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# Four Models of Assistive Technology Consideration:

# How Do They Compare to Recommended Educational Assessment Practices?

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Although the concept of assistive technology has been around for some time in the fields of study for rehabilitation (Scherer, 1998), communication as it relates to speech and language (Bryant & Bryant, 2003; Church & Glennen, 1992) and medicine (Porter, Haynie, Bierle, Caldwell, & Palfrey, 2001), assistive technology pedagogy is relatively new to the field of special education (Blackhurst, 1997). Thus, practitioners and researchers have begun to try to explain the meaning, legal requirements, and service delivery practices of assistive technology consideration.

*Definition Issues*

Federal law states that *assistive technology* is "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" (Individuals with Disabilities Education Act of 1997). This codified definition is broad in scope and not very descriptive in the nature or category of tools that can be identified as assistive technology (Nalty & Kochany, 1991). Lewis (1993) attempted to clarify the definition of assistive technology through delineating the purposes for which assistive technology is used: (a) to augment an individual's strengths so that his or her abilities counterbalance the effects of any disabilities, (b) to provide an alternate mode of performing a task so that any effects from an individual's disabilities are compensated, or (c) to bypass entirely. Lewis (1993) explained that assistive technology may represent adapted everyday devices, or devices that can be used together with everyday devices, or very specialized equipment that is designed to perform specific functions that everyday items cannot.

One role of assistive technology is further defined as being a cognitive prosthesis that can replace an ability that is impaired or as a cognitive scaffold that provides support needed to accomplish a task more effectively, efficiently, and independently than otherwise possible (Blackhurst, 1997; Cavalier, Ferretti, & Okolo, 1994). Behrmann (1998) indicated that assistive technology may include instructional applications. However, disagreement exists over whether or not instructional applications should be included as assistive technology (Anderson, 2000; Breslin-Larson, 2000; Garza, 2000; Hartsell, 2000; QIAT Consortium Leadership Team, 2000). The Office of Special Education Programs (OSEP) has provided some guidance on what equipment can and cannot be considered assistive technology (OSEP, 1992a; OSEP, 1992b; OSEP, 1993; OSEP 1994; OSEP 1995a, OSEP 1995b; OSEP 1995c), but OSEP also has issued a letter of clarification stating that there is no defined list delineating what can and cannot be considered assistive technology (OSEP, 1995c). Obviously, a single view of what constitutes assistive technology has not been adopted.

*Assistive Technology Consideration Issues*

To further complicate matters, the Individuals with Disabilities Education Act Amendments of 1997 (1997) mandated that Individualized Education Program (IEP) teams need to consider assistive technology and corresponding assistive technology services for all children who are receiving special education services. However, once again, the federal law does not stipulate what constitutes consideration or which components are to be included in the consideration process. A variety of factors related to consideration of assistive technology have been proposed in the literature relating to family, cultural, and funding issues (Bradley, Parette, & VanBiervliet, 1995; Parette, 1995; Parette, 1996; Parette & Angelo, 1996; Parette &

Brotherson, 1996; Parette, Brotherson, & Hourcade, 1996; Parette & McMahan, 2002; RESNA, 1989; Smith-Lewis 1992), but no consensus has been reached on this issue.

Models have been proposed to guide the important work of school teams as they implement the assistive technology consideration process (Bowser & Reed, 1995; Chambers, 1997; Melichar & Blackhurst, 1993; Zabala, 1995). However, serious shortcomings exist in the implementation of the models of assistive technology consideration. The validity and reliability of these consideration procedures have not been established. Few guidelines advise practitioners whether these models should be applied unilaterally or conditionally in relation to the idiosyncratic needs of their students. In addition, practitioners often do not feel that they have adequate training in how to consider and implement assistive technology in their classrooms (McGregor & Pachuski, 1996). The recent and continuing legislative emphasis on the inclusion of assistive technology in special education (Bryant & Bryant, 2003; Fein, 1996) should encourage the field to address the lack of a guiding process for assistive technology consideration within the overall paradigm of special education. Some school teams resort to a single checkbox on the IEP form to document consideration of assistive technology while others use more elaborate protocols to guide the consideration process (QIAT Consortium Leadership Team, 2000). When a school team considers the use of assistive technology, the process for assessing individual student needs should be identified (Bryant & Bryant, 2003). A school team should hold fast to recommended best practices in educational assessment in order to more effectively choose an assistive technology model to apply when assessing an individual student.

The goal of this article is to provide guidance to school teams in the assistive technology consideration process by comparing educational assessment practices to four selected models of assistive technology consideration, as an initial step in the process of paradigm construction.

