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## History of Assistive Technology Outcomes in Education

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### Abstract

The idea of identifying and measuring Assistive Technology (AT) outcomes seems at first to be simple. However, AT is part of a larger process that includes AT implementation services and the intervention of which AT is itself a part. Given the expansion of AT options available today, we also must examine the question of which AT solution best meets a client's needs.

While rehabilitation and other medical fields have sought to measure outcomes for some time, concern for AT outcomes in education began to emerge in the mid 1990's. Consensus as to what outcomes should be measured has remained elusive. Several federally funded projects, professional surveys, and summit discussions have provided a context for examination of the collection of AT outcomes data.

Recent developments have rekindled discussion of outcomes by demonstrating that the field remains unprepared with regard to

producing AT outcomes evidence. An historical context for addressing these current challenges is described.

**Keywords:** assistive technology, outcomes, educational measurement, special education

### Introduction

According to the Individuals with Disabilities Act of 1997, assistive technology (AT) refers to "any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of children with disabilities." In education, AT serves to enhance learning and support classroom performance and participation. AT can range from pencil grips and raised-line paper to screen reading software and high-tech speech generating devices.

The law also defines AT services to encompass and support the selection, acquisition, and use of AT including evaluation and training for student, family and professionals. Edyburn (2004b) suggests that while these definitions of AT and AT services are important, they represent only two legs of a three-legged stool. The third leg should address AT outcomes. Without greater definition, educational professionals have little on which to base instructional and purchasing decisions regarding AT.

Simply put, an assistive technology (AT) outcome is the impact of an AT intervention (Scherer, 1998). Teachers, administrators, and families all have an interest in discovering how well AT is helping students to achieve their personal and academic goals. Publishers, manufacturers, and researchers all seek evidence of the impact of specific AT upon learning and classroom performance. While this seems straightforward, there are several challenges associated with measuring AT outcomes in education.

Among these challenges has been the task of determining the impact that AT has played, apart from other influencing factors (Smith, 2000). A lack of validated data collection tools for measuring outcomes has frustrated outcomes research (Edyburn & Smith, 2004; Watson, Ito, Smith & Andersen, 2010). From this has emerged the undertaking to address the need for a model or framework for conceptualizing outcomes in education (Bromley, 2001; Edyburn, 2001; Lenker & Paquet, 2003). Complicating matters further has been the diversity of the students whose progress is being measured (Smith 1996; RESNA, 1998a, 1998b, 1998c ; Watson, Ito, Smith & Andersen, 2010) and the lack of agreement as to what specific data to collect, (Smith, 2000; Parette et al., 2006).

The study and discussion of outcomes has been prevalent in the medical and

rehabilitation fields since the mid 1980's (Assistive Technology Outcomes Measurement System, 2004). Concern for the importance of AT outcomes in the field of education developed in the next decade as the number of AT solutions increased. Parents and administrators alike wanted to understand "what works?" (Smith, 2000). After a flurry of attention and activity throughout the first decade of the new century, the field still lacks outcomes data to support the use of specific AT and agreement as to how best to collect such data. The goal of this article is to set an historical context for future discussion of AT outcomes in education.

Over the past two decades in education, there has been broad acceptance of the notion that AT use will positively impact students with disabilities (Ashton, 2005; Edyburn, Higgins, & Boone, 2005; Smith & Smith, 2004). Today, as budgets remain tight, schools and systems are being urged to look at the outcomes research behind the AT in which they invest (Satterfield & Smith, 2015). Guidelines for this process have been vague and limited (Parette, Peterson-Karlan, Smith, Gray, Silver-Pacuilla, 2006). These problems persist today for reasons that will be explored in the next section.

### **The Complexity of Measuring AT Outcomes**

A shortage of definitive research on AT use and AT outcomes in Education (Watson, Ito, Smith, & Anderson, 2010) perhaps can be understood given the diversity of individuals in the population under study (Smith 1996; RESNA, 1998a, 1998b, 1998c; Fuhrer, 2001). Beyond this, it has been acknowledged that the process of measuring student classroom performance, functionality of the AT and changes in student well-being must take into account all the support, therapy, and other interventions (besides classroom use of AT) that an individual receives (Smith, 2000). These

factors have proven difficult to isolate. While the use of subjective measures of success has been considered to be inadequate for measuring some aspects of AT (Fuhrer, 2001; Watson, Ito, Smith & Anderson, 2010), Smith (2000) has shown how subjective measures of perceived value of AT and AT services and self-satisfaction of the school, student and family with AT and AT services can be a significant element in AT outcomes measurement. Beyond this, Smith (2000) also stresses the importance of considering cost when measuring outcomes because the school systems that are purchasing assistive technology are looking for ways to make their funds go further.

