Measuring the outcomes of word cueing technology

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Key words

▪ Assistive technology devices ▪ Pediatric occupational therapy ▪ Cognition
▪ Canadian Occupational Performance Measure (COPM)

Abstract

Background. *Measurement of assistive technology outcomes is complex because many factors (e.g., environment and model of service delivery) influence the successful use of the technology.* **Purpose**. *Using the example of measuring the outcomes of word cueing technology, this paper presents an approach for measuring assistive technology outcomes.* **Method**. *The Canadian Occupational Performance Measure (COPM) was administered to 29 children with physical and learning disabilities, between the ages of 3.9 and 19 years. Participants were provided with WordQ, a software program designed to assist the development of writing skills. Follow-up data were collected through telephone interviews.* **Results**. *The COPM findings supported the effectiveness of WordQ Version 1 to enhance written productivity, with a mean performance change score of 3.5 (SD = 1.5). The COPM was an effective tool for measuring clients' perceived outcome of word cueing technology. Telephone interview was considered a successful method for collecting outcome data.* **Practice Implications**. *A mix of tools and methodologies should be used to gain a comprehensive understanding of the impact of assistive technology.*

Résumé

Description. *La mesure des résultats de la technologie d'assistance est complexe car de nombreux facteurs (p. ex., environnement et modèle de prestation des services) influent sur l'utilisation de la technologie.* **But**. *Se basant sur l'exemple de la mesure des résultats d'un logiciel de prédiction de mots, cet article présente une méthode pour mesurer les résultats de la technologie d'assistance.* **Méthode**. *La Mesure canadienne du rendement occupationnel (MCRO) a été administrée à 29 enfants âgés de 3,9 à 19 ans ayant des déficiences physiques et des troubles d'apprentissage. Les participants ont reçu le logiciel Word Q, conçu pour faciliter l'acquisition des habiletés pour l'écriture. Les données de suivi ont été recueillies à partir d'entrevues téléphoniques.* **Résultats**. *Les résultats de la MCRO permettent d'affirmer que la Version1 de Word Q est efficace pour rehausser la productivité écrite, selon un score de rendement moyen de 3,5 (ETM = 1,5). La MCRO s'est révélée un outil efficace pour mesurer les résultats perçus par les clients face au logiciel de prédiction de mots. L'entrevue téléphonique a été considérée comme une méthode efficace pour recueillir des données sur les résultats.* **Conséquences pour la pratique**. *Un ensemble d'outils et de méthodologies doivent être utilisés pour mieux comprendre les effets de la technologie d'assistance.*

Writing is an important occupation for children. Not being able to transfer thoughts to paper and produce legible handwriting at a speed fast enough to meet the writing demands at school may hinder academic progress and success (Briggs, 1980; Sweedler-Brown, 1992). Over time, children who encounter these challenges may avoid writing, which in turn compromises their development of written language skills (MacArthur & Graham, 1987). Children with neurological impairments, learning problems, attention deficits, and developmental disabilities often experience difficulties in writing (Amundson, 1992). When remedial writing practices fail to produce a significant improvement, the use of a computer is commonly recommended as an alternative means of text generation (Amundson & Weil, 1996). A computer is also an important tool that helps children with learning difficulties transfer their thoughts onto paper (Hunt-Berg, Ranking, & Beukelman, 1994).

Word cueing is an assistive technology that is designed to provide assistance with text composition to individuals with learning difficulties (Shein, Nantais, Nishiyama, Tam, & Marshall, 2001). It is a relatively new technology that was introduced around the year 2000. Before word cueing technology was made available, word prediction and text-to-speech technology (also known as auditory feedback or speech synthesis) were used to assist individuals with writing. Word prediction technology monitors the letters that the user types, generates a list of the most likely words and displays them in a prediction list. The user then selects the desired word from the prediction list by pressing a designated key on the keyboard, usually a number key. With text-to-speech

technology, the user can selectively listen to the computer's echo of typed letters, words and sentences. Users can also have the computer read a selected paragraph or the whole document. Word cueing combines word prediction and text-to-speech technology with new research in natural language processing to provide "appropriate visual and auditory cues to assist the writer with text composition" (Shein et al., 2001, para.5). This assistive technology includes a customizable dictionary that matches the user's vocabulary, custom-built topic dictionaries, the ability to highlight text as the computer reads the text, and control over the readback function for editing (i.e., ability to start, stop and pause).

