Edited by
Lynn Gitlow
Kathleen Flecky

Assistive Technologies and Environmental Interventions in Healthcare

An Integrated Approach

WILEY Blackwell

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About the companion website

This book is accompanied by a companion website:

www.wiley.com/go/gitlow/assitivetechnologies

The website includes
interactive MCQs for each chapter

1

The person, the environment, and technology: Introduction to the human-tech ladder

Lynn Gitlow and Kathleen Flecky

Outline

Learning outcomes

After reading this chapter, you should be able to:

1. Describe human technology as a complex interaction between a person and the environment.
2. Delineate distinguishing features of the Human-Tech Ladder and a client-centered approach.
3. Describe the relationship between the Human-Tech Ladder and assistive technology.
4. Identify the components of the assistive technology continuum.
5. Compare medical and social models of disability in relationship to a client-centered focus on the Human-Tech Ladder and assistive technology.
6. Define assistive technology and environmental intervention.

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Active learning prompts

Before you read this chapter:

1. Describe the role that technology plays in your life in terms of how you interact with the environment on a daily basis to meet needed and desired tasks and goals.
2. Complete a brief literature search using the keywords, client-centered, health, disability and assistive technology, medical models of disability, and social models of disability.
3. Using the website, www.resna.org, define assistive technology and locate the eligibility requirements for Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) certification as an Assistive Technology Professional.
4. Define assistive technology using two or more sources.
5. Compare and contrast three definitions of assistive technology.
6. Classify assistive technology in three different ways.

Key terms

Assistive technology
Assistive technology continuum
Client-centered
Contextual factors
Disability
Disability models
Environmental factors
Environmental intervention (EI)
Human-Tech Ladder
Technology
Technology and environmental intervention (TEI)

The person, the environment, and technology: Introduction to the human-tech ladder

The changes we have all seen in technology and correspondingly with assistive technology in the past 10 years are mind-boggling. Futurist and inventor Ray Kurzweil (2000) stated early in the twenty-first century that computers are 100 million times more powerful than they were 50 years ago. The exponential growth of computer capacity that Kurzweil and others predicted in the late 1990s continues to advance and has the potential for improving all aspects of life (Diamandis and Kotler 2014). These exponential changes in technology make it hard to keep up with the latest innovations. For example, one of the chapter authors worked in an assistive technology laboratory in which serial port add-ons to computers evolved into Universal Serial Bus (USB) ports rendering the former connections and their attachments obsolete within in less than five years. Currently, computers no longer come with disk drives and all of the software one needs to load on the computer comes from the cloud. Vicente (2006) stated, "… more and more technology is being foisted upon us at a faster and faster pace" (p. 13).

In addition, technology is clearly a necessary part of our lives. For many of us, it is difficult to remember a time when cell phones, laptops, or navigation devices were not available to those who could afford it. Furthermore, the convergence of multiple technologies into a single, small, handheld device such as a smartphone is common as part of our work and personal experiences.

Medical technology has evolved to intervene when the body fails. For example, you may know someone who has a heart pacemaker to pick up the pace when the heart lags. Moreover, as older adults live longer in many countries, these family members or neighbors may likely experience a joint replacement or utilize assistive or medical devices to recover or make daily tasks easier on either a short-term or a long-term basis.

Given the pervasiveness of technology in our lives, it is not surprising that the words "human" and "technology" are conceptualized in new ways to describe the link between our humanness and the non-humanness of technology. The "Human-Tech Ladder" is a unique concept developed by Vicente (2006) to merge the humanistic view of social sciences with the mechanistic and reductionist views of basic sciences and technological sciences. It is a systems approach that considers how to holistically match humans and technology. Rather than coming up with a new conceptual model, this book will use Vicente's Human-Tech Ladder to provide a systematic way of structuring the text to consider all of the factors, which interact to make a match between humans and technology. The Human-Tech Ladder is a five-level visual model which can be used

to conceptualize human factors, such as personal and environmental factors that interact with technology.

According to Vicente (2006), a bad fit or match occurs if human factors are not at the center of the technology design process. Knowing how the human mind and body react to multiple stimuli and situations with technology, and understanding the complexity of human interaction with both the physical and the social environment, can lead to better use of technology (Vicente 2006). This multifactorial approach mirrors development in the field of matching those who have disabilities with technology interventions. Moreover, a multifactorial approach is considered to be critical to making a successful human technology match (National Academies of Sciences, Engineering, and Medicine 2017). This interactive approach in using technology as an intervention for people with disabilities has not occurred in a vacuum, and changes in ways of thinking about people with disabilities are important to review as an introduction to this text.

Models of disability

With the primary chapter author having practiced in the area of assistive technology for over 20 years, there have been many changes in the field, which influence the things one needs to consider when using assistive technology as an intervention. One critical change is the way that disability is viewed. *Disability* is "the dynamic interaction between an individual (with a health condition) and that individual's contextual factors (personal and environmental factors)" (World Health Organization [WHO] 2001, p. 190). This change in thinking about disability parallels the shift in thinking about disability from viewing it as strictly a medical problem to viewing it more as an interactive social problem (Charlton 2000). *Disability models* are conceptual frameworks that delineate how disability has been regarded by society over the centuries.

