Guiding principles towards inclusive design: research notes for meaningful change

Princípios orientadores para o design inclusivo:
notas de pesquisa para mudanças significativas

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diversity, accessibility, learning, multimedia, games

Educational media (games, animations, virtual labs) offer expansive content to various audiences and often use multiple modes to provide a meaningful learning experience. Unlike their counterparts designed solely for entertainment, educational media are designed to transform the learner and often require a combination of visual, audible, and interactive components. When integrating inclusive design practices, development teams and educators work to ensure that learners with various needs can use any given material for its entire purpose, that they feel represented, and that they can relate to the media while learning. This article presents research notes from one information designer working with a development team toward inclusive design practices. It provides a set of guiding principles to use when applying inclusive design to educational media as a way for design teams to build their own frameworks for creating more meaningful transformational media.

diversidade, acessibilidade, aprendizado, multimídia, jogos

As mídias educacionais (jogos, animações, laboratórios virtuais) oferecem conteúdo amplo para diversos públicos e muitas vezes usam vários modos para proporcionar uma experiência de aprendizagem significativa. Ao contrário dos seus homólogos concebidos exclusivamente para entretenimento, as mídias educacionais são projetadas para transformar o aluno e frequentemente requerem uma combinação de componentes visuais, sonoros e interativos. Ao integrar práticas de design inclusivo, as equipes de desenvolvimento e os educadores trabalham para garantir que os alunos com diversas necessidades possam utilizar qualquer material para todo o seu propósito, que se sintam representados e que possam se identificar com as mídias enquanto aprendem. Este artigo apresenta notas de pesquisa de um designer de informação que trabalha com uma equipe de desenvolvimento em direção a práticas de design inclusivo. Ele fornece um conjunto de princípios orientadores a serem usados ao aplicar o design inclusivo às mídias educacionais como uma forma de as equipes de design construírem seus próprios frameworks para a criação de mídias transformacionais mais significativas.

1 Introduction

Educators and researchers use the modality of educational media to communicate a wide variety of transformational messages: from knowledge gain (e.g., science facts) to health behavioral change (e.g., how to use a face mask correctly) to values and approach (e.g., cultivating care for vulnerable people as a reason to practice food safety). In many cases, it is the combination of multiple forms of media that create engagement and appeal—such as aesthetically pleasing and interesting graphics, engaging animations and video, compelling interactivity, or the affordances of new technologies, such as Virtual Reality. Empirical data support the observation that people learn better when words and images are used together, thus, the multimodal aspect of multimedia (Mayer, 2021).

Research points to several psychological benefits multimedia fosters in learning environments (Clark & Lyons, 2011). Multimedia can **support learners' attention**, helping them focus on specific parts of the content; **reduce the cognitive load** by introducing content and examples gradually; and **support motivation** by explaining complex concepts visually and interactively. Additionally, more interactive multimedia, such as games and virtual laboratories, allow learners to explore, make mistakes and experience things in a safe and scaffolded environment. The personalization of interactive media speaks to the importance of addressing the needs, abilities, and identities of each individual user. Teaching institutions, design teams, and educators have been moving towards *inclusive design*, a theory and practice that designs by, with, and for varied identities, backgrounds, and abilities (Lupton et al., 2021), specifically for designing learning tools and environments. This continued focus on inclusive design incorporates long-standing work in Universal Design (UD); Universal Design for Learning (UDL); and Diversity, Equity, and Inclusion (DEI).

The universal design for learning framework, originating in the mid-1980s, recognized the need for a learning curriculum that considered the needs of all learners, originating from the special needs of diverse learners (Meyer et al., 2014). At approximately the same time, the term Universal Design was coined by Ronald Mace and articulated seven principles for universal design, from access to flexibility and the amount of required effort and affordance for errors (Bruner, 2016). Universal design originally considered built environments, services, and products and focused largely on making these items accessible for specific physical needs (Maisel & Steinfeld, 2012). Both UDL framework and UD have continued to evolve, and both have incorporated cultural competency and elements of representation, diversity, equity, and inclusion in their frameworks and guiding principles.

