

**The Development of a Measurement Tool for Mastery of Assistive Technology**

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### **Abstract**

This report describes the development of a survey tool used to measure and assess “mastery of assistive technology”. A Delphi Panel comprised of experts in the area of Assistive Technology (AT) was gathered to explore the question of “What is mastery of AT?” For the purposes of this study, mastery was defined as becoming a “power user” of AT. Panelists were asked to identify what characteristics are associated with being a power user of AT. The panel gave these characteristics Likert Scale rankings as to their applicability as a predictor of becoming a power user and as an indicator of having become a power user. The rankings were compared, and the panel was asked to revisit the rankings in order to identify the most important factors. The panel identified 12 predictors and 14 indicators that they felt were highly predictive of becoming a power user or indicative of being one. These factors were analyzed and found to coalesce around four constructs or areas of mastery: (1) Experience (Usage) with AT; (2) Proficiency with AT; (3) Knowledge of AT; and (4) Personal Connection with AT. An online survey-based tool for measuring AT mastery was developed based on these constructs and presented to the panel for feedback and critique.

Key words: Assistive Technology, Delphi Study, Mastery of Assistive Technology, Assistive Technology

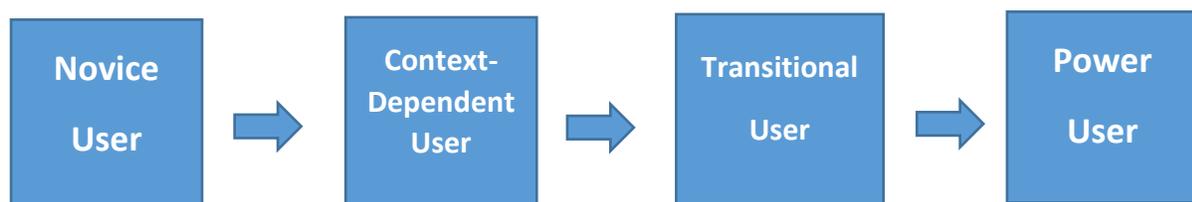
Outcomes

## Introduction

As society looks to the future of work in the 21<sup>st</sup> Century, it inevitably encounters the question: How can people with disabilities be successful in a workplace that depends heavily on technology? Currently, people with disabilities can use assistive technology (AT) to help them accomplish what they might not be able to do otherwise. For instance, an employee who struggles with spelling can use speech-to-text tools to dictate emails and reports. A struggling reader can use a text reading software tool to have text read to them. But will a greater level of mastery of technological skills be required to be able to find and keep appropriate employment in the future? If so, how will this requirement shape how people with disabilities are prepared for working, given that each person with a disability faces different challenges and possesses unique abilities? Additionally, how will their progress toward mastery be measured? How will their success be realized?

This study sought to explore the concept of a *Continuum of AT Use* (see Figure 1 below) as a way of thinking about how people with disabilities come to master their AT. “Mastery” involves the use and experience with technology such that it becomes an extension of the individual user. Reaching full mastery may be referred to as becoming a “power user”. This is because of the power and impact the technology provides. The process also involves fitting the technology to the individual as well as to the workplace, so that the AT actually helps the individual perform their work tasks successfully.

**Figure 1. Continuum of AT Mastery**



## Impact

This project addressed one of the National Science Foundation's 10 Big Ideas, namely The Future of Work at the Human-Technology Frontier. The workplace of the 21<sup>st</sup> Century is one that relies heavily on technology. If we are shaping an inclusive society, we must grapple with the issue of how we will accommodate people with disabilities into these present and future work settings. Persons with disabilities have unique gifts and talents. Connecting these individuals to sustainable competitive employment in the years ahead will likely involve a customized approach to technical preparation as they transition to the world of work.

Central to the process of preparing individuals with disabilities for this workplace is helping them develop mastery of the AT they will use. They will need this AT in order to be productive workers and successfully engage in the teams and problem-solving activities in their future work settings. In order to prepare and support them, VR counselors, transition specialists, and others will need a framework for assessing mastery of AT and for charting a path forward toward mastery for their charges.

This project has suggested a framework for addressing the issue of mastery of AT and has developed a tool to measure that progress. With such a tool, VR counsellors, transition specialists, employers, parents, therapists, and teachers can identify their individual's current level of AT mastery. The tool also helps describe what the next step, or stage, in their journey toward AT mastery looks like. With this tool, strategies can be shaped to help the individual progress toward the next stage in their development of AT mastery.

### What is Mastery of Technology?

Going back to the 1980's, training models have suggested that the development of mastery of any skill is a process. Individuals proceed through a series of stages or levels of competence in a journey

from being a novice to the achievement of mastery of any particular skill (Attri, 2017). However, progress toward mastery involves several areas. Among these are usage or practice, proficiency, knowledge, and individual connection.

Dreyfus and Dreyfus (1986) observed that mastery is an ongoing process of development which involves **practice and experience**. In that model, the individual progresses through a series of stages from “novice” to “expert” in which they build skill, attain situational awareness, develop *discretionary judgement* regarding the skill, and develop an intuitive approach to decision making.

