



(Photo courtesy of Etsy shop, [WindyCityHardwoods](#))

# Sustainability, Braille, & Assistive Technology



(Photo courtesy of Les Mains Pour Voir, by Yoshiko Murakami)

For most people,  
technology makes  
things easier. For  
people with  
disabilities,  
technology makes  
things possible.

Mary Pat  
Radabaugh,  
formerly with the IBM  
National Support  
Center for Persons with  
Disabilities  
National Council on  
Disability 1993

# A little about me...

## Roles:

- Twin Sister
- Special education teacher
- Dyslexia therapist
- TVI
- ATP
- Doctoral Student

## Background:

- Behavior Analysis

## Foreground:

- Educational Sustainability



# A little about sustainability...

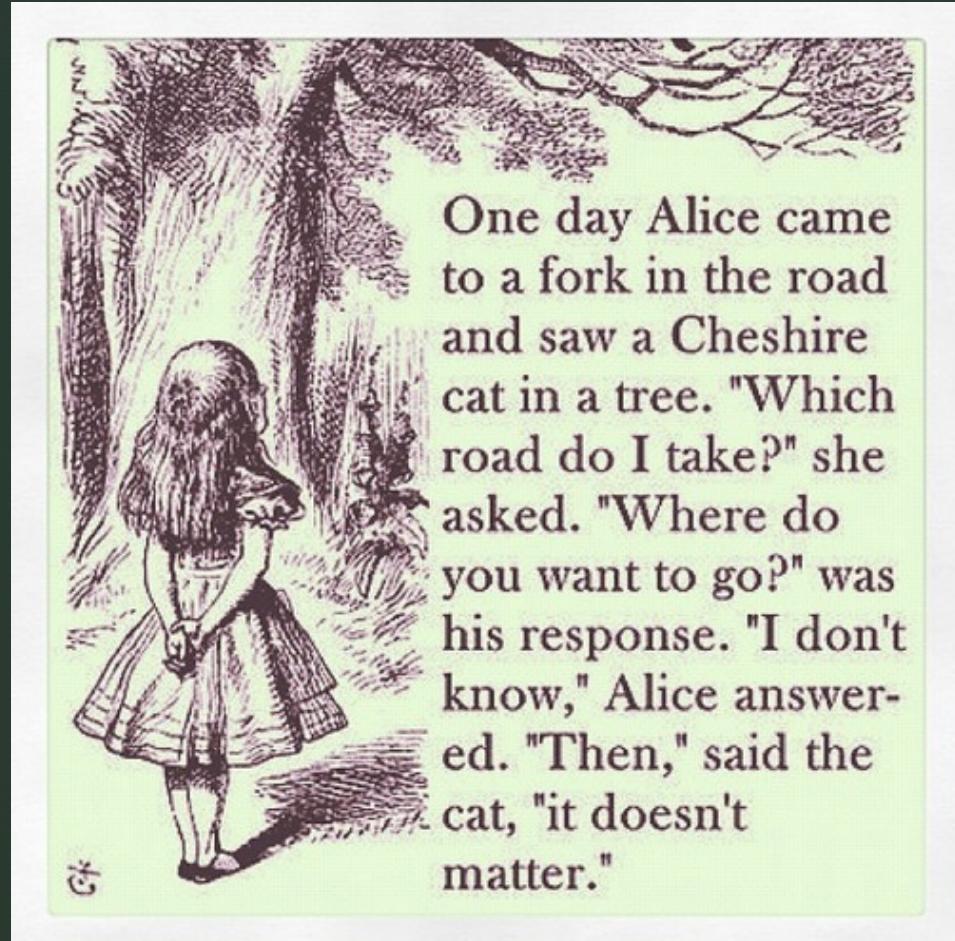


(Image courtesy of University of Wisconsin)

- “Sustainable” is defined as:
  - Capable of being supported or upheld, as by having its weight borne from below
  - Pertaining to a system that maintains its own viability
  - Able to be maintained or kept going, as an action or process (dictionary.com)
- Sustainability involves a balance between three areas: social, economic, and environmental

