THESIS

# USE OF A MODIFIED OCCUPATIONAL THERAPY PERFORMANCE MEASURE (mCOPM) FOR ASSISTIVE TECHNOLOGY OUTCOMES IN POSTSECONDARY EDUCATION

Submitted by

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ABSTRACT

USE OF A MODIFIED OCCUPATIONAL THERAPY PERFORMANCE MEASURE (mCOPM) FOR ASSISTIVE TECHNOLOGY OUTCOMES IN POSTSECONDARY EDUCATION

It is widely agreed upon that there are functional benefits in the use of assistive technology for individuals with disabilities (Fuhrer, 2001). However, clinicians and researchers have struggled to adopt a unified practice to measure outcomes of intervention (Arthanat, Simmons, & Favreau, 2012; DeRuyter, 1996; Scherer, 1996). This challenge grows especially difficult when looking outside of the major rehabilitation sector to other settings such as education. Assistive technology can be unique in its focus of intervention, accessibility of services, and clientele. According to Section 504 in the Rehabilitation Act of 1973, postsecondary schools must provide means to accommodate students to participate in education including using assistive technology to meet this goal. However, there currently is no assessment measure for assistive technology that considers the unique factors of a postsecondary education setting. The Canadian Occupational Performance Measure (COPM) (Law et al., 2000) has been used to assess the effectiveness of assistive technology. However, modification of the areas of occupation in the COPM is necessary to better reflect areas addressed by assistive technology in a postsecondary education setting. The major finding of this research project is that a modified version of the COPM is a sensitive and useful measure of performance and satisfaction utilizing assistive technology services in a postsecondary education setting.

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# LITERATURE REVIEW

Cook and Hussey (2008) define assistive technology as "a broad range of devices, services, strategies, and practices that are conceived and applied to ameliorate the problems faced by individuals who have disabilities" (p.5). This definition is congruent with Public Law (PL) 108-364, also known as the Assistive Technology Act of 1998. This act, amended in 2004, defines assistive technology as:

> Any item, piece of equipment or product system whether acquired commercially off the shelf or modified, or customized that is used to increase, maintain or improve functional capabilities of individuals with disabilities.

The given definitions have important components in that they define AT as encompassing not only technology itself, but also the services, strategies, and implementation programs occurring with the distribution of these technologies. This is especially important to consider when assessing the positive effects of these technologies. Any technological or common device is more efficiently used with direction, education, or training. Therefore, the inclusion of such services are important to consider when assessing the value of assistive technologies in the lives of individuals with disabilities (Fuhrer, 2001).

## Importance of Outcome Measures

While the use of assistive technology has been shown to impact the performance and participation of individuals of various ages with a wide range of disabilities (Bottos, et al., 2001; Reid, 2002; Cooper & Stewart, 1997; Draffan, Evans, & Blenkhorn, 2007), practitioners and researchers have struggled to agree on measures to assess the outcomes of technology. In the field of assistive technology, outcome measures are used not only to determine the result of the intervention, but also to associate outcomes of the assistive technology and service delivery (Cook and Polger, 2008). This includes services related to the selection, training, and implementation of assistive technology, the client's personal factors such as adaptability and temperament, and the environment in which the device will be used (Tam et al., 2005). In his 1996 article, DeRuyter explained that compared to other practices in the human service industry, outcomes research in assistive technology has experienced a slow start. This has led to challenges regarding customer access to

services, financial barriers, customer dissatisfaction, and abandonment of implemented assistive technologies. The need for outcome measures extends across the progression of assistive technology development, service, and user adoption (Smith, 1996; Fuhrer, 2001).

## Current Measures Used Across Settings

While assessments have been developed to measure change in performance and participation, they do not meet the needs of a variety of settings. For instance, in the realm of rehabilitation the Psychosocial Impact of Assistive Devices Scale (PIADS) aims to assess the influence of social environment faced by assistive technology users in relation to use and the abandonment of assistive technology devices (Day and Jutai, 1996). Additionally, the Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST) was developed to measure the sources of satisfaction and dissatisfaction with assistive technology to determine how specific attributes of the device and assistive technology service influence the user's experience (Demers et al., 1999). While both PIADS and QUEST may have utility in a major rehabilitation setting, other settings including education have complexities that make these outcome measurements less useful.

The differences between setting structure and expectations for intervention using assistive technology in educational settings make measuring outcomes quite different than in rehabilitation. Specific goals of assistive technology intervention in a K-12 school setting are greatly influenced by legislation outlined in the Individuals with Disabilities Education Act (IDEA) amendments of 1997, while services in postsecondary education are influenced by section 504 of the Rehabilitation Act and the Americans with Disabilities Act (ADA) (1990). Such legislation encourages and may mandate areas of intervention be limited to academic performance areas of reading, writing, mathematics; manipulation of educational equipment such as pencils, rulers, keyboards; managing educational materials in a desk, locker, or cubby; and mastering student responsibilities such as engagement in class discussion, note-taking, and task management (Smith, 2000). The educational nature of and mandates specific to school settings require different methods and outcomes than those used in rehabilitation, and thus assessments

such as the PIADS and QUEST are not likely appropriate. While there are some similarities with rehabilitation, assistive technology outcomes in a school setting are narrowed to how the student is able to engage in academic activities. Smith (2000) discussed measuring outcomes in education: "While rehabilitation outcomes overlap with educational outcomes, as health and personal maintenance is relevant for students, domains of outcome in education usually relate more to the performance or participation of a student with the disability in educational settings" (p. 275).