Atherton (2013) suggested a four-stage model of achievement of mastery which focuses upon the **development of creativity**. The individual moves from stages of greater to lesser context-dependency as a sense of flexibility and adaptability emerge as the individual becomes more independent in problem solving and application of the skill.

Mastery involves the development of skill and the ability to apply technology, but it also involves **internalization of this knowledge and capacity**, to the level of unconscious competence (Langvin, 2012) where the individual has developed skill that has become automatic and does not stop to think about what should be done. Dreyfus (2004) suggested that expertise also involves a process whereby decision making moves from analytical to an intuitive dimension that is the result of an automaticity in **the individual’s connection** with their AT.

### **Assistive Technology Mastery**

Most studies of AT outcomes have tended to focus upon product efficacy or whether or not individuals use AT, rather than the quality of that use (Alper & Raharinirina, 2006; Sauer, Parks & Heyn, 2010). Studies that focus upon AT competence and skill have focused upon teachers and caregivers, and not individuals with disabilities (Alabbas & Miller, 2019; Blackhurst, et al., 1999; Lahm & Nickels, 1999, Zou, et al., 2012). Yet, a few studies suggest that experience with AT in high school leads to improved postsecondary education outcomes. Satterfield (2018) found that students with disabilities who had become comfortable with the AT they used in high school had greater likelihood of maintaining or

improving upon high school GPA when they went to post-secondary institutions. Poudel (2014) suggested that students with high incidence disabilities who became experienced users of AT while in high school reported improvements in their academic performance and positive outcomes in college.

Nevertheless, it is not yet known how this might translate to the workplace. What are the relationships between AT mastery level and hiring outcomes, or between AT mastery and job performance? As students transition from K-12 settings to work or to post-secondary education, the locus of decision making and control over AT shifts from the school's IEP team squarely to the student. It is important for students to discover what AT works for them, to develop the skills and knowledge to use their AT, and to develop the capacity for self-advocacy with regard to the AT they will need to use (Alper & Raharinirina, 2006).

### ***What does mastery of AT look like?***

Mastery is a process that involves the movement of the locus of motivation from external to internal. Deci & Ryan (2000) have suggested that in our social and physical dimensions, as people encounter and wrestle with daily challenges, we develop competence and mastery. This process involves the discovery of the actions that lead to success and the development of skills to perform those actions. As we build patterns of action that result in success, the positive feedback we experience reinforces our intrinsic motivation – particularly as we build successful patterns independently.

In learning how to use AT, students should receive training and support to fit their unique functional needs and goals. Best practice suggests that demonstration with modelling, and opportunities to practice with feedback and positive reinforcement are essential (Darling-Hammond, Hylar & Gardner, 2017). Successful use of an AT tool involves the development of strategies for how and when to employ the tool. How to use the tool is but one aspect. Making use of the tool to accomplish a specific task is another. With an individual with a disability, discovering how he or she will use the tool to maximum personal benefit is paramount. This process necessarily relates to the personal goals and the assigned tasks the individual faces (Haven, 2019).

For a time, continued support is important for the student to learn how and when to use the AT tool. But ultimately, the focus must shift from guided and directed use to autonomous use. The motivation needs to shift from external to intrinsic (Deci & Ryan, 2000; Deci, et al., 1991). The concept of mastery of AT is important as we seek to empower transition age youth for success at the next level. However, this currently remains an abstract concept. Nevertheless, there may be elements that are associated with mastery of AT.

### ***Mastery by persons with disabilities***

Serving individuals with complex communication needs (CCN), Light (1989) described four areas in which users of augmentative and alternative communication (AAC) systems would need to develop competence in order to communicate effectively. These areas of communication competence involved (1) operational, (2) strategic, (3) social, and (4) linguistic (functional) competencies (Light, 1989). While individuals who use assistive technology (AT) each face a unique set of challenges, these competencies form the basis for the development of a structure for understanding mastery of AT.

Zabala, Bowser & Korsten (2005) observed that Light's construct would apply directly to use of AT tools. Operational competency applies to activating the technology and effectively accessing it. Strategic competency applies to the skills associated with effectively using the system to obtain desired ends. Social competency relates to use of the tool to foster connection and interaction with others. Functional competency relates to the "telos" or the reason for use of that tool. Within AAC this involves linguistic skill. For a wheelchair user this area is more about mobility. For all users of AT, functional competency is related to the technology they use.

### **How does one come to mastery of AT?**

An AT-related framework that begins to examine the process of developing mastery is the Continuum of Communication Independence (Brady, et al., 2012). This tool was developed by Patricia Dowden to describe the progression of stages through which individuals with CCN pass on their way to being independent communicators. The stages include (1) emergent, (2) emergent-transitional, (3)

context-dependent, (4) transitional-independent, and (5) independent. Each stage consists of descriptive communicative behaviors and skills that define that stage. That framework elaborates upon Light's Four Competencies (1989) by presenting a continuum of profiles that build toward efficient use of an AAC device.