First, a review of recommended educational assessment processes documented in the literature are presented and explored. Second, summaries of the selected models of the assistive technology consideration process are given. Third, a synthesis of the literature is performed comparing and cross-referencing the selected models of the assistive technology consideration process with respect to the features of recommended educational assessment practices. Finally, recommendations for future research and practices are presented.

## Educational Assessment Features and Assistive Technology Consideration

### *Research Methodology*

The field of educational assessment offers a historically rich (Sattler, 1992) research base and extensive integrative literature reviews, predominately focusing on standardized norm-referenced assessment and, more recently, performance-based assessment (Popham, 2000). The field of assistive technology and the related consideration of assistive technology, on the other hand, are relatively new (Edyburn, 2000a). In the efforts to review the literature related to educational assessment processes and models of assistive technology consideration, two discrete approaches, necessitated by the idiosyncratic nature of the fields, were implemented. Educational assessment literature was reviewed using a multiphase inductive approach that systematically derived assessment process themes. Next, literature regarding four models of assistive technology consideration, previously reported by Watts and O'Brian (2002), was acquired through a comprehensive search inclusive of journals, reports, and texts relating to assistive technology.

### *Educational Assessment Literature*

Using literature search techniques recommended by Cooper (1989), initial steps in the first phase for reviewing educational assessment literature were directed toward the fields of

general education, special education, and school psychology to discover common themes. While there is a plethora of assessment texts, only widely used texts, reports, and books were included. To expand the search and to provide a strong sense of content validity, the related fields of rehabilitation, augmentative and alternative communication, and program evaluation were also included through online and manual searches of texts and field-specific research journals. As a result, eleven features of educational assessment were derived from the literature published from 1989 to 2002.

The second phase focused on incorporating the previously identified education assessment features as key descriptors in a comprehensive literature search. The literature search employed several methodologies. Online computer searches of the following databases were conducted: ERIC, Wilson Select Plus, PsychLit, and Social Science Abstracts. In addition, manual searches of the following journals were conducted: *School Psychology Review, Intervention in School and Clinic, Diagnostique, Exceptional Children, Teaching Exceptional Children, Rehabilitation Counseling Bulletin , Occupational Therapy Journal of Research, American Journal of Occupational Therapy, and American Journal of Physical Medicine and Rehabilitation*. Then, ancestral searches of reference sections of all journal articles and texts were conducted in order to winnow out additional sources that did not result from the online database searches. Finally, all the educational assessment articles were reviewed based on two selection criteria: (a) publication in a refereed journal and (b) the article was not exclusively a description of a particular assessment tool but rather addressed one or more features of the educational assessment process.

*Assistive Technology Literature*

As with the educational assessment literature review, multiple methods (Cooper, 1989) were used to locate the articles and other sources published on the consideration of assistive technology. Online computer searches were conducted using the following databases: ERIC, Wilson Select Plus, PsychLit, and Social Science Abstracts. Terms for the searches involved a variety of combinations of both subject heading and keyword descriptors including: (a) assistive technology, (b) assistive devices (for the disabled), (c) consideration, (d) assessment, (e) assessment process, (f) technology, (g) disabilities, (h) computer-aided instruction, (i) rehabilitation, (j) occupational therapy, (k) augmentative communication, (l) evaluation, (m) communication aids, (n) augmentative and alternative communication, and (o) research. Manual searches were conducted using journals related to the fields of assistive technology, special education, augmentative and alternative communication, occupational therapy, and rehabilitation. These journals included *Journal of Special Education Technology, Exceptional Children, Special Education Technology Practice, Rehabilitation Counseling Bulletin, Diagnostique, Learning Disabilities Research and Practice, Learning Disabilities Quarterly, Research and Practice for Persons with Severe Disabilities, Intervention in School and Clinic, Teaching Exceptional Children, Assistive Technology, Occupational Therapy Journal of Research, American Journal of Occupational Therapy, and American Journal of Physical Medicine and Rehabilitation.* Finally, ancestral searches of reference sections of all journal articles and texts were conducted to discover additional sources that did not result from the previous searches.

The rationale for inclusion of the selected sources was not limited to publication in refereed journals. The authors agreed that the recent nature of assistive technology in education

mandated the incorporation of additional sources such as electronic documents, proceedings, resource guides, and reports. With regard to texts and books, the limited volume of published texts specific to assistive technology prompted inclusion of all assistive technology texts currently available.

## Features of Educational Assessment

Despite the multitude of components for quality assessment, the assessment literature is extremely consistent in addressing certain features as critical aspects of many types of assessment processes and tools. Whether one examines a particular assessment tool or a model for the assessment process, these consistent features should be evident in the tool or model. The assumed outcome of the educational assessment process is the provision of support to students with disabilities. A thorough sampling of the widely used, foundational assessment textbooks and articles provide a framework of variables that indicate the appropriateness of a given tool or assessment process. The following descriptors are those features that appear within a broad scope of the educational assessment literature, as shown in Table 1. An expanded description of each of these features follows.