The modern Diversity, Equity, and Inclusion (DEI) movement (also expanded to include DEIA to add "accessibility" or DIB to consider "belonging") has roots in the American Civil Rights movement of the 1960s but expands to incorporate multiple identities other than race, now including sexual orientation, gender, veteran status, etc. Multiple

frameworks exist for incorporating DEI into educational and organizational work, calling attention to the needs of considering each individual as an equal and valued learner and user of educational products.

The concept of inclusive design incorporates several principles from UDL, UD, and DEI. It reflects the importance of developing products for a variety of learners—including needs of accessibility and representation—while recognizing the importance of including diverse individuals in developing those spaces, products, and learning tools (Treviranus, 2018). Treviranus defines three dimensions of inclusive design: recognize diversity and uniqueness (users' variability); design with and for people with diverse needs and perspectives (inclusive processes and tools); and understand the complexity of the adaptive system that needs to be designed (broader beneficial impact) (Treviranus, 2018, p. 17).

Despite the growing discussion about inclusive design for learning, for many teams, design for inclusion feels challenging for various reasons. One is a lack of knowledge, leading to fear of the unknown. Teams may be fearful about engaging in the discussion due to a lack of vocabulary and fear of unintentionally hurting others; designers may fear that they cannot solve the entire problem, so it is not worth trying. Another is fear of scarcity, worrying that there aren't enough resources, such as people, money, and time (Holmes, 2018).

When creating educational media, inclusive design frameworks guide teams in understanding that there is no default learner. With that in mind, how can design teams apply this understanding to create educational multimedia? What do design teams need to consider to ensure their multimedia is inclusive and provides equal opportunities for learners which consider their needs? Given the existing complexity and challenges of developing educational media, how can designers use guiding principles to integrate inclusive design in manageable ways?

As research notes, this study offers a set of guiding principles articulated by one information designer working with an educational media development studio as they continue their efforts in inclusive design. The principles and reflections presented here offer an analysis of the approaches used to integrate inclusive design with the development of educational media. This work is not prescriptive; it intends to foster discussions as more designers and design teams move towards the same inclusive design journey.

2 The intentional design of inclusive educational media

When creating educational media, the goal is to have an effective and meaningful learning experience while changing the learner's knowledge, skill, behavior, emotion, or physiology (Chamberlin & Schell, 2018). Through the lens of inclusive design, we understand that there is no default learner, and in recognizing learners' variability, design teams and developers can work to foster an equal opportunity for learners to learn through inclusive design activities (Meyer et al., 2014).

Design is powerful. It is an evolving field that aims to solve problems, addressing people's needs with creative and innovative solutions for specific situations, tasks, and activities. These solutions (e.g., graphics, furniture items, products, websites) are designed to foster an experience, impacting the way we communicate, learn, and live as a society. However, "design is much more likely to be the source of exclusion than inclusion" (Holmes, 2018); every design decision is intentional and will determine who can use a product or who does and does not belong. A mismatch between users' needs and the product creates barriers; for example, when the needs of users with disabilities (visual, hearing, motor, cognitive) are not considered, users with these needs will have difficulty or will not be able to use a determined product or interface, leading to exclusion.

Even though every design decision is intended, design exclusions are not always intentional; it could happen because design teams are unaware of the wide range of user needs and their different abilities, or the team does not know how to address these needs in their design process (Keates et al., 2000). Similarly, equity, inclusion, diversity, and belonging concepts include a focus on identifying who is excluded—asking designers to see what is unseen. Because exclusion can be unintentional or rooted in unacknowledged biases, it isn't enough to have the desire to design for all users; there must be practices, procedures, and training in place that make inclusive design intentional. For example, researchers and design teams can intentionally reflect on and change how they design, in the sense of *Who is part of the design team? For whom they are creating products? Who gets access? Who is represented? Who is making the decisions? Who feels part of it? What bias do we bring?* (Gilbert, 2019; Lupton et al., 2021). Inclusive design practices guide these changes.

Through an inclusive design lens, we understand various identities, backgrounds, and abilities that will inform design and be part of the process. This understanding changes the way we teach, research, and design for learning. Design literature uses different terms to describe practices that ensure the accessibility and inclusion of users and their multiple identities. Terms such as *barrier-free design*, *design for all*, *accessible design*, *inclusive design*, and *universal access* have little consensus regarding definitions and use (Persson et al., 2015).