For example, an "emerging" communicator lacks a consistent means to communicate thoughts or ideas. Instead, an emergent communicator uses gestures, body movements and facial expressions to communicate acceptance, rejection, or need. A context dependent communicator typically has the ability to communicate concepts and ideas effectively, but only within specific contexts or when engaged with familiar partners. An independent communicator is able to talk about ideas and express thoughts across all contexts and partners. Typically, the individuals with CCN in these profiles are using, or learning to use, a communication system (AAC).

The Continuum of Communication Independence serves teachers, families, and therapists as a framework for identifying where students are in their progress toward communication independence and helps them identify appropriate strategies and supports for working with students with CCN. However, it also provides a framework for a general AT mastery. Craddock (2006) proposed a similar, three-stage view of mastery of technology in education: (1) Novice; (2) Transitional User; and (3) Power User. Dreyfus & Dreyfus (1980) had earlier posited a framework for the development of technical skill that involved five stages: (1) Novice; (2) Competence; (3) Proficiency; (4) Expertise; and (5) Mastery.

We have synthesized these three approaches to identification of the stages of AT mastery into the Continuum of AT Mastery shown in Figure 1 above.

### Study Methodology

The purpose of this study was to identify the factors which determine mastery of assistive technology, on the way to the development of a measurement tool. A Delphi approach (Dalkey &

Helmer, 1963) was chosen in order to obtain an inventory of indicators and predictors of mastery and to obtain a ranked hierarchy of their importance (Helmer, 1983). The Delphi method provides a means of establishing consensus as well as a means to identify and measure contrasting views (Martino, 1993). Delphi panels are found to reach more precise and dependable conclusions than focus groups or interviews (Dalkey, 1969; Riggs, 1983).

Funded by a seed grant from the Georgia Tech Research Institute (GTRI), the Mastery of AT research team set about to employ the Delphi method to identify the factors that indicate and predict Mastery of AT. The team posited that reaching mastery was a process and that an individual progressed from novice to power user over time, developing across several areas of practice, proficiency, knowledge and personal growth. The team sought to test this concept by empaneling a group of AT experts: accomplished users of AT (individuals with disabilities), teachers & trainers of AT (practitioners who have guided others to mastery), and those who had studied AT (academics).

There were 12 members of this panel. Seven members were persons with disabilities (2 with vision impairments, 2 with learning disabilities, 2 with motoric impairments, 1 with a hearing impairment and 1 with a communication disorder). Seven were affiliated with academic institutions. Eight were also practitioners who had guided others to mastery of AT. Many panelists were in more than one category. This rich diversity and breadth of experience provided access to a range of valuable perspectives and insights.

The Delphi process employs a series of iterative explorations of a concept in which each expert on the panel shares their insights and ideas. This is done individually and remotely so that an expert may share their insights completely and without conflict with other panelists. The research team then collects the responses and insights and then presents them to the panel for a second round of comments. Often this involves a process where panelists provide Likert scale ratings of these comments

to indicate their level of agreement. This process continues through a series of “rounds” to provide an opportunity for ideas and perspectives to converge. The goal of the Delphi process is for the panel to reach consensus on these ideas and concepts.

This study involved four rounds. Round 1 was used to brainstorm on what the indicators and predictors of a “power user” were. Then a framework for thinking of these characteristics—which depicted a continuum of progress from novice to power user across some of these factors—was presented for panel comment and critique. In Rounds 2 and 3 the characteristics the panel had identified were collected and presented to the group. Panelists were given the task of identifying which were the most important indicators, and which were the most likely predictors of someone becoming a power user. The panelists used a 5-point Likert scale to indicate how important each indicator and predictor might be. At the end of Round 3 the rankings pointed to a series of characteristics that clustered around four specific areas of mastery. These characteristics were inserted into the rubric-style framework the panel had reviewed in Round 1. This was set up as a scoresheet so that points could be tallied for progress toward mastery for each indicator / predictor.

In the final round, Round 4, the newly constituted scoresheet was presented to the panelists for further feedback and initial validation. They were asked to use this tool to assess themselves and one or two other people on their progress toward mastery of AT, then provide feedback on the accuracy of the results. We also solicited their opinions on the structure and organization of the content and ideas for how and where this tool might be applicable (K-12, transition, post-secondary, workplace settings, etc.) as well as who might be able to administer the assessment.

## Findings

Round 1 of this study identified a total of 129 phrases or characteristics that the panelists associated with becoming a “power user” of AT. The team analyzed these factors and found a “super set” of 30 items that were mentioned most often by the panel (See Figure 2).

**Figure 2. Super Set of Power User Characteristics**

<b>Super Set of Power User Characteristics</b>
access to support
problem solving
access to training
flexibility
independence
ingenuity
creativity
technical knowledge
knowledge of AT options/solutions
ability to troubleshoot
use
curiosity
technical skills
motivation
self-awareness
diligence
opportunities to use AT
self-advocacy
technical experience
proactive
connection to AT community
patience
time to experiment and learn
adaptability
access to AT
experience with AT
persistence
practice
connected to AT developers
money and resources

In Round 2, panelists were asked to think about each of these “super set” items and how likely each might be as a predictor or as an indicator of becoming a power user of AT. Panelists were asked to rank each factor on a 5-point Likert scale where 1 was “not an indicator / predictor” and 5 was an “essential indicator/ predictor (see Figure 3).