### *Comprehensive Ecological Approach*

Gathering data in all potential environments that may be accessed by the student as well as gathering data that examine all the complex factors extant in the learning environment (Andrews, Saklofske, & Janzen, 2001; Browder, 2001; Flynn & Clark, 1995; McLoughlin & Lewis, 2001; Nastasi, 2000; Overton, 2003;Welch, 1994) should occur in all assessment processes. Access to various environments is essential, and assessment should include the areas of economic and social opportunities as well as academic and vocational skills (Barnett, Lenz, Bauer, Macmann, Stollar, & Ehrhardt, 1997; Bryant, Seay, & Bryant, 1999; Denham & Zabala,

1999). Data must include the supports in the environment and the necessary skills to perform those required activities in the designated environments (Beukelman & Mirenda, 1998; Haney & Cavallaro, 1996).

Assessment using a comprehensive ecological approach incorporates Serafini's (2000) inquiry paradigm. In this approach, the gathering of all data leading to potential interventions is not limited by a priori conceptions. For example, access to a laptop computer with a writing program could be an environmental support for a student who has difficulty writing. The availability of a laptop computer in multiple environments (e.g., home, school, community) should be considered. When members of the school team eliminate the feasibility of a laptop computer for a student prior to assessment data being collected across environments, they violate the inquiry process.

*Emphasis on Individual Supports*

Another purpose of the educational assessment process is the collection of data for the provision of individualized supports in order to achieve success for learners. The educational assessment process should focus on those specific supports that are unique for the student to achieve educational access (Andrews, Saklofske, & Janzen, 2001; Flynn & Clark, 1995; Overton, 2003). Individuality of the educational assessment process could be obtained through generation of specific assessment questions based on the IEP team's determination of student needs. The educational assessment process should not be, in total, a series of predetermined activities leading to a preconceived support plan (Federal Regulations for Individuals with Disabilities Education Act, 1999; Serafini, 2000). For example, different assessment processes should be evident for a student who has a vision impairment versus a student who is deaf, resulting in assistive technology recommendations that are uniquely matched to support the

learning needs of each of those students. While this example represents a wide variation in student assessment, the mandate of individualization remains constant for all learners.

*Technical Adequacy*

The methods of educational assessment must have sufficient technical adequacy for valid and reliable decisions to be made (American Educational Research Association, 1999; Jett-Simpson & Leslie, 1997; McLoughlin & Lewis, 2001; McMillan, 2000; Nitko, 2001; Popham, 2000; Salvia & Ysseldyke, 1995; Sattler, 1992; Shinn, Rosenfield, & Knutson, 1989). Inferences made through the educational assessment process should be truthful and reasonable in the representation of the learner (Federal Regulations for Individuals with Disabilities Education Act, 1999). The criteria of validity should lead to an accurate picture of the learner. The educational assessment process should result in a clear understanding of the individual student that can be confirmed by all of those involved with the student. The issue of validity is also addressed through the implementation of multiple tools in data collection and the match between daily classroom performance and the process of data collection (Jett-Simpson & Leslie, 1997). The assessment process must be consistent enough to produce similar results over time, thus demonstrating reliability. Additionally, the data generated by two different observers should be consistent, demonstrating inter-rater reliability.

Finally, there must be an "absence of bias" (Popham, 2000, p. 57) in the assessment process. The process should not have an *a priori* conclusion hidden in the process itself or in the inferences that will result from the process. Therefore, utilization of only the supports currently extant in the environment would, *a priori*, prevent consideration of other supports. Educational assessment should not contain judgments that would have a detrimental effect on learners thereby biasing the assessment process. Reliability, validity, and absence of bias must be

addressed across school teams, across individual students, and across contexts to compile data indicating the technical adequacy of the model itself as well as the technical adequacy of the specific implementation for an individual student.

For example, technical adequacy may be derived from the use of many assessment tools, such as an interview of the student regarding preferences for a communication device, observation of the learning environment in which the student is required to communicate, and use of assessments directly related to communication tasks required by the curriculum, as well as social contexts. The larger context of technical adequacy requires empirical study of the issues of reliability and validity for assistive technology consideration models through data collection across variables. In the example above, the particular model of assistive technology consideration should be examined not just in the case of the individual student, but across many students. Furthermore, technical adequacy requires that the issue of assessment bias be addressed. Assessment activities should not be limiting or prejudicing to the individual thereby tainting the process. Such is the case when a test requiring spoken responses is administered to a non-speaking student.

