Creating an Assistive Technology Outcomes Measurement System: Validating the Components

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Abstract: The topic of assistive technology (AT) outcomes has only recently received attention in the professional literature. As a result, there is a considerable void in the profession's ability to address contemporary questions about the value and use of AT. The purpose of this article is to highlight the theory, development, and research efforts of the ATOMS Project as it seeks to create a prototype of an AT outcome measurement system. Specific attention is devoted to research efforts to socially validate selected components of a proposed outcome system. The results reveal significant support for a system that utilizes a theoretical framework; involves paper or electronic format data collection instruments that do not require extensive training and expertise; assimilates data from multiple sources; and provides visual representation of the data to facilitate interpretation and decision-making. The benefits and outcomes of this research and development agenda are described.

Keywords: Assistive technology outcomes, Theoretical considerations, Social validation research, The ATOMS Project

Fuhrer (1999) observed that interest in the outcomes of assistive technology (AT) is a relatively recent phenomena. Support for this observation is easily gathered by reviewing the journal literature and leading personnel preparation textbooks. Prior to 1996, there is little evidence to indicate that the profession was concerned about issues associated with the collection and use of AT outcome data. Apparently, we never asked ourselves for evidence concerning the impact of AT. It was

obvious that AT was valuable for an individual with a disability. We observed a problem, provided appropriate AT devices and services, and then watched the transformation that occurred when an individual completed a task that was formerly difficult or impossible to do. To the extent that we sought to collect data, we simply asked the individual if they liked the new device and whether they found it helpful. In hindsight, we appear so naive.

An Emerging Field

Arguably, several milestones can be documented that served to increase the profession's awareness and sensitivity about the need to begin asking questions regarding the measurement of AT outcomes (The ATOMS Project, 2003). Early works raised questions about whether or not the profession would make the commitment to measuring assistive technology outcomes (DeRuyter, 1995) and why outcome data was essential for addressing questions about the quality of service delivery systems (DeRuyter, 1997). The first special issue of a journal devoted to AT outcomes appeared less than a decade ago (Smith, 1996) with a second special issue following four years later (Edyburn, 2000). Thus, the first indications of an emerging discipline focusing on measuring AT outcomes can be found in the journal literature.

Developmentally, the discipline of AT outcome measurement is less than 10 years old. The emerging literature can be characterized as philosophical and theoretical as leaders clarify the importance of the research and development agenda. As a result, there is an urgent need for maturation of

measurement theory and instrumentation development.

RESNA (1998a, 1998b, 1998c) published a three-volume monograph with the results of a state-of-the-art survey of AT outcome assessment practices. The findings revealed that a majority of the instruments used by practitioners for measuring the outcomes of AT were self-developed with unknown technical adequacy qualities. This landmark work graphically illustrated the dismal condition the profession was in relative to AT outcome measurement.

The current state of AT outcome measurement can also be understood from the results of two studies that have sought to extract AT outcome data from large extant data sets. While the findings provide a glimpse of the number of individuals that use AT, they are also disappointing as we have learned that there are serious flaws in current professional practice such that outcome data are not routinely collected (Carlson, Ehrlich, Berland, & Bailey, 2001; Moser, 2003).

Increased awareness about the deficits in the AT outcome knowledge base and the dawn of the 21st century created a context of increased accountability and desire for understanding the value of technology investments. Recognition of these issues resulted in the establishment of three national research centers to advance an agenda to substantially increasing the knowledge base surrounding AT and its effective use by individuals with disabilities.

The Office of Special Education Programs (OSEP) funded the National Assistive Technology Research Institute (NATRI) based at the University of Kentucky. This center is charged with conducting assistive research, translating research into assistive technology practice, and providing resources to improve the delivery of AT services.

Several in-progress studies hold considerable potential for informing state and federal policy concerning effective AT practices (Lahm, Bausch, Hasselbring, & Blackhurst, 2001). To learn more about this center, visit the NATRI home page: http://natri.uky.edu.