**Figure 3. Likert scale for predictors of becoming a power user of AT**

Value	Ranking level	Description
1	<b>Not a predictor</b>	as admirable as this characteristic might be, it does not predict future power use of AT
2	<b>Unlikely predictive</b>	these characteristics may be associated with power use of AT but probably are not be predictive
3	<b>Possible Predictor</b>	These characteristics may or may not be predictive of future Power User.
4	<b>Highly predictive</b>	these characteristics suggest that the individual is most likely going to become a Power User of AT
5	<b>Essential predictor</b>	this is a characteristic that is an essential aspect of becoming a Power User of AT

The results from Round 2 were tabulated and analyzed. Panelist comments suggested some differences of opinion about interpretations of the meaning of certain indicators and predictors. In particular the panel suggested that “use of AT”, “flexibility”, and “experience with AT” needed clarification. These were broken out into multiple items for Round 3 to address distinctions which reflected the comments panelists shared about their interpretations.

The tabulated results from Round 2 were presented to the panel for their consideration with the clarifications noted above. Again the panelists were asked to use the 5-point Likert scale to rate the factors. The results from Round 3 were tabulated and analyzed. Analysis of Round 3 suggested that our panel had identified 12 predictors and 14 indicators that they felt were highly predictive of becoming a power user or indicative of being one. Results from Round 3 may be found in Figure 4.

Figure 4. Round 3 Results

Rank	Predictor	Mean	Rank	Indicator	Mean
1	Opportunity to use AT	4.50	1	Problem Solving	4.42
2	Knowledge of AT Options	4.46	2	Adaptability	4.29
3	Problem Solving	4.42	3	Knowledge of AT Options	4.25
4	Able to T-shoot	4.42	4	Access to AT	4.25
5	Motivation	4.33	5	Able to Troubleshoot	4.17
6	Persistence	4.25	6	Opportunity to use AT	4.17
7	Adaptability	4.21	7	Independence of AT Use	4.09
8	Self-advocacy	4.08	8	Motivation	4.08
9	Time to Experience & Learn	4.08	9	Flexibility: High Tolerance for error	4.04
10	Access to AT	4.08	10	Technical Knowledge	4.04
11	Flexibility: High Tolerance for error	3.96	11	Improved Effective Use	4.00
12	Technical Knowledge	3.96	12	Self- Advocacy	4.00
13	Positive experience w/ AT	3.92	13	Time to Experience & Learn	4.00
14	Practice	3.92	14	Desire to be Independ	3.96
15	Independence	3.83	15	Use over Time	3.92
16	Technical Skills	3.83	16	Flex to react to unfamiliar	3.92
17	Self- awareness	3.79	17	Positive experience w/ AT	3.92
18	Proactive	3.79	18	Proactive	3.88
19	Use over Time	3.75	19	Technical Skills	3.83
20	Flexibility to react to unfamiliar	3.75	20	Self- awareness	3.79
21	Access to Set Up Support	3.71	21	Practice	3.75
22	Access to Train.	3.67	22	Frequency of AT Use	3.71
23	Improved Effective Use	3.64	23	Technical Experience	3.67
24	Access to Technical Support	3.63	24	Persistence	3.67
25	Technical Experience	3.58	25	Access to Technical Support	3.54
26	Frequency AT Use	3.41	26	Access to Set Up Support	3.46
27	Experience w/ range of AT	3.33	27	Experience w/ range of AT	3.42
28	Years of exp. w/ AT	3.25	28	Years of exp. w/ AT	3.42
29	Ingenuity	3.21	29	Ingenuity	3.38
30	Connection to AT Community	3.21	30	Connection to AT Community	3.38
31	Diligence	3.17	31	Diligence	3.17
			32	Connect to AT Developers	3.00

The team analyzed these indicators and predictors and found that they fell into four distinct constructs or areas of mastery: (1) Experience (Usage) with AT; (2) Proficiency with AT; (3) Knowledge of AT; and (4) Personal Connection with AT. The team restructured the factors into a matrix format and populated a rubric-style set of descriptions of progress a user might go through in their journey from novice to power-user.

In Round 4 the panel was asked to use this as a scoresheet or a guide for evaluating themselves and at least one other person on their mastery of some AT tool. Feedback and critique was solicited and collected. Panelists found several inconsistencies and areas that needed clearer definition. Nevertheless, overall feedback from the panel suggested that the tool was useful and generally accurate.

Panelists were asked about the applicability and the administration of the scoresheet (see figure 5 below). They were asked whether the instrument could be used as a measure of mastery of AT and whether it could be used as a guide to improve future performance at school or in the workplace. Panelists were also asked who might be able to administer such a tool. Did it require an AT specialist or could anyone provide this tool? Could it be self-administered? Lastly the panel was asked to identify the areas in which the tool might be especially applicable: K-12 school, post-secondary settings, transition situations, and in the workplace. There was broad agreement that the tool itself was useful and could be effective at measuring progress toward mastery of AT. Panelists provided concrete suggestions for changes. The feedback and suggestions from Round 4 were incorporated into the Continuum of AT Mastery Tool (see Appendix).