In contemplating the measure of AT Outcomes, the full set of stakeholders and their perspectives must be considered (Rust & Smith, 2006) because their viewpoints are often different. Parents are looking for positive impact upon the student both in the classroom and overall. While teachers, therapists, and administrators anticipate achievement of academic goals, administrators also must consider the costs of AT. Manufacturers and publishers of AT consider user satisfaction, usage, cost, improved student function, and classroom results. These considerations have sometimes extended beyond academic performance alone. Scherer (1996) reviewed research on AT use and concluded that AT choice and decision making should be focused upon the individual beyond the classroom and how that specific selection of AT will enhance the student's quality of life. DeRuyter (1998) contended that AT outcomes should incorporate quality of life measures, achievement of objectives and performance targets, student satisfaction with the AT, and the expense involved. Enhanced community involvement also has been suggested as an important measure (Fuhrer, 2001).

## Early History of AT Outcomes in Education

The first scholarly discussions of outcomes with regard to AT emerged in the mid 1990's (DeRuyter, 1995) and were broadly focused but nevertheless influential with regard to education. The first peer-reviewed journal with an issue which was dedicated to AT Outcomes (*Assistive Technology*; Smith, 1996) followed quickly thereafter. The first textbook on AT, *Assistive Technologies: Principles and Practice* (Cook & Hussey, 1995) was published at this time. In 1998, the Rehabilitation Engineering Society of North America (RESNA) published an extended three-part discussion of AT Outcomes, including the first national survey of AT outcomes practices (RESNA 1998a, 1998b, 1998c). The turn of the century saw the creation of the National Assistive Technology Research Institute (NATRI) and a second journal with an issue which focused upon AT Outcomes (*Diagnostique*; Edyburn, 2000a).

## Studies Related to AT Outcomes in Education

Early studies related to AT outcomes focused upon device abandonment (DeRuyter, 1997; Riemer-Ross & Wacker, 2000; Scherer, 1996) revealing that the rate of abandonment ranged from 8% to 75% of AT in the field. These studies relied heavily upon customer satisfaction surveys without establishing goals or anticipated results (Watson, Ito, Smith & Andersen, 2010). Riemer-Ross and Wacker (2000) explored the factors related to AT use that served to decrease abandonment. Their results suggested to the field that the centrality of the student in the consideration process, the appropriateness of AT selected for use, and the advantages that the specific AT provided the student all had a positive impact.

A limited number of studies sought to examine the changes in functional performance of AT use by students in public schools (Smith, 2002).

It was difficult to generalize from the several studies of AT and students in school (Campbell, Milbourne, Dugan, & Wilcox, 2006; Evans & Henry, 1989; Gerlach, 1987; Hall, 1985; Hetzroni & Shrieber, 2004; Higgins & Raskind, 2004; Wallace, 2000) as these studies involved small groups of diverse students or focused upon specific AT or strategies involving AT.

The AT Infusion Project under the Ohio Department of Education (Fennema-Jansen, 2004; Fennema-Jansen, Smith, & Edyburn, 2004), however, did feature a large group (just under 3000) of students. The study attempted to examine the effect of a broad spectrum of AT upon these students. This project demonstrated how collection of AT outcomes data might be done on a large scale. In the process, a tool for collecting information about the impact of AT in an educational setting was developed, the Student Performance Profile (SPP; Fennema-Jensen, Edyburn, Smith, Wilson, & Binion, 2005; Watson, Ito, Smith, & Andersen, 2010).

Another study of younger students with Cerebral Palsy (CP) was conducted by Ostensjo, Carlberg, and Vollestad (2005). While this was a descriptive study, it involved 95 students and employed the Pediatric Evaluation of Disability Inventory (PEDI) tool to measure mobility, self-care, and social function. It was the social function scale of this tool that looked at aspects of learning and intellectual growth.