2.1 Research notes toward inclusive design

The Learning Games Lab team has been developing educational media for more than 20 years, applying university-based research to create effective and meaningful transformational media. The Lab is part of NMSU's Innovative Media Research and Extension[1] department as a non-profit development studio that develops educational games, virtual labs, videos, animations, virtual reality experiences, and other interactive tools to help learners of all ages learn from research-informed interventions. As a core value, the team believes learning transformation is most effective when materials meet the learner's needs.

[1] innovativemedia.nmsu.edu/

In the past four years, an information designer has been working with the lab research and development team focusing on research-based strategies to increase accessibility and diversity in their work. Researchers with the lab have developed their own complete framework for the inclusive design of educational media (Cezarotto et al., 2022a), an accessibility framework for developers (Cezarotto & Chamberlin, 2021), and documented redesign processes for accessibility in educational games (Cezarotto et al., 2022b).

Action research guides the team to create change in their process to prioritize inclusion, following a continuous, ongoing, and iterative process, a self-reflective spiral cycle of planning, acting, observing, and reflecting (Muratovski, 2016; Kemmis & McTaggart, 2005). Additionally, the research team constantly seeks knowledge through literature review, investigating the work of other developers and community organizations, presenting at conferences, and consulting experts on the topic.

As part of the information designer journey, research notes were taken from conference presentations (e.g., *Games for Change*,[2] *Games Learning Society*,[3] *Dust or Magic—Child Development 101*[4]), interactions with researchers and developers (e.g., Lindsay Browder— Roblox; Ethan Cayko—GBH Education), observations from project development (where products include educational games and interactive modules), and experiences teaching accessibility to youth (Think Tank Sessions— Learning Games Lab[5]) and college students (as instructor of "Accessibility in Educational Media"). This study reflects and discusses those notes outlining six guiding principles grounded on theories and inclusive design best practices. These principles focus on the design process and actions toward inclusive design and represent one initiative.

[2] www.gamesforchange.org/
[3] glsconference.net/
[4] dustormagic.com/

[5] innovativemedia.nmsu.edu/think-tanks.html
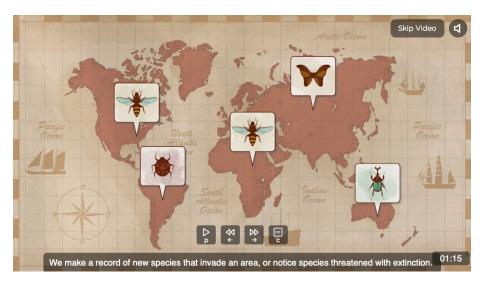
3 Guiding principles for inclusive design

3.1 Poor product design is disabling

From the social model of disability perspective, accessibility lives in the product, not in the user; this is a critical concept in understanding the power of design to include or exclude people. Through the social model of disability lens, people are not disabled by their impairment or differences but by society's barriers and disabling factors (Oliver, 2013). Design creates many of these barriers when disregarding people's needs and differences. It means the disability is a mismatch between the design and the person's needs instead of a personal health condition (Holmes, 2018).

For example, when creating an animation to teach science content, if the team does not include captions, this product disables and excludes deaf or hard-of-hearing users who will not have access to the narration's audio content. Providing captions for the narration enables deaf or hard-of-hearing users to use the media (Figure 1).

Figure 1 Insect Pinning Collection—intro animation with captions, supporting users' hearing needs.

The principle "Poor product design is disabling" helps design teams understand that a good design that matches users' needs enables and includes users; conversely, a bad design that does not match users' needs disables and excludes users. This shift in thinking—away from disability of a user and towards the disabling nature of a product mechanic—helps guide designers in accepting their responsibility for design. It also shifts the mindset of the design team away from a well-intentioned viewpoint of "adding on features to help specific users" towards "integrating quality design from the start of the project, for as many users as possible."

3.2 We are all on a spectrum of need

One of the biggest misconceptions regarding accessibility is that accessibility is solely for people with disabilities. All users of any product (e.g., game, website, chair), disabled or nondisabled, need a degree of accessibility to appropriately use and interact with a product (Hersh & Leporine, 2013). Accessibility is about user needs, and all users are in a spectrum of low to high in four main categories of needs: visual, hearing, motor, and cognitive (Cezarotto et al., 2022a).