# Scenario Planning & Futurecasting

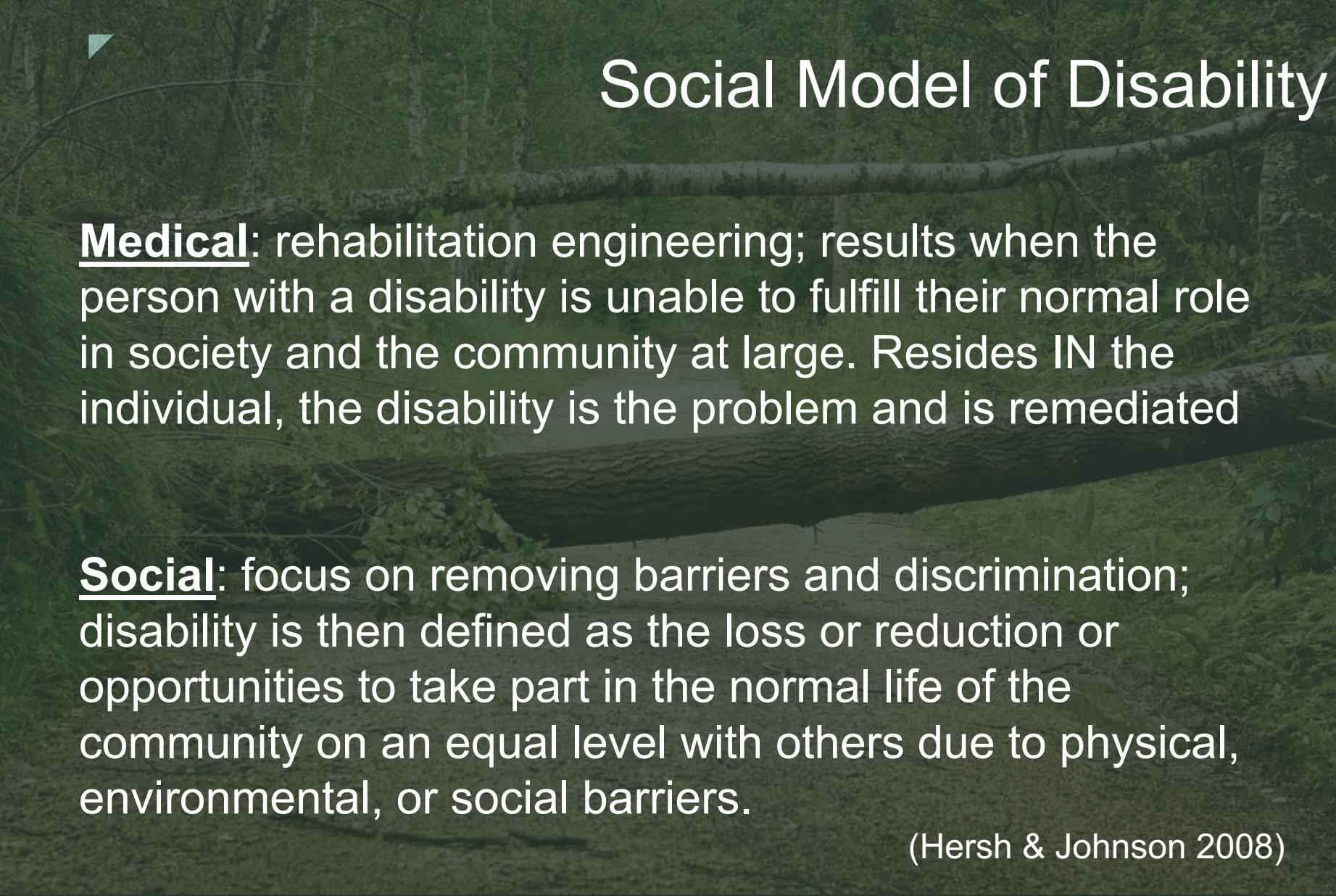
- Start with the future & work backwards
- Where does the student need to be at graduation? In 5 years? In 1 year? 1 semester?
- Don't let the present distract from the future
- Envision multiple scenarios
- Prepare for plot twists
- Consider prerequisites & pathways
- Tools:
  - [111 Competencies](#)
  - [Michigan Guidelines & Tips](#)



One day Alice came to a fork in the road and saw a Cheshire cat in a tree. "Which road do I take?" she asked. "Where do you want to go?" was his response. "I don't know," Alice answered. "Then," said the cat, "it doesn't matter."