As it is a new technology, there is little evidence on the effectiveness of word cueing. In a college program designed to help students with learning disabilities in reading and writing, Reinhardt and Parkins (2002) found that a word-cueing software called WordQ (Version 1) opened up new opportunities to their students. WordQ (Version 1) enabled them to read information from the Internet newspaper, discussion groups and other sources. Their students also gained confidence and independence in writing. Tam, Mays, Archer, and Skidmore (2004) found that WordQ (Version 1) motivates children to be engaged in writing. Children were more independent, used a wider variety of words in writing and were more accurate in spelling and grammar. Both of these two reports were clinical reports and not controlled studies. The effectiveness of word cueing has not been formally assessed.

DeRuyter (1995) stresses that technology providers have an ethical obligation to evaluate outcomes of assistive devices. Outcome information is necessary to guide prescription and development of the technology, improve service delivery and demonstrate accountability to funding agencies and consumers. The literature recognizes the complexity of measuring assistive technology outcomes (Gelderblom & de Witte, 2004; Smith, 1996). Many factors influence the outcomes of assistive technology, including the characteristics of the user, environment in which the technology is used, and model of service delivery. Technology is seldom used in isolation. Often a user will have a mixture of technologies, which may also be combined with other interventions.

Heaton and Bamford (2001) suggest that there are three broad approaches to evaluate outcomes of equipment and adaptations: changes in functional status, changes in quality of life or health status, and indirect approaches (e.g., usage and user satisfaction). Many studies have been done on the issue of device abandonment (Phillips & Zhao, 1993; Scherer, 1990). In their study, Philips and Zhao recommend that consideration of user opinion in all processes of assistive technology provision is an important factor for device acceptance and use. The use of an individualized measure that captures the user's goals, perceived competency in performance and satisfaction with the performance would allow outcomes to be targeted to meet the client's needs. Angelo, Buning, Schmeler and Doster (1997), in a focus group study, found that a client-centered approach is a best-practice approach in the occupational therapy assistive technology evaluation. Their view is shared by other researchers in the field of assistive technology (Fuhrer, Jutai, Scherer, & DeRuyter, 2003; Gelderblom & de Witte, 2004).

There are few measurement tools that address user's subjective perception of change in functional performance after using assistive technology. The Matching Technology and Child (MATCH) was developed as a tool to help parents/caregivers of children with disabilities select appropriate technologies for their child (Scherer, 1999). It addresses the broad range of technology intervention that a child may require and not the impact of a specific technology.

The Individualized Prioritized Problem Assessment (IPPA) was designed as a tool to measure the effectiveness of assistive technology provision (Wessels et al., 2002). The IPPA is a generic instrument that assesses the user's perception of decrease in difficulties with self-identified activities. The users rate the level of importance of these activities and their level of difficulties with these activities with a 5-point scale. The IPPA has been used with an adult population to evaluate effectiveness of devices for mobility, communication and self-care. Clinical utility with the paediatric population is not documented. The literature also provides no information on the degree of change on the IPPA score that could be considered as a significant change.

While it is not a specific tool for measuring the outcomes of assistive technology interventions, the Canadian Occupational Performance Measure (COPM) has been proposed as an outcome measure for assistive technology (Smith, 1996). A recent publication provided a comprehensive review of the COPM (Carswell et al., 2004). The review listed studies that have supported the reliability, validity and clinical utility of the COPM for a wide variety of clinical situations and populations, including children. The COPM considers the importance of the skill or activity to the client using a semi-structured, individualized interview approach (Law et al., 2005). The COPM uses three 10-point scales to rate importance, performance, and satisfaction. A score of 1 refers to a low rating (i.e., not important at all, not able to do at all, not satisfied at all). A score value of 10 refers to a high rating (i.e., extremely important, able to do it extremely well, extremely satisfied). Mean performance and satisfaction scores are derived by summing the ratings across the occupational performance issues and dividing by the total number of issues. The COPM has been used successfully as a measure for effectiveness of a number of technologies (Grillo, 2001; Reid, 2002; Reid, Rigby, & Ryan, 1999; Tam, Reid, O'Keefe, & Naumann, 2002).