A measure that was developed specifically to assess the outcome of assistive technology in the K-12 school system is the School Function Assessment Assistive Technology Supplement (SFA-AT). This assessment measures a student's performance over time comparing using to not using assistive technology. The practitioner must assess, through skilled observation, the child's initial performance, and assess again four months later (Silverman et al., 2003). While a functional measurement such as the SFA-AT allows the practitioner to assess a student's performance with assistive technology in a school setting, factors once the child exits secondary education and pursues higher education make this assessment more difficult to administer and less beneficial to assess outcomes of assistive technology. While assessments have been developed to measure outcomes of assistive technology services, they do not meet the needs of a variety of settings. This is especially true in assessing outcomes of assistive technology in postsecondary education.

## Postsecondary Education

The attendance of students with disabilities in postsecondary education settings is on the rise (Stodden et al., 2006; Day & Edwards, 1996). Although there are several commonalities between K-12 and postsecondary education, the differences between these settings are significant. In the realm of assistive technology, typical means of use include access to academic areas such as reading, writing, and note taking as well as access to facilities, and school-related programs and activities (Stodden et al., 2006). While services outlined in IDEA help identify assistive technology needs, IDEA does not apply to postsecondary education. Legislation such as Section 504 of the Rehabilitation Act (1973) and the

Americans with Disabilities Act, Title II (1990) both can be referred to in regard to assistive technology services mandated in postsecondary education. Day and Edwards (1996) clarified such legislation explaining section 504 of the Rehabilitation Act mandates that postsecondary institutions make education accessible to all "otherwise qualified" students with disabilities. This includes reasonable accommodations in the form of auxiliary aids such as assistive technology, making such services mandated by law. Furthermore, although the Americans with Disabilities Act (1990) does not specifically address assistive technology, it states that civil rights protection extends to postsecondary students with disabilities. In order to meet the provisions of ADA, the inclusion of available assistive technology services is commonly agreed upon (Day & Edwards, 1996).

Although legislation such as Section 504 and ADA requires colleges and universities to provide services and accommodations to meet the needs of individuals with disabilities, it does not mandate that such institutions identify students with disabilities and take responsibility for assuring students receive needed services. In the postsecondary education environment, the student must self-advocate in disclosing their disability, expressing their needs, and ensuring they are met. Instead of having the support of teachers and therapists as in secondary education, the student takes the responsibility to advocate for their assistive technology needs. This includes seeking out and determining the utility of assistive technology devices and accommodations. The adequacy of services then depends on the skill and resources of the agency through which services are sought to identify needs and solutions for the student.

Along with the pressures of advocacy faced by postsecondary students, the impact of disability can be a factor in seeking assistive technology supports. The physical and social contexts in which students in postsecondary education must compete is quite different than those of their previous educational experiences. Students in this setting are typically transitioning to a life with more independence and autonomy, including living on their own and managing their academic, leisure, and self-care tasks. Often, students face a learning curve in problem-solving strategies to manage their time and prioritize responsibilities. This may be especially true for students with disabilities who face challenges and barriers, who are additionally navigating through academic services and learning

strategies, such as assistive technology, to support their success. A study conducted by Sharpe (2005), addressed the differences among assistive technology used in postsecondary education compared to high school. She found that although the types of assistive technology used in each of these settings were similar, the use of these technologies was significantly greater among postsecondary education students. However, only 22% of college graduates indicated disability support services staff trained them to use assistive technology while an astonishing 74% indicated they taught themselves. This greater amount of self-instruction in the use of assistive technology may be attributed to the lack of one-to-one instruction and support services required by IDEA in secondary education and/or the need for students to be self-advocates in the postsecondary setting. In postsecondary education, students must quickly learn to seek solutions to their needs to avoid academic and financial consequences of lower grade point averages, loss of funding, or reduced future employment opportunities (Sharpe, 2005).

In order to demonstrate the efficacy of assistive technology services in postsecondary institutions, it is necessary to employ a valid outcome measure. However, there currently exists a significant gap in literature determining such a measure appropriate for assessing gains from assistive technology use in this setting. Given the focus on academic areas of performance and participation, as well as the autonomy of a student in higher education, many current measures used in other settings are not suitable for higher education.

Recently, there has been increasing research in the use of a clinical measure for occupational therapy in the outcome assessment of assistive technology. The Canadian Occupational Performance Measure (COPM) (Law et al., 2000) has proven and documented utility in the assessment of assistive technology (Carswell, 2004). It is hypothesized that a modified version of this assessment, focusing on the academic areas of performance in a postsecondary education setting, is a sensitive measure to assess assistive technology outcomes.