*Strength-based Model*

When planning for support, the identification of student strengths is a crucial feature of assessment process (Bellini, Bolton, & Neath, 1998). A systematic process that identifies "characteristics that create a sense of personal accomplishment" (Epstein, Rudolph, & Epstein, 2000, p. 50) and consistently utilizes these data in the resulting plan of support should be present. The assessment process should incorporate these strengths in the model (Nitko, 2001) and not be a single checkbox to fill in on an IEP form. For example, a student with limited verbal responses may demonstrate excellent fine motor skills and good range of motion in her or his hands. This

strength in hand dexterity should be a primary building component for the assessment process and subsequent intervention for the individual.

*Consistency Between Framework and Process*

All assessment processes are grounded in a theory of learning, regarding how people acquire information, regarding what people know, and regarding how people develop knowledge over time (Andrews, Saklofske, & Janzen, 2001; Farr & Trumbull, 1997; McMillan, 2000; National Academy of Sciences, 2000). Assessment processes also should be closely aligned with the underlying assumptions of the epistemological framework (Beigel, 2000; Edyburn, 2000b; Lahm & Sizemore, 2002). If learning is conceptualized as response to stimuli, then this conceptualization should inform all assessment procedures; student responses to stimuli are given precedence in the assessment process. Likewise, if learning is conceptualized as the building of cognitive frameworks in response to interactions with the environment then, this should be the basis for a different assessment model which reflects these beliefs.

For example, a student who is involved in an assessment to determine needed support in the area of written expression would engage in different assessment processes based on varying conceptual frameworks. If the assumption is that writing should be based on the theory of a process approach and metacognition, then the assessment would place emphasis on the collection of student writing samples from various points in the writing process as well as dialoguing with the student about his or her writing. In contrast, if the assumption is that writing should be based on a framework in which writing is a highly structured and sequential task resulting in a uniform product (e.g., writing samples required by high stakes tests), then the assessment would place emphasis on the degree to which the final product matches the task framework (e.g., writing rubrics used with high stakes testing) without regard for the process of achieving the final

product. Another example of the consistency between framework and process would be the underlying assumptions of assistive technology usage as compensation versus remediation. If one subscribes to the model of assistive technology as compensatory, a student would be provided with a calculator during all activities, assessment included. If one ascribes to a remediation model, then a calculator would not be incorporated into an assessment process because one would be examining the student's skills without supports to determine individual skills in comparison to others.

*Team Problem-solving Model*

Federal law (Individuals with Disabilities Education Act, 1997) and assessment literature (Edyburn, 2000b; Haines & Sanche, 2000; Johnson & Johnson, 2002; McLouglin & Lewis, 2001) clearly mandate the inclusion of a variety of people to make educational decisions with and on the behalf of students with disabilities. The team must include parents and representatives of general education as well as those professionals with expertise in the areas needing support for the student (Browder, 2001; Bryant & Bryant, 2003; Chambers, 1997; Flynn & Clark, 1995; Lahm & Sizemore, 2002; Merbler, Hadadian, & Ulman, 1999; Parette, 1998; Welch, 1994). Additionally, the approach utilized by the team should incorporate person-centered planning (Browder, 2001). Therefore, recommended approaches to assessment would involve the student, his or her family, and others in all aspects of the process. The strength of this approach allows for diverse voices to be part of the decision-making process (McLoughlin & Lewis, 2001).

Consideration of information collected by and from the family must be accorded equal weight in the assessment process. Examples of data may include the activities in which the student participates in the community, data provided by the student as to perceptions of needed

supports, and other information provided by teachers and therapists, such as data that reveal the environmental demands within the educational setting.

Problem solving implies a process approach, which is inductive in nature (National Academy of Sciences, 2000; Serafini, 2000). The purpose of the assessment process is to make decisions regarding intervention for students (Haines & Sanche, 2000; Nitko, 2001; Wiggins & McTighe, 2001) and therefore it is imperative that a defined schema for decision-making is included in the assessment model. An IEP team, for example, may determine that an inquiry centered on a student's participation in the general education art program and the necessary supports for that participation will guide the process of assessment because student participation is a priority as communicated by the family. As a result of identifying this line of inquiry with respect to family preferences, the collection of data to determine the most effective intervention and the analysis of these data is systematically undertaken. The school team then uses the decision-making schema to delineate an action plan, thereby remaining faithful to the problem solving process. The decision-making schema, in the preceding example, gives priority to the preferences of the family. The family-indicated preference that any assistive technology used as supports for participation should not call undue attention to the student, thus emphasizing student differences. Therefore, one potential decision made by using the decision-making framework could be the use of drawing and painting software to complete art activities while other students within the class will use the same software on a rotating basis.