For example, within the medical model, disability is viewed as being a personal problem – one that lies within an individual and must be fixed by a practitioner's intervention. This model is aligned with a mechanistic or reductionist view of human life (Vicente 2006). In this view, the practitioner is the expert and the client or person with a disability has little to add to the relationship.

In the 1950s, Carl Rogers used the term *client-centered* to describe the active and directive role of the client in collaboration with the therapist to problem-solve issues uniquely related to each client's care (Rogers 1951). Building on the work of Rogers and others, terms such as client-centered care, client-centered counseling, and person-centered practice are used to describe a focus on the client or patient as central to all decision-making about care, emphasizing client strengths and unique cultural and environmental contexts and capacities (Fearing and Clark 2000; Institute of Medicine [IOM] 2001, 2003; Morgan and Yoder 2012). In rehabilitation therapies, client-centered care respects the client as an active partner whose choices and participation in care are valued and facilitated with dignity and respect (Law 1998; Sumsion 2006).

Vicente's concept of human technology as noted earlier highlights the importance of the person as the center of the technology process in a similar way to that in which client-centered concepts view the client as person in the center of the therapeutic process (Vicente 2006). Following this client-centered focus and in concert with the human rights movements of the 1960s and 1970s, people with disabilities advanced a social model of disability which emphasized that disability results from a mismatched and therefore unsuccessful interaction between an individual and the environment (WHO 2001).

This interactive relationship, exemplified in the International Classification of Functioning, Disability and Health (ICF) (WHO 2001), moves the notion of disability from an individual issue to a societal issue, increasing the complex causality of disability. Disability is viewed as the interaction of a person with factors external to that person. Thus, it is critically important that practitioners consider environment, often also called context, when making technological intervention recommendations for clients. According to the WHO (2001), *contextual factors* "represent the complete background of an individual's life and living. They include two components: Environmental Factors and Personal Factors, which may have an impact on the individual with a health condition and that individual's health and health-related states" (p. 22). For example, if a healthcare practitioner recommends that a client use a wheelchair, then one must simultaneously consider that some home modifications or workplace modifications may be required. *Environmental factors* are organized in relationship to the individual's immediate environment, in which one interfaces with physical or material aspects of daily life, or the societal environment, in which one engages at a community, institutional, attitudinal, and policy level (WHO 2001). Practitioners using assistive technology with clients must have an awareness and knowledge of the key contextual and environmental factors impacting a client's daily life when making any assistive technology recommendations.

Assistive technology and the environment

As will be presented later in this textbook, the conceptual practice models that guide thinking about assistive technology (AT) and environmental interventions (EIs) recognize the influence of environment or context as well as technology or AT when providing interventions for clients. In general, *AT* is conceptualized as services and products that aim to support and aid an individual's ability to engage with the environment, regardless of disability. Later in this chapter, AT will be defined from a legal perspective. Since AT is utilized in a variety of settings, its definition takes on complexity and specificity based on setting, service, product, and client. *Environmental intervention* or *EI* is a term frequently used in combination with AT. It refers to how the environment can be changed or modified as part of the AT process and is occasionally used synonymously with the term AT. For example, with the emergence of smart home technology, the Internet, and remote caregiving, technology interventions may be the same as or part of EI.

While AT and environment interventions have commonly been regarded to impact disability and the disabling process, over the past few decades there has been a shift from viewing AT and EI as separate entities to a unified whole. Environment is such an integral part of the disabling process that an environmental task force was created by the World Health Organization (WHO) to inform the development of the ICF (Schneider et al. 2003). The ICF acknowledges the impact that environment has on creating disability (WHO 2001). "The environment may be changed to improve health conditions, prevent impairments, and improve outcomes for people with disabilities. Such changes can be brought about by legislation, policy changes, capacity building or technological developments" (WHO and World Bank 2011, p. 4).

In 2010, The American Occupational Therapy Association (AOTA) updated the document *Assistive Technology within Occupational Therapy Practice* (AOTA 2004) with the revised document *Specialized Knowledge and Skills in Technology and Environmental Interventions for Occupational Therapy Practice* (AOTA 2010). This document reflected a change from thinking about AT and the environment as separate to recognizing they are vital to each other. This is consistent with what was discussed earlier in this chapter in terms of conceptual models of disability changing over time and how the environment, both physical and social, is now considered as part of disability and the disabling process. Thus, in this book both AT and EI will be considered together as *technology and environmental intervention* (TEI). Use of this term reflects the interactive relationship between technology and environmental factors in the AT process.

It is important to state from the outset of the book that, when thinking about TEI, the editors do not just consider and provide recipes for providing assistive device(s) or EIs. Consistent with a client-centered approach and conceptual models which guide practice, TEI must be considered with a person in mind who functions in an environment or context and wants to do something that he or she cannot do without the intervention.