## Canadian Occupational Performance Measure

The COPM was developed in 1991 and has since been used in a number of occupational therapy practice settings. It is a standardized measure and has been extensively studied for reliability and validity (Carswell et al., 2004). Conducted in a semi-structured interview format at the initiation of occupational therapy services, the client is asked to identify and prioritize areas of concern in occupations including self-care, productivity and leisure. Once these areas are identified, clients rate the importance (from 1-10, higher ratings suggest higher importance) of such occupations and pick up to five areas to focus on during therapy. Clients are then asked to rate their satisfaction and perceived performance in these chosen areas. Performance and satisfaction scores are then each averaged over the number of addressed concerns. Initial data serve as a baseline, and can be used to guide intervention. The difference between the baseline and re-administration scores in the same performance areas (change scores) are used as one measure of outcomes of intervention (Law et al., 2000).

In 2004, Carswell et al. conducted a literature review of the COPM. In this review, thirty-three articles were collected and analyzed that used the COPM as an outcome measure. Among the research articles identified were varied experimental designs, client populations, and intervention techniques. It is significant to note that six articles were acknowledged in evaluating the effectiveness of "specific devices or innovative therapeutic approaches." These included the use of a rigid anterior pelvic device for children with cerebral palsy (Davis et al., 1998), early use of a powered wheelchair in children with tetraplegia (Bottos et al., 2001), and vision technology services (Petty & Treviranus, 2003). These studies demonstrated the ability of the COPM to measure change after the initiation of assistive technology intervention. In addition to Carswell's review, other studies have effectively used the COPM to measure outcomes of assistive technology. These include studies on the use of word cueing technology in children with physical and learning disabilities (Tam et al., 2005) and the use of word prediction software for children with spina bifida and hydrocephalus (Tam et al., 2002). The successful use of the COPM to measure outcomes for such studies that included the use of assistive technology supports its usefulness as a standard outcome measure for assistive technology interventions.

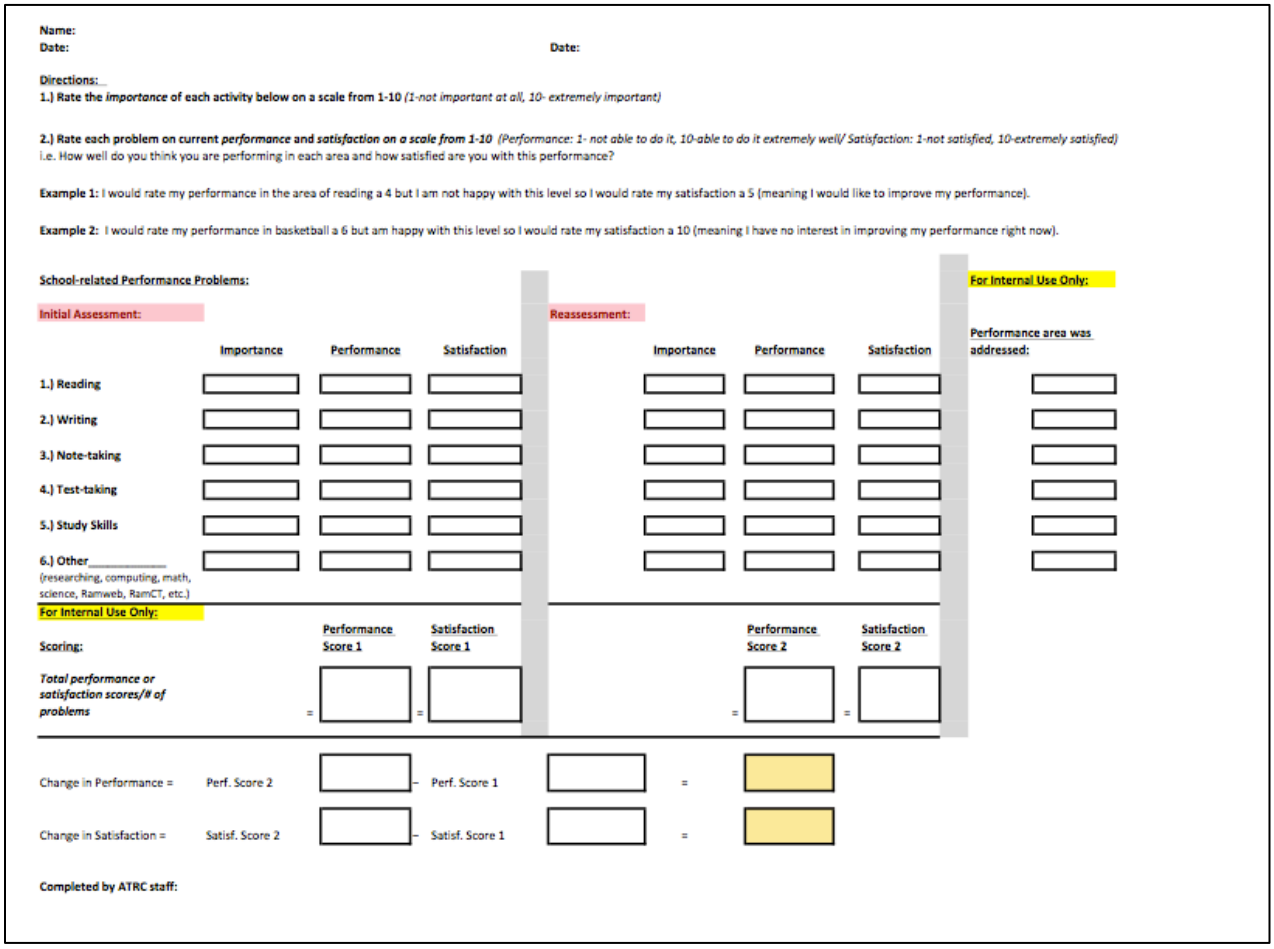
*Modified Canadian Occupational Performance Measure*