Watson, Ito, Smith, and Anderson (2010) suggest that many of these early studies were narrowly focused or methodologically limited, that others were qualitative or non-experimental, and that the field suffers from a scarcity of well-conceived studies that address AT outcomes. Lenker et al. (2005) called for future research to be more deliberate and

suggested the need to include a rationale for the instruments used and more detail about the sample, the length of the study, and the sites involved.

### **Process: Setting the Stage for Good Decisions**

While these studies were under way, other efforts were taking place to establish a framework for good decision making with regard to AT. In 1999, Dave Edyburn (2000b) launched a series of annual reports to the field, known as “What have we learned lately?” Each year, he identified a set of key articles appearing the previous year in journals that addressed AT research in education. He identified the trends that were represented in AT research that year and summarized the highlights from the articles. He especially pointed to evidence of AT outcomes where they appeared in the literature, and provided observations as to how the approaches to research represented in these articles could be made stronger (Edyburn, 2002, 2003, 2004a, 2006). In recent years, Edyburn has developed visual mappings to illustrate how published research has clustered around specific themes (Knowledge by Design, Inc., 2015). These articles were broadly read by educators, administrators, and researchers in the field.

In 2005, RESNA announced the launch of its certification process to identify and establish qualified practitioners for the field. The Assistive Technology Professional (ATP) certification was designed to establish a standard of professionalism for the field and foster increased confidence among those who use AT products and services (RESNA, 2014). While AT certification is generally not required in educational circles, it does provide an opportunity for educators who work in AT to obtain credentials that highlight their skills.

In 2000, the National Assistive Technology Research Institute (NATRI) was launched to explore AT and AT services in schools and to discover what practices were most effective. The NATRI team examined planning and implementation of AT in K-12 schools as well as professional development in AT. The Institute produced the Status of AT Use Survey (Quinn et al., 2008) which helped inform the field of the breadth of AT use in K-12 schools as well as the locus and contexts in which AT was being used, pointing to a need to broaden AT use to general education settings and beyond communication and access. NATRI also launched a study of state and local level policies with regard to AT and the Individualized Education Program (IEP) process (Bell, 2001) which suggested that, while many agencies had AT policies in place, awareness at the teacher level remained limited. An investigation of AT and IEP process (Bausch, Quinn, Chung, Ault, & Behrmann, 2009) revealed that some districts had more explicit and complete directions and policies regarding AT and the IEP than others. The study highlighted areas where a lack of information regarding AT could jeopardize some students' academic success. This study also revealed a lack of planning for AT implementation. Bausch, Ault and Hasselbring (2006) developed the *AT Planner*, a set of materials to guide this process including the monitoring of progress related to AT use.

NATRI also sought to explore the impact of AT upon academic progress. Using interviews of teachers, students and families, NATRI discovered frequent reports of positive results. However, teachers reported cases of device abandonment relating to student dissatisfaction with the device chosen for them (either the AT was stigmatizing or it was not their choice), that inadequate training was provided, or the AT provided was inappropriate relative to the student's needs (Bausch, Ault, & Hasselbring, 2015). A NATRI study of institutions of higher

education illustrated the limits of the preparation of pre-service teachers and therapists for implementation and effective use of AT (Bausch & Alt, 2012), reporting that many professionals had only a general awareness of AT as they entered the field. While the NATRI project ended in 2006, its studies have highlighted issues that persist today and raised questions that continue to be relevant.

Simultaneously, a series of conceptual models were being articulated for the field. There were several models for AT Consideration. The ultimate goal of these models was to connect the person with appropriate AT by exploring the individual, the setting, and function (Bromley, 2001). These models attempted to lay out a set of considerations to aid AT teams to choose appropriate tools for individuals (Edyburn, 2001; Lenker & Paquet, 2003). Among these were: the Lifespace Access Profile (Williams, et.al, 1995); the SETT Framework (Zabala, 1995); Education Tech Points (Bowser & Reed, 1995); Chambers Consideration Model (Chambers, 1997); Matching Person and Technology (MPT) Model (Scherer 1998b); AT CoPlanner Model (Haines & Sanche, 2000); and the Wisconsin Assistive Technology Initiative (WATI, 1998). A common feature of these models is their emphasis upon student outcomes. By exploring the student's strengths and needs and by defining the context and activities in which the student needs to perform, appropriate AT can be identified. Each model calls for the collection of data related to the AT introduced and the gains made by the student involved.