Ladner (2010) would assert that this is no different for able bodied people than for people with disabilities and states "'(a)ssistive technology' is a really redundant term because, in some sense, all technology is assistive, making tasks possible or easier to do" (p. 25). Conceptual practice models that guide TEI practice, presented in more depth in Chapter 2, have also resulted from shifts in the way disability is perceived by society (from a medical to a social model). Inherent in these models are the outcomes one expects from use of AT for people with disabilities. These outcomes are influenced by a variety of factors that go beyond the person. For example, in the medical model the outcomes expected for people with disabilities are that they will be fixed and return to "normal" (Silvers 2010). The technology aligned with this model is that which enables a person to be as close to fixed or normal as possible, for example, through the recommendation of prosthetics for an impaired limb.

Alternately, if disability is regarded from a social model, people with disabilities do not need to be fixed as their disability is part of who they are and should be accepted as part of our human differences and diverse social fabric. Finally, if disability is viewed from a legal model, then people with disabilities are protected by certain laws and have rights. Therefore, technology provision and environmental access are mandated by legislation (Ladner 2010).

Successful implementation of TEI is a complex issue, which involves creating change at multiple levels, including at the level of individual, the healthcare provider, the healthcare organization and also at the levels of policy and legislation. For example, according to Gritzer and Arluke (1986), "Before World War II, disability was not considered a medical or social problem in America" (p. 8). As previously mentioned, sociocultural views related to disability have changed over time due to a variety of social influences. Changes in persons with disabilities are now regarded and the notion of disability impacts policy and legislation, which, in turn, influences services and outcomes that service providers recommend for their client.

Thus, even though we as practitioners may see ourselves as providing services for a given client whom we serve in our practice, there is a complex set of issues which influence this one-to-one interaction. In day-to-day practice, for example, a service provider may make a recommendation for a client to use a mobility device such as a wheelchair to increase the client's ability to participate in daily activities. Anyone who has made a similar recommendation is aware of numerous other factors which must be considered, such as funding, training, environmental assessment, and the costs and considerations that go along with that recommendation. In addition, what if the client does not want to use a mobility device? We hope you understand by now that the provision of TEI is a complex issue. Whenever change is being made at the level of an individual or beyond, many factors must be considered.

Because there are so many considerations that impact the use of TEI, the editors have chosen Vicente's (2006) Human-Tech Ladder as a roadmap to guide the writing of this book. Additionally, the road map is suggested as a systematic framework, which can be used in practice to help practitioners consider many factors, which interrelate to make a successful human-tech interaction when using technology as a therapeutic intervention. Using this road map will help the reader reflect on complex issues that impact our delivery of TEI.

Moreover, readers will be challenged to expand current notions of TEI by exploring a full range of simple to more complex options in each section. In a research study by Gitlow et al. (2011), results indicated that practitioners who utilize AT in mental health settings reported their reluctance to recommend a range of low and high technology because they perceive themselves as having a lack of AT competency and knowledge.

The editors of this book hope that, as a reader, you will be empowered to realize that, as healthcare professionals, all of us use technological or adaptive strategies in our work with others. Why professionals often do not realize this fact is that we don't perceive this technology as TEI. It may be that healthcare practitioners do not really understand the definition of TEI. Once the definition is elucidated, the reader will quickly understand that the no tech or low-tech solution is often the best option yielding the most successful outcome for the client (Carlson and Ehrlich 2006; Norman 2013).

Choosing the human-tech ladder

Contemporary approaches to the way that the disabling process is conceptualized did not evolve in a vacuum. Vicente (2006) describes new ways of viewing the nature of knowledge (epistemology) that parallel what underlies healthcare professionals' changing notions of disability. As stated above in the section "The Person, the Environment, and Technology: Introduction to the Human-Tech Ladder," underlying the medical model is a reductionist or mechanistic approach to the nature of knowledge (Kielhofner 2009). In this approach, knowledge is divided up into parts and different disciplines are experts in each part. According to Vicente, those who take a mechanistic approach focus solely on technology. In contrast are the humanists who focus on the human or people aspect of the world (Vicente 2006). This may parallel with a more social model of disability where people with disabilities no longer need to have their parts fixed but may need TEI options to function optimally.

Vicente (2006) stated that both views need to be considered and presents his human-tech approach. This approach reflects a systems approach, which guides us to think about the relationship between humans and technology. It is this human-tech approach that Vicente (2006) refers to as the Human-Tech Ladder. The human-tech approach helps us to "… organize our knowledge of people systematically, in a multi-faceted way …" (Vicente 2006, p. 53). This approach in turn helps us to view the complexities we described above in a systematic way. While using different frameworks and approaches to understand complex issues is not new, we have chosen Vicente's approach for a variety of reasons.

One way of making sense out of complexity is to use a conceptual model to guide one's thinking. Some authors (Cook and Polgar 2015) have chosen one conceptual model, the Human Activity Assistive Technology (HAAT) model, to guide their presentation of AT-related information. The editors have decided not to do so here because there are numerous conceptual models that are available for the reader to explore and make your own. You will be introduced to them in Chapter 2. Other authors have used a three-dimensional analysis at macro, meso, and micro levels to consider environmental impact on the disabling process (Fougeyrollas and Gray 1998). More recently, Sanford (2012) employed the principles of universal design, which will be discussed in more depth in Chapter 2, to structure an approach to rehabilitation intervention.