**Figure 5. Application and Administration of the Tool**

*Could the tool/scoresheet be used as a way to identify where an individual is in their journey toward mastery of AT?*

	Yes	With Changes	Not	Yes	With Changes	Not
Could the tool/scoresheet be used as a way to identify where an individual is in their journey toward mastery of AT?	7	5	0	58.33%	41.67%	0.00%
Could it help identify next steps toward AT mastery?	10	1	1	83.33%	8.33%	8.33%
Could it be used prescriptively to assist a student or an employee to improve performance/effectiveness?	6	4	2	50.00%	33.33%	16.67%
Could it be used as an Indicator of preparedness, readiness?	5	5	2	41.67%	41.67%	16.67%

*Who should administer this?*

	Yes	With Changes	Not	Yes	With Changes	Not
Can anyone do it?	7	3	2	58.33%	25.00%	16.67%
Could it be a self-report?	9	3	0	75.00%	25.00%	0.00%
Should it only be done by AT specialists?	3	6	3	25.00%	50.00%	25.00%
Should some other set of qualifications be stipulated?	0	7	5	0.00%	58.33%	41.67%

*Where would this tool be applicable?*

	Yes	With Changes	Not	Yes	With Changes	Not
K-12	10	2	0	83.33%	16.67%	0.00%
Post 2nd	10	2	0	83.33%	16.67%	0.00%
Transition	7	5	0	58.33%	41.67%	0.00%
Workplace	8	4	0	66.67%	33.33%	0.00%

## Analysis of Findings

### Four Constructs of AT

The following is an analysis of the panel's comments and rankings of the predictors and indicators of being a Power User.

#### ***Experience with AT***

In general, the AT construct we are calling *Experience with AT* suggests that power users have had time to experiment with their AT and learn how to use their tool. This necessitates sufficient access to their AT and opportunity to use their AT such that mastery might develop. This is evidenced in improved effectiveness of use and greater independence of their use of their AT. While having access to AT is important, it does not reflect what an individual does with their AT. When the opportunities arise, the individual pursuing mastery can and does take advantage of them. Once you have AT you must use it (i.e., practice) and learn how to use it effectively. The opportunity for exposure to AT at school, and/or at home is essential for a power user. Proficiency is achieved through learning in a variety of different environments and circumstances.

Power users use AT frequently and with purpose. They use AT effectively when and where it is needed. A power user's effectiveness increases with use (frequency & duration). They build skill and experience by exposure to an expanding set of novel scenarios. This gives the user opportunity to employ a broader range of the features of their AT. The more that practice takes place in natural, high importance (to the user) activities, the greater their transparency with the tool becomes, so that they can concentrate on what they want to accomplish and not upon using the tool.

A power user has taken the time to experiment and learn about the AT they use. This helps them become creative users with regard to their AT. They have developed the ability to customize strategies for using their AT in response to new situations or barriers. It often takes time to "play with"

the technology and explore what it can and cannot do. Their experimenting and learning is probably taking place to some extent whenever they use their technology.

### ***Proficiency with AT***

The development of proficiency with AT is indicated and predicted by several factors including effective use of AT, troubleshooting, problem solving, and technical skills.

Effective use of AT reflects growth, experience, and aptitude toward use of the AT tool the individual is mastering. It can only come with time and practice with the AT as the individual applies it to more scenarios and engages more fully the features of their AT.

The user's ability to troubleshoot their AT and solve problems using their AT is essential to the development of their Mastery of AT. Power users build skill and experience by exposure to an expanding set of novel scenarios. Troubleshooting with AT is essential for a power user, since the user is very often the expert in the room with regard to their particular AT solution. Troubleshooting is essential when a user encounters unique situations and barriers or when support is not available. Expanded use leads to encounters with more obstacles and issues. From these experiences the individual develops a "toolkit" of insights and knowledge that equips them for solving future issues.

The acquisition of technical skills and understanding contributes to independence of use. As individuals pursue mastery of AT they will become successively more proficient with their technology. They will often fluctuate in the level of independence as proficiency improves - as they move from discovery to competence with each feature or application. The internalization of skill and efficient use enables the user to focus more upon what they want to do and less upon the tool itself.

Problem Solving is the ability to know what you need to do and what prevents you from doing it. It involves a systematic process of isolating the cause of an issue. Understanding the critical components involved in problem-solving helps improve understanding of the AT tool and promotes greater mastery

of its use. Novice users may therefore be challenged if they run into difficulties or obstacles outside of their immediate comfort zone. The individual who is pursuing mastery of their AT gains experience, demonstrates aptitude and growth in skills, and develops Improved effectiveness of AT through use over time.

### **Knowledge of AT**

The AT construct we are calling *Knowledge of AT* Involves technical knowledge about AT and knowledge of AT options. A power user in this area is able to expand their knowledge about AT and makes informed choices about AT. Functional knowledge about AT is developed through its use. A power user has made their own meaning out of the purposes for their AT use. Power-users have a framework for understanding and shaping solutions when encountering difficulties, problems, or barriers.