Although there is documented utility in the use of the COPM to measure outcomes of assistive technology, an argument may be made regarding the spectrum of areas it covers. Cook and Polger (2008) reported the use of the COPM was "somewhat limited unless the client was asked to think about goals that specifically involved the use of assistive technology" (p.120). Studies have used modified versions of the COPM (mCOPM) in the assessment of intervention outcomes (Di Rezze et al., 2008; Roberts et al., 2014), each narrowing the areas of occupation to be addressed. Due to the specific academic nature of a postsecondary setting, the varieties of occupational areas that are appropriate to address are best narrowed to those based in academic performance. The COPM may provide the most relevant information if areas of occupation are modified to address specifically the needs within academia. The Assistive Technology Resource Center at Colorado State University also developed a modified version of the COPM to assess outcomes of assistive technology intervention, the Assistive Technology Resource Center Modified Canadian Performance Measure (ATRC-mCOPM). Modifications include narrowing down areas of occupations to those related to academia, including reading, writing, note-taking, test taking, and study skills and prompting clients to rate each area in importance, perceived performance, and satisfaction. In addition to these academic areas, a 6$^{th}$ area is an option for students to include any other area they feel is important to their success as a postsecondary student, such as research, mathematics, computer access, etc. (Please see the entire ATRC-mCOPM in Figure 1.)

While the ATRC-mCOPM has been considered useful by the ATRC to assess outcomes of services, it lacks research justifying its utility in the postsecondary setting. Also, there is a need to demonstrate utility of the mCOPM as a self-administered online post-assessment.

The primary hypothesis of this study is that the COPM, modified to assess the specific areas of occupation assistive technology can support in a postsecondary setting, is a measure sensitive to the change in self-perceived performance and satisfaction for students in higher education. A secondary hypothesis is that the results of the post-test mCOPM will correlate with those of the ATRC's post-intervention web-based survey, an instrument developed to gain feedback from students regarding their

experience using assistive technology. Finally, this study also explored the equivalent-forms reliability of the mCOPM as a self-administered online post-test measure.



Name:
Date: Date:

Directions:
1.) Rate the *importance* of each activity below on a scale from 1-10 *(1-not important at all, 10- extremely important)*

2.) Rate each problem on current *performance* and *satisfaction on a scale from 1-10* *(Performance: 1- not able to do it, 10-able to do it extremely well/ Satisfaction: 1-not satisfied, 10-extremely satisfied)*
i.e. How well do you think you are performing in each area and how satisfied are you with this performance?

**Example 1:** I would rate my performance in the area of reading a 4 but I am not happy with this level so I would rate my satisfaction a 5 (meaning I would like to improve my performance).

**Example 2:** I would rate my performance in basketball a 6 but am happy with this level so I would rate my satisfaction a 10 (meaning I have no interest in improving my performance right now).

School-related Performance Problems:

For Internal Use Only:

| Initial Assessment: | Importance | Performance | Satisfaction | Reassessment: | Importance | Performance | Satisfaction | Performance area was addressed: |
|---|---|---|---|---|---|---|---|---|
| 1.) Reading | | | | | | | | |
| 2.) Writing | | | | | | | | |
| 3.) Note-taking | | | | | | | | |
| 4.) Test-taking | | | | | | | | |
| 5.) Study Skills | | | | | | | | |
| 6.) Other_____ (researching, computing, math, science, Ramweb, RamCT, etc.) | | | | | | | | |

For Internal Use Only:

| Scoring: | | Performance Score 1 | | Satisfaction Score 1 | | Performance Score 2 | | Satisfaction Score 2 |
|---|---|---|---|---|---|---|---|---|
| *Total performance or satisfaction scores/# of problems* | | = | | = | | = | | = |

| | | | | | | |
|---|---|---|---|---|---|---|
| Change in Performance = | Perf. Score 2 | | – | Perf. Score 1 | = | |
| Change in Satisfaction = | Satisf. Score 2 | | – | Satisf. Score 1 | = | |

Completed by ATRC staff:

Figure 1- Assistive Technology Resource Center Modified Canadian Occupational Performance Measure (ATRC-mCOPM)

# METHODS

## Objectives

This study aimed to answer the following questions:

1. Is the ATRC-mCOPM a measure sensitive to change in the assessment of assistive technology service delivery in a postsecondary education setting?
2. Is there a correlation between items of the mCOPM and items of the ATRC post-intervention web-based survey?
3. Are the results of a self-administered online ATRC-mCOPM post assessment equivalent to a staff administered version?

## Participants and Setting

Participants in this study were from a convenience sample comprised of university students referred to the ATRC from the University's Office of Resources for Disabled Students. Of the 109 students who actively received services from the ATRC for the entire Fall 2014 semester, 35 students gave written consent according to Colorado State University Institutional Review Board procedure, to participate in the study and followed through with all assessments. Demographics of participants are illustrated in Table 1.