There were other technology-enhanced performance models that sought to define technology's role in improving individual functioning (Edyburn, 2001). These included: the Model of Human Performance technology (Wile, 1996); Baker's Ergonomic Equation as adapted by King (1999); the Human Activity

Assistive Technology (HAAT) Model (Cook & Hussey, 2002); and the Human Function Model (University of Kentucky Assistive Technology (UKAT) project, 2002) which incorporates principles of Melichar and Blackhurst's (1993) Unifying Functional Model. While these models brought renewed focus upon the individual, they conceptualized successful AT as fitting into specific contexts and situations in which the individuals find themselves. In general, these models did not attempt to isolate AT from other factors. In fact, in some cases, adherents to these models have made the case that it may not be necessary to isolate AT from the constellation of other interventions and factors in order to conclude that a positive outcome related to AT has been achieved. If the student previously could not read, but through introduction of a screen reader is now reading, then from the perspective of the student, the functionality sought has been achieved. Even if it was not the sole factor, AT was part of what made the positive outcome possible. Nevertheless, Edyburn (2015) has noted that the standard of evidence in AT outcome research has become more exacting as the field has matured.

There were also a series of developmental models that emerged. These models described how delivery of AT services in school environments contributed to individual progress and development (Edyburn, 2001). These included: the QIAT Consortium – Quality Indicators for Assistive Technology (1998); the Model of Technology Integration Process (Edyburn, 1998); STAGES (Pugliese, 2001); and the A3 Model (Schwanke, Smith & Edyburn, 2001). These models served as a basis for development of “Best Practices” for AT implementation as the field began to mature by bringing clarity and definition to the steps involved in integrating AT in the classroom such that positive outcomes could be achieved.

Still other models were appropriated from other fields and examined for their applicability

as tools to explore how AT might reshape our conceptualization of the challenges surrounding the individual with a disability (Lenker & Paquet, 2003). These models included: the Social Cognition Model (Carter, 1990); the Perceived Attributes Theory (Rogers, 1995); the Career Path Model (Gitlin, 1998); and the International Classification of Functioning for Disability and Health (ICF) Model (WHO, 2001). These models have implications for the measurement of AT outcomes, especially regarding the challenges in the larger environment in which the student operates, the changes that take place in the environment over time, and individual perceptions of the value of the AT to be used.

Lenker and Paquet (2004) expanded upon Rogers' Perceived Attributes Theory to outline a predictive person-centered conceptual model. The authors sought to relate the use of AT to how the client perceives the relative advantage of using that AT. While developed with the rehabilitation environment in mind, this model has implications for collection of information on AT outcomes in education.

### **Federal Projects**

Also at the turn of the new century, two federal projects were launched to address the questions and obstacles relating to AT outcomes. These were five-year research programs that sought to improve the field's measurement capability with regard to AT and AT outcomes and to reduce barriers to the use of AT outcome measures.

One project was the Assistive Technology Outcomes Measurement Project (ATOMS). The goals of this project included finding the relationships among AT outcomes factors to help create a better understanding of AT use and disuse, identifying and developing data collection instruments for AT outcomes, and, through the Ohio Project, developing experience collecting data on AT Outcomes in

education (Assistive Technology Outcomes Measurement System, 2005a). The project, which ended in 2006, laid a foundation for future AT outcomes research in education by producing a range of technical reports on the current collection and use of AT outcomes data and by developing a set of patterns for measurement tools to help collect outcomes data on AT use (Assistive Technology Outcomes Measurement System, 2005b).

The second federal project was the Consortium for Assistive Technology Outcomes Research (CATOR). This project sought to bring conceptual clarity to the field on the topic of AT outcomes measurement, identify barriers and factors contributing to AT abandonment, improve platforms for acquiring AT outcomes data, and understand the processes for AT use and disuse (Consortium for Assistive Technology Outcomes Research, 2011a). Among the achievements of this project were the establishment of a common set of terms and definitions for collecting outcomes data from mobility-related AT interventions and the development of tools and procedures for administering and measuring AT in seating and mobility clinics. The project's ongoing work currently addresses the development of more precise measurement tools for evaluating the effectiveness of mobility-related AT devices and how such AT can support, enhance and impact the assistance provided by individual caregivers (Consortium for Assistive Technology Outcomes Research, 2011b). Aspects of these tools may provide elements that can be grafted into instruments used in the measurement of educational outcomes.