One reason the editors of this book find Vicente's Human-Tech Ladder useful as a road map for this text is that one of the levels of the ladder considers the team. It is the only road map that we know of that gives recognition to the importance of the team of people who work together to provide TEI. There are numerous people who make up a TEI team, including the client, therapists,

educators, building contractors, architects, engineers, and the list goes on. TEI requires collaboration and teamwork in order for changes to occur. When teams work well, change can happen (Fullan 2015).

However, literature has also revealed that working successfully as part of a team is challenging and often can present barriers to successful implementation of TEI (Decoste et al. 2005; Vicente 2006). Because the team is so important to the TEI process the topic, this book will contain two chapters devoted to best practice of teams. The importance of teamwork will also be presented throughout other chapters in this book. Finally, Vicente's Human-Tech Ladder considers multiple factors that impact the complexity described above.

Human-tech ladder

Vicente places equal value on all levels of the ladder and emphasizes that not all levels are integral in every individual case. Yet we will begin our discussion on the Human-Tech Ladder by taking a top-down approach to honor the importance of all levels of the ladder in learning to apply this model for the first time (Vicente 2006). As displayed in Figure 1.1, the Human-Tech Ladder, the top rung of the ladder is the political rung. Here different laws and policies will be listed as they influence TEI.

These will include laws that protect people with disabilities form discrimination, laws that provide services for people with disabilities, laws that regulate the built environment, and more. The chapter describes important laws as well as the funding policies that result from these laws and how these policies influence the provision of services in the area of AT and EI intervention. An example of how this level of the Human-Tech Ladder impacts practice can be seen in the way technological innovation interacts with policies, laws, and funding decisions.

Within the past five years, tablets and smartphones have become very important additions to the toolbox of interventions that practitioners can use with their clients. Reimbursement of these devices is very controversial, being paid for in certain settings and not funded in others. Many practitioners are involved at a political level trying to change the funding requirements to enable people who could benefit from these new technologies to obtain them. As the pace of technological innovation continues, this will be an ongoing consideration for those who work in the field.

A review of the *World Report on Disability* (WHO and World Bank 2011) provides a stunning example of how the political rung of the road map influences

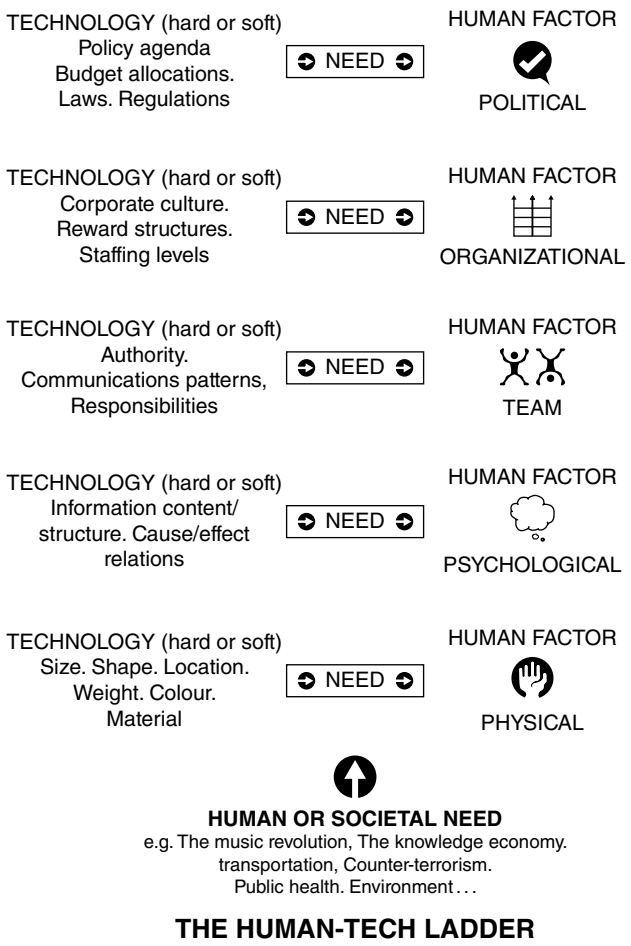

Figure 1.1 The human-tech ladder. Source: Reproduced with permission of Taylor & Francis.

treatment and policy regarding people with disabilities worldwide. It discusses policies and practices that are necessary to provide people with disabilities the services and responses that will enable them to participate in society on an equal par with their non-disabled counterparts. Best practices based on scientific evidence are illuminated in the report to promote accessibility of health and wellness for all people as a human right. Reviewing and updating legislation and policies, and funding mechanisms, which relate to people with disabilities is one of the first recommendations described in this important report (WHO and World Bank 2011). For example, the report states, "United States surveys report considerable unmet needs – often caused by funding problems – for assistive technologies" (WHO and World Bank 2011, p. 103).

