants in the telepractice service delivery model with the 5,332 students nationwide enrolled for that academic year in the direct, in-person delivery model was provided by the NOMS administrators at the end of the school year. The first analysis compared the telepractice caseload with the NOMS database, focusing on similarities and differences between the two samples on the features of gender, grade level, eligibility for special education services, amount of previous therapy, and types of communication impairment.

Table 1 contains the demographic information related to gender, grade level, and eligibility for special education services. For the telepractice students, 45 (63.4%) were male and 26 (36.6%) were female. These percentages were similar to those of the NOMS database, where 67% of the students were male and 33% were female. Grade levels were also reported for each student. There was similarity across the two sets of students; however, most of the telepractice sample was represented in the earlier elementary grades, with only two students in junior or senior high school, as two of the three schools in the study offered telepractice service delivery to elementary school students only. Review of the eligibility categories revealed that a higher percentage of students were identified as having a SLD in the telepractice sample, as compared with the national database. A smaller percentage was identified as having speech-language impairment as the primary disabling condition among the

Table 1. Summary of Data for Telepractice Students and NOMS Database for Gender, Grade Level, and Eligibility for Special Education Services.

Characteristic	Telepractice students		NOMS database students
	<i>n</i>	Frequency %	Frequency %
Gender			
Male	45	63.4	67.0
Female	26	36.6	33.0
Grade level			
K	7	9.9	11.2
1	15	21.1	15.8
2	16	22.5	19.5
3	10	14.1	17.2
4	8	11.3	13.3
5	5	7.0	9.1
6	8	11.3	5.6
7	1	1.4	3.7
8	0	0.0	2.1
9	1	1.4	1.4
10	0	0.0	0.5
11	0	0.0	0.5
12	0	0.0	0.2
Eligibility for special education-related services			
Specific learning disability	24	33.8	26.0
Speech or language impairment	47	66.2	74.0

Note. NOMS = National Outcomes Measurement System.

telepractice participants, as compared with the NOMS database.

Previous therapy services are summarized in Table 2. Previous years of therapy were unknown for 32 (45%) of the students in the telepractice program, as compared with 27% in the NOMS database. Similarly, it was unknown if 43.7% of students in the telepractice program received therapy services in the summer preceding the current school year, as compared with only 13.7% in the NOMS database. The high percentage of unknown data for the telepractice program is due, in part, to lack of availability of records and/or nonresponse from parents when this information was requested through written communication sent to the students' homes.

FCM scores were reported for the primary disorder(s) being remediated for each student in the telepractice condition and the NOMS database. A student may be evaluated on the FCM for spoken language production as well as speech sound production if he or she has an expressive language and a speech sound disorder. Table 3 summarizes the types of disorders that the students in the telepractice program presented, as compared with the students in the NOMS database. The telepractice and NOMS database showed

Table 2. Summary of Data for Telepractice Students and NOMS Data set for Previous Therapy Services.

Service	Telepractice students		NOMS database students
	<i>n</i>	Frequency %	Frequency %
Previous years of SLP service			
None	2	2.8	5.6
1 or less	5	7.0	15.3
2	9	12.7	19.1
3	12	16.9	15.1
4	3	4.2	5.8
5	5	7.0	4.9
6 or more	3	4.2	7.0
Unknown	32	45.1	27.2
Students receiving services summer preceding present school year			
Yes	4	5.6	6.0
No	36	50.7	80.2
Unknown	31	43.7	13.7
Setting for previous SLP services			
School	58	81.1	94.1
School and other	9	13.5	4.8
Other	0	0.0	0.0
Unknown	4	5.4	1.0

Note. NOMS = National Outcomes Measurement System; SLP = speech-language pathologist.

Table 3. Summary of Data for Types of Disorders Presented by Telepractice Students and NOMS Data Set.