A second federal agency was also concerned about AT and has funded priorities to advance a research agenda concerning assistive technology outcomes. In October 2001, National Institute on Disability and Rehabilitation Research (NIDRR) funded two, five-year, research centers to address the gap in data collection efforts concerning AT outcomes, as well as the paucity of measurement instruments and strategies. The Assistive Technology Outcomes Measurement System (ATOMS) Project is based at the University of Wisconsin-Milwaukee. To learn more about this center, visit: http://www.atoms.uwm.edu. The Consortium for Assistive Technology Outcome Research (CATOR) is housed at Duke University. To learn more about this center, visit: http://www.atoutcomes.org.

Given the lack of data on AT outcomes and the importance of such information for a wide variety of stakeholders (i.e., individuals with disabilities, AT service providers, administrators, funding agencies, AT developers), one of the key activities of the ATOMS Project has focused on the development of a prototype of a large-scale AT outcome measurement system. The purpose of this article is to describe the theory development underlying such a system and preliminary research that has been conducted to socially validate the components.

Method

In order to begin operationalizing a vision of what a future AT outcome system might look like, the ATOMS Project has engaged in a number of research and development

activities to design a prototype. These activities include conducting an extensive number of field scans to ascertain the what efforts have been devoted to measuring the outcomes of AT and determining what types of innovative research methodologies might be suitable for collecting reliable and valid outcome data to inform AT decision-making.

For the purpose of this investigation, seven components of a proposed AT outcome system were identified by the research team for social validation. The seven components included: (a) theoretical framework; (b) expertise, training, and availability of the assessment instruments; (c) data collection techniques; (d) data assimilation; (e) data reduction and visualization; (f) dynamic norming; and (g) data-based decision-making. Each component is described briefly below.

Components of an AT Outcome System

Previous research by the ATOMS Project suggested that the construct of AT outcome may be multidimensional (change in performance/function, change in participation, usage (why or why not), consumer satisfaction (process, devices), goal achievement, quality of life, and cost) rather than something that can be captured in a single score (Edyburn, 2003). In addition, significant methodological challenges remain to be resolved on how to isolate and discern the specific impact of AT as it is frequently implemented concurrently with other interventions (Smith, 2002). As a result, ATOMS Project researchers believe there is a significant need for building AT outcomes systems that are grounded in a *theoretical framework*.

Test developers use a continuum of approaches for designing assessment instruments: from informal assessment tools that require little training to administer to expensive and comprehensive instruments

that require extensive training to administer and interpret. As a result, questions must be raised about the desired level of commitment needed to implement an AT outcome system. That is, will the profession need a cadre of assessment professionals (e.g., school psychologists) to administer, analyze, and interpret comprehensive evaluation tools? Or, will it need to focus on creating powerful assessment tools that are easily, validly, and reliably administered by a wide range of professionals? Hence, there is a need to understand the perspectives of the field regarding the *expertise, training, and availability of the assessment instruments*.

Traditionally, assessment data has been collected through paper and pencil instruments. However, personal digital assistants (PDAs) and web-based data entry interfaces have emerged as potential tools for streamlining the time involved in data collection and improving the quality of data. While this vision is futuristic, is it practical given current levels of technology access and the availability of trained personnel? As a result, questions must be raised about the assumptions associated with data collection methods and preferences. That is, should an outcome system be built that only permits data to be uploaded from PDAs? Or, should users have to enter all data through a web-based interface? Hence, there is a need to understand the design features necessary to support legacy, as well as, emerging *data collection techniques*.

In an attempt to improve the quality of AT outcome data, some have suggested the creation and validation of a select set of assessment instruments will resolve the issues associated with what data to collect. Others have argued that an outcome system must be inclusive in that the profession cannot dictate the specific data collection instruments that may be used in a given locale. As a result, questions must be raised about the desirability

of data assimilation tools built into an outcome system. That is, will the system accept data from a wide variety of assessment tools rather than a standardized list? To the extent possible, can the system help users understand the relationships among data collected using instruments that are based on a variety of assumptions and methodological approaches? Hence, there is a need to understand the desirability of *data assimilation* as a design principle for a prototype AT outcome measurement system.