Next on the Human-Tech Ladder is the organizational level (Vicente 2006). TEI is provided in a variety of organizations each with its own rules, regulations, and requirements. Medical, educational, and vocational

organizations, and the Veterans Administration, have a great deal of variety in the way they define, regulate, and view TEI. For example, in medical environments, Medicare does not use the term assistive technology in its reimbursement vocabulary. Devices that are considered AT are called durable medical equipment and have to have qualifying attributes to be considered for a client (Centers for Medicare and Medicaid Services 2015). This is just one example of the difference between a medical organization and the numerous other organizations where AT and EI interventions are provided. In this section of the book, authors who work in the wide variety of organizations that provide TEI will describe the considerations specific to each venue.

The next step on the ladder is the team. TEIs are provided by an interdisciplinary group of practitioners. Members of Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) encompass a wide variety of practitioners including rehabilitation engineers, educators, occupational therapists, physical therapists, speech-language pathologists, and manufacturers and suppliers of assistive devices (RESNA 2011). While it is often taken for granted that teams work together successfully, this is not always the case, as shown by literature gathered by the Institute of Medicine (IOM 2001).

Moreover, in a report entitled *Health Professions Education: A Bridge to Quality* (2003), the Interprofessional Education Collaborative Expert Panel noted the need for educational programs to prepare preservice healthcare providers to work as team members and it was cited as one of the most important needs for improving the future of healthcare delivery. Making sure that team members communicate and collaborate as well as understand and respect the variety of perspectives that come together to provide successful TEI outcomes is a complex task and one that can make or break successful interventions. In Chapters 9 and 10, best practices related to teams will be described.

The next rung on the ladder, the psychological rung, considers cognitive as well as psychosocial factors that are part of the human experience (Vicente 2006). The classic story of the therapist trying to explain to someone that they must remove their beloved scatter rugs from the floor to prevent falling only to meet with absolute resistance is an example of the psychological impact practitioners face. In this section, cognitive factors such as memory, problem-solving, and expectations of technology are considered. These are critical considerations for matching a person to a TEI.

At the bottom of the ladder are the physical attributes of people as a human factor (Vicente 2006). Strength, size, capabilities, and limitations are considered here. In this section, physical factors are targeted in providing TEI services. While factors such as strength, range of motion, and sensory factors such as touch, hearing, and vision to name a few are important to assess, research shows that technology considerations beyond merely the physical factors are essential to investigate in order to have a successful match between a human, a technology, and/or an EI (Polgar 2010; Scherer et al. 2005; Scherer and Bodine 2006).

The human-tech approach adds a systematic breadth and depth to the relationship between technology and human factors in a way that enriches the area of AT and EI with insights into human behavior. The next part of this chapter will introduce legislative and professional policy statements that present various definitions of AT, and environment/context interventions.

In the definition section of this chapter the hard and soft attributes of technology are described as they relate to the human experience. The hard attributes are the technology itself, while the soft attributes are things like information that relate to the technology (Rogers 2003). Both of these aspects of TEI vary from organization to organization, further complicating the situation. Vicente (2006) states that these subtle factors at the organizational level can certainly impact the human-tech fit.

Why are definitions important?

A variety of professionals have long been involved in promoting everyday engagement in valued activities by matching a person with environmental demands. This match often involves the use of adaptive equipment, AT, and/or EI.

If you have looked at the certification requirements listed on the RESNA website (https://www.resna.org/certification) you will have learned about the wide variety of professionals listed under the term rehab science. Rehab Science, for the purposes of this book, is defined as one of the following: medicine, nursing, low vision rehabilitation, occupational therapy, physical therapy, speech-language pathology, audiology, special education, vocational rehabilitation, engineering (biomedical, clinical, or rehabilitation), prosthetics and orthotics, recreation therapy, and rehabilitation technology.

Despite the group of qualified professionals who provide TEI, research suggests that many practitioners from a variety of rehabilitation fields perceive themselves as not having the skills and knowledge necessary to provide technology-related or EIs to those who might need them (Gitlow and Sanford 2003; Gitlow et al. 2007; Long and Perry 2008). Please review Box 1.1 for an evidence-based practice application activity.

Box 1.1 Here's the evidence

Gitlow, L., Hofmaster, P., and Wade, J. (2007). Investigating the assistive technology skill and need for knowledge of CPRPs. *International Journal of Psychosocial Rehabilitation* 11 (2): 61–73.

Key Words: psychiatric rehabilitation practitioners, assistive technology

Purpose: Investigate the knowledge and skills of certified psychiatric rehabilitation practitioners in the area of AT.

Sample/Setting: Convenience sample of certified psychiatric rehabilitation practitioners.

Method: Survey design.

Findings: Surveyed practitioners reported having a basic knowledge in technologies related to activities of daily living (ADLs) learning disabilities and team collaboration. Areas reported as having a need for training and education included: medication management, enhanced vocational activities, self-advocacy, time management skills, memory skills for clients, and funding of devices.