Disorder	Telepractice students		NOMS database students
	<i>n</i>	Frequency %	Frequency %
Intelligibility	15	21.1	19.8
Fluency	3	4.2	5.1
Pragmatics	1	1.4	3.3
Speech sound production	39	54.9	48.8
Spoken language comprehension	17	23.9	33.5
Spoken language production	23	32.4	38.6
Composition	0	0.0	4.7
Emergent literacy	0	0.0	1.6
Reading comprehension	2	2.8	8.4
Word recognition	0	0.0	4.7
Voice	1	1.4	0.7
Writing accuracy	1	1.4	3.7

Note. NOMS = National Outcomes Measurement System.

similar distributions of students with less-frequently occurring communication disorders (e.g., fluency, voice). Conversely, both data sets reflected similar percentages of students with higher frequency communication disorders (i.e., speech sound disorders, spoken language disorders). One major difference was that children with literacy-related disorders (e.g., reading comprehension, word recognition) were much less represented in the telepractice group than in the NOMS database. The reason for this difference has not been identified.

In both groups, the four most frequently occurring disorder classifications were intelligibility, speech sound production, spoken language comprehension, and spoken language production. These four FCMs will be the focus of the remainder of this article, because they are the only FCMs for which there was a sufficient sample size to produce meaningful data. The intelligibility FCM was used for students who have multiple speech sound substitutions, distortions, and/or omissions that affect overall speech intelligibility (ASHA, 2003). The speech sound production FCM was used with students whose speech is readily intelligible but contains a limited number of isolated speech sound errors (ASHA, 2003). The spoken language comprehension FCM measures a student's ability to understand spoken language, while the spoken language production FCM measures a child's ability to use words, sentences, and discourse to express ideas.

Table 4 compares the intervention location and service delivery model for the groups of students rated on the FCMs of speech intelligibility, speech sound production, spoken language comprehension, and spoken language production. The majority of students received pull-out intervention services in the telepractice and direct, in-person service delivery models. However, more students received individual pull-out sessions in the telepractice program as compared with the students in the NOMS database for all disability categories.

Student Progress

Table 5 summarizes the progress made by students in the telepractice program as measured by change in FCM level. Fifteen students with disorders related to intelligibility were identified. For this group, 33.3% made no progress, 26.7% improved one level, and 40% improved multiple levels. These percentages were similar to the percentages of students in the NOMS data set (37.6%, 28.2%, and 34.1%, respectively).

Thirty-nine students were seen for speech sound production. Thirty-three students (approximately 85%) made progress during the school year. Of these, 53.8% improved one level and 30.8% improved multiple levels. Only 15%, or six students, made no progress. This progress is similar to the progress made by students included in the NOMS database (78.4%).

Table 4. Service Delivery Models Used for Telepractice Students and NOMS Data Set, by Four FCMs.

FCM/Model	Telepractice students		NOMS database students
	<i>n</i>	Frequency %	Frequency %
Speech sound production			
Individual pull-out	19	48.7	24.5
Pull-out group of 2-4	11	28.2	60.1
Self-contained	1	2.6	3.8
Collaborative consultation	8	20.5	7.2
Spoken language production			
Individual pull-out	14	60.9	17.5
Pull-out group of 2-4	6	26.1	65.1
Collaborative consultation	3	13.0	4.8
Spoken language comprehension			
Individual pull-out	9	52.9	16.0
Pull-out group of 2-4	8	47.1	64.6
Intelligibility			
Individual pull-out	7	46.7	34.1
Pull-out group of 2-4	8	53.3	56.5

Note. NOMS = National Outcomes Measurement System; FCM = Functional Communication Measure.

There were 17 students with disorders related to spoken language comprehension. Similar numbers of students made no progress or improved one level, and two students, or 11.8%, improved multiple levels. For this group of students, a higher percentage of students made no progress than the percentage of students in the NOMS data set (41.2% vs. 34%); a higher percentage improved by one level compared with the NOMS data set (47.1% vs. 38.2%), and a lower percentage improved by multiple levels (11.8% vs. 27.8%).