*On-going Longitudinal Approach*

The assessment process should allow for data collection over multiple assessment opportunities and should be viable for learners at various stages in their learning process (Buekelman & Mirenda, 1998; McLoughlin & Lewis, 2001; Wiggins & McTighe, 2001). The

usefulness of one-shot assessment models for appropriate planning for students with disabilities is limited (Browder, 2001; Glennen, 1997; Haines & Sanche, 2000). The assessment model and tools that one uses should have the flexibility to monitor the progress of the learner over time, allowing a consistent view of the student from the past, the present and for the future. For example, an assessment model that examines the mobility needs of a student with visual impairments should be viable at the crawling stage of the young child's development as well as the stage at which the adolescent may be navigating the public transportation system.

*Student Involvement*

Best practice in assessment designates that the student is involved, as much as possible, in the assessment process (Alper, Ryndak, & Schloss, 2001; American Educational Research Association, 1999; Parette, 1998). The learner makes decisions with the other members of the assessment team (Stiggins, 2001) as to the focus of (a) the inquiry, (b) the tools and activities to be used to gather data, (c) the decision making process, and (d) the development of the resulting intervention. The involvement of the student presupposes the person-centered approach (Browder, 2001). An IEP team that is focusing on the assessment of a student's needs in the vocational area might invite the student to give his or her preferences to determine specific assistive technology tools that may be used during data collection. The student would be involved also in the decision making process about the final selection of assistive technology once the relevant data have been collected.

*Documentation*

An assessment model must include a method for recording information gained throughout the process (Beukelman & Miranda, 1998; Haines & Sanche, 2000; Federal Regulations for Individuals with Disabilities Education Act, 1999; McLoughlin & Lewis, 2001).

Additionally, there should be congruence between the documentation forms and the assessment process (Denham & Zabala, 1999; Glennen, 1997). Recording of assessment data should be efficient and consistently integrated into the assessment process (Bonwich & Reid, 1991). For example, the IEP team considering assistive technology for an individual student should have detailed documentation for this consideration (Edyburn, 2000b) and should also have a set of forms for recording the necessary data that the team collects (Denham & Zabala, 1999). Furthermore, the documentation must be in a format such that it is understandable by others.

*Student Outcomes*

The primary purpose of assessment is the provision of data for team decision-making (Nitko, 2001; Stiggins, 2001). One of the major categories of decisions that a team can make relates to student attainment of specific skills and knowledge (Federal Regulations for Individuals with Disabilities Education Act, 1999). Those evaluative activities that are on-going with the process of instruction, formative assessment, assist the team in determining the student's learning style (Hobson, 1997). The assessment model chosen by the team must have a direct link to the learning objectives and student outcomes (Bellini, Bolton, & Neath, 1998; National Academy of Sciences, 2000; Silverman, Stratman, & Smith, 2000). The assessment process should logically result in formative assessment of the student's progress towards specified goals. For example, as a result of an assistive technology assessment, a student who is experiencing difficulty with writing essays may receive a recommendation to use a computer program that supports the writing process. The assessment process that is utilized should also include a component that results in ongoing data collection to determine the effectiveness, or overall outcomes, of this assistive technology intervention related to the student achievement of curricular writing goals.

*Program Outcomes*

An additional purpose of the assessment process is the determination of effectiveness of various educational program services (Nitko, 2001; QIAT Consortium, 2000). In fact, major certification and accreditation bodies require overall program reviews (Bonwich & Reid, 1991). Assessment processes should provide educational professionals and other stakeholders with the necessary information to make decisions about educational program services so that appropriate adjustments can be made. The data collected within the assessment model should incorporate information that guides program decisions including aggregation of outcome data across assessments of individual students (Nitko, 2001). For example, an IEP team should collect information on the use of various assistive technology interventions with different students to allow evaluation of the effectiveness of the assistive technology consideration process and the implementation process. Further, the assessment model should provide a means for program evaluation with regard to student progress by systematically collecting data through ongoing documentation (Edyburn, 2000c; QIAT Consortium, 2000).

## Models for Considering Assistive Technology

Models can serve as useful approaches to guide school teams in their consideration of assistive technology for individuals with disabilities (Bryant & Bryant, 2003). Few models for the consideration of assistive technology have been presented in the literature, however. The extent to which school teams are aware of any of these models or have adopted one or more for use to guide their assistive technology consideration process has not been documented.

Nonetheless, the practice of consideration of assistive technology for students with disabilities occurs on a regular basis throughout our nation's schools. In keeping with the stated purpose of this article, the following four models will be described for comparing with

educational assessment features: Chambers' Consideration Model (Chambers, 1997), Education Tech Points (Bowser & Reed, 1995), SETT Framework (Zabala, 2002), and Unifying Functional Model (Melichar & Blackhurst, 1993).