In a 1-year program evaluation project conducted between 2003 and 2004, the COPM was used as an outcome measure to evaluate the effectiveness of WordQ (Version 1). This paper will report the findings. However, the focus of this paper is not to establish the effectiveness of WordQ (Version 1),

but to use the measurement of word cueing technology as an example to present the method used and the challenges encountered in evaluating assistive technology outcomes. This paper will describe the approach that has been adopted to measure outcomes in a consultative setting, discuss the clinical utility of the COPM for measurement of assistive technology outcomes and the effect of a heavy clinical demand on outcome measurement, as well as to suggest future directions.

Method

Setting

The clinical setting for the study is a writing aids clinic in a pediatric rehabilitation centre in Toronto, Ontario. The clinic's clients are children aged 19 and under who have a physical disability that affects their ability to write. The clinic operates under a consultative model providing assessment, equipment recommendations, purchase assistance and initial training to clients, families and community team members. The community team assumes the primary responsibility to support the family and children in their home environment. Children are not actively followed after the initial training. Follow-up service is provided upon request of the family or the community therapist.

Software

During the time of this project, two software programs were known to employ word cueing technology: Co:Writer 4000 (2000) and WordQ (Version 1) (2001). Co: Writer 4000 must be used with Write: Outloud (Version 3) (1999) to provide text-to-speech technology for editing purposes. The Co:Writer 4000 and Write:Outloud (Version 3) combination lacked text-to-speech support for standard word processing software (e.g., Microsoft Word). In contrast, WordQ (Version 1) provided word cueing in one package and was compatible with Microsoft Windows applications. The ability to write with standard word processing software and to communicate through E-mail was important for students because it allowed them to share their work with their peers. Therefore, WordQ (Version 1) was adopted by many school boards in the area.

Clients

All children seen at the writing aids clinic using WordQ (Version 1) were included in the 12-month data collection period between 2003 and 2004. These children may have received handwriting training at some point in their life, but they had come to the clinic because they had been identified as non-functional writers and in need of technological intervention. Attempts were made to conduct the COPM interview in the initial assessments, but it was not possible to accurately complete the COPM with 19 children and their families because of difficulties with English or understanding the rating scales.

Procedures

In the summer of 2003, the COPM was adopted as a part of the assessment process. As much as possible, the COPM interviews were conducted by the occupational therapists with the children. However, for the very young children or for those who had difficulty rating their performance and satisfaction on a 10-point scale, the ratings were done with their parents with the children involved in the discussion.

The COPM interview was modified to focus on the issues relating to writing in the three areas of occupational performance: self care, productivity, and leisure. During the initial COPM interview, children or their parents were asked to identify writing tasks that they were expected to do, needed to do, or wanted to do in a typical day. They were guided to discuss details of the tasks in order to focus on the aspects of the task that were difficult for the children. Usually the children or parents identified no more than 5 tasks, therefore they were not asked to rate the importance of the tasks, but they were asked to rate the child's current performance with each task and their satisfaction with the child's performance for each task on 10-point rating scales.

The follow-up interview was done by the occupational therapist or occupational therapy student over the telephone. The target date for follow-up was 3 months after the children received their computer and the WordQ (Version 1) software. During the follow-up interview, children or their parents were asked to rate their performance and satisfaction with performance on the writing tasks identified in the initial COPM interview. The baseline scores were not provided to them. In addition to the ratings, children or their parents' comments regarding the use and non-use of WordQ (Version 1) were recorded.

Analysis

The difference in the children or patents' evaluation of performance and satisfaction on initial assessment, compared with their evaluation at follow-up was used as the indicator for the outcome of word cueing technology. The results were analyzed descriptively. Comments on the benefits and limitations of WordQ (Version 1) were summarized. Paired t-test was used to analyze the difference of the group's initial and final ratings of performance and satisfaction.

Results

The COPM was successfully conducted with 42 children and their families, but only 29 families responded to the request for a follow-up interview. Of the 29 children, 15 were female and 14 were male (Table 1). Seventeen interviews were done with the parents in the presence of their children. Twelve were done with the children in the presence of their parents. The average age of the children was 11.1 (SD = 3.7, range = 3.9 - 19.1). A variety of diagnoses were represented in this group (see Table 1). All children were able to type using a

TABLE 1
Participant demographics and COPM change scores.