Twenty-three students were seen for disorders related to spoken language production. As with the group of students with spoken language comprehension disorders, similar numbers of students made no progress or improved one level. For this group of students, 43.5%, or 10 students, made no progress, which is a higher percentage than that of students in the NOMS database (28.9%). Also, 47.8%, or 11 students, improved one level. This is a similar percentage to that of the NOMS data set, which was 41.6%. Finally, only two students, or 8.6%, improved by multiple levels, which is fewer than those in the NOMS data set, where 29.5% improved more than one level.

The final analysis focused on changes in FCM related to the amount of intervention time and are summarized in Table 6. Most of the students in the telepractice program received fewer than 10 hr of treatment during the school year. This is dissimilar to the treatment hours for students in the NOMS, who received more time in treatment but, as

Table 5. Progress Based on Four FCMs for Telepractice Students and NOMS Data Set.

Student disorder/functional level at admission	No progress		Improved 1 level		Improved multiple levels	
	<i>n</i>	Frequency %	<i>n</i>	Frequency %	<i>n</i>	Frequency %
Speech sound production (<i>n</i> = 39)						
Level 1	0	0.0	0	0.0	0	0.0
Level 2	1	2.5	1	2.5	1	2.5
Level 3	1	2.5	4	10.2	6	15.4
Level 4	1	2.5	4	10.2	3	11.5
Level 5	2	5.1	3	11.5	2	5.1
Level 6	1	2.5	9	23.1	n/a	n/a
Total	6	15.1	21	53.8	12	30.8
NOMS %		21.6		34.6		43.8
Spoken language production (<i>n</i> = 23)						
Level 1	0	0.0	1	4.3	1	4.3
Level 2	1	4.3	2	8.7	0	0.0
Level 3	5	21.8	5	21.8	0	0.0
Level 4	3	13.1	0	0.0	0	0.0
Level 5	0	0.0	2	8.7	1	4.3
Level 6	1	4.3	1	4.3	n/a	n/a
Total	10	43.5	11	47.8	2	8.6
NOMS %		28.9		41.6		29.5
Spoken language comprehension (<i>n</i> = 17)						
Level 1	0	0.0	2	11.8	0	0.0
Level 2	1	5.9	4	23.5	0	0.0
Level 3	3	17.6	1	5.9	2	11.8
Level 4	3	17.6	0	0.0	0	0.0
Level 5	0	0.0	1	5.9	0	0.0
Level 6	0	0.0	0	0.0	n/a	n/a
Total	7	41.2	8	47.1	2	11.8
NOMS %		34.0		38.2		27.8
Intelligibility						
Level 1	0	0.0	0	0.0	0	0.0
Level 2	1	6.7	0	0.0	1	6.7
Level 3	1	6.7	2	13.3	3	20.0
Level 4	1	6.7	0	0.0	2	13.3
Level 5	2	13.3	1	6.7	0	0.0
Level 6	0	0.0	1	6.7	n/a	n/a
Total	5	33.3	4	26.7	6	40.0
NOMS %		37.6		28.2		34.1
Total all disorders	28	29.8	44	46.8	22	23.4

Note. FCM = Functional Communication Measure; NOMS = National Outcomes Measurement System; n/a = not applicable.

noted earlier, were less likely to be seen individually. Thus, the profile of the telepractice group is that of children who were generally seen for less time and in individual pull-out sessions, which is a different treatment profile than in the NOMS data set.

Discussion

The purpose of the present study was to compare data from a sample of school-age students receiving speech-language intervention by telepractice with direct, in-person service

delivery data available from the NOMS database. The latter provides a means for describing students receiving speech-language intervention as well as measuring student progress using FCMs. A total of 71 students were included in the telepractice therapy group, and these students were compared with approximately 5,332 students in the NOMS database. The descriptive information gathered included types of students, types of communication disorders, student progress as measured by NOMS FCMs, type of intervention delivered, and amount of time spent in intervention. Comparisons for changes in FCMs were completed for

Table 6. Summary of Progress by Number of Intervention Minutes for Telepractice Students and NOMS Data Set.