- **Visual needs**: *covers how people see things*, considering that people may have some degree of vision loss, such as low vision, legal blindness, complete blindness, and color blindness.
- **Hearing needs**: *covers how people hear things*, considering that people may have some degree of loss in the ability to listen, either from one or both ears, such as hearing loss, hard hearing, or deafness.
- **Motor needs**: *covers how people move and manipulate things*, considering that people may have some mobility limitation or

muscle control, such as cerebral palsy, lack of steadiness, lack of mobility, age-related issues, neurological disorders, repetitive stress injury, paralysis, and arthritis.

- **Cognitive needs**: *covers how people process information*, considering that people may have mental or psychological disorders which cause a deficit in the ability to learn, process or remember information, communicate, make social interactions, and make social decisions. Examples include neurodivergent learners, learning disabilities, or intellectual disability.

Additionally, user needs occur in three possible situations (Microsoft Design, 2016):

- **Permanent need**: A need that more likely would not change over time, for example, on visual needs, a blind user will have a permanent need for receiving information in other channels rather than visual.
- **Temporary need**: A need that will change after a specific time, for example, on visual needs, a user recovering from a cataract surgery will temporarily need to receive information through audio while recovering from the eye procedure.
- **Situational need**: A need specific to certain circumstances, for example, on visual, a user driving will need to interact with devices using voice instead of looking and interacting with a device.

When design teams brainstorm activities and gameplay, it helps to understand the four categories of need, and to design for the spectrum. It may be unlikely to address everyone on a spectrum given a specific mechanic, but the team is freed to do as much as they can. For example, in *Math Snacks: Game Over Gopher*, learners experiment with graphic coordinates on a plane (Figure 2). They are encouraged to explore multiple options in multiple ways to place and design paths based on coordinates. Because graphing is inherently a visual presentation of data, it would be easy to ignore visual needs, assuming that those with no vision would not make sense of the data in this way. By understanding the spectrum of needs, designers are able to consider contrast, color, font size, captions, and other controls that help users with low, poor or adapted visions to play that game.

The principle "We are all on a spectrum of need" helps design teams understand that accessibility is not something extra or solely for disabled users; all users, disabled and non-disabled, will need levels of accessibility to use any product. Understanding accessibility as directly connected with user needs shows the importance of understanding user needs in a wide range, avoiding the "average user" concept, and addressing users' abilities within a range of activities. It can be helpful for designers to think of that spectrum and design as far through that range as possible, acknowledging that this may be without reaching everyone, in some situations.

Figure 2 The *Game Over Gopher* gameplay interface supporting users' visual needs.

3.3 We all have implicit biases and gaps in our knowledge

All individuals have several biases based on their culture and experiences, influencing and impacting their attitudes and behavior. Bias represents an inclination or prejudice toward or against someone or something. Unlike conscious bias, individuals are unaware of implicit biases; these biases negatively influence people's evaluation or association of a particular concept, which can be a person, group, community, idea, value, etc. Implicit biases have harmful effects on and by group members for which a negative stereotype is known or has been perpetuated (Berg, 2017, Flanagan & Kaufman, 2016).

For example, consider who and how design teams represent professionals in STEM (Science, Technology, Engineering, and Math) in games or virtual labs. Negative or overgeneralized beliefs about marginalized groups' abilities can socially perpetuate a non-diverse environment in STEM. These beliefs are common even among individuals who are members of marginalized groups (Flanagan, 2019). Despite decades of progress, especially in gender diversity (Miller et al., 2018; Bian et al., 2017), STEM careers continue to be less diverse than the population regarding gender and race/ethnicity (National Science Foundation & Engineering Statistics, 2019).
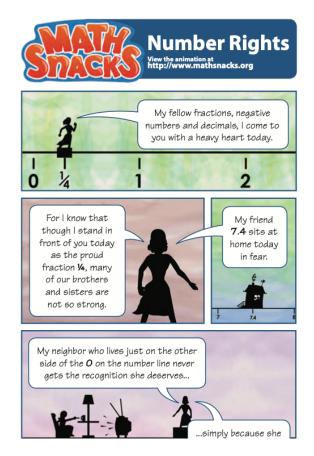
Understanding that design is never neutral, designers need to acknowledge and challenge implicit biases in their designs, ensuring that their products and interfaces do not reinforce implicit biases, stereotypes, and exclusion of certain groups. In addition, it is crucial to actively engage diverse users in informing, reviewing, and designing materials.