# Social Model of Disability





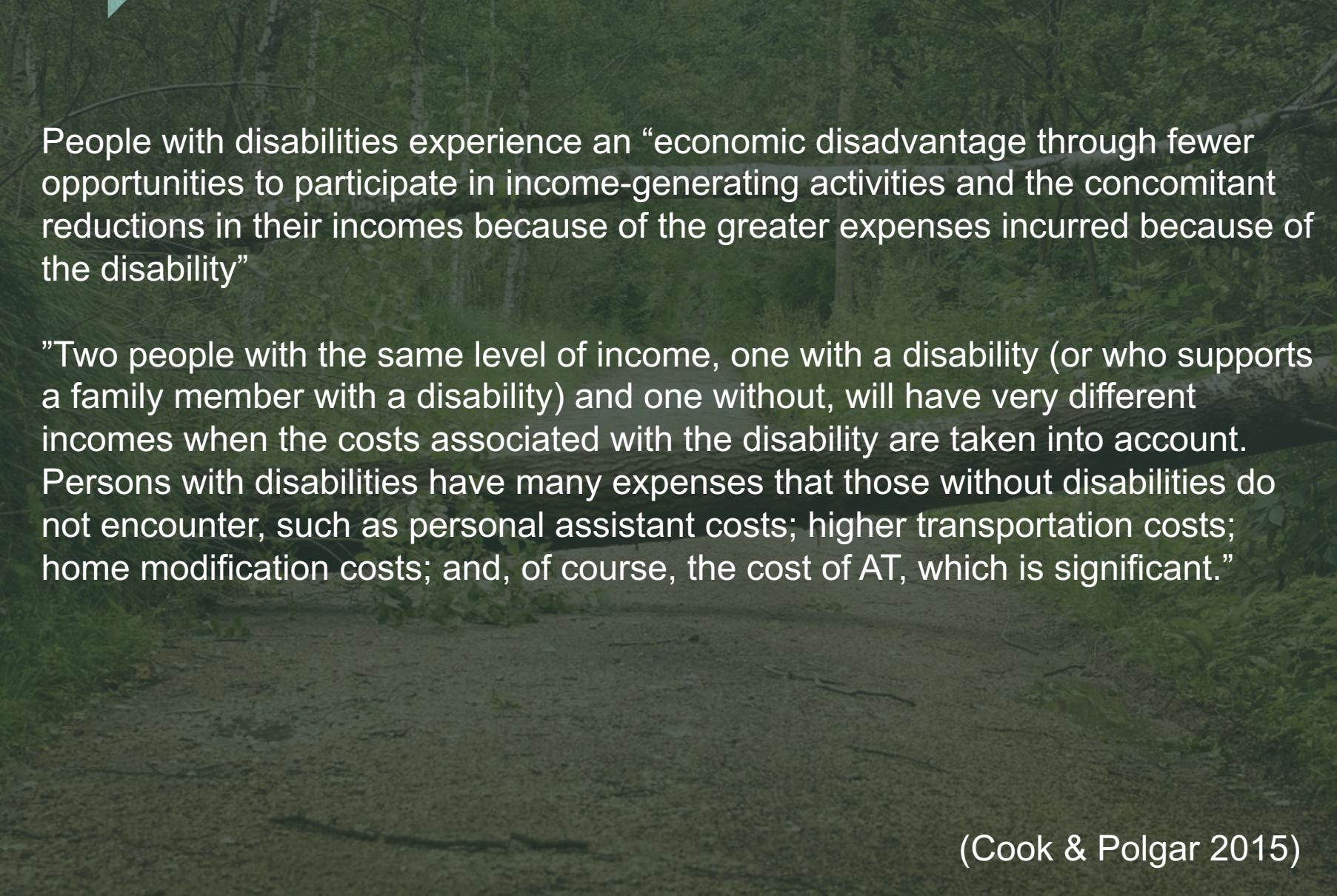
# Social Model of Disability

**Medical**: rehabilitation engineering; results when the person with a disability is unable to fulfill their normal role in society and the community at large. Resides IN the individual, the disability is the problem and is remediated

**Social**: focus on removing barriers and discrimination; disability is then defined as the loss or reduction of opportunities to take part in the normal life of the community on an equal level with others due to physical, environmental, or social barriers.

(Hersh & Johnson 2008)

# Social Model of Disability



People with disabilities experience an “economic disadvantage through fewer opportunities to participate in income-generating activities and the concomitant reductions in their incomes because of the greater expenses incurred because of the disability”

“Two people with the same level of income, one with a disability (or who supports a family member with a disability) and one without, will have very different incomes when the costs associated with the disability are taken into account. Persons with disabilities have many expenses that those without disabilities do not encounter, such as personal assistant costs; higher transportation costs; home modification costs; and, of course, the cost of AT, which is significant.”

(Cook & Polgar 2015)

# Access

- Who has access?
  - Classroom example
  - Conference example
- What factors affect access?
  - Awareness
  - Intention
  - Options
- What creates barriers to accessibility?
  - Design
  - Missed opportunities
  - Bureaucracy & management methods



# Access

- TVI as Accessibility Facilitator (Siu & Emerson 2017)
  - Digital workflow
  - Facilitator/decision maker
- Dual Model of Access (McClinden & Douglas 2016)
  - Access to Learning: ensuring that the child's environment is structured to promote learning throughout their education
  - Learning to Access: supporting the child to learn distinctive skills in order to afford more independent learning
- Higher Education case studies
  - Statistics (Godfrey, A.J.R., Loots, M.T. 2015)
  - Chemistry (Harshman, J., Bretz, S.L., Yezierski, E. 2013)



# Systems Theory

# Systems Theory

- Macrosystem: Drivers for change at national, international level
- Exosystem: Educational system structure, culture, curriculum, policies, etc.
- Mesosystem: Relationships between home, school, community, or work
- Microsystem: Instructional settings
- The Child