## Instruments

Upon initiation of services, students completed the Canadian Occupational Performance Measure (COPM), modified by the ATRC (ATRC-mCOPM) to specify occupations related to the role of a student using assistive technology, including reading, writing, note-taking, test-taking, and study skills. At the initial administration of the ATRC-mCOPM, and according to the standard protocol for the COPM, students were prompted by an ATRC staff member to rate the importance, perceived performance, and satisfaction with performance in each area using a scale form 1-10. On this scale, a score of 1 represents no importance, inability to perform, and extreme dissatisfaction; a score of 10 represented vital

importance, very effective performance, and complete satisfaction with performance. Scores for performance and satisfaction in each of the five areas are usually averaged to determine separate total scores for performance and satisfaction. For the purposes of this study, scores for each domain of satisfaction and perceived performance were used as data points to represent the student's baseline scores. At the end of the semester, after assistive technology assessment and implementation took place, the ATRC-mCOPM was administered as a posttest, by the same staff member who provided his/her assistive technology services.

One day after completing the ATRC-mCOPM post-assessment, participants were sent a URL and asked to complete the ATRC post-intervention web-based survey using Survey Gizmo online survey service. This survey includes several questions regarding the participant's experience with the ATRC, the use of assistive technology to promote their performance and participation in coursework, and services that support its use. The link to the ATRC post-intervention survey was sent to the user's e-mail account and included a separate link to an online version of the ATRC-mCOPM, asking participants to rate their performance and satisfaction in the same five academic areas - this time completing the mCOPM independently instead of with their ATRC staff member.

## Procedure (Data collection)

As students completed the initial ATRC-mCOPM as a pretest during their initial intake with staff, results were documented on the ATRC-mCOPM's score sheet, stored within the client's folder, and compiled in a secure Microsoft Excel file linking data to individual participant numbers and removing participant names to preserve confidentiality. Throughout the assistive technology service delivery process, client's worked with the same staff member. As participants completed the ATRC-mCOPM posttest with the staff member, and the ATRC post-intervention online survey, their results were stored in the same Excel file. Finally, responses to the repeated posttest ATRC-mCOPM administered online were stored and used to explore the equivalent-forms reliability of the staff administered and online version of the ATRC-mCOPM.

## Study Design and Data analysis

This study was configured as a 2 X 2 factorial design with repeated measures on the second variable (pretest – posttest). The two levels of the grouping variable were determined based on self-reported frequency of use of assistive technology – either daily or once weekly to once monthly. Considering multiple dependent variables, between-groups and within-subjects effects were analyzed via a repeated-measures multivariate analysis of variance (MANOVA). Pearson product moment correlations were used to evaluate relationships between outcomes of the mCOPM and the ATRC post-intervention survey. Correlation coefficients above .75 were interpreted as good to excellent strength, .50 to .75 as moderate to good strength, .25 to .50 as fair strength, and 0.00 to .25 as no or a very weak relationship (Portney & Watkins, 2000). Finally, the intra-class correlation coefficient was used to analyze the equivalent-forms reliability of the in-person versus online administration of the ATRC-mCOPM.

Table 1
Descriptives by Group

| | **Daily AT use *n*= 14** | | **Weekly-Monthly AT use *n*= 21** | |
|---|---|---|---|---|
| | *n* | % | *n* | % |
| **Gender** | | | | |
| Male | 3 | 21.42 | 5 | 23.8 |
| Female | 11 | 78.57 | 16 | 76.19 |
| **Year in school** | | | | |
| Freshman | 2 | 14.29 | 5 | 23.8 |
| Sophomore | 1 | 7.14 | 4 | 19.04 |
| Junior | 1 | 7.14 | 1 | 4.76 |
| Senior | 4 | 28.57 | 2 | 9.52 |
| Second Bachelor | 1 | 7.14 | 1 | 4.76 |
| Graduate | 5 | 35.71 | 8 | 38.09 |
| **Semesters with ATRC services** | | | | |
| 0 | 6 | 42.85 | 12 | 57.14 |
| 1 | 3 | 21.42 | 3 | 14.28 |
| 2 | 1 | 7.14 | 3 | 14.28 |
| 3 | 2 | 14.29 | 2 | 9.52 |
| 4 | - | - | - | - |
| 5 | - | - | 1 | 4.76 |
| >5 | 2 | 14.29 | - | - |
| Non-traditional | 3 | 21.42 | 4 | 19.04 |
| **Academic College** | | | | |
| Health and Human Services | 3 | 21.42 | 7 | 33.33 |
| Liberal Arts | 2 | 14.29 | 3 | 14.28 |
| Engineering | - | - | 1 | 4.76 |
| Natural Resources | 1 | 7.14 | 4 | 19.04 |
| Intra-programs | - | - | 2 | 9.52 |
| Agriculture Sciences | 5 | 35.71 | 4 | 19.04 |
| Veterinary Medicine and Biomedical Science | 2 | 14.29 | - | - |
| Business | 1 | 7.14 | - | - |
| **Primary Diagnosis** | | | | |
| Learning Disability | 5 | 35.71 | 9 | 42.85 |
| ADD/ADHD | - | - | 4 | 19.04 |
| PTSD | - | - | 2 | 9.52 |
| TBI | 3 | 21.42 | 2 | 9.52 |
| Autism | 1 | 7.14 | - | - |
| Orthopedic Impairment | 1 | 7.14 | 1 | 4.76 |
| Depression | - | - | 1 | 4.76 |
| Irlen's Syndrome | - | - | 1 | 4.76 |
| Pregnancy | - | - | 1 | 4.76 |
| **Language challenges** | 1 | 7.14 | - | - |
| **Visual Impairment** | 2 | 14.29 | - | - |