Critical Thinking Questions:
1. After reading this research article, what do you understand to be the limitations of this research? Are there any limitations not stated?
2. If you were to replicate this study using a different method or design, what designs would you use to increase the rigor and why?
3. Based on the findings of this study, what additional research is needed that is not addressed in the discussion section?

Once you have reviewed Box 1.1, this lack of perceived competence may appear to stem from confusion about what exactly the terms assistive technology and environmental intervention mean. Definitions and understanding of terms help us to be clear. Confusion in defining terms can result in misunderstandings about concepts that we are trying to communicate to others. It may be that this is the case when trying to define the terms technology, AT, and EI. Demystifying the definitions of technology and AT may help to understand where some of the confusion is coming from.

Defining technology

Refer to Box 1.2 and investigate definitions of AT from credible resources.

Let's see how your findings compare with what is presented below. As stated in the preface to the book, the authors feel that it is important for students to engage in active learning so that they will expand their notion of what these definitions mean by doing their own research and then comparing it to the text. A Bing browser search

Box 1.2 Active learning: definitions of AT

Define AT using two credible resources or references	
Definition 1:	Resource:
Definition 2:	Resource:

engine retrieval for definitions of "technology" came up with 17 900 000 entries while a Google search engine query for AT yielded over 8 420 000 entries for the definition of "assistive technology." Research demonstrates how most practitioners tend to narrowly define technology and AT (Gitlow and Sanford 2003; Gitlow et al. 2007; Long and Perry 2008). Examining how laws, policies, and leaders in the field define these terms can help to broaden what we really mean by these definitions.

A definition of *technology* that the authors find useful is "any tool – physical, virtual conceptual, or cultural – that helps people make decisions, act, and achieve their goals is technology" (Vicente 2006, p. 20). Further, Rogers (2003) stated, "A *technology* usually has two components: (1) a *hardware* aspect consisting of the tool that embodies the technology as a material or physical object, and (2) a *software* aspect consisting of the information base for the tool" (p. 13). With these two definitions, we begin to broaden our idea of technology to include any tool that helps us to achieve a goal and begin to consider that technology is more than just the physical or material tool.

In practice, clinicians need to provide information about a technology tool and how to use it in order for it to be useful. This is important to remember because we must always think of technology as part of a system that involves multiple factors. As will be presented later in Chapter 11, which focuses on psychological factors related to TEI use, failure to think of technology in a systematic fashion is one of the biggest reasons for its lack of use. Remember, no matter how simple a tool a practitioner provides to a client, failure to consider where the tool will be used and how the client feels about using the tool can result in lack of its use.

Let's return to the technology definitions. How did these two definitions fit with what you investigated? Were there differences? Similarities? Hopefully the definitions you found have expanded your thinking about what technology is.

Defining AT

Now let us go on to define AT in a specific way. In the search for definitions of AT, examples include legal, organization, or setting-based definitions. Furthermore,

there are also insurance-based definitions of AT which further complicate our understandings. One definition stated that the term AT is used to describe a wide variety of technologies that are helpful for people with disabilities to gain independence. It is a general term that covers everything from wheelchairs to alternative keyboard computers (Coombs 2005).

The Assistive Technology Act of 2004, which amends the previous act of 1998, defined the term AT as "technology designed to be utilized in an assistive technology device or assistive technology service" (Assistive Technology Act of 2004 2004). Important in this definition is that AT is not conceived as merely a device. This mirrors Roger's definition earlier in the chapter, that technology, and thus AT, is more than just a device. The law also defines an AT device as "any item, piece of equipment, or product system, whether acquired commercially or off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities" (Assistive Technology Act of 2004 2004).

In addition, AT services are defined as, "any service that directly assists an individual with a disability in the selection, acquisition, or use of an assistive technology device" (Assistive Technology Act of 2004 2004).

These services include AT evaluation, selecting and obtaining AT, fitting and fabricating service coordination, training, advocacy, etc. The Individuals with Disabilities Education Improvement Act (IDEIA) of 2004 (IDEIA of 2004 2004) incorporated essentially the same definition within its document. More information regarding this definition will be discussed later on in this book in the chapter on educational organizations in Chapter 6.

Returning to initial definitions of technology in this chapter, take time to review hard and soft aspects of technology, which may include more than just the device. Refer to Box 1.3 and fill in these definitions as part of your resource investigation active learning exercise. What did you find?

The practitioner must think about legislation, and there is more than just the technology itself to consider when matching a device to a person. Devices (hard) and services (soft) correlate to these dual aspects of technology, and under the law both are mandated.

Box 1.3 Active learning: Definitions of hard and soft technology

Define hard and soft technology using two credible resources or references

Hard technology Definition 1:	Resource:
Hard technology Definition 2:	Resource:
Soft technology Definition 1:	Resource:
Soft technology Definition 2:	Resource:

Environmental interventions

Another useful definition for AT is based on Gitlin (2002) and relates to EI: AT is viewed as including the following items: (i) structural alterations (changes to the original structure of a physical environment, e.g. widening doors in a house); (ii) special equipment (attachments to the original structure of the physical environment, e.g. handrails, grab bars, and stair glides in the home); (iii) assistive devices (applied to or directly manipulated by a person, e.g. wheelchairs, reachers, voice output communication aids, and hearing or vision aids); (iv) material adjustment (alterations to non-permanent features of the physical environment, e.g. clearing pathways, removing throw rugs, and adjusting lighting in the home); (v) environmentally based behavioral modification (changes to a person's interaction with the physical environment, e.g. conserving energy in particular activities and segmenting tasks to facilitate their execution). This begins to broaden the definition even more by including a consideration of the environment within the definition of AT.