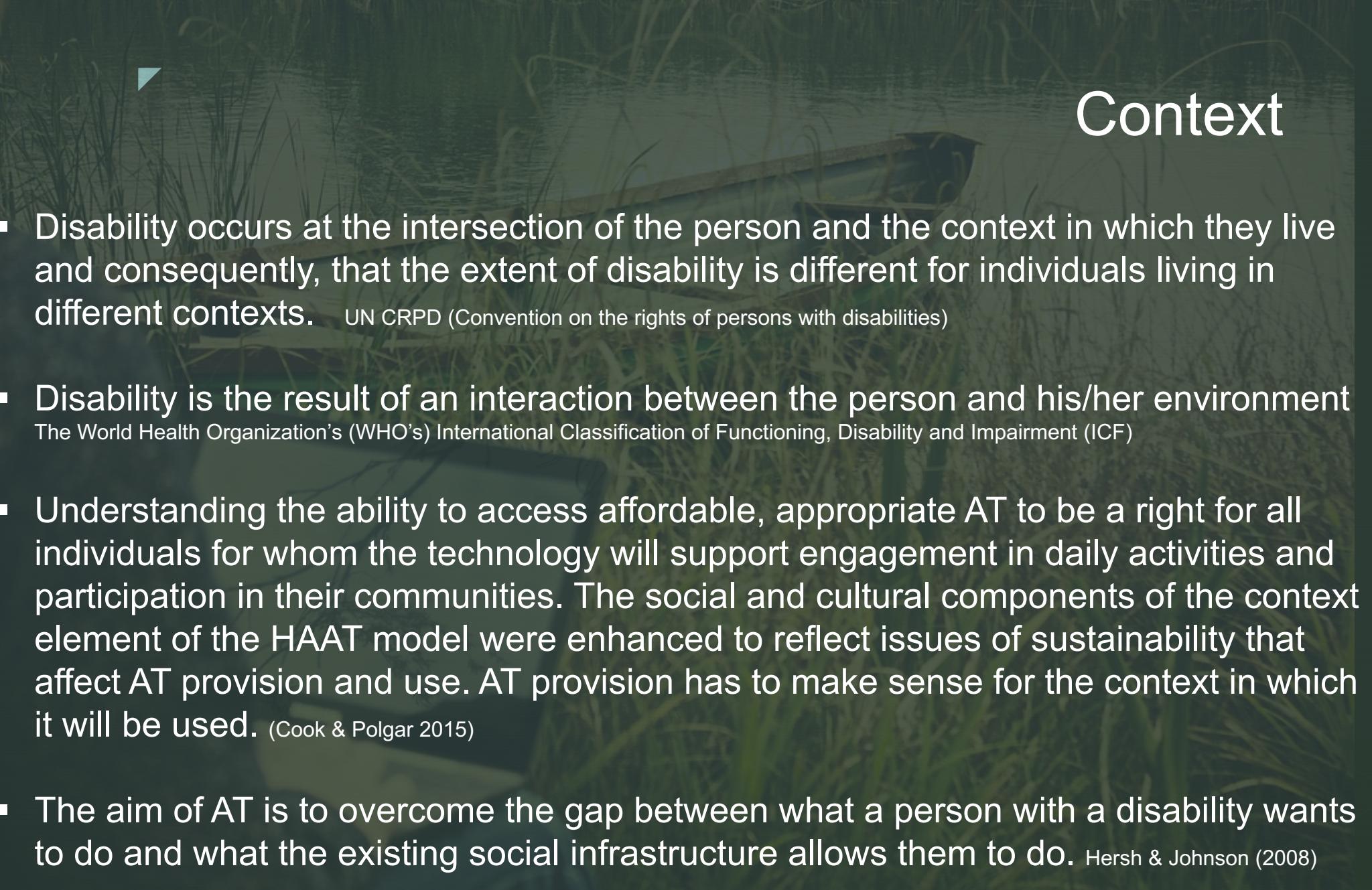
# Systems Theory

- General education
  - content/curricula
  - plans & practices
- Teacher of students with visual impairments
  - Trained & prepared?
- Braille production resources & workflow
  - Materials/curricula available
  - Equipment available?
  - Personnel available?
  - Personnel trained? (Herzberg study)
- Family
  - What support are they able to provide?
  - What support do they need?
- Student
  - How can AT help them NOW?
  - How can AT help them in the future?

# Context



“Relationships with others in the environment affect the use of technology. Those close to the individual, such as family, friends, teachers, or coworkers, have a better understanding of the person’s capacities, so use of technology is often easier. (Cook & Polgar 2015)



# Context

- Disability occurs at the intersection of the person and the context in which they live and consequently, that the extent of disability is different for individuals living in different contexts. UN CRPD (Convention on the rights of persons with disabilities)
- Disability is the result of an interaction between the person and his/her environment  
The World Health Organization's (WHO's) International Classification of Functioning, Disability and Impairment (ICF)
- Understanding the ability to access affordable, appropriate AT to be a right for all individuals for whom the technology will support engagement in daily activities and participation in their communities. The social and cultural components of the context element of the HAAT model were enhanced to reflect issues of sustainability that affect AT provision and use. AT provision has to make sense for the context in which it will be used. (Cook & Polgar 2015)
- The aim of AT is to overcome the gap between what a person with a disability wants to do and what the existing social infrastructure allows them to do. Hersh & Johnson (2008)