Client	Diagnosis	Gender	Age (years)	Number of tasks identified score	Change in performance score	Change in satisfaction score
1	Tourettes syndrome	M	10.1	5	2.6	4.0
2	cerebral palsy	F	10.9	5	3.8	4.2
3	hypotonia	M	12.8	4	4.8	5.3
4	cerebral palsy	F	17.7	2	3.5	5.5
5	fine motor delay	M	3.9	2	5.0	5.0
6	skeletal dysplasia	M	11.1	1	1.0	3.0
7	developmental delay	M	8.4	4	5.3	8.3
8	cerebral palsy	F	10.3	4	6.5	7.0
9	cerebral palsy	M	19.1	5	6.6	8.2
10	cerebral palsy	F	9.5	4	4.3	3.8
11	cerebral palsy	F	18.2	5	3.6	4.6
12	cerebral palsy	F	8.2	4	3.3	5.0
13	cerebral palsy	F	10.7	5	4.0	4.2
14	cerebral palsy	F	5.0	5	3.4	5.2
15	fine motor dysfunction	F	8.6	5	1.6	3.2
16	cerebral palsy	M	9.4	5	2.2	2.0
17	cerebral palsy	M	8.1	5	3.0	7.0
18	cerebral palsy	M	15.9	2	4.0	5.0
19	agenesis of the corpus collosum	M	14.0	3	3.6	2.7
20	cerebral palsy	F	8.9	4	4.8	4.8
21	acquired brain injuries	M	7.6	4	3.0	4.3
22	spina bifida with hydrocephalus	F	11.0	4	2.3	2.0
23	cerebral palsy	F	14.6	2	0.5	2.0
24	cerebral palsy	M	9.4	5	1.8	1.0
25	cerebral palsy	F	9.0	5	2.4	4.0
26	developmental delay	M	15.5	4	2.8	5.3
27	viral encephalitis	F	13.0	4	4.5	5.0
28	fine motor delay	M	11.4	4	2.5	3.0
29	bilateral duplicated thumbs	F	8.6	5	5.4	6.2

standard keyboard. WordQ (Version 1) was the only adaptive software they needed. No other adaptive device was used with the software.

While the target date for follow-up was 3 months after the children received their computer and the WordQ (Version 1) software, scheduling difficulties and time spent trying to establish contact caused delay in following up with the families. The average time interval between the receipt of the equipment and the follow-up interview was 6.9 months (SD = 2.6, range = 3.0 - 10.5). As with any assistive technology, funding issues delayed the availability of the technology to clients. As a result, the longest time interval between the initial COPM interview and the follow-up interview was 14.8 months, and the shortest interval was 3.6 months (M = 9.7, SD = 2.7).

Children and families identified a variety of tasks (Table 2). On average, children and their families identified 4 writing tasks as occupational performance issues for the children (SD = 1.2, range = 1 - 5; Table 1). Individual child's changes in average COPM performance and satisfaction scores are presented in Table 1. The mean COPM scores at the initial assessment were 3.6 (SD = 1.5, range = 1 - 5.5) for the performance scale and 3.1 (SD = 1.4, range = 1 - 6) for the satisfaction scale. At follow-up, the mean COPM scores were 7.1 (SD = 1.6, range = 4.3 - 10) for the performance scale and 7.6 (SD = 0.8, range = 3.8 - 10) for the satisfaction scale. The performance mean change score was 3.5 (SD = 1.5, range = 0.5 - 6.6) and the satisfaction mean change score was 4.5 (SD = 1.8, range = 1 - 8.3; Figures 1 and 2). The increases in both performance scores and satisfaction scores are statistically significant ($t = 12.7$, SD = 1.5, $p = 0.005$ for performance; $t = 13.6$, SD = 1.8, $p = 0.034$ for satisfaction).

Generally, families and children were finding WordQ (Version 1) helpful. They reported increased productivity, increased motivation to write and use of a broader variety of words in writing. Children gained enhanced independence as they did not need their parents to be available to help them with spelling. Parents reported that their children were more willing to experiment with words and were therefore using a richer variety of words in their writing. For the 4 children whose changes in COPM scores were below 2, families reported reasons such as health problems prevented the child from doing more work, or the child was more interested in playing games on the computer than doing writing.