Power-users have the capacity to grow their knowledge and search out new applications for their AT. Having time to make mistakes and learn from them in a relaxed environment is essential. Power-users have knowledge of how their AT operates and available options in specific circumstances. Non-power users often get stuck due to technical issues with the AT. Power users make good choices about what they need and what is "out there" that could meet their need...what would lower barriers for them.

Power users know whom to ask and how to ask for help when they lack specific knowledge. They can and do use their tech when and where it is needed. Power users of AT maintain connections (as AT is ever-evolving) with other users of AT and with AT manufacturers and publishers. In this way they stay up to date with AT options/solutions.

The individual pursuing mastery of AT may only need to know about the one AT they have or use. The power user has discovered much along the way and has explored or tried other options.

### **Personal Connection to AT**

The construct called *Personal Connection to AT* includes personal characteristics and soft skills that have been nurtured and developed particularly with regard to AT use. Characteristics such as adaptability, persistence and flexibility (especially a tolerance for error) are likely indicators of and predictors of AT mastery. Power users are motivated and demonstrate a desire to be independent. They have developed the capacity to advocate for their AT needs.

Power users are active participants in their care and life decisions. It is important that they make decisions regarding their environment and seek to carry these out using their AT. They are able to communicate what is needed and wanted. (If you have an advocate, you can still be a power user). Power users are internally motivated to learn how the tools help them do the tasks needed to reach their goals. Power-users benefit from their ability to adapt as they learn to work through various levels of success and failures.

Power-users are adaptable and channel energy & experience into new learning rather than expend energy in frustration and impatience. Power users adapt to the times when the technology doesn't work, but still keep their goal in mind. AT changes all the time and to stay current as AT evolves, the user who seeks mastery must adapt.

A power user likely has had to use their AT in various ways and get creative at times. A power user tolerates errors, can be flexible, and patient to move through challenges successfully. A power user reacts effectively to novel situations. Power users are motivated to achieve their goals and are diligent in their pursuit of mastery of AT.

One seeking mastery of AT will curate a sense of agency and self-determination. This user decides her goals and what she needs/wants to be done. She will seek ways to use whatever tools and/or strategies that are available toward achieving goals. The desire to be independent will grow and be reinforced as the user realizes how important AT is to support that independence.

The panel observe that AT can be low tech or mid tech and does not have to be high tech for these constructs to apply. There is some overlap between constructs.

### **Applications and Administration of the Measurement Tool**

The panel broadly affirmed the tool as potentially useful in assessing an individual's progress toward becoming a power user. However, there were a number of changes that were suggested and that were incorporated by the research team. Over 80% of the panel felt that the tool was especially applicable to K-12 and Post-secondary education and that, with some modifications, it could be effectively used in the workplace and in transition situations as well. The panelists reported that the tool was structured in a way that did not necessarily require a specialist to administer it. Three-fourths of the panel felt that it was possible that the tool could be self-administered.

The panel was asked about the best platforms for this tool. Most suggested that while a paper version of the tool was useful, an online version of the tool, or perhaps an app, might be more convenient. The ability to compare scores and note progress of an individual from one administration of the tool to another was important to the panel.

### **Summary and Directions for Future Research**

This project has sought to develop a conceptual framework and a measurement tool for assessing individual progress toward mastery of AT. The Delphi Panel convened for this project has identified and prioritized a set of predictors and indicators of AT mastery. The resulting development of a tool for measuring or assessing general AT mastery needs further testing. Initial responses have been very encouraging. Such a tool could be helpful to teachers, rehab counsellors and families who seek to assist their students and young adults in developing personal mastery of the AT they use and preparing them for success in their future work settings.

AT use has been associated with encouraging results related to independent living as well as with positive educational and employment outcomes (Bouck, Maeda & Flanagan, 2012). However, there has been little research on what proficiency or mastery of AT is required to achieve those outcomes. Previous to this research, there has been no tool available with which to measure mastery of AT for the broad range of AT in use. With this tool, data about AT mastery can be collected in a more quantitative and concrete manner.

Additional study should be devoted to an examination of how this framework aligns with, or contrasts with, those of Light (1989) and Zabala, Bowser & Korsten (2005). This will involve addressing questions as to differences between kinds of AT and how this framework applies to different disabilities.

With this framework for thinking about mastery of AT, a basis now exists for considering the implementation of AT at times and in situations that will produce the greatest growth and development for persons with disabilities. Future research will examine the possible relationships and impact that AT mastery has on outcomes in the workplace, classroom, and the community. Based on those findings, recommendations will be developed for AT services and training to maximize those outcomes.

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## Appendix

### Continuum of AT Mastery Tool

Instructions:

Use the matrix/scoresheet as follows: For each line, place a check in the box of the statement that best describes the individual's level for that indicator/predictor. At the right of each line is a box to record the

number of points associated with the box you checked (Novice=1; Context-Dependent=2; Transitional = 3; Power User=4). Go through each line in the matrix this way. There is a line where you can tally up points for each section. At the end, follow the instructions to calculate the score for each section and a total score.