*Chambers' Consideration Model*

Chambers (1997) introduced a model of consideration that offers a periodic recursive protocol for on-going consideration of assistive technology. The model was derived from responses received from assistive technology experts and focus groups that consisted of trainers and consumers of assistive technology services. Chambers' model contains a series of opened-ended questions arranged in a flowchart configuration. The initial question addresses the student's needs within the educational program from a deficit perspective (i.e., what is the student not able to do or participate in daily).

Chambers (1997) proposes that this model facilitates documentation of the consideration process and supports evidence gathering as the team attempts to answer each question. The questions lead the school team to reflect upon whether current strategies, devices, and modifications are working or not. Furthermore, details are gathered as to which tools and strategies were tried, the period for which they were implemented, the procedures used in the implementation, and the outcomes of the trial process. Members of the school team must also reflect upon their level of assistive technology knowledge and available resources. If needed, members are prompted to seek additional information, resources, or consultation from others with assistive technology expertise. Finally, the model recognizes and promotes a periodic repetition of this process as part of the IEP review.

*Education Tech Points: A Framework for Assistive Technology Planning*

Bowser and Reed (1995) developed a model containing a series of questions, referred to

as points (i.e., referral, evaluation, extended assessment, IEP development, implementation, and periodic review) that facilitate the assistive technology consideration process across particular times within the service delivery process. This model is based on a process associated with the delivery of vocational rehabilitation services. Bowser and Reed propose that this approach is not a stand-alone process, but one that integrates assistive technology into the special education service delivery process.

According to Bowser and Reed (1995), at the referral point (Education Tech Point 1 – Initial Referral Questions), school teams are directed to ask whether commonly available, simple technology would meet the student's needs as a pre-referral strategy within the general education setting, thus avoiding the need for referral for special education services. The second point (Education Tech Point 2 – Evaluation Questions) focuses on whether assistive technology devices are necessary to support an assessment process that reflects the student's abilities and needs. In addition, the assessment team members consider recommendations for what types of devices, modifications, or equipment might be needed in order to improve the student's educational performance. The third point (Education Tech Point 3 – Extended Assessment Questions) directs the school team's attention toward gathering data during the student's trial periods with a variety of assistive technology. Subsequently, decisions should take into account both environmental and task variables. The fourth point (Education Tech Point 4- Plan Development Questions) corresponds to the time that school teams would be involved in IEP development and deciding whether or not assistive technology is needed to ensure that the student receives a free appropriate public education (FAPE) and equal access as mandated by Section 504 of the Rehabilitation Act of 1973. The fifth point (Education Tech Point 5- Implementation Questions) focuses on the practical who, what, when, and how questions for

implementing the student's plan. The logistics of daily monitoring, maintenance or repair of the assistive technology, and team collaboration are carried out at this time. The sixth point (Education Tech Point 6 - Periodic Review Questions) corresponds to the time that program evaluation or planned periodic review would take place. Bowser and Reed contend that the timing of this review should be flexible to meet changing student needs, as well as those unpredictable events such as the mechanical breakdown of a device or introduction of a new innovation in assistive technology.

*SETT Framework*

Zabala (1995, 1996, 2002) developed a guide for considering assistive technology that focuses the attention of the IEP team on four explicit areas: (a) the student, (b) the environment (across multiple, customary environments), (c) the tasks required for active participation in those environments, and (d) the tools that enable the student to access environments, participate, and gain skills or enhance performance. Zabala (2002) describes the following elements associated with her framework: (a) collaboration; (b) communication; (c) incorporation of multiple perspectives; (d) gathering of pertinent information; (e) use of shared knowledge; (f) flexibility; and (g) on-going processes. A series of questions in each of the four areas are intended to stimulate thought, promote dialogue and consensus among team members, and guide decision-making.

Within the Student area, team members work together to decide what the student needs to do (i.e., primary goals) that is difficult or not likely to be achieved independently at this time (Zabala, 1995, 1996, 2002). Information is gathered and then shared about the student's abilities, preferences, and special needs. Within the Environment area of SETT, team members consider factors related to physical and instructional arrangements, accessibility (physical, instructional

and technological), availability of materials and equipment, and supports available to the individual. In addition, resources available to those who support the individual are identified and attitudes and expectations of the parties involved are examined. For the Tasks area, team members identify activities that are required for the student to progress toward mastery of IEP goals or that foster student involvement in the environment. Additionally, Zabala recommends that team members review the critical elements of those activities and how modifications could be made to increase student participation while not altering the salient parts of the activity. Finally, the school team members focus on the Tools area. With a clear understanding of the student, environment, and tasks, members of the school team are challenged to brainstorm a range of possible assistive technology solutions (no-tech, low-tech, and high-tech options), delineate the most probable and most fitting technology solutions, identify strategies for using the chosen technology, and document the effectiveness of the assistive technology.