# Complexity



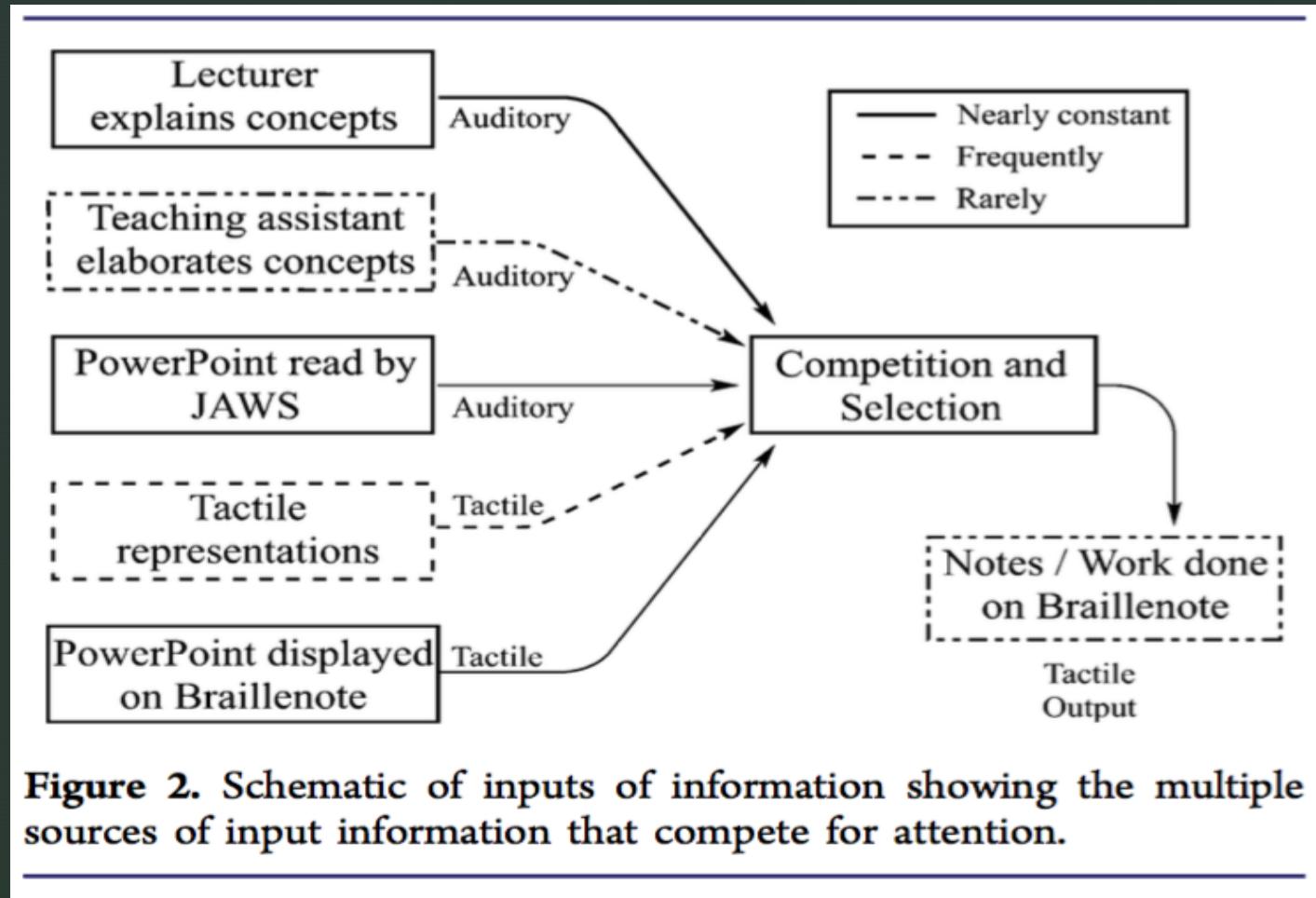
“We can see how our world is, in many ways, becoming more complex, fast-paced, and unpredictable. As a result, the problems we face are getting more complicated as well, and we need longer and more elaborate sets of instructions for technologies and institutions that can effectively solve them.”  
Thomas Homer-Dixon,  
The Ingenuity Gap

# Complexity

## Key Features of Usability

- ◆ Learnability
- ◆ Efficiency (minimal frustration, effort)
- ◆ Memorability (how the device is used can be easily remembered, particularly when a function has not been used over a long period of time)
- ◆ Errors
- ◆ Satisfaction (user has positive experience)
- ◆ Authors add EASE OF USE

(Fisk et. al, Cook & Polgar 2015)



**Figure 2.** Schematic of inputs of information showing the multiple sources of input information that compete for attention.

(Harshman, Bretz, & Yezierski 2013)

# Complexity

- Consider the devices our students use
- Consider the context, the systems
- Consider usability
- What percentage of the device's capability are actually being used?
- How many are gathering dust?
- Statistics example



# Adaptability

- Braille
  - Embossed braille
  - Refreshable braille
- Nemeth Code
- Tactile Graphics
- Digital Audio Media
- Varieties of digital files
- How adaptable is braille compared to other media in today's society?