Disorder type/treatment hours	No progress			Improved I level			Improved multiple levels		
	Telepractice		NOMS	Telepractice		NOMS	Telepractice		NOMS
	<i>n</i>	Frequency %	Frequency %	<i>n</i>	Frequency %	Frequency %	<i>n</i>	Frequency %	Frequency %
Speech sound production									
<10 hr	5	17.2	23.9	15	51.7	37.0	9	31.0	39.1
10-20 hr	1	10.0	17.5	6	60.0	32.5	3	30.0	50.0
>20 hr	0	0.0	25.0	0	0.0	33.3	0	0.0	41.7
Total	6	15.4	21.6	21	53.8	34.6	12	30.8	43.8
Spoken language production									
<10 hr	10	43.5	34.8	11	47.8	41.6	2	8.7	23.6
10-20 hr	0	0.0	26.1	0	0.0	37.0	0	0.0	37.0
>20 hr	0	0.0	16.1	0	0.0	48.4	0	0.0	35.5
Total	10	43.5	28.9	11	47.8	41.6	2	8.7	29.5
Spoken language comprehension									
<10 hr	6	40.0	36.5	7	46.7	39.2	2	13.3	24.3
10-20 hr	1	100.0	31.1	0	0.0	40.0	0	0.0	28.9
>20 hr	0	0.0	32.0	1	100.0	32.0	0	0.0	36.0
Total	7	41.2	34.0	8	47.1	38.2	2	11.8	27.8
Intelligibility									
<10 hr	3	33.3	52.4	2	22.2	26.2	4	44.4	21.4
10-20 hr	2	40.0	25.9	1	20.0	22.2	2	40.0	51.9
>20 hr	0	0.0	18.8	1	100.0	43.8	0	0.0	37.5
Total	5	33.3	37.6	4	26.7	28.2	6	40.0	34.1

Note. NOMS = National Outcomes Measurement System.

students being seen for disorders of intelligibility, speech sound production, spoken language comprehension, and spoken language production. From the demographic data, the students in the telepractice group were similar to the NOMS database for gender and for number of students who had speech and/or language impairments or specific learning disabilities as their primary disability conditions. A larger percentage of students in the NOMS database were in junior high and high school when compared with students in the telepractice group; however, telepractice services were not available for junior and senior high school students in two of the three districts involved in the program. In addition, a higher percentage of the students in the NOMS database had received previous speech-language intervention when compared with the telepractice students. As noted earlier, it is difficult to determine if previous therapy was truly as divergent as it appeared between the two samples, as records of previous therapy were not readily available for many of the students in the telepractice project.

Further evidence of the similarities between the two caseloads is found in the description of communication disorders. The telepractice group and the NOMS database had the highest percentages of students with impairments in intelligibility, speech sound production, spoken language

comprehension, and spoken language production, as well as similar numbers in the lower prevalence communication disorders. One notable difference between the two samples is the low percentage of telepractice students who were also receiving intervention services for literacy-related impairments. Control for this type of difference could not be established, because the data set was self-selected and participants were not initially identified by the SLPs conducting the intervention through telepractice.

Students in both service delivery models were seen primarily in pull-out intervention sessions. However, a higher percentage of students in the telepractice group received individual pull-out sessions, as compared with a higher percentage of students who received small-group pull-out sessions in the NOMS database. This difference is best explained by the method of individualized delivery of the telepractice services in the present study, and is due, at least in part, to the typical location of telepractice equipment outside of the classroom setting.

One finding of the study was that the telepractice students were seen for fewer hours of therapy than the students in the direct, in-person delivery model. This finding was consistent for the four FCMs analyzed in this study. This difference can be best explained by the amount of therapy minutes identified on the IEPs for the telepractice students.

Review of the IEPs for the students in the telepractice condition revealed that the majority of them were scheduled for 20 min of therapy once a week. Amount of time in therapy was established before the present research project was initiated. Consequently, an explanation for this procedure is not known.