"Not only can designers be mindful of the ways their creations may (often unintentionally and subtly) reinforce implicit bias, but, indeed, designers can (and should) design in ways that can effectively counteract stereotypes and discrimination through play" (Flanagan & Kaufman, 2016, p. 220).

The principle "We all have implicit biases and gaps in our knowledge" helps design teams acknowledge and challenge implicit biases counteracting stereotypes and discrimination through design. It also serves as a reminder to include members of our target audience in identifying needs, recommending solutions, and designing and reviewing learning materials designed to offer those solutions.

3.4   When we make a change for one, we often improve for many

By making educational media inclusive, development teams not only benefit learners with specific needs but can also make their media better for users without those needs. Designing media towards inclusion increases the value of media as a meaningful experience for learners and the community; accessibility can foster equality and a relevant social connection between learners with and without disabilities (Cairns et al, 2021). One common example of this concept in accessibility is the Curb Cut Effect. When curb cuts were introduced to increase accessibility for those using wheelchairs, other users saw benefit to having curbs that enabled access for wheels (such as on luggage, carts, and strollers) and reduced the need to step up onto the curb (for people with medical conditions that make it hard to lift their feet). Similarly, weighted blankets originally designed to treat children with severe anxiety, autism, and post-traumatic stress disorder (PTSD) now help individuals feel more comfortable in sleeping; open captions originally created to support hearing needs can increase retention of information displayed and support those without hearing loss who are in situations where reading is more convenient.

When the Learning Games Lab team created their popular Math Snacks animations and games, they sought to provide a written transcript of the narration on animations (Figure 3). By default, they create educational animations with open captions, but teachers wanted to give students written transcripts in whole. Because the animations convey so much visual information, they were hesitant to provide only scripts, without the visuals. As a result, the design team created graphic-novel style transcripts which included images and text. After they had been released, they heard from several teachers of the value of using these transcripts with students for whom English was a second language: they gave learners the ability to work more slowly through what was said, tying the language to the visual. Though reaching second-language learners was not the intent, it is an example of when expanding design for accessibility also allows the product to reach new audiences.

Figure 3 The written transcript for the animation "Number Rights" provided graphic information and text. Though intended as a guide for hearing-impaired, it also enabled better understanding for learners whose primary language is not English. Note: the comic book transcript is also available in Spanish.

An important recent invocation of the curb-cut effect is to be aware of the potential of erasing needs related to disability (Reid, 2022). As specific accommodations become more commonplace, and more people use them, it can be easy to overlook specific design requirements that instigated the accommodation. For example, wheelchair users require certain grades, levels and other design features of a curb cut: any ramp won't do. There is a risk to assuming accessibility can improve products for every user, if we fail to investigate specific needs, or fail to include accessibility advocates and various users when testing and reviewing products.

The principle "When we make a change for one, we often improve for many" helps design teams to understand the value and how much accessibility and inclusion efforts improve the overall quality of their product, allowing more users to have good experiences with it.

3.5 The work can present contradictions: some products aren't for every user

One-size-fits-all sounds promising, but it is a myth. Understanding the wide range of user needs, identities, and abilities, we can assert that it is almost impossible to design for all; there is no average user (Abascal & Nicolle, 2005). People look, behave, and have different abilities and needs. With that in mind, it is clear and natural that people need help and support in various ways (Ladau, 2021).

Trying to make media usable by all learners brings some intrinsic conflicts, since providing access to users with a type of disability may make this product notably more difficult or even impossible for use by other groups of users, either for nondisabled people or those with a different type of disability (Newell et al., 2011). For example, in a game or interactive module, a rollover feature providing more details/description in a given graphic or interface element can help players with cognitive needs better understand the meaning or nature of that graphic, yet be inaccessible for players with motor needs, who may not be able to use such a fine motor skill movement due to temporary or permanent conditions.