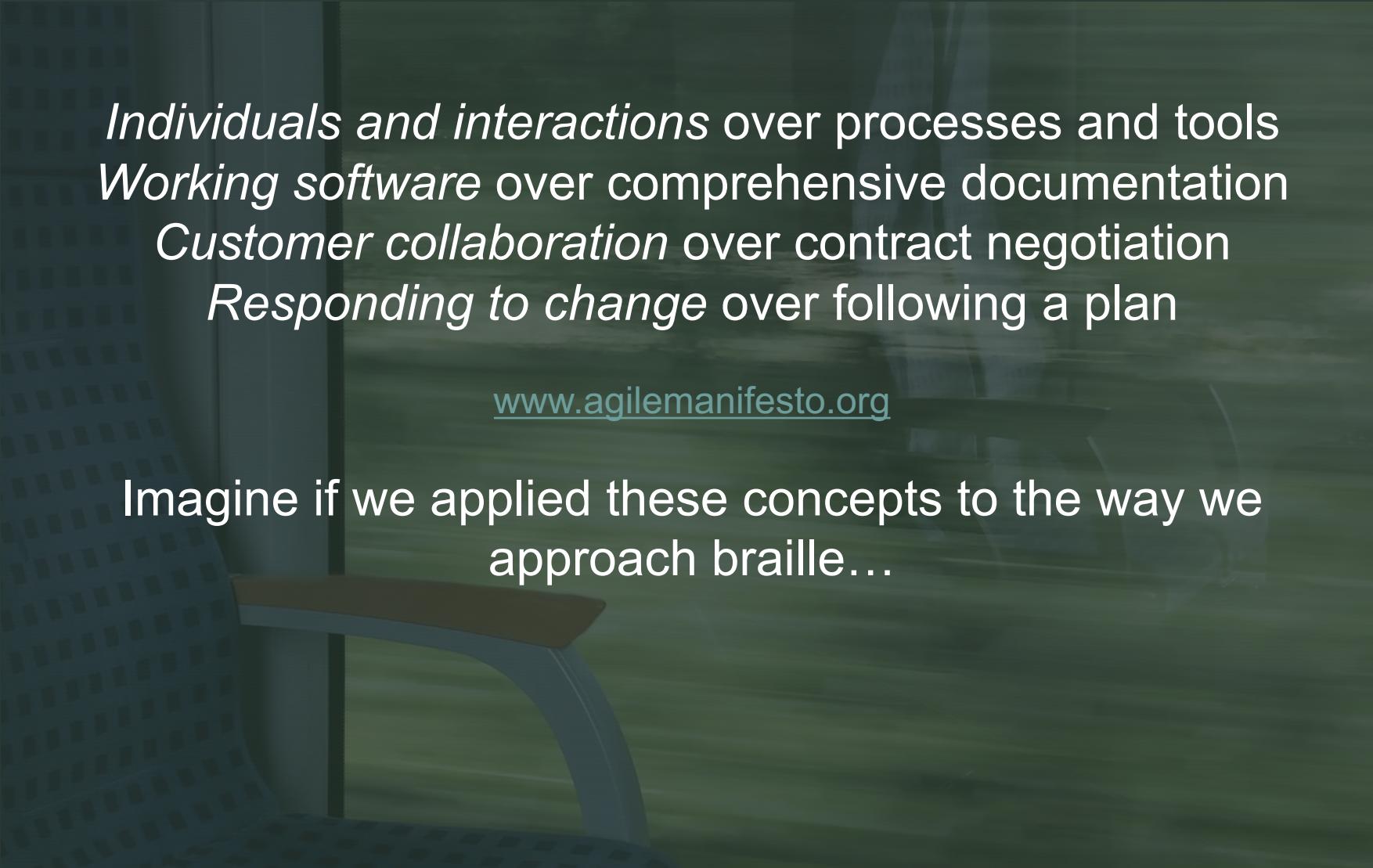
# Agility



“Let’s start with why. Agile enables organizations to cope with continuous change. It permits them to flourish in a world that is increasingly volatile, uncertain, complex and ambiguous...the only way to cope sustainably with today’s marketplace is to embrace Agile. Firms must become as nimble as the rapidly shifting context in which they find themselves.” (Denning 2016)

“Agile” describes an approach to software development under which requirements and solutions evolve through the collaborative effort of self-organizing cross-functional teams and their customer/end users. (Wikipedia)

Agile means “able to move quickly and easily” (dictionary.com)



*Individuals and interactions* over processes and tools  
*Working software* over comprehensive documentation  
*Customer collaboration* over contract negotiation  
*Responding to change* over following a plan

[www.agilemanifesto.org](http://www.agilemanifesto.org)

Imagine if we applied these concepts to the way we approach braille...

- “User Experience refers to a person's emotions and attitudes about using a particular product, system or service. It includes the practical, experiential, affective, meaningful and valuable aspects of human–computer interaction and product ownership” (Wikipedia)



# UX & Digital Capital

- “Disabled students have little control over the timing, speed or content of AT training and tend to be treated as empty vessels that need filling with information about how to use AT.” (Seale et al. 2015)
- Possession of digital capital (social connections and networks that support technology use) “enables individuals to become producers and distributors of their own cultural products, rather than active or passive consumers of the products of others” (Selwyn 2004)



# UX Preferences & Practices

“The lines have blurred between the concepts of ‘reading’ and ‘access,’ and between ‘book’ and ‘information.’ The students valued the greater access to information they have compared to students who read braille in previous generations. Although the interviewed students continue to value the literacy opportunities that braille affords, particularly for specific subjects such as mathematics, they also appreciate the virtually unlimited access to information that technology allows.”