### **AT Outcomes Summit 2005**

In 2005 a summit on AT outcomes in Education was held in Chicago, IL. AT professionals from all aspects of the field gathered to discuss questions relating to assessment. Specifically, the summit explored

the difficulties in the incorporation of AT into educational assessment and how these challenges affected the assessment of content area learning for students who use AT. Beyond this, the group considered what would be required to determine the influence of AT on student progress. (Parette et al., 2006)

Participants were concerned that the technology that was being approved for use on standardized tests might be influencing purchase and policy decisions for instructional classrooms: If the AT cannot be used for the test, then it should not be used in the classroom. This would have the effect of denying students tools that could assist them in making academic progress. Attitudes persist among the educational leadership that AT use is "cheating." The summit participants suggested that Universal Design principles (including access through technology) should be incorporated into assessment models (Parette et al., 2006). Concerns remain as the PARCC and Better Balanced national testing consortia have sought to include students with disabilities in their online testing environments. (Marachi, 2015).

The summit called for the field to encourage the growth of research that makes evident the impact of AT upon educational progress. This requires that data collected be amassed and combined around a set of agreed upon outcomes measures. Access to these data needs to be open to teachers as well as researchers. Participants also proposed that professional preparation be overhauled such that the emphasis would be upon strategies for implementation of AT rather than the AT tool and its operation. Instructional environments and curriculum need to reflect the technology that is a core component of 21<sup>st</sup> century life and business (Parette et al., 2006).

The summit pointed to the trend that technology is becoming generalized. What once was technology reserved for

accommodation of a few students is becoming the pathway to curriculum access for all students. They suggested that there is too little focus upon the skills that are required for proficiency with the emerging technology (Parette et al., 2006).

Thurlow et al. (2007) further explored the implications for large scale testing upon the role of AT and found that there were wide differences among states in how they addressed the needs of students for accommodations on state-wide testing. The application of AT, which has been commonly understood as an individual accommodation, to large-scale testing argues for a broader perspective on its applicability which now involves staff resources from instructional technology, assessment, and administration. In the process, several issues are raised which include accessibility to the testing format and how test security can be maintained while students are given access to the test content. In many states these issues have been passed on to the national testing consortia (PARCC and Better Balanced) to address. States such as Georgia, who have developed their own online test (Georgia Milestones Assessment), assert that their testing is accessible to all students (Georgia Department of Education, 2014), but the ability to implement accessible testing across the state has encountered challenges (Waylock, 2015).

### **Questions Regarding the Collection of AT Outcomes Data**

Several questions emerge when we seek to measure AT outcomes by making use of data currently being collected. Can we get visibility into what data is being collected by existing systems? Each system that is currently collecting data has established its data set based upon its most significant needs. Billing requirements are significant to private practice and clinical settings. Some schools bill today for speech and occupational therapy services.

These may collect some data relative to AT usage, but do they collect enough information to draw conclusions as to efficacy of AT solutions and strategies? Can we assume quality of life issues are being addressed by currently collected data? When privacy concerns are considered, what data *can* we obtain?

With regard to schools, we assume that data is maintained on students who have Individualized Educational Plans (IEPs). As schools employ the AT consideration models (mentioned above) in the selection of AT for student use, what is done with the data that is collected on AT trials? Many schools make use of online IEP systems today. What data are these systems currently collecting? What data elements might be used to provide some insight into AT use and its impact?

Several important questions asked by the Outcomes Summit of 2005 still remain unanswered. What should be the standards we are looking for? What outcomes should be tracked? Are there some that would be elective and others that would be required? Who decides this? How would the various perspectives of the students and their families, the research community, the manufacturers and publishers, and the schools be addressed?