Recognizing that we can't make a product for everybody sounds contradictory to the inclusive design approach, but it is not. Contradictions are part of the design process, and addressing these conflicts with creativity makes design impactful to society. What inclusive design brings to this equation is a process that aims to design a product excluding as few people as possible from using it. Through flexibility and adaptability, inclusive design tries to provide accommodations to a wide range of users' needs and preferences, acknowledging that sometimes it is impossible to accommodate all users in a single version of the product (Keates et al., 2000; VanderHeiden & Tobias, 1998). Inclusive design recognizes the different nuances in user needs and deals with conflicts to make a product useful and meaningful for a wide range of users.

The principle "The work can present contradictions: some products aren't for every user" supports teams in understanding the intrinsic contraction they will find when making an inclusive product. The contradictions are inevitable, but the team can establish specific actions to address them, improve the product for a wide range of users, and in some cases, recognize the need for more than one product version to support accommodations. Additionally, it's important to inform users of what affordances the media offers and how it can support user needs.

3.6 We may get it wrong, but we will still do our best

Design for inclusion is doable, but there is no magical formula or checkbox that teams will complete and be done. Moving towards inclusive design is a process; as the team learns more, every product gets a little bit better. In the same way users are diverse, design teams are diverse in many ways, and this diversity needs to be considered when planning actions toward inclusiveness in products. Additionally, as products and technology improve, our field learns more about needs, and more diverse and abled developers are joining design teams, bringing their perspectives and experiences with them. This can mean—in looking at our previous work—that we may feel embarrassment or shame when we make errors or resolve tradeoffs in a different way than we wish we had.

In 2011, the Learning Games Lab released a cooking game called Ninja Kitchen. This popular and effective game (Quick et. al, 2013) introduced young cooks to safe food preparation. It used bold red, black and gold

colors, a graphic narrative visual style, and characters in costume for a ninja or kung fu styled theme. The theme was suggested by youth co-designers and reflected a trend in movies and other pop culture products at that time. The team recognizes now that we engaged in cultural appropriation by taking a real, historical group of people (along with visual elements from other historical groups) and reducing them to cartoon characters in our themed game. While there may be ample opportunities to take this field agent from feudal Japan into a more modern interpretation: it was simply not ours to do so. We recognized this error and are releasing an updated version of the game, "Theme Park Cafe". A diversity expert visiting our team casually mentioned how "appalled" new team members must be when they saw we created Ninja Kitchen. We hope to recognize errors when we make them, but we also hope to acknowledge that given our knowledge at the time, we did the best we could. If we, rather than taking responsibility for doing better, we become ashamed of our past work, it can paralyze us from trying to move forward in taking the best steps. Our department head frequently reminds the team that "We may look back and realize we got it wrong. That's what growth looks like."

In a previous study our team was able to outline five steps to support team actions toward inclusive design (Cezarottoet al., 2022a):

- **Engage** the entire team in working toward inclusivity.
- **Create** a list of guidelines for inclusivity best practices.
- **Implement** best practices for inclusion in design of individual products.
- **Test** products with multiple types of users and get expert review.
- **Review & reflect** on your team's approach to inclusion.

The principle "We may get it wrong, but will still do our best" supports teams in understanding that they may get it wrong, which is okay; it is part of the process. Inclusion is an ongoing process that teams get better at with every project. Every project will bring different and specific challenges. Through engaging with best practices, reflecting on those practices, and committing to review and renew strategies, design teams can continue improving to make products more inclusive and accessible.

4 Final considerations

Inclusive design practices are not new but have gained more attention due to increased interest in diversity, equality, and inclusion and from requirements for fully accessible websites such as the 508 Accessibility Mandate for websites using funding from the U.S. Government (U.S. General Services Administration, 2022). Designers, educators, and teaching institutions are moving towards practices and artifacts that can support various learners by understanding and accommodating multiple needs, abilities, and identities. Despite these efforts and initiatives,

for many design teams, inclusive practices can feel complex even to talk about. Or, inclusive design may not feel doable due to time and budget.

Over the past four years, I have worked with the Learning Games Lab team, engaging in discussions, research, and approaches to foster more inclusive educational media. My role has focused on accessibility, while others have focused on DEI. Together, we have explored the inclusive design process with each new product. The team has struggled with and experienced many of the challenges that are described in this article. The set of guiding principles listed here emerged from practical and theoretical knowledge reflection in this process, which has lessened the perceived burden, and made the full integration of inclusive design possible throughout our work.