- Braille users ages 16-22: between 4-8 devices each
- College students rarely had materials in embossed braille, but preferred it for math, science, & foreign languages
- Students produced very little embossed braille, choosing to write using word processing equipment such as computers or notetakers
- “It has become critically important to provide students with as many tools as possible...they must be proficient in multiple methods and tools for learning.”
- “A main advantage of using technology is that it is faster than using braille. Even the students who stated that they preferred to use braille if possible acknowledged that in some cases using technology, particularly speech access, allowed them to complete school tasks faster.”
- Another advantage of technology was searching & indexing functions

# Interconnection & Interdisciplinarity

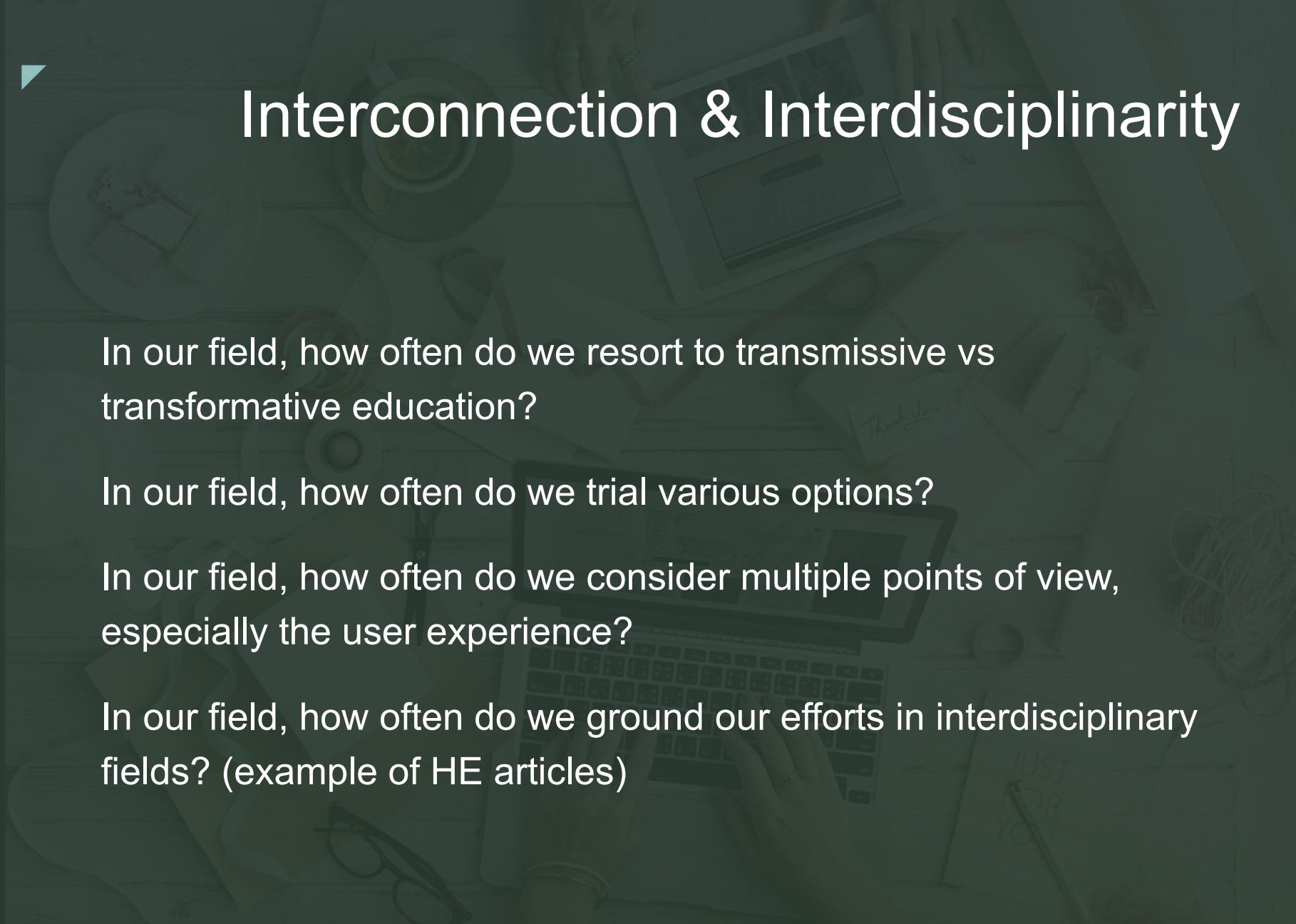
## Principles that ground AT service delivery:

1. Person centered (not AT centered)
2. Outcome is enablement of participation in desired activities
3. Evidence-informed process is used
4. Provided in an ethical manner
5. Provided in a sustainable manner

Note: AT that is recommended or prescribed without input from the user and relevant others ends up abandoned or not used to its full potential.