One of the intrinsic challenges associated with data interpretation involves seeing past the raw numbers in order to distill and understand patterns. This is particularly important in large data sets where the sheer volume of data can skew significant findings. As a result, questions must be raised concerning preferences for interacting with data. One promising application in this area involves visualization analysis tools. Hence, there is a need to understand the importance of designing tools that facilitate *data reduction and visualization* as part of an outcome measurement system.

One of the inherent difficulties associated with disability research is the intrinsic nature of making inter-individual comparisons. That is, the unique nature of an individual's disability often precludes the opportunity to make comparisons with others. This is especially true with low incidence disabilities where an individual may be the only one in a geographic area. Combine this challenge with the incidence of a specific type of AT and it is readily apparent that it is not possible to compare an individual's performance to a group in order to understand the developmental context of enhanced performance. However, the ubiquitous nature of the Internet offers some intriguing possibilities for addressing these challenges. The ATOMS Project has outlined a concept we call, "dynamic norming." Essentially this

involves extracting data in a real-time database to make comparative norm groups. Users of the outcome system could make any number of comparisons using with simple search parameters to compares a client's performance to (a) other individuals with similar disabilities who have used the same AT; (b) the types of services the client has received; or (c) a gap analysis of the compensation (AT) by comparing the performance results with the results of non-disabled individuals. Hence, there is a need to understand the perceived value of a *dynamic norming* component in an AT outcome system.

Little is currently known about decision-making associated with AT outcome data. That is, if several professionals were to review the same data set, would they all come to the same conclusion about whether or not the AT devices and services were enhancing performance? The lack of attention to AT outcomes in personnel preparation suggests that there could be considerable variation in understanding and interpretation outcome data. As a result, there is an urgent need to understand the need for tools and resources that support *data-based decision making.*

Sample

In order to obtain social validation data concerning the emerging design framework for a prototype assistive technology outcome system, data were collected as part of a presentation about the ATOMS Project at a large annual conference on AT (Edyburn & Smith, 2002). The conference attracts a diverse group of participants (e.g., special educators, occupational therapists, speech/language pathgologists, administrators, AT specialists, parents) that could be considered potential users of the proposed outcome measurement system. Approximately 80 participants attended the presentation and were invited to voluntarily complete an anonymous feedback form

during the presentation. A total of 58 responses were received at the conclusion of the presentation. Clearly, the procedures represent a convenience sample which limit the generalizability of the results but provide valuable formative social validation evidence.

Validation

The seven components of the proposed AT outcome system were each communicated by the presenter through (a) verbal description, along with (b) a single *PowerPoint* slide to describe the function and possible utility of the component. Following the description of each component, session attendees were asked to validate the importance of the component by ranking on a five-point scale (1=*no value*, 3=*some value*, 5=*great value*) the perceived value of the strategy for including the proposed component in an AT outcome system. The anonymous questionnaires were returned to the presenter at the conclusion of the presentation.

Analysis

To analyze support for each component, data from the social validation exercise were counted and totaled. For this analysis, responses 4 and 5 were combined to indicate each respondent's valuing of a component as being of *significant value* in an outcome system.

Results

The results of this social validation investigation are illustrated in Table 1. The respondents provided overwhelming support for the seven proposed components of an AT outcome system. That is, the following formative design principles were socially validated by a diverse group of potential users of a proposed outcome measurement system:

    1. A system should be designed using a *theoretical framework* supporting the

relationship of variables involved in AT outcomes (e.g., satisfaction, performance, use, quality of life, etc.). 95% of the respondents indicated that this component would be of *significant value.*

2. Outcome assessment instruments *should not require extensive training* and expertise to administer and should be readily available. 86% of the respondents indicated that this component would be of *significant value.*