Further, broadening of the term AT to include the concept of environmental adaptation follows an historical change in the way disability is defined. This change was previously noted in this chapter, when it was stated that when notions or models of disability changed from a medical model view to a more inclusive social model of disability, the environment became a critical part of the disablement process. In the medical model, disability is viewed as being a personal problem that lies within an individual and must be fixed by a practitioner's intervention. In a social model, disability occurs from an interaction between an individual and the environment in which he or she chooses to function (Longmore and Umansky 2001). Disability occurs as an imbalance between the two. Thus, it is not possible to consider an AT intervention without considering the environment as well.

So, let's return to focus on definitions again. Although there is certainly a range of variability within these definitions, most include some mention of a device and most make reference to these devices impacting access or independence for people with disabilities. More specifically, if we look at Coomb's definition, we see that it

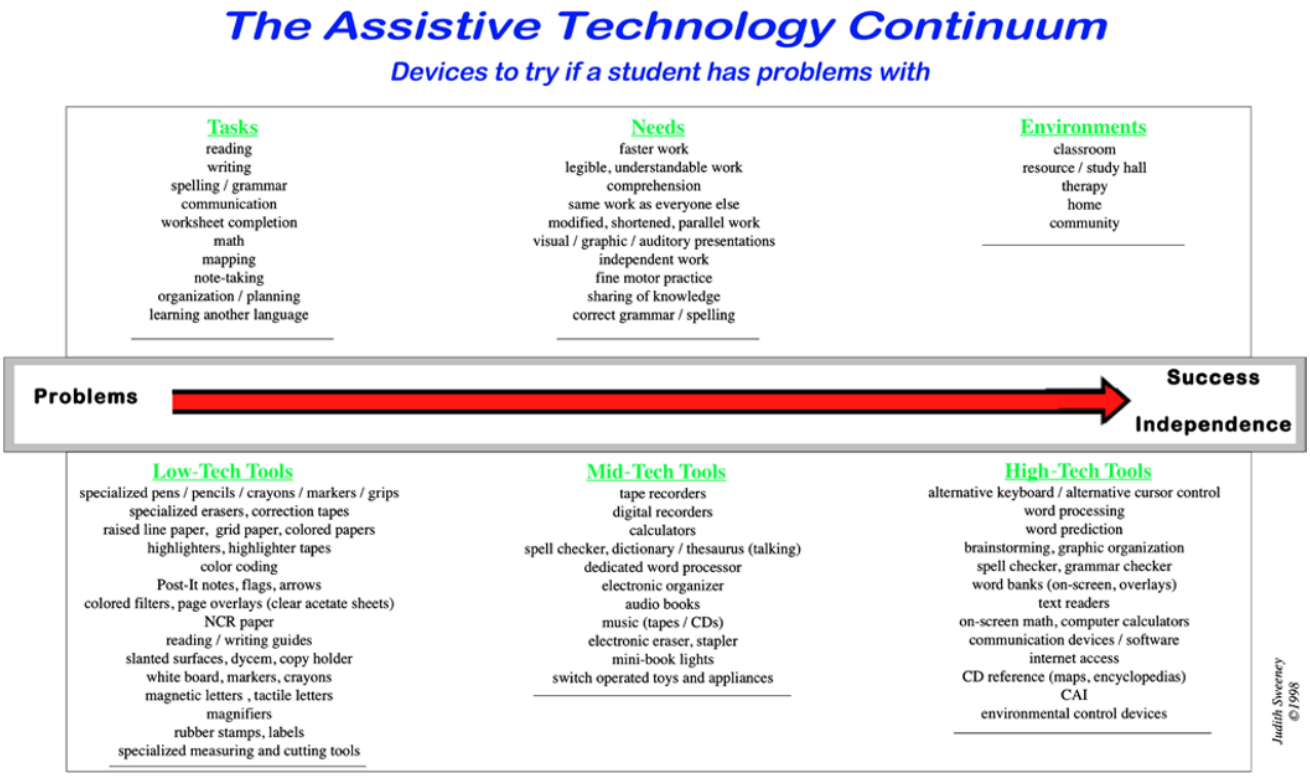

Figure 1.2 Assistive technology continuum. Source: Retrieved from http://opsb.us/wp-content/uploads/2014/01/AT_Continuum.pdf.

stated that AT includes a wide variety of devices (Coombs 2005). The AT law (Assistive Technology Act of 1998) states that it is *any* device and Gitlin's (2002) definition includes a range of devices from reachers to voice output communication aids. Therefore, our notion of AT continues to expand: it can be simple device such as an adapted pencil or an extremely high-tech device such as a robotically controlled prosthetic. Figure 1.2 shows a continuum of technology considerations that might be useful in thinking about solutions for a client or user. While this figure relates to school-based settings, it provides us with a visual of the *AT continuum*, which is a range of various TEI options categorized as low technology to mid technology to high technology.