(Cook & Polgar 2015)



# Interconnection & Interdisciplinarity

In our field, how often do we resort to transmissive vs transformative education?

In our field, how often do we trial various options?

In our field, how often do we consider multiple points of view, especially the user experience?

In our field, how often do we ground our efforts in interdisciplinary fields? (example of HE articles)



# Constraints

- Cost
- Time
- Attention
- Training
- Experience
- Understanding
- The industry

# Emergence



“Unlike music from an orchestra led by the conductor, emergent behavior arises spontaneously due to (often simple) interactions of the constituent parts with each other and the surrounding environment. Here, there is no “leader” deciding on the behavior of the system.”  
(Martin & Helmerson 2014)



# Emergence

- Biological metaphor that describes a phenomenon in which skills or properties spontaneously arise
- Linear lesson plans vs. rabbit trails
- Meaning making (Glossika example, Rastle example)
- Watch for opportunities & plot twists; allow a space for emergence
  - Speech menu
  - Poem

# Global/International View



- “Sustainability means providing AT products and services in a manner that ensures that people who need them have access in a timely and continuing manner.”
- “This idea looks different in well resourced vs under-resourced countries “
- “Globally, the purchase of these devices is inconsistently supported, with the result that a person or family that must obtain AT will have less disposable income than someone without a disability with the same level of income who does not need to purchase AT.”

▪ (Cook & Polgar 2015)

# Global/International View

- These problems are experienced in the North American schools with laws in place to protect students with disabilities and their rights to learn, where teachers are required to be educated and certified and there is federal funding for equipment and service.
- What is the situation in other countries? Exchange student example
- Information and Communications Technology (ICT) offers options, but infrastructure is not built out in many areas of the world
- Examples
  - Benetech [www.benetech.org](http://www.benetech.org)
  - Computers for the Blind <https://www.computersfortheblind.net/>
  - Raising the Floor [raisingthefloor.org](http://raisingthefloor.org)
    - Global issue of disability
    - ICT access
    - Infrastructure for web accessibility
    - “International coalition of individuals and organizations working to ensure that the Internet, and everything available through it, is accessible to people experiencing accessibility barriers due to disability, literacy, or age.”

# Getting Specific

- Triple Bottom Line:
  - Environmental: Consider the school's ecosystem. What learning management systems are being used? What is the workflow? What resources are already available? What is non-negotiable? What are the constraints?
  - Social: What supports are in place within the social context? What barriers? What activities does the device allow, in what contexts? (HAAT model)
  - Economic: What devices are available? What is the budget? Are trials and loaners possible? What organizations can assist with funding?
- Specific Device Examples
  - Mountbatten braillewriter
  - Tablet+RBD
  - Computer+RBD
  - “Hybrid” notetakers



# Keeping the conversation going

- We think there are real differences between the important issues for blind students and what their sighted teachers think are the crucial issues for teaching blind students. In many respects, the classroom is an environment where perhaps those irritating aspects of living in a visual world will be intensified. Blind students are likely to know more about the worries sighted teachers have than do sighted teachers about the needs of blind students. As a consequence, we feel that sighted teachers need to find out what the issues are for the students, which means thinking about the learning side of the teacher-student relationship beyond those initial impressions which are primarily sighted-teacher-centric. (Godfrey & Loots 2015)



# Keeping the conversation going

“Imagine you went into a bookshop with 4 percent of its shelves filled with books; those books were at least two years old and consisted almost entirely of light fiction, textbooks and an idiosyncratic miscellany. How would you feel? How, do you think, would this affect your life as a human being, as a citizen, as a person intent on rewarding work and stimulating leisure?”

(Carey 2007)

- “We live in a world of global data networks and increasing interoperability but, as I noted in my comments on the less than satisfactory impact of computing on Braille production, automation has not achieved what it should.”
- We need “common format source files (pure HTML files which can be rendered through style sheets to produce different formats of Braille, print, and synthetic audio”
- RNIB Dante’s Divine Comedy Example: “the production of high-quality Braille is too costly and specialist to be devoted to replication. Perhaps the key point of this story, however, is the failure to use automation”

# Now What?

- Balance the present and the future
- Prioritize the UX!
- Consider the context
- Watch for plot twists & create your own worst case scenario handbook!
- Reframe constraints as creativity (Scott Sonenshein: [Stretch](#))
- Support initiatives to get AT into the hands of braille readers (Computers for the Blind, New Orbit Reader 20, Raising the Floor)
- Support initiatives for accessibility & adaptable file formats
- Prioritize embossed braille for foreign languages and math
- Expose students to a wide variety of tools
- Teach students to use their technology to promote their own agility
- Allow space for emergence
- Support & consider all levels of the system when making AT decisions
- Understand possibilities, prerequisites & pathways of AT choices
- Keep the conversation going

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