3. *Data collection tools* should support traditional paper and pencil instruments as well as portable handheld devices (PDAs) and web-based interfaces. 100% of the respondents indicated that this component would be of *significant value.*

4. Tools should be available for *assimilating data from multiple sources* and instruments in ways that allow comparisons to be readily made. 83% of the respondents indicated that this component would be of *significant value.*

5. Easy to use tools must be provided to allow professionals and end users to reduce multiple scores into easy-to-understand *visuals that foster interpretation of the data.* 86% of the respondents indicated that this component would be of *significant value.*

6. Given the unique and low incidence nature of many AT interventions, tools should be available that facilitate *dynamic norming* (individual and group comparisons) of the AT outcomes data. That is, it should allow comparisons of an individual's scores with others like him/her in terms of their disability, length of device use, type of device, environment, expectations, and other variables? 88% of the respondents

indicated that this component would be of *significant value.*

7. Tools should be available to *facilitate decision-making* based on the data. 78% of the respondents indicated that this component would be of significant value. This item received the lowest rating of the seven components. This may be a reflection of the thinking of several respondents who questioned the value the entire system if it did not address this component.

Discussion

The discipline of AT outcomes is still in its infancy and suffers from a lack of data to support claims about the effectiveness of AT. As a result, there is a need for considerable conceptual work to guide research on AT outcomes (Lenker & Paquet, 2003).

The ATOMS Project has proposed the development of an AT outcomes information system that would facilitate the collection and

preliminary study reveal a high level of support for seven components of a proposed system.

The current study is subject to a number of limitations primarily due to the conceptual format of the proposed outcome system prototype and lack of a working prototype. Also, the use of a convenience sample limits the application of the results. Despite these shortcomings, the social validation process provides important formative evaluation of the current development efforts and engages the profession in a dialogue about a shared vision concerning the purpose and use of an AT outcome system. Obviously, additional research is needed concerning the development and use of AT outcome measurement system.

Outcomes and Benefits

Preliminary research and development work by the ATOMS Project reveals the following insights associated with the outcomes and

TABLE 1
Percentage of Respondents Valuing Proposed Components of an AT Outcome System

Component	*Perceived Value of This Strategy (%)*		
	No Value	*Some Value*	*Great Value*
Theoretical Framework	0	4	96
Expertise, Training & Availability	0	9	91
Data Collection	0	2	98
Data Assimilation	2	14	84
Data Reduction & Visualization	2	12	86
Making Data Meaningful	3	9	88
Applications of Data (Decision-Making)	5	13	82

use of outcome data. The results of this

benefits of AT:

1. The suggestion that AT outcomes involves more than simple consumer satisfaction received an encouraging reception by the participants in this study. In response, they supported efforts to develop conceptual models that will enable the profession to develop data-based evidence about AT outcomes.

2. Participants in this investigation preferred data collection instruments that do not require extensive training to implement and are inclusive of a variety of assessment instruments and data collection tools (e.g., paper and pencil, PDA, web-based interfaces) rather than approaches that involve extensive clinical data collection efforts and expertise to administer. This work also supports the desirability of initiatives within the AT industry to build data capture mechanism into AT devices.

3. Potential users of AT outcome data expressed a preference for tools that help them understand the meaning of the outcome data they have collected. This, in turn, would facilitate appropriate decision-making.

4. The concept of dynamic norming, extracting data in the database to make comparative norm groups, was positively received by the participants in this study. Social validation of this unique design principle in developing AT outcome systems is important given that it represents an advance that would be impossible to achieve with traditional approaches to tests and measurement.

Conclusion

The knowledge base concerning how to measure the outcomes of AT is still in its infancy. Considerable work is needed to define the theoretical constructs necessary to create data collection systems that will produce outcome data for subsequent analysis and understanding of the impact AT.

This report presents a brief summary and analysis of some initial efforts of the ATOMS project to define potential components of an AT outcome system. Future studies will explore additional design considerations, usability, and applications of an AT outcome system. For additional information, please contact: atoms@uwm.edu.

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