Additionally, it is important to remember that technology intervention is more than providing just a device. Providing service related to the device and its use is equally as important, and both the device and the service depend on the environment and context of the user. Use of a cane is different if the individual is using it to kneel in church versus walking down a long hospital hallway. This is a point the authors will reinforce over and over in this book. Additionally, environmental modification has a variety of options. It range from something as simple as removing a rug to prevent falling to more complex interventions such as installing elevators.

Categories of AT

Table 1.1 displays two ways of categorizing AT using disability models. Based on Table 1.2, sample differences show a data collection tool that organizations receiving funds through the AT Act use to collect program outcomes data. The other is from abledata.acl.gov, an online database that categorizes over 45 000 products (make sure to visit this website often). Included in both you will notice environmental adaptations along with specific product categories and a very wide variety of things included in the categories of AT.

Please review differences in how AT is categorized in Table 1.2. In addition to these types of categorization, we also find AT classified as being no-tech, low-tech, or high-tech. No-tech or low-tech devices are inexpensive and easy to obtain. High-tech devices tend to be more expensive and more complicated to obtain (Cook and Polgar 2015). Examples of no-tech or low-tech AT solutions are built-up handles for utensils, or pencil grips. High-tech solutions may include computer technologies, robotics, and smart home technology. It is important to remember, when considering AT solutions, to systematically begin investigation at the no-tech end of the spectrum and move up rather than starting

Table 1.2 Sample Differences in How AT is Categorized.

Assistive Technology Act of 2004 Data collection categories	AbleData AT product database
Speech communication	Aids for daily living
Vision	Blind and low-vision products
Hearing	Communication products
Computers and related daily living learning	Computer products
Cognition and developmental	Control products: environmental controls, control switches
Environmental adaptations	Deaf and hard-of-hearing products
Mobility	Deaf–blind products
Seating and positioning	Education products
Vehicle modification and transportation	Environmental adaptations products
Recreation, sports, and leisure	Housekeeping products
Other	Orthotics braces and other products to support and supplement joints or limbs
	Prosthetics products for amputees
	Recreation
	Safety and security products
	Seating products
	Therapeutic aids products
	Transportation products
	Walking products
	Wheeled mobility products
	Workplace products

Table 1.1 Disability Models.

Features	Religious model	Medical model	Social model
Views of disability	Either afflictions due to sinfulness and deviancy, or impairments that indicated a special relationship with higher powers	Impairments and disability are a result of disease, illness, injury, and other abnormal health conditions; impairments are the cause of disability	Social, economic, and political factors create disability along with individual characteristics

Source: Adapted from: Flecky and Goertz (2014).

right at the high-tech end of possible solutions. We will discuss this more in later chapters in the book.

How did these categories compare to the ones you found? Has this changed your understanding of the full range of possibilities included in the definitions we have presented in this chapter?

At this point, the authors hope that you have expanded your notion of what solutions are available to you when you use AT and environmental adaptations as interventions. The range is quite inclusive, and if you understand the full range of low-tech to high-tech options available to increase independence for those who need it, maybe you will feel less intimidated and more empowered to use these interventions in your everyday or future practice. Our goal in requesting that you investigate definitions and categories of AT and then compare them with the book's definitions is to help you to expand your awareness and understanding of these important definitions within this book.

In conclusion, there are common elements that recur in the definitions discussed in this chapter. In all of the definitions, there is a device to think about as well as a user of the device or a person. Then there is a goal or task or an increase in independence that the person wants to accomplish, which must be considered, as well as the context or environment in which the person wants to do the task or increase their independence. Finally, when targeting a potential device, there are more than just the physical attributes or the hard aspects of the device that must be considered. There is relevant information, training, psychological impact, etc. or the soft attributes to inform the thinking process. Finally, we summarize the chapter with these elements within our definitions to build the foundation for the next chapter, which will discuss conceptual models that guide thinking processes about TEI.

Summary

In this introductory chapter, a conceptual road map for visualizing technology and the human experience has been presented. The roadmap is derived from Dr. Kim Vicente's (2006) work exemplified in the book *The Human Factor: Revolutionizing the Way People Live with Technology*. As an engineer, Dr. Vicente provides a fresh perspective of the interaction of technology with human physical, psychological, organizational, and sociopolitical dimensions. His professional engineering expertise and work with engineering students as described in this book uncovers a way of thinking that integrates mechanistic and humanistic philosophies to focus on human needs and behaviors foremost and technology adjunctively to meet needs, or human-tech (Vicente 2006). Various definitions and ways of categorizing technology, AT, and EIs were presented. Multiple elements, which underlie TEI, have been described and in the next chapter will be related in the theories that guide TEI practice.

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