The guiding principles articulated in this work represent one initiative to foster inclusive design practices. With a focus on design, they support teams with vocabulary, key concepts, and conceptual and practical knowledge about accessibility, diversity, equity and inclusion. The principles are not a set of rules or steps that teams can take; instead, they give teams agency and understanding of inclusive design practices, vocabulary to build discussions, and knowledge to identify how they can make meaningful, inclusive changes to their process and products. Even though the study focuses on educational media, the principals can inform design practices in multiple fields.

Understanding inclusive design—especially how design as a practice can include or exclude people from interactions, experiences, or social activities—has implications not only for the way design teams work or who is part of the team, but also to how design research and user testing impact each other. As a design team, our intentional actions and steps in the design process ensure that we are designing for and by those with various abilities, needs, and backgrounds. Future studies to identify and discuss the implications of inclusive design can build on existing frameworks and principles as our collective understandings evolve, and can provide insight on teaching design students with these principles.

As part of a team committed to making educational media more inclusive and accessible to various users, it is valuable to understand that it is a continuous and intentional work, that as more and more as design teams move towards it, it will become intrinsic to the design process, and that, with deliberate work, the future of design will be inclusive by its nature.

Acknowledgment

References

Abascal, J., & Nicolle, C. (2005). Moving towards inclusive design guidelines for socially and ethically aware HCI. *Interacting with computers*, *17*(5), 484–505. https://doi.org/10.1016/j.intcom.2005.03.002

Berg, J. (2017, September 1). Measuring and managing bias. *Science*, *357*(6354), 849. https://doi.org/10.1126/science.aap7679

Bian, L., Leslie, S.-J., & Cimpian, A. (2017, January 27). Gender stereotypes about intellectual ability emerge early and influence children's interests. *Science*, *355*(6323), 389–391. https://doi.org/10.1126/science.aah6524

Bruner, D. (2016). Universal design for learning: Academic access for diverse learners. *Journal of Inclusive Practice in Further and Higher Education*, *7*, 4–8.

Cairns, P., Power, C., Barlet, M., Haynes, G., Kaufman, C., & Beeston, J. (2021). Enabled players: The value of accessible digital games. *Games and Culture*, *16*(2), 262–282. https://doi.org/10.1177/1555412019893877

Cezarotto, M., Martinez, P., & Chamberlin, B. (2022a). Developing inclusive games: Design frameworks for accessibility and diversity. In B. Sobota (Ed.), *Game theory: From idea to practice* (pp. 41–59). IntechOpen. https://doi.org/10.5772/intechopen.108456

Cezarotto, M., Martinez, P., & Chamberlin, B. (2022b). Redesigning for accessibility: Design decisions and compromises in educational game design. *International Journal of Serious Games*, *9*(1), 17–33. https://doi.org/10.17083/ijsg.v9i1.469

Cezarotto, M., Chamberlin, B. A. (2021). Towards accessibility in educational games: A framework for the design team. *InfoDesign*, *18*(3), 102–113. https://doi.org/10.51358/id.v18i2.931

Chamberlin, B. A., Schell, J. (2018). Connected learning summit, "The secret process for making games that matter." MIT, Boston, MA (August 2, 2018).

Clark, R. C., & Lyons, C. (2011). *Graphics for learning: Proven guidelines for planning, designing, and evaluating visuals in training materials*. John Wiley & Son.

Flanagan, M. (2019). *Cutting through the bias: Using games and interactive experiences to transform bias against women in STEM*. Independently Published.

Flanagan, M., Kaufman, G. (2016). Shifting implicit biases with games using psychology: The embedded design approach. In Y. B. Kafai, G. T. Richard, & B. M. Tynes. (Eds.), *Diversifying Barbie and Mortal Kombat: intersectional perspectives and inclusive designs in gaming* (pp. 219–233). Carnegie Mellon University ETC Press.

Gilbert, R. M. (2019). *Inclusive design for a digital world: Designing with accessibility in mind*. Apress.

Hersh, M. A., Leporini, B. (2013). An overview of accessibility and usability of educational games. In C. Gonzalez (Ed.), *Student usability in educational software and games: Improving experiences* (pp. 1–40). IGI Global. https://doi.org/10.4018/978-1-4666-1987-6.ch001

Holmes, K. (2018). *Mismatch: How inclusion shapes design*. MIT Press.