One particular challenge that remains unresolved is how to determine the relative impact of the various therapies and interventions that are taking place with an AT user. In many cases individuals who use AT are also receiving other services. We can assess a desired outcome to some degree, but can we isolate the impact of AT hardware or software? Indeed, do we have to separate AT from the other services and therapies provided if we can establish a positive result in student performance? Clearly, as the range of AT options grows, manufacturers, publishers, teachers and administrators want insight into what AT might be most appropriate and effective. However, this “black box” effect, in



which observers lose the granularity with which to distinguish the effect of specific elements in an intervention, will create impediments to measuring outcomes of specific AT use (Smith, 2000).

### **Conceptualizing a Framework for Measuring AT Outcomes**

A call for a theoretical framework for measuring AT outcomes in education has been issued. Fuhrer, Jutai, Scherer, and DeRuyter (2003) contributed a model for measuring AT outcomes that incorporates both objective and subjective measures, includes data that addresses concerns of various stakeholders, gives primary consideration to the goals and needs of the individual (student), addresses the need for common definitions (ICF), and provides visibility to mediating and moderating factors. The model specifically identified effectiveness and efficiency of the AT, satisfaction with the AT itself, and how well the AT contributed to the individual's feelings of competence and sense of well-being as critical aspects to be measured. The authors called for examination of these factors in both the short and long run, listing a number of moderating factors such as comorbidities, environmental factors, other simultaneous treatments, and expense.

Lenker and Paquet (2004) assert that without a predictive conceptual model, professionals will find it difficult to apply research to practice. The authors have developed a model for conceptualizing AT outcomes as relating to the AT user's perception of the relative advantage of the use of the AT in question. This model employs AT usability (duration, frequency, environments, contexts, and tasks) and quality of life (health and well-being, quality of social relationships, and ability to perform in social roles) as outcomes indicators. While conceptualized as a model for AT in rehabilitation settings, it would be instructive to explore how this might guide the

development of a predictive model for education. Clearly some redefinition of the quality of life measures would be required. As a student-centered model, some study must be given to how to capture the student perception of relative advantage as opposed to projection of teacher-perceived advantage (although such a model may want to find a place for teacher and parent perceptions of relative advantage).

Edyburn (2015) observed that little has been accomplished with regard to developing AT outcome measurement tools. He suggests two possible reasons for why the field has not yet developed AT outcome measurement tools. First, the field is still in the early stages of integrating AT into instruction and has not had sufficient time to establish a core research base. Edyburn points to an evolving criteria for quality of evidence regarding AT outcomes as the second reason. Where a case study may have been perceived as indication of efficacy in the early days of AT, now teachers and administrators are expecting more robust research with regard to outcomes.

There is tremendous diversity among the persons with disability who use AT (Smith 1996; RESNA, 1998a, 1998b, 1998c; Watson, Ito, Smith & Andersen, 2010). This makes it challenging to produce randomized controlled trials. The field has been seeking to make its research more rigorous by using methods such as single subject design and seeking to apply the principles of treatment integrity to studies which are of necessity small in scope (Smith, 2015).

### **Perspective from the Field**

In an attempt to sample the thoughts of professionals in the field regarding a framework for measuring AT outcomes, the ATOMS project (Edyburn & Smith, 2004) conducted a survey of 80 AT conference attendees (including individuals with a broad range of roles and professional duties related to

AT) to discover what the practitioners believed was of greatest importance with regard to a framework for measuring AT outcomes. Agreeing that a framework was needed, the participants explored the extent to which expertise and training should be required of those administering AT outcomes data collection systems. Several points of agreement emerged. The survey indicated a preference for instruments that are easy to administer and could be employed by many practitioners in the field, as opposed to being administered only by those steeped in AT outcomes theory.

Regarding data collection techniques, the participants in the survey indicated a desire to preserve the option to employ paper-based as well as web-based instruments, suggesting a desire to maintain the flexibility that paper-based instruments provided, and possibly reflecting the level of technical sophistication of much of the field at that time. One wonders if a more current set of survey participants would be more inclined to accept web-based instruments.

Concerning the integration and analysis of data, participants indicated a preference for using data that can be obtained from multiple current data sources, including both new specialized data collection tools and data culled from existing data collection mechanisms. When considering the process of constructing meaning from data results, the survey asked about the desirability of simplification and visual representation as opposed to the need for drill-down visibility and granularity of collected data. The survey indicated a preference for simple and visual interpretation.