*Unifying Functional Model*

Melichar and Blackhurst (1993), pioneers in disseminating an educational model for considering assistive technology, provide a comprehensive flowchart detailing elements of the consideration process in their Unifying Functional Model, sometimes referred to as the Human Function Model (UKAT Project, 2002). The emphasis of their model is on the interrelationships among numerous dynamic elements. Those elements are: (a) the functioning of a student with a disability across environments (home, school, and community) and contexts within those environments (e.g., dining room, auditorium, and workplace), (b) the functional demands placed on the student (e.g., communicating, grooming), (c) the exploration of options for the student (e.g., assessment, adaptation), (d) the student's personal perceptions (e.g., perceived benefits, problems), (e) the personal resources available to them (e.g., talents, coping skills), and (f) the

existence of external supports (e.g., special education, social services). All of these elements, in combination which each other, guide the functional response of the school team. A functional response may include the following: resource allocation, an individualized plan, program implementation, and support services. According to Melichar and Blackhurst (1993), the last two remaining elements of this model are (a) resulting personal changes for the student across several dimensions (e.g., achievement, coping strategies, control) and (b) an evaluation and feedback loop that encourages the school team to continually review all elements previously considered. The model emphasizes the entire process as an ever-changing one.

## Discussion

The purpose of this article is to provide guidance to school teams in the assistive technology consideration process by comparing and evaluating selected models of the assistive technology consideration process with respect to recommended practices in educational assessment. This article represents a beginning exploration and adaptation of a yardstick for comparing models that was proposed originally by Watts and O'Brian (2002). In their article describing models for considering assistive technology for students with disabilities, the authors introduced the notion of cross-referencing the literature in educational assessment processes with literature in the field of assistive technology consideration processes.

Some of the major issues confronting the field are: (a) the current state of the art for assistive technology consideration does not draw from a vast literature base, (b) the legal requirements that mandate assistive technology consideration are not explicit in IDEA (1997), and (c) training needs are extensive for practitioners in the field. Nonetheless, an initial analysis of where and to what extent the educational assessment literature and the assistive technology literature intersect is worthwhile.

*Cross-referencing Recommended Practices and Models for Consideration*

As to the process of cross-referencing educational assessment recommended practices and models for consideration of assistive technology, a systematic method was used to compare and evaluate the models. First, the educational assessment features were reviewed one by one in relationship to whether or not the features were reflected in each model. For example, features were examined and consensus was reached on whether or not a particular feature was present in the model or the corresponding documentation. Codes for presence (+) or absence (-) of the feature were then assigned. For example, the Chambers Model clearly addresses the educational environment, however, community, home and other potential environments are not specifically addressed. Therefore, the code indicating absence (-) was assigned to the feature of "comprehensive ecological approach." This coding process was applied for all of the educational assessment features in relation to each of the assistive technology consideration models (see Table 2).

*Strengths of the assistive technology consideration models.* Each model allows for multiple assessment opportunities over time and for the provision of a consistent view of the student's abilities, needs, and outcomes thus evincing the educational assessment feature of ongoing longitudinal approach. For example, in the SETT Framework model, Zabala (2002) states that on-going processes represent a "critical element of SETT" (The Task section, para. 2). Another strength exhibited in all of the selected models is the attention to student outcomes. An essential characteristic of each model is the collection of formative data to determine on-going student progress toward attainment of specific skills and knowledge. In the Unifying Functional Model, a variety of elements labeled as personal changes (e.g., achievement, independence, functional abilities) within the model are synonymous with student outcomes.

For the feature of documentation, Chambers' Model, Educational TECH Points, and SETT Framework all include a process for recording data in an easily understandable format for school teams. In contrast, the Unifying Functional Model does not provide for the gathering of such information. The models provide a sequential or branching process that prompts school teams to document data at various points within the process. For example, Chambers' Model directs school teams to "provide documentation and evidence to support" conclusions (p. 23). For the feature of team problem solving, critical components of the same three models include the involvement of the student (if appropriate) and his or her family in collaboration with a diverse group offering different perspectives to the problem solving process and the gathering of data by the school team for use in a defined schema for decision-making. A strength of the Educational TECH Points model is the focus on teaming with skilled members providing "unique perspectives" (p. 1) to solve assistive technology questions.

In regard to the feature of emphasis on individual learner supports, three out of the four models (i.e., Educational TECH Points, SETT Framework, and Unifying Functional Model) provide for supporting the individualization of the assessment process based on particular student needs. For example, the Unifying Functional Model emphasizes numerous, dynamic variables directly tied to the student and his or her environments having potential impact on possible assistive technology outcomes. Therefore, it is the inclusion of these variables that fosters the individualization of the assessment process for each and every student.