Date
Name
Version

**Section A. Experience to AT**

Category	Novice AT User 1 point	Context Dependent AT User 2 points	Transitional AT User 3 points	Power User of AT 4 points	Score
<b>Access To AT:</b>	Individual has limited access to AT – is just being introduced <input type="checkbox"/>	Individual has occasional access to AT – usually for specific tasks, people, places <input type="checkbox"/>	Individual has frequent access to AT <input type="checkbox"/>	Individual’s AT is available to them whenever they want/ need it <input type="checkbox"/>	
<b>Opportunity to Use AT:</b>	Individual has limited opportunity to use AT or makes limited use of AT that is available <input type="checkbox"/>	Individual occasionally takes advantage of opportunities to use AT on familiar tasks,, people, places <input type="checkbox"/>	Individual regularly takes advantage of opportunities to use AT with familiar tasks, people, and places and starting to use in new contexts <input type="checkbox"/>	Individual takes opportunity to use AT to address a range of familiar and new tasks, people, and places <input type="checkbox"/>	
<b>Positive Experience with AT:</b>	Individual is just beginning to experience using AT. The nature of these experiences are as yet unclear <input type="checkbox"/>	Individual is having occasional experiences with AT. Some are positive experiences <input type="checkbox"/>	Individual regularly/frequently experiments or practices with AT to learn how it work <input type="checkbox"/>	Individual has regular experience with AT and has consistently positive experiences using their AT <input type="checkbox"/>	
<b>Time to Experiment &amp; Learn:</b>	Individual is just beginning to experiment or practices with AT to learn about how it works <input type="checkbox"/>	Individual occasionally experiments or practices with AT to learn about how it works <input type="checkbox"/>	Individual is often taking advantage of opportunities to learn from use of their AT <input type="checkbox"/>	Individual experiments or practices on a consistent or daily basis with AT to learn how they can use it <input type="checkbox"/>	
Total for this section					

**Section B. Proficiency with AT**

Category	Novice AT User 1 point	Context Dependent AT User 2 points	Transitional AT User 3 points	Power User of AT 4 points	Score
<b>Effective Use:</b>	Individual is beginning to learn how to use their AT but lacks effectiveness with AT <input type="checkbox"/>	Individual occasionally demonstrates effectiveness particularly with AT on familiar tasks, people, & places <input type="checkbox"/>	Individual frequently demonstrates effectiveness with AT including new tasks <input type="checkbox"/>	Individual consistently uses their AT independently and effectively <input type="checkbox"/>	
<b>Trouble Shooting:</b>	Individual is beginning to use their At and is not able to trouble-shoot their AT <input type="checkbox"/>	Individual occasionally demonstrates l ability to trouble-shoot their AT <input type="checkbox"/>	Individual frequently demonstrates broad ability to trouble-shoot their AT <input type="checkbox"/>	Individual is consistently and independently able to trouble-shoot their AT <input type="checkbox"/>	
<b>Technical Skills:</b>	Individual is beginning to use their At and seldom displays technical skills <input type="checkbox"/>	Individual occasionally is displays technical skill through AT use on familiar tasks, people, & places <input type="checkbox"/>	Individual frequently displays technical skill through use of their AT and applying it to new tasks <input type="checkbox"/>	The individual consistently demonstrates extensive technical skills related to their AT use <input type="checkbox"/>	
<b>Problem Solving:</b>	Individual is just beginning to use their At and is seldom able to identify or resolve problems encountered when using their AT <input type="checkbox"/>	Individual occasionally displays ability to identify or resolve problems when using their AT <input type="checkbox"/>	Individual frequently displays ability to identify or resolve problems when using their AT <input type="checkbox"/>	Individual is consistently able to identify or resolve problems when using their AT <input type="checkbox"/>	
Total for this section					

**Section C. Knowledge of AT**

Category	Novice AT User 1 point	Context Dependent AT User 2 points	Transitional AT User 3 points	Power User of AT 4 points	Score

<b>Functional AT Knowledge:</b>	Individual is beginning to use their At and rarely displays ability to use of AT to shape solutions <input type="checkbox"/>	Individual occasionally displays ability to use of AT to shape solutions related to specific tasks, people, places <input type="checkbox"/>	Individual frequently displays ability to use of AT to shape solutions to both familiar and new problems <input type="checkbox"/>	The individual consistently demonstrates ability to use of AT to shape solutions when encountering difficulties, problems or barriers <input type="checkbox"/>	
<b>Technical AT Knowledge:</b>	Individual is beginning to use their At and rarely demonstrates technical knowledge related to their AT and relies on outside guidance on when to use their AT <input type="checkbox"/>	Individual occasionally is displays technical knowledge through AT use on familiar tasks, people, & places, but still relies on outside guidance at times <input type="checkbox"/>	Individual frequently displays technical Knowledge through AT use when using their AT and demonstrates a ability to identify new situations and applications for their AT <input type="checkbox"/>	The individual consistently demonstrates extensive technical Knowledge related to their AT use. Individual determines how and when to use their tech when and where it is needed <input type="checkbox"/>	
<b>Knowledge of AT Options:</b>	Individual is beginning to use their At and Is mostly unaware of AT options <input type="checkbox"/>	Individual occasionally displays awareness of AT options, particularly with regard to familiar tasks <input type="checkbox"/>	Individual is frequently aware of and has begun to explore AT options <input type="checkbox"/>	The individual consistently demonstrates awareness of what is "out there" that could meet their need <input type="checkbox"/>	
<b>Expanding Knowledge of AT :</b>	Individual is beginning to use their At and rarely displays ability to gain knowledge of AT independently and generally depends on others for guidance and direction <input type="checkbox"/>	Individual occasionally displays ability to gain knowledge of AT independently and is less dependent upon others <input type="checkbox"/>	Individual is frequently displays ability to gain knowledge of AT independently and is less dependent upon others <input type="checkbox"/>	Individual is able to grow their knowledge about AT and of optional technologies and knows when to ask for support <input checked="" type="checkbox"/>	
<b>Making Informed Choices of AT:</b>	Individual is beginning to use AT, is learning about using their AT in specific situations, and Is yet to look at other AT and other situations <input type="checkbox"/>	User occasionally decides to apply their AT - mostly in relation to familiar tasks, people and places. Still relies on guidance on when to apply their AT in novel situations <input type="checkbox"/>	Individual frequently decides when to apply their AT in new situations and when another tool is more appropriate <input type="checkbox"/>	Individual consistently makes informed choices about what AT they use and when <input type="checkbox"/>	
Total for this section					