In addition to describing the caseloads in both service delivery models, this project sought to compare student progress in the telepractice group using the NOMS FCMs and then to relate those results to the data for students who receive speech-language intervention in a direct, in-person service delivery model. One key finding is that 70% of the students in the telepractice program made progress as measured by a gain of one or more levels of the FCMs. This supports findings of past studies indicating that students in school districts can make improvements when intervention is provided with a telepractice service delivery model (Grogan-Johnson et al., 2010; Grogan-Johnson et al., 2011). The amount of improvement varied across the four disorders studied, with the best outcomes experienced by those students receiving intervention for intelligibility and speech sound production disorders. For these two groups, the data compared favorably with the percentages reported for the students in the direct, in-person service delivery model. For the groups of telepractice students with disorders of spoken language comprehension and spoken language production, the data did not compare favorably with the direct, in-person students, because higher percentages of students made no progress and lower percentages improved multiple levels. However, caution must be exercised in interpreting these results, as the number of participants in the telepractice service delivery model was only 71 students, as compared with more than 5,000 students in the direct, in-person service delivery model, which contributes to the percentage differences between the two groups. Nevertheless, the NOMS system provides data on the direct, in-person service delivery model, and it is a useful tool for initial descriptive comparisons between the two service delivery models.

Study Limitations and Future Research

In addition to the differences in sample size, there are other limitations to the present study. While a useful tool, the NOMS data set provides only limited descriptive information regarding the SLPs who participated in the data collection and the students enrolled in the database, making it difficult to interpret all factors that potentially impact student performance. Also, the FCMs utilized for comparison purposes were specifically designed to be a general measure of communication functioning, demonstrating overall improved functional communication and not necessarily progress toward specific goals in intervention. Future research should attempt to make measures of FCMs and quantitative measures as the basis for exploring treatment

outcomes. It is of note that past research conducted with this specific telepractice program has relied on clinical measures, and found that students made similar improvements in intervention provided by telepractice and direct, in-person delivery models (Grogan-Johnson et al., 2010; Grogan-Johnson et al., 2011).

In addition, the study did not control for the amount of time students received services or the type of service (i.e., individual or group services). These issues raise important avenues for future research. In this study, the students in telepractice received less time in treatment and primarily individual therapy, while students seen in direct, in-person intervention primarily received group therapy and more time in terms of minutes in treatment. The nature of this present investigation was descriptive and preliminary in nature. Future studies should consider using control groups to control for time and type of treatment (i.e., individual or group).

Conclusion

The description of the reported telepractice program highlights similarities and differences relative to a direct, in-person service delivery model as described in the NOMS database. Descriptive data from this study support the effectiveness of the reported telepractice service delivery model for providing speech-language intervention services to school-age children. The results suggest that school-age children with communication disorders who receive speech-language services in a direct, in-person service delivery model can also receive these services and make progress in a telepractice service delivery model.

Appendix

K-12 NOMS Intelligibility FCM

- Level 1:** Familiar listeners understand a small number of student's isolated words and phrases in educational activities.
- Level 2:** The student's connected speech in educational activities is rarely understood by familiar listeners when the context is not known, but is understood when the context is known.
- Level 3:** The student's connected speech in educational activities is occasionally understood by familiar listeners when the context is known but only rarely understood when the context is not known. Unfamiliar listeners rarely understand the student's connected speech when the context is known.
- Level 4:** The student's connected speech in educational activities is usually understood by familiar listeners when the context is known and occasionally understood when the context is not known. Unfamiliar

listeners occasionally understand student's connected speech when the context is known, but rarely understand without context.

Level 5: The student's connected speech in educational activities is consistently understood by familiar listeners when the context is known and usually understood when the context is not known. Unfamiliar listeners usually understand connected speech when the context is known, but are occasionally able to understand without context.

Level 6: The student's connected speech in educational activities is consistently understood by familiar listeners. Unfamiliar listeners consistently understand connected speech when the context is known and are usually able to understand the student's speech without the context.

Level 7: The student's conversational speech in educational activities is consistently understood by all listeners.

From *National Outcomes Measurement System (NOMS): K-12 Speech-Language Pathology User's Guide* (p. 26), by the American Speech-Language-Hearing Association, 2003, Rockville, MD: Author.

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