TABLE 2
Writing tasks identified by clients.

Writing tasks	Number of clients
Projects	23
Essays	20
Research on the Internet	19
Worksheet	11
Stories	8
Journal	6
MSN or other on-line chat	6
Email	5
Agenda	4
Note-taking	3
Book report	2
Copy from board	2
Letter	2
Drawing	1
Math	1
Poems	1
Spelling list	1
Wish list	1

Discussion

The findings of this project indicate that the COPM is an effective tool for measuring children's perceived outcome of word cueing technology. The use of the COPM supports evidence-based, client-centered assistive technology practice. The COPM interview helps the occupational therapist understand the writing tasks that are important but difficult for the children to accomplish. The performance and satisfaction ratings on the tasks help to set a baseline for comparison after the technology is implemented. In addition to the ratings on performance and satisfaction, the comments gathered during the follow-up interviews provided information about the benefits and limitations of word cueing technology.

The use of the COPM as an outcome measure showed an overall significant change in the children' evaluation of occupational performance and satisfaction as a result of using word cueing technology. Both the performance and the satisfaction scales showed a statistically significant change in children's occupational performance. Most of the families (25 of 29) reported a positive change of more than 2 in average performance and satisfaction scores. The change of 2 or more in COPM score was considered to be clinically significant (Law et al., 2005). The findings of this project demonstrated that the use of WordQ (Version 1) improved children' performance in and satisfaction with their self-selected writing tasks. However, demonstration of the effectiveness of WordQ (Version 1) is not the primary purpose of this paper. This finding needs to be verified by a research study that controls other variables that may affect the results.

The findings of this project demonstrate that the COPM is able to detect changes in occupational performance and satisfaction with performance. This finding is in agreement with previous studies where the COPM was found to be an effective outcome measure for evaluating the impact of assistive technology on clients' occupational performance and on their satisfaction with this performance (Grillo, 2001; Petty & Treviranus, 2004). The COPM has reported clinical utility with the pediatric population (Carswell et al., 2004). However, in this project, 17 out of the 29 ratings were done with parents, as the children were not able to understand the abstract concept of ratings. While some researchers allege that parents' perception could be a valid measure for evaluation of outcomes on behalf of their children with disabilities (Forsang, Thomason, & McCoy, 1998), others suggest that setting goals based on parents' or teachers' identified concerns may not be optimal because parents and children often establish different priorities for intervention (McGavin, 1998; Pollock & Stewart, 1998). Martini and Polatajko (1998) suggested that having children set their own occupational goals may help to motivate them in doing the activities. The issue of involving children and adolescents in goal setting warrant

FIGURE 1
Change in performance scores, frequency histogram.

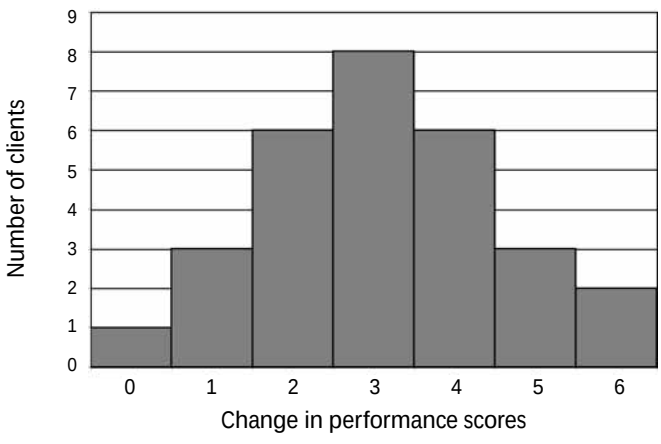
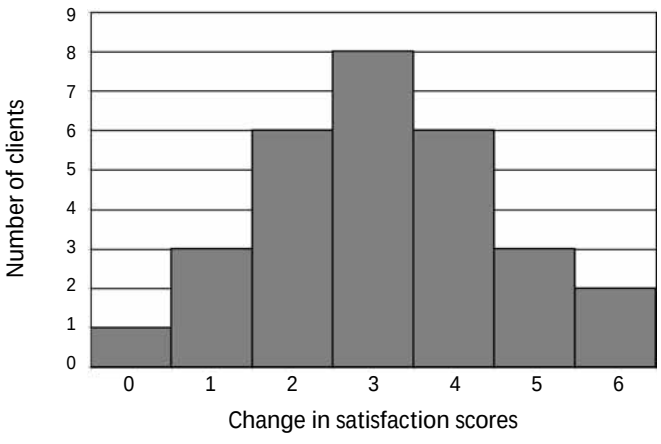