# RESULTS

The ATRC-mCOPM pre and post assessments as well as the ATRC post-intervention survey were completed by 35 students who were instructed in the use of assistive technology over the course of one semester. These students were subsequently divided into two groups based on frequency of use: 14 students who reported using assistive technology daily and 21 students who used assistive technology weekly to monthly. (See Table 1 for descriptive information per group.) The multivariate analysis showed a significant main effect between the pre and post assessment in all five domains of Perceived Performance ($p<.001$) and Satisfaction ($p<.001$). Additionally, the interaction of pre and post Perceived Performance and frequency of use (daily versus weekly/monthly) was significant ($p = 0.054$), yet there was not a significant interaction between pre and post Satisfaction scores and how often participants used assistive technology (see Table 2). When looking at the individual Perceived Performance domain areas of the ATRC-mCOPM, significant interactions were found in the domains of Writing ($p = 0.036$), Test Taking ($p = 0.035$), and Study Skills ($p = 0.046$). (See Table 3 for significance levels for all five domains.)

Table 2
Multivariate Analysis: Significant Results

| **Main Effect or Interaction** | ***p*-value** |
|---|---|
| PrePostPerf main effect | <.001** |
| PrePostPerf by HowOften interaction | .054* |
| PrePostSatis main effect | <.001** |
| PrePostSatis HowOften interaction | .129 |

*significant at 0.05 level; **significant at .001 level.

Table 3
Univariate Significance Levels for Perceived Performance

| mCOPM Domain | Frequency-of-Use Gp | Pretest Mean (SE) | Post-Test Mean (SE) | Pre-Post Mean Difference* | PrePost X Gp Interaction *p* |
|---|---|---|---|---|---|
| Reading Performance | Weekly-Monthly | 5.452 (.460) | 7.190 (.399) | 1.74 | |
| | Daily | 5.231 (.585) | 7.846 (.507) | 2.62 | 0.199 |
| Writing Performance | Weekly-Monthly | 6.881 (0.42) | 7.595 (0.292) | 0.71 | |
| | Daily | 6.154 (0.534) | 7.769 (0.371) | 1.62 | 0.036* |
| NoteTaking Performance | Weekly-Monthly | 6.952 (.492) | 7.786 (.368) | 0.83 | |
| | Daily | 5.846 (.625) | 7.846 (.468) | 2.00 | 0.112 |
| TestTaking Performance | Weekly-Monthly | 6.976 (.409) | 7.524 (.316) | 0.55 | |
| | Daily | 6.077 (.519) | 7.846 (.401) | 1.77 | 0.035* |
| StudySkills Performance | Weekly-Monthly | 7.19 (.464) | 7.905 (.339) | 0.72 | |
| | Daily | 5.462 (.589) | 7.462 (.430) | 2.00 | 0.046* |

*Interaction significant at $p = .05$ level; main effects of time (domain pre-post mean differences) significant at the p<.001 level

Domains of the ATRC-mCOPM in Perceived Performance and Satisfaction were correlated with 10 questions on the ATRC post-intervention survey. (See Table 4 for *r* values and percent of variance explained for each correlated pair). Two questions showed moderate correlation with both Perceived Performance and Satisfaction in the Reading domain. These questions referenced the user's ability to independently use assistive technology to meet his/her needs (independent use with Reading Perceived Performance $r$=0.557, independent use with Reading Satisfaction $r$=0.524). Fair strength correlations with the Reading domain include user's comfort asking instructors and faculty for accommodations (comfort asking for accommodations with Reading Perceived Performance $r$=0.424, comfort asking for accommodations with Reading Satisfaction $r$=0.419) and the user's comfort requesting class documents that work best for their learning style and assistive technology (comfort requesting class documents with Reading Perceived Performance $r$=0.450, comfort requesting class documents with Reading Satisfaction $r$=0.423). Additionally, the user's view that the assistive technology positively impacted their ability to succeed and remain in courses correlated with both Perceived Performance ($r$=0.488) and Satisfaction (r=0.490) in the domain of Study Skills, as well as Test-Taking Satisfaction (r=0.400).