Edyburn and Smith (2004) also suggested the possibility of “dynamic norming” of the data being gathered. Given the limitation of the size and diversity of the population involved and the breadth of AT products and services, it would be difficult to establish a group against which to compare changes. Would a web-

based, real-time database to provide normative comparisons be important? Respondents indicated that a system that provides “dynamic norming” would be of significant value. No such process has been established to date.

The survey asked how the data might be used for decision-making. Would different users of the same data arrive at similar conclusions? Would there be a need for training for the field in how the data might be viewed and interpreted? Should the system support decision-making on the basis of data? Specifically, should the system include nuanced inferences about services and products and implications for implementation strategies? The survey indicated that such a feature would be valuable, but to a lesser degree than other factors (Edyburn & Smith, 2004).

Edyburn and Smith (2004) highlighted the need for validated instruments for measuring AT outcomes and observed that the field lacks the consistency and skill in its practice that would permit effective collection of AT outcomes data. Further, they identified concerns about the readiness of the field to collect, analyze, and interpret AT outcomes data.

### **Where Do We Go From Here?**

There remains no consensus relative to a model for defining and anticipating AT outcomes. Some suggested starting points and tools have been proposed that are worthy of the field’s consideration. Research is needed to help frame the collection of outcomes data and to establish a foundation for predictive models to emerge.

After examining AT outcomes studies in the rehabilitation field, Lenker et al. (2010) assert that the field needs to approach AT outcomes research in more systematic ways. Specifically, clearly articulated theories of treatment that specify the philosophy and methodological

underpinnings of the research are needed. These theories will serve as guides for teachers as they seek to apply outcomes data to their classroom. There is need for greater specificity regarding the intervention so that consumers of the research can understand not only what AT was involved, but what was done with the AT (strategies, usage, application, and how the AT was integrated into instruction). Lastly, greater attention to treatment integrity is needed so that readers may have certainty that treatment was carried out in accordance with the stated research protocols.

Smith (2000) has posited that in order to be comprehensive and efficient, AT outcomes measurement in education must be student-centered, incorporate measures of AT use across different contexts, be consistent in measurement approach across student populations, be inclusive of subjective information about quality of education and impact upon quality of life, and discern the impact of AT on the student from among multiple interventions. One instrument which attempted to incorporate many of these elements was the Student Performance Profile (SPP) which was developed in conjunction with the Ohio Assistive Technology Infusion Project (Fennema-Jensen, Edyburn, Smith, Wilson, & Binion, 2005). The SPP employed individual student IEP goals as outcome measures to provide an approach that was student-centered and consistent across populations. Rating scale questions were asked of case managers as to the relative impact of AT compared to that of other therapies and treatments. Watson, Ito, Smith and Andersen, (2010) were able to develop a study from a subset of this data (13 students with a variety of disabilities) to analyze the effectiveness of the AT used upon the IEP goals of the students involved. Among the 11 of 13 students who made progress on IEP goals during this study, AT was identified as one of

the factors contributing most often to the improvement made. This was a small study, but it provides one example of how AT as an outcome among a number of interventions and factors may be measured.

Edyburn, Fennema-Jansen, Hariharan, and Smith (2005) have pointed to the fact that IEPs are most often generated online. They suggest that this fact may open the door for the collection of information about AT outcomes. They describe how online IEP systems might be modified to collect data on how well individual goals are met when AT is involved. Such a view would be of particular value to teachers and systems as it helps connect the outcomes information with the planning and instructional process. The availability of data that was de-identified and aggregated would help researchers provide the field with useful insight into how AT might be effectively applied with different students.

Another possible strategy for collecting AT outcomes data might be to examine the data collected for AT trials (Edyburn, Fennema-Jansen, Hariharan, & Smith, 2005). When data collected on a student's trial use of a particular AT tool, is used for a decision as to whether the student might use that tool on an on-going basis, what happens to that data? Could it be aggregated with data from other student trials?

Data is also kept on AT inventory use. Generally school systems collect items at the end of the school year so that they may be inventoried and refreshed over the summer for use the next fall. How might we collect data on which students have used which AT items? Could we use this as an opportunity to include a survey which might help us also discover how successful or satisfied the student and teacher (maybe parent) were with that tool (Edyburn, Fennema-Jansen, Hariharan, & Smith, 2005)?