FIGURE 2
Change in satisfaction scores, frequency histogram.



further study in order to establish best practice guidelines. The use of a tool designed to be used with children such as the Perceived Efficacy and Goal Setting System (Missiuna & Pollock, 2000) should also be explored.

When opportunities to conduct face-to-face follow-up visits are limited by the service delivery model and funding, the options for follow-up are limited to the choice between mail survey and telephone interview. A mail survey methodology may be less costly as it can be easily managed by administrative staff. In 2002, in an attempt to gather general outcome information, a questionnaire was sent to all of the clients who had received writing aids through the writing aids clinic. The questionnaire was designed to capture usage, satisfaction and activities for which the clients were using their equipment. Even with a postage-paid self-addressed envelope, the response rate was only 13%. Therefore, mail survey may not be an appropriate way to gather outcome information. The concern is that responses from a small proportion of the clients may not provide adequate outcome information.

Telephone interview is an effective means of collecting follow-up information in a consultative setting. This finding is in agreement with other assistive technology providers (Petty & Treviranus, 2004). Studies that compare face-to-face interviews with telephone surveys as a means to collect outcome information also support the use of a telephone survey for data collection in outcome studies (Korner-Bitensky & Wood-Dauphineee, 1995; Korner-Bitensky, Wood-Dauphineee, Siemiatycki, Shapiro, & Becker, 1994). Telephone interviewing has also been found to have a high response rate (Angelo, Buning, Schmeler, & Doster, 1997; Finlayson & Havixbeck, 1992; Petty & Treviranus, 2004). Moreover, telephone interview is a necessary and effective means of obtaining information from young people who have difficulties with writing and most likely cannot respond to a paper survey independently.

While telephone interviewing provides an effective means of collecting outcome data, it is a time-consuming exercise that requires sufficient allocation of time and human resources. Flexibility in working hours had to be provided to accommodate clients' time schedule. Children and their parents were often not available during the day because of schooling and work. Therefore, most of the interviews had to be conducted in the evenings, resulting in overtime work. Also, as the clinic provided a provincial-based service, some long-distance calls were necessary which added to the cost.

Evaluator bias has been raised as a concern in conducting outcome measures (Letts et al., 1999). Letts and colleagues (1999) recommend using an evaluator who is not involved in service delivery. In this project, occupational therapy students who were not involved in the initial assessments conducted many of the follow-up interviews. The use of an evaluator who is not directly involved with service delivery not only reduces evaluator bias, but is also very helpful in view of limited clinical resources. This has allowed the therapists more time to focus on assessment and recommendations of technology, while remaining available to respond to follow-up requests. The clinicians of the writing aids clinic are exploring the option of training support personnel to conduct the follow-up interviews and gather outcome information. This will hopefully address the issue of evaluator bias and ensure that the repeat measure of the COPM is done within the 3-month time frame. However, future study is required to examine the reliability of the ratings when the pre and post interviews are conducted by different people and by clinicians versus trained support staff.

Andrich, Ferrario and Moi (1998) suggest that outcomes should be measured shortly after the provision of the equipment, and then at two other intervals after that to capture longer term outcomes. However, in the case of a pediatric population, growth and maturity can significantly affect outcomes. Effects of word cueing technology is expected to be found in the area of written language and written productivity. If the outcome is measured over a long period of time, it will be difficult to determine if the results are the effect of the technology or a combination of factors such as education, growth and maturity. A 3-month follow-up period is considered an appropriate time frame as it gives the young people and their family's time to learn the software and yet it is not too long a period for other variables to make a significant impact. The increasing length of wait time for assessment in the writing aids clinic puts a demand on servicing new clients in a timely manner. Often, follow-up for outcome measurement becomes a secondary priority. As a result, instead of the planned 3-month follow-up, the average follow-up time in this project was 6.9 months. The long delay in conducting the second COPM evaluation reduces the validity of the results and should be noted as a limitation.