Table 4
Significant Correlations between the ATRC-mCOPM areas and the ATRC User Survey

| Correlating factors | Correlation Strength ($r$) | % Variance ($r^2$) |
|---|---|---|
| Reading performance and independently able to use AT to meet needs | .557 | .31 |
| Reading performance and comfort asking instructors and faculty for accommodations | .424 | .179 |
| Reading performance and comfort requesting class documents that work best for learning style and AT | .450 | .202 |
| Study skills performance and AT positively impacted grade | .488 | .238 |
| Reading satisfaction and independently able to use AT to meet needs. | .524 | .274 |
| Reading satisfaction and comfort asking instructors and faculty for accommodations | .419 | .175 |
| Reading satisfaction and comfort requesting class documents that work best for learning style and AT | .423 | .178 |
| Test taking satisfaction and AT positively impacted ability to succeed and remain in courses. | .400 | .160 |
| Study skills satisfaction and assistive technology positively impacted ability to succeed and remain in courses. | .490 | .240 |

Finally, the intra-class correlation (ICC) was assessed between the staff administered ATRC-mCOPM and the self-administered online ATRC-mCOPM to determine the equivalent-forms reliability. This analysis showed moderate to strong reliability with an inter-item correlation of $r$=0.664.

# DISCUSSION

Results from this study showed that the ATRC-mCOPM is a measurement tool sensitive to change in perceived performance and satisfaction during one semester of assistive technology services among postsecondary students with disabilities. All five domains in both performance and satisfaction of the ATRC-mCOPM showed significant change in scores, demonstrating its effectiveness to measure outcomes. To specify outcomes related to frequency of use of assistive technology service delivery, results additionally showed the more often students reported using assistive technology the greater scores for perceived performance increased in three perceived performance domains (Writing, Test-Taking, Study Skills). Interestingly, although reading and note-taking assistive technology is the most popularly recommended assistive technology to students in the Assistive Technology Resource Center at Colorado State University, perceived performance in these two domains showed no significant change over time regarding high versus low use. One must consider the possibility that beneficial effects of assistive technology targeting Reading and Note-taking may be more obvious to students, and more likely measured in other domains like Writing, Test-Taking, and Study Skills.

While results are promising for the ATRC-mCOPM's ability to measure change in perceived performance related to the frequency of use of assistive technology, results relating to the frequency of use and change in satisfaction did not show significance. This suggests that the frequency at which students use assistive technology is not associated with change in satisfaction with performance in the various domains. However, it is important to consider the student's level of need for AT relative to the level of difficulty of course work. In the beginning of the semester, experiencing milder academic challenges, students may report high levels of satisfaction as a baseline measurement. Considering a lack of change in a student's disability over a semester, overall satisfaction also may not change. It may be reasoned that that students with milder disabilities may not need to use their assistive technology as often as those with more serious disabilities, yet would have their needs met and be satisfied with this less frequent use. Therefore, to supply further evidence for the effectiveness of the ATRC-mCOPM to

measure satisfaction outcomes, level of disability should be controlled in comparisons based on frequency of use.

The correlation results between the ATRC-mCOPM and questions from the ATRC post-intervention survey revealed additional insight on the effectiveness of the ATRC-mCOPM as a tool to measure outcomes of assistive technology services in postsecondary institutions. Both the Perceived Performance and Satisfaction components of the assessment significantly correlated with similar-themed questions on the survey including, associations with independence using assistive technology, asking for accommodations, and requesting class documents to meet learning style and assistive technology needs. These correlations make sense in that assistive technology related to reading is one of the most recommended and utilized assistive technology solutions for students receiving services through the ATRC. A student who believes his or her performance has improved because of assistive technology, and is satisfied with this improvement would be inclined toward self-advocacy. This is an encouraging finding considering the heightened need for self-advocacy in seeking accommodations in postsecondary education (Sharpe, 2005). Additionally, the many types of reading technology offered by the ATRC give the student more options to find a solution that meets their needs and learning style, promoting their ability to use the technology independently. Many reading programs require the student discuss their needs with their instructors in order to get reading materials in formats that are compatible with their reading technology. These results suggest that important targets of assistive technology in postsecondary education were impacted, and that the ATRC-mCOPM was effective in capturing these aspects of performance and satisfaction.

Furthermore, both the Perceived Performance and Satisfaction components of the ATRC-mCOPM significantly correlated with the ATRC post-intervention survey question relating to retention and success in classes. This suggests if a student perceives that assistive technology services helped improve performance, and the student is satisfied to a greater degree with this performance, that improved study experiences and success in school are likely. This effect with postsecondary students with learning disabilities was outlined in a 3-year study that found positive academic outcomes due to training and

implementation of assistive technologies. Results included increased GPAs in courses with a heavy load of reading or writing, low attrition rate over the 3 year period, similar incomplete and withdrawal rates to the control group yet increased rates of repeating classes until a satisfactory grade was achieved, and finally higher first time passage rates on the Upper Division Written Proficiency Examination (Raskind & Higgins, 1998). If a student using assistive technology feels satisfied with their technology and its ability to increase their performance, they are more likely to persevere to succeed in areas where they struggle. By correlating with these factors of the survey, the ATRC-mCOPM demonstrated effectiveness to capture how assistive technology effects retention and postsecondary success.

Finally, addressing the efficacy to gather outcome data in a postsecondary education setting, results comparing the staff administered and online, self-administered ATRC-mCOPM showed moderate to strong agreement. This suggests the scores gathered by the staff and those gathered electronically in the self-assessment produce similar results, justifying post-intervention data collection in either format. This reliability check for the online version of the ATRC-mCOPM is important to consider as a solution to the concern regarding the difficulty getting students to meet with staff to complete a post-intervention assessment.