*Limitations of the assistive technology models.* Across the four models, the educational assessment feature, student involvement, is most directly addressed in the Unifying Functional Model. This model includes the student as an active participant in the assessment process by incorporating aspects of the student's own perceptions of assistive technology across

environments, contexts and time (Blackhurst, Lahm, Harrison, & Chandler, 1999). The other models indicate that the student may serve as part of the team. However, the primary emphasis is on involvement of persons (e.g., parents, teachers, therapists) other than the student in the actual decision-making that occurs throughout the assessment process.

Two educational assessment features, (a) technical adequacy and (b) consistency between epistemological framework and assessment process, are clearly not demonstrated in any of the four models. Technical adequacy relates to the constructs of validity, reliability, and absence of bias, resulting in an accurate picture of the learner and appropriate decision-making. While application of each of the models in the consideration of assistive technology may lead a particular school team to their own judgment about the accuracy of the match between the learner and assistive technology, the broader application of these models across many students, across various teams, and across a variety of environments (as well as other variables) has not yet been statistically analyzed nor reported in the literature.

In reviewing the models and their corresponding documentation, there were no clearly stated epistemological frameworks linked to the models of assistive technology consideration. When consistency between epistemological framework and the assessment process is evident, there is an overt, conceptual match between assumptions and beliefs regarding the theoretical foundation for knowledge and learning and the process of assessment. The authors recognize that the theoretical foundation for each of the four models exists implicitly within the model and the corresponding documentation. However, due to the absence of an epistemological framework, school teams may not be able to discern an explicit match between the underlying framework and the model of assistive technology consideration. Therefore, school teams may struggle with the crucial task of implementing a model. Additionally, due to the lack of explicit assumptions

and beliefs regarding knowledge and learning, the issue of consistency is moot. For example, the SETT Framework implicitly assumes that tasks and environments will be fully explored yet the rationale underlying these assumptions is absent from the model. As a result, there could be no examination of the consistency between implementation of the SETT model and the epistemological framework.

Program outcomes, as an educational assessment feature, are absent also from the four assistive technology consideration models. Systematic data collection is a hallmark of recommended practices in both educational assessment and special education service delivery. Data collected within the assessment model should incorporate a well-defined process that guides program decisions including aggregation of outcome data across assessments of individual students and allows for documentation of overall program effectiveness. The models certainly guide decision-making regarding individual students, but there is no mechanism within any of the models for aggregating these data to determine program efficacy.

*Limitations of Synthesis of the Literature*

Due to the limited research in the field of assistive technology in school settings, the cross-referencing of assistive technology practices with educational assessment reveals an imbalance between a historically rich research base and one that is relatively new. Only recently has the field of assistive technology begun to contemplate the issues of applying educational assessment practices to the assistive technology consideration process. Another limitation is the manner in which features of educational assessment were determined to be present or absent in the four selected models of assistive technology consideration. A dichotomous rating (i.e., plus/minus) does not allow for gradations; therefore, the potential for misinterpreting the rating is substantial. Future examination of these ratings would provide needed reliability. Also, ratings

were determined by a limited number of researchers on a selected set of models. Finally, while other models of assistive technology consideration exist, this article includes only four of them.

*Recommendations for Future Research and Practices*

This investigation serves as the first step in a lengthy process for researching features of the assistive technology consideration process with regard to research-supported educational assessment practices. Further research is needed on current and proposed models of assistive technology consideration using established foundational features of educational assessment. Understanding the features of educational assessment provides the basis for practitioners' appropriate implementation of assistive technology consideration models. Additionally, knowledge of educational assessment features should allow school teams to better match their choice of a model to their own idiosyncratic needs and those of their students. In a larger sense, the incorporation of features of educational assessment as being intrinsic to the design of the assistive technology consideration process should drive the construction of future models, perhaps resulting in strong and comprehensive models of assistive technology consideration. In particular, researchers should conduct investigations into the technical adequacy of current models. Quantitative and qualitative methodologies should be used to establish a body of empirical knowledge that validates the features of educational assessment in relation to assistive technology consideration processes. In addition, researchers should investigate and further differentiate the descriptions of the indicators of educational assessment features such that practitioners could then employ these fine-tuned indicators to rate the models through the use of a validated rubric.

Dialogue could promote the identification and dissemination of various epistemological frameworks regarding assistive technology practices. This dialogue could also support

construction of consideration practices that are anchored in an epistemological framework, leading to an assistive technology paradigm. Expansion of this dialogue between members of the field of assistive technology and those in educational assessment should be encouraged and considered a priority.

In summary, there are strengths inherent in each of the selected assistive technology models reviewed in relationship to recommended educational assessment practices. At the same time, however, there are pronounced limitations of these models as shown in the disparities between the features of these consideration models and those of research-supported educational assessment. Understanding the assistive technology consideration process situated within the larger contexts of educational assessment, special education, and related fields provides a beginning to paradigm construction of assistive technology consideration.