Jackson, D. N. (2023, July 19). Using digital communications to deliver health information, [Conference presentation in panel, *How to engage diverse populations with culturally competent campaigns*]. International Association for Food Protection Conference, Toronto, Canada.

Keates, S., Clarkson, P. J., Harrison, L. A., & Robinson, P. (2000, November). Towards a practical inclusive design approach. In *Proceedings on the 2000 conference on Universal Usability* (pp. 45–52).

Kemmis, S., & McTaggart, R. (2005). Participatory action research: Communicative action and the public sphere. In N. K. Denzin & Y.S Lincoln (Eds), *The Sage handbook of qualitative research* (pp. 271–330). CA, USA: Sage publications.

Ladau, E. (2021). *Demystifying disability: What to know, what to say, and how to be an ally*. Ten Speed Press.

Lupton, E., Kafei, F., Tobias, J., Halstead, J. A., Sales, K., Xia, L., & Vergara., V. (2021). *Extra bold: A feminist, inclusive, anti-racist, nonbinary field guide for graphic designers*. United States: Princeton Architectural Press.

Maisel, J., & Steinfeld, E. (2012). *Universal design: Creating inclusive environments*. United Kingdom: Wiley.

Mayer, R. E. (2021). *Multimedia learning* (3rd ed.). Cambridge University Press.

Meyer, A., Rose, D. H., & Gordon, D. (2014). *Universal design for learning: Theory and practice*. CAST.

Microsoft Design. *Inclusive Microsoft Design*. Microsoft, 2016. https://inclusive.microsoft.design/tools-and-activities/Inclusive101Guidebook.pdf

Miller, D. I., Nolla, K. M., Eagly, A. H., & Uttal, D. H. (2018, November/December). The development of children's gender-science stereotypes: A meta-analysis of 5 decades of U.S. draw-a-scientist studies. *Child Development*, *89*(6), 1943–1955.

Muratovski, G. (2016). *Research for designers: A guide to methods and practice*. Research for Designers. SAGE Publications

National Science Foundation, National Center for Science and Engineering Statistics (2019). *Women, minorities, and persons with disabilities in science and engineering: 2019*. Special Report NSF 19-304. Alexandria, VA. https://www.nsf.gov/statistics/wmpd

Newell, A. F., Gregor, P., Morgan, M., Pullin, G., & Macaulay, C (2011). User-sensitive inclusive design. *Universal Access in the Information Society*, *10*(3), 235–243. https://doi.org/10.1007/s10209-010-0203-y

Oliver, M. (2013). The social model of disability: Thirty years on. *Disability & society*, *28*(7), 1024–1026. https://doi.org/10.1080/09687599.2013.818773

Persson, H., Åhman, H., Yngling, A. A., & Gulliksen, J. (2015). Universal design, inclusive design, accessible design, design for all: Different concepts— one goal? On the concept of accessibility—historical, methodological and philosophical aspects. *Universal Access in the Information Society*, *14*, 505–526. https://doi.org/10.1007/s10209-014-0358-z

Quick, V., Corda, K. W., Chamberlin, B., Schaffner, D. W., & Byrd-Bredbenner, C. (2013). Ninja kitchen to the rescue: Evaluation of a food safety education game for middle school youth. *British Food Journal*, *115*(5), 686–699. https://doi.org/10.1108/00070701311331481

Reid, Blake Ellis, The Curb-Cut Effect and the Perils of Accessibility without Disability (October 31, 2022). Feminist Cyberlaw (Amanda Levendowski and Meg Jones, eds., Forthcoming), U of Colorado Law Legal Studies Research Paper No. 22–24. https://ssrn.com/abstract=4262991or http://dx.doi.org/10.2139/ssrn.4262991

Treviranus, J. (2018). *The three dimensions of inclusive design: A design framework for a digitally transformed and complexly connected society*. PhD thesis, University College Dublin. http://openresearch.ocadu.ca/id/eprint/2745/

U.S. General Services Administration (2022, July 28). *Government-wide section 508 assessment*. https://www.section508.gov/

Vanderheiden, G. C., & Tobias, J. (1998). Barriers, incentives and facilitators for adoption of universal design practices by consumer product manufacturers. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *42*(6), 584–588.

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