## Section D. Personal Connection to AT

Category	Novice AT User 1 point	Context Dependent AT User 2 points	Transitional AT User 3 points	Power User of AT 4 points	Score
<b>Self-Advocacy:</b>	Individual is beginning to use their At and rarely displays advocacy for their need for/use of AT <input type="checkbox"/>	Individual occasionally advocates for their need for/use of AT. Individual sees AT as contributing to their success with specific tasks, people, & places <input type="checkbox"/>	Individual frequently advocates for their use of AT. Individual is often confident and assertive regarding their need for/use of AT <input type="checkbox"/>	Individual consistently advocates for their use of AT. Individual is a confident, assertive and effective self-advocate regarding AT <input type="checkbox"/>	
<b>Adaptability:</b>	Individual is beginning to use their At and rarely displays ability to adapt their use of AT to different situations <input type="checkbox"/>	Individual occasionally displays ability to adapt how they use their AT in specific tasks, people, & places <input type="checkbox"/>	Individual frequently displays ability to adapt their use of technology to novel situations <input type="checkbox"/>	Individual is consistently able to adapt how they use their technology in both familiar and unusual circumstances <input type="checkbox"/>	
<b>Flexibility:</b>	Individual is beginning to use their At and rarely displays flexibility: can get frustrated when encountering difficulty and failure <input type="checkbox"/>	Individual occasionally displays flexibility - and is beginning to navigate through error and difficulty <input type="checkbox"/>	Individual frequently displays flexibility - has greater tolerance for error and difficulty <input type="checkbox"/>	Individual is consistently flexible - has a high tolerance for error and difficulty and is able to react to unfamiliar situations <input type="checkbox"/>	
<b>Persistence:</b>	Individual is beginning to use their At and rarely displays persistence in resolving issues with AT <input type="checkbox"/>	Individual occasionally displays persistence in resolving issues with AT <input type="checkbox"/>	User frequently demonstrates persistence in resolving issues with AT <input type="checkbox"/>	Individual is consistently persistent in resolving issues with their AT <input type="checkbox"/>	
<b>Independence:</b>	Individual is beginning to use their At and rarely displays Independence with AT, but continues to need support & guidance <input type="checkbox"/>	Individual occasionally uses their AT independently especially with familiar tasks, people, & places, but continues to need support for novel situations <input type="checkbox"/>	Individual frequently uses their AT independently in more situations, and is beginning to discern when to ask for help and assistance <input type="checkbox"/>	Individual consistently uses their AT independently, but asks for help when needed or appropriate <input type="checkbox"/>	
<b>Motivation:</b>	Individual is beginning to use their At and rarely displays internal	Individual occasionally displays intrinsic	Individual frequently demonstrates intrinsic	Individual consistently demonstrates intrinsic	

	motivation for using AT <input type="checkbox"/>	motivation for using AT <input type="checkbox"/>	motivation to use AT <input type="checkbox"/>	motivation to use A <input type="checkbox"/>	
<b>Proactive:</b>	Individual is beginning to use their AT. They are rarely proactive about AT use and are generally passive relative to AT issues and choices <input type="checkbox"/>	Individual is occasionally proactive in their AT use - especially about specific tasks, people, & places <input type="checkbox"/>	Individual is frequently proactive about AT use, demonstrating anticipation of situations and needs in both familiar and new situations <input type="checkbox"/>	Individual is consistently proactive about issues related to their use of AT <input type="checkbox"/>	
Total for this section					

**Scoring**

Section	Score Pts.	Average
Exposure to AT		
Proficiency with AT		
Knowledge of AT		
Personal Connection to AT		
Overall		

**Graphical Representation**

Section	1 Novice	2 Context Dependent User	3 Transitional User	4 Power User
Exposure to AT				
Proficiency with AT				
Knowledge of AT				
Personal Connection to AT				
Overall				