Children and families in this project did not identify more than 5 writing tasks as a focus of the intervention. Therefore, children and families were not asked to rate the importance of the task. However, this should probably be noted as a limitation because it would have been interesting to see if the importance rating is related to change in performance and satisfaction ratings. Another limitation in the sample is that it does not totally represent the clinic population. A number of families experienced difficulties in using the COPM. These include children and families for which English is a second language, and with those who had difficulties understanding the rating scales. Alternative tools need to be identified to measure outcomes with this group of children and families.

While the use of the COPM is an effective outcome measurement tool, the future challenge is to look beyond a subjective measure. Clinicians need to identify objective measurement tools that could demonstrate the effectiveness of word-cueing technology as a scaffold for writing, and for promoting the development of written communication skills. Providers of similar technology have reported successful use of

measures for written language such as the Test of Written Language (TOWL-3) (Hammill & Larsen, 1996; Trillium Lakelands District School Board, 2004). Acknowledging that the objective measures may not be feasible tools to be used in routine practice, outcome studies with a random sample of children can be done to address the need for objective outcome data.

In a previous study (Tam et al., 2004), parents of children reported increased motivation for writing, and increased self confidence with the use of WordQ (Version 1). The literature has also indicated that handwriting difficulties are related to poor self-esteem (Bergman & Mclaughlin, 1988). It will therefore be interesting to explore the psychosocial effects of the use of WordQ. A suitable tool will have to be identified that measures the relevant psychosocial functioning and that is valid to be used with children.

Hammel (1996) suggested that the assistive technology field should "embrace a multidimensional long-term outcomes measurement program" (p. 97). She feels that outcomes should be measured in natural settings where the technology is making an impact, such as school or work place. It should also be measured over time to assess the long-term outcomes. With the hypothesis that increased written productivity could lead to better development of written language skills, it is necessary to study the outcomes of the application of WordQ at school and at home over a period of time and at regular intervals.

Measuring assistive technology outcomes is very complex as success of assistive technology application is affected by many factors. Technology is constantly changing. New features are frequently being added to software or devices. A challenge in measurement of outcomes is therefore the possible change of versions and the related features with the same product during the measurement period. The support that the child has at home and at school for the use of the technology, the accessibility of the environment where the technology is used, the motivation of the children in the use of the technology, and the level of training and technical support offered to the family and to the school all affect the outcomes of the technology. In assessing the outcomes, clinicians need to be cognizant of the effect of these factors on the outcomes.

Understanding the relationship of assistive technology and other types of interventions is another concern (Smith, 1996). In the case of word-cueing technology application, the instruction on language skills, availability of proper positioning, implementation of other technologies, and growth and maturity would all contribute to the outcomes. Attempts should be made to isolate as much as possible the particular impact of assistive technology from all other possible interventions. A good baseline measure and documentation of concurrent intervention would help with the interpretation of data. A well-controlled outcome study with the use of a control group may also help isolate the effect of the technology.

Conclusion

The COPM has been found to be an effective outcome measure to evaluate the effectiveness of WordQ (Version 1). The findings support the effectiveness of WordQ (Version 1) to enhance written productivity. Where face-to-face follow-up visits are not regularly conducted, telephone interview methodology can be a viable option to collect assistive technology outcome data. The failure to collect the second set of the COPM ratings at and around 3 months after clients received their equipment limits the validity of the results.

The findings in this project are directly relevant to occupational therapists working in the field of assistive technology, but the methodology and the discussion on clinical realities may be applicable to occupational therapists in all areas of clinical practice. This project supports the potential use of the COPM to be used as an outcome measure for assistive technologies. However, clinicians need to continue to explore valid measurement tools and methods that can capture necessary outcome information. Measuring the outcomes of assistive technology is so complex that a mixture of tools and methodologies may be necessary to gain a comprehensive understanding of the impact of the technology. This project also highlights the clinical reality where caseload demands often direct resource utilization and outcome measurement is often given a lower priority. Clinicians need to explore creative ways to measure outcomes while working with limited resources.

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