While the modification of the COPM was unique to this study, other modified versions of the COPM have been used to assess the outcomes outside the field of assistive technology. Di Rezze et al. (2008) modified the COPM to direct participants to choose from a menu of occupational tasks related to their intervention of life skill social groups. Participants then rated the importance, perceived performance, and satisfaction of the chosen areas. This modified version of the COPM showed significant median pre-to-post differences in perceived performance and satisfaction, demonstrating its sensitivity to change. This provides further evidence of the efficacy of the COPM to measure outcomes given modification to its administration procedures and narrowing of occupational tasks, like the ATRC-mCOPM.

Results using the ATRC-mCOPM were additionally similar to other studies that have used the traditional COPM to assess outcome specific to assistive technology. In fact, the COPM is currently used

in some settings as a reliable outcome measure, satisfying the needs of program development and accountability to funding agencies (Petty, McArthur, & Treviranus, 2005). The utility of the COPM to assess outcomes of assistive technology is further supported by Bottos et al. (2001), who found success using the COPM to determine changes in daily life after the implementation of power wheelchairs for children with tetraplegia. After gathering baseline data, this study found significant increases in both perceived performance and satisfaction ($p<0.0001$). Additionally, Tam et al. (2005) had like findings when using a modified COPM to assess the outcomes of word-cueing technology for school-aged children. After discussing occupational concerns with tasks related to writing, participants rated the importance, perceived performance, and satisfaction in these addressed areas. Post intervention data were then collected showing statistical significance in both perceived performance and satisfaction.

## LIMITATIONS AND FUTURE RESEARCH

A number of limitations must be noted in this study. The sample size was small and biased. It is likely that students who participated felt confident, in control, or capable enough of progressing in their studies that they could afford what they might have perceived as extra time involved. In contrast, those who opted out perhaps felt they could not give up the increased time that they thought might be required. This is essentially a self-selection problem, which is especially problematic when measuring self-perception of performance and satisfaction. One cannot purport to measure the beneficial effect of assistive technology on all students with disabilities if data are not collected from those feeling more overwhelmed by their need for accommodations. Additionally, while this study clearly demonstrates a main effect of time on both perceived performance and satisfaction, without a control group, internal validity suffers. A *post hoc* frequency-of-use grouping was used to allow a quasi "alternative-group" comparison and offer support for the validation of the sensitivity of the ATRC-mCOPM to measure change as a consequence of assistive technology interventions. However, this attribute grouping based on frequency of use was problematic in that not all assistive technology interventions require daily use to be effective and affect performance and satisfaction. So it might have been a somewhat erroneous assumption that more frequent use should increase the strength of the intervention and result in higher self-perceived performance and satisfaction. This might explain the lack of significant between-groups differences in some domains of perceived performance and all domains of satisfaction. Finally, there is a limitation in the time frame in which this study conducted pre and post assessments. It is noted that some students take longer to gain proficiency in the use of implemented assistive technology. Therefore, pre and post assessments being conducted within the fall 2014 semester may not have allowed ample time for students to gain proficiency and reach the full benefit of using assistive technology. It may further be noted that not all students received the pre-assessment and intervention at the same time. Some students had not received assistive technology intervention until up to halfway through the semester. This poses a

threat to the fidelity of intervention because not all students were allotted the same amount of time to gain proficiency and implement assistive technology into their daily lives.

It is recommended that future research further explore the use of the ATRC-mCOPM to assess the assistive technology outcomes in postsecondary education. An area that warrants further investigation includes the analysis of the rating of importance of each domain in relation to changes in performance and satisfaction. This study did not include the importance-rating scale because its primary use in the ATRC has been to guide intervention. However, including this scale may uncover additional insightful data relating to change in areas specifically important to the student. Additionally, the sixth optional area of performance where the student may include an area not outlined in the other five domains, was not included in this study. This was due to a small sample of students and large amounts of missing data in the optional category. It would be beneficial for future studies with a larger sample size to include this element of the assessment. Finally, it may also be beneficial for future studies to compare the results of the ATRC-mCOPM with those of a more objective measure. Due to its emphasis on client report of perceived experiences, the ATRC-mCOPM may not meet the needs of all postsecondary education settings. Therefore, further exploration of appropriate measures of assistive technology outcomes in postsecondary education is warranted.

# CONCLUSION

It was found that the COPM could be modified to meet the needs of a postsecondary education setting and still be sensitive to change in perceived performance and satisfaction. It was further identified that daily use of assistive technology may result in increased perceived performance in the domains of writing, test-taking, and study skills. Furthermore, perceived performance and satisfaction scores in the domain of reading correlated with areas of the ATRC post-intervention survey regarding independently using assistive technology, comfort asking for class accommodations, and requesting class documents that are compatible with learning style and assistive technology. Finally, perceived performance and satisfaction scores in study skills as well as satisfaction with test taking all correlated with the survey question relating to assistive technology impacting success and persistence in classes. In all, these correlations between the ATRC-mCOPM and the ATRC post-intervention survey provide a rich postsecondary education environmental context for the basic performance and satisfaction measures used in the COPM. These results suggest that the ATRC-mCOPM is a useful and sensitive tool and should be considered as a measure for assessing assistive technology-related outcomes in higher education either in its staff-administered or self-administered, online format.

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