The changes and developments in technology itself may have the effect of hastening a solution. The ease of collection of survey data today, for example, may make it easier for us to collect and analyze outcomes information (Smith, 2000). The proliferation of polling and survey tools, such as SurveyMonkey.com (SurveyMonkey, 2015), have made collection of data such as customer satisfaction with a product or service an easier and much less expensive task.

As the technology progresses, will we soon see the capability of such data being gathered by the AT tool itself? An increasing number of AT products incorporate some form of data collection in their design. Almost all speech generating devices (SGDs) collect information about client usage in a data logging tool that is resident in the device. Apps for the iPad tablet such as LAMP: Words for Life (Prentke Romich Company, 2015) are emerging that are able to collect usage data. Tools such as the AAC Performance Report Tool (Romich et al., 2003) and the Realize Language web site (Cross, 2013) provide visibility to this usage data (once extracted and uploaded) and allow some analysis of outcomes. Instructional software tools such as Classroom Suite (Ablenet, 2015) have the capacity to collect and analyze student responses (Parette, Blum & Boeckmann, 2009). This trend may provide another source of data by which outcomes may be measured.

### **Target Audience and Relevance**

This article has described the contributions of many to further professional awareness of AT outcomes and how they might be collected and applied. And yet, well into the second decade of this discussion, the field of education has reached little consensus in defining the outcomes it values most and still has no valid accepted instruments for collecting data regarding these outcomes. Much information is collected on students who use AT, but little has been done to compare or aggregate this

information. While the field is still maturing, the pressure from limited budgets, questions about standardized testing accessibility, and curriculum policy decisions demand that we rapidly address the need for AT outcomes data. This article has identified several concepts relating to outcomes measurement from the perspective of rehabilitation that can offer guidance to researchers as they craft the theories, framework, and tools for measuring AT outcomes in education.

Manufacturers and publishers may look at AT outcomes somewhat differently from other stakeholders, but still have a strong interest in providing information that addresses concerns of the field. This article has identified ways that outcomes data is already being collected within apps, computer software and hardware devices. As technology advances, industry members can look for ways to build data collection features into new product designs. At minimum, these tools may help the field establish sources of information on elements of usage such as frequency, duration, and contexts.

Administrators have the responsibility to make wise and effective decisions with regard to AT implementation, especially relating to cost. The literature has suggested that they may find in their backyards a potentially significant amount of data relevant to outcomes. Beyond the data collected in online IEPs and testing data, this article has asked about other information which is currently being collected that might inform not only administrative policy and purchasing decision, but also instruction. Administrators can make an important contribution to the field by exploring these sources of data and how they can be enhanced to be more informative. Privacy is always a valid concern, but well planned data collection and storage can de-identify data while retaining the features needed to support decision making and research. The ideas presented in this article can serve as a starting point.

The agencies that fund AT purchases in the rehabilitation field (Medicaid, Medicare, private insurance, etc.) want to have confidence that the resources they are devoting to AT purchases for their clients have a likelihood of success. In education, these agencies play a peripheral role with regard to AT. Nevertheless, dependable AT outcomes data would provide a framework for making decisions about AT for their clients. The federal Department of Education and the state education agencies could serve a pivotal role by providing leadership and by supporting, encouraging, and helping to resolve problems and issues with outcomes data collection, especially by helping find ways to combine data from different sources.

Classroom teachers and therapists in the school setting also have a role to play in the development and application of AT outcomes data. This article has identified the importance of accurate application of treatment theory and of attention to treatment integrity. Also, parents and professionals who together make up the IEP teams in the local setting, are in position to examine AT outcomes data as they

are collected and make judgments as to how to apply AT in the specific cases of the students they serve.

### **Outcomes and Benefits**

While there remains a great deal of work to do to establish a system for measuring AT outcomes in education, those engaged in the field would benefit from reviewing the work of those who have preceded us in wrestling with outcomes measurement. Their contributions to the discussion of AT outcomes have laid the groundwork and shaped the questions that we must face if we are to develop an effective system for collecting and analyzing outcomes data.

### **Declarations**

The content is solely the responsibility of the author and does not necessarily represent the official views of ATIA. The author disclosed a financial relationship with AbleNet Inc. and Prentke Romich Company. No non-financial disclosures were reported by the author of this paper.

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