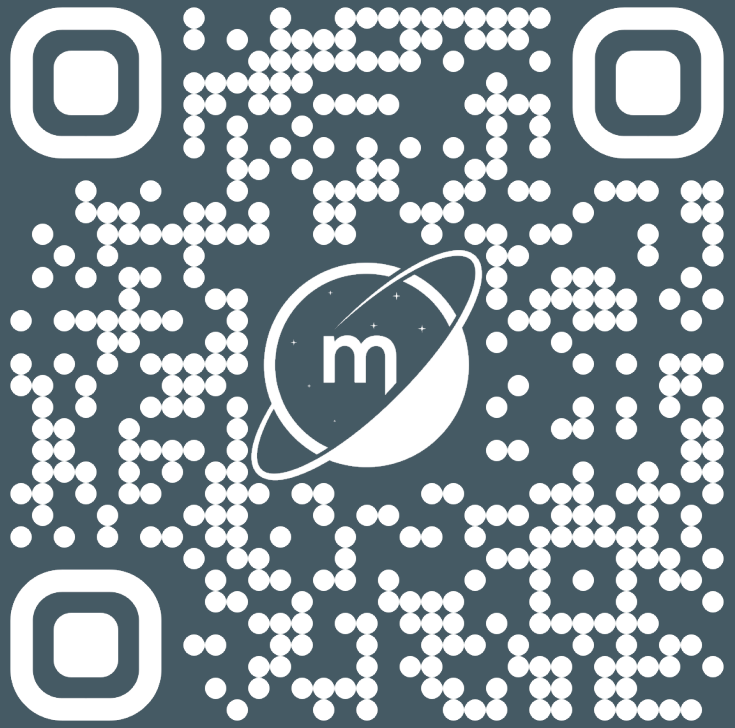
Measuring the Obvious 🔍

A Human Factors Engineering Analysis of Kiosk Accessibility

By: Mark Ogra
Shaaz Rizvi
Aaron Elrington-Edwards

GitHub

Follow Along! 📱



markuryy.github.io/IE323

- View slides on your own device
- Access all code and resources
- Available on GitHub

Introduction

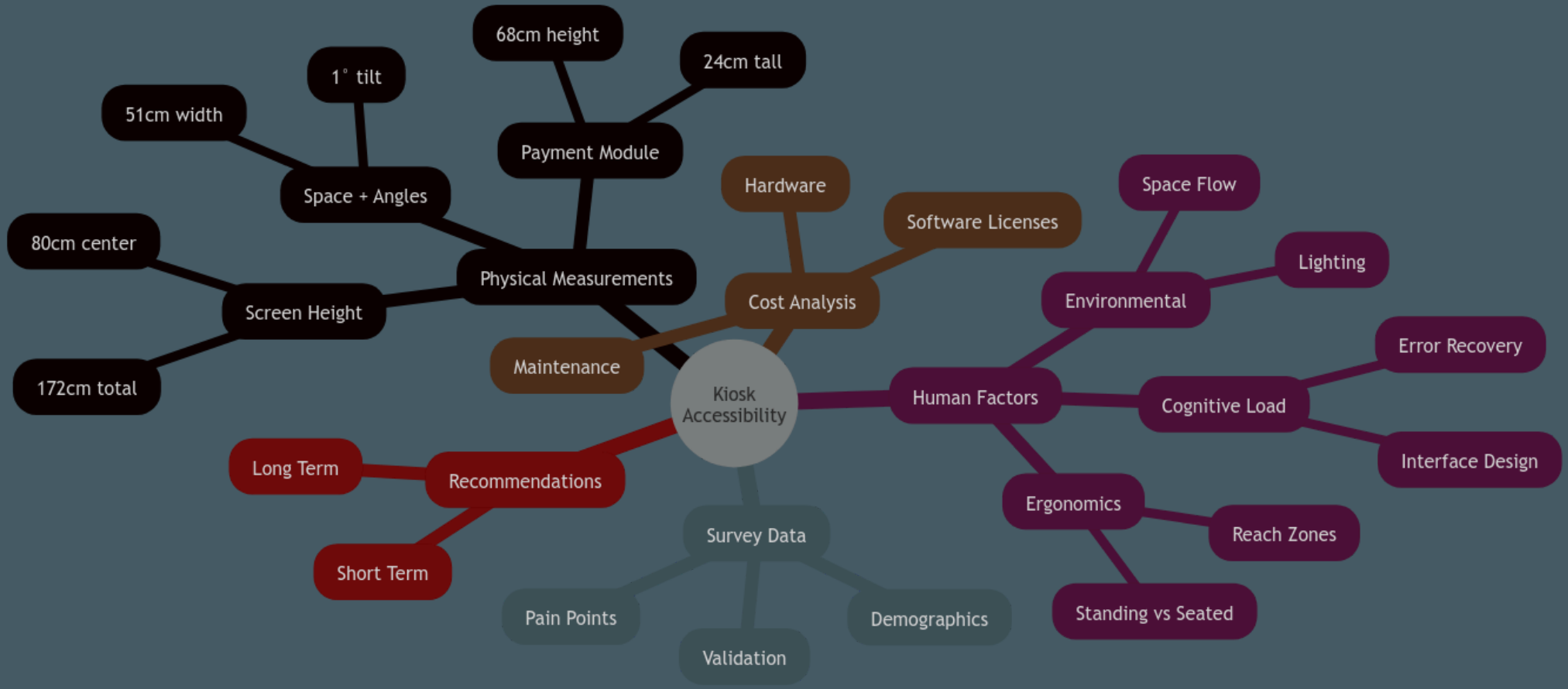
Human Factors Foundation

1. **Fitts' Law & Target Acquisition**
    - Touch target difficulty ∝ distance/size ratio
    - 172cm height + small UI = computational nightmare
    - Fixed angle compounds motor planning issues

Human Factors Foundation (cont.)

2. **Cognitive Load Theory**
   - Physical strain increases cognitive overhead
   - Error recovery requires additional reaching
   - Time pressure compounds both issues
3. **Norman's Design Principles**
   - Visibility compromised by physical design
   - Feedback requires additional physical effort
   - Mapping ignores natural affordances

Problem Space Overview



Interconnected barriers require systematic analysis

Current Implementation Issues

- Fixed designs violating ergonomic standards
- Conflicting accessibility accommodations
- Environmental factors impacting usability
- Resource allocation revealing priorities

Methodology

Initial Research Steps

1. **Initial Approach (Failed)**
    - Attempted traditional user testing
    - Proposed menu item compensation
    - Received justified criticism
    - Recognized ethical issues
2. **Research Pivot**
    - Developed measurement protocol
    - Created evaluation form
    - Obtained survey permission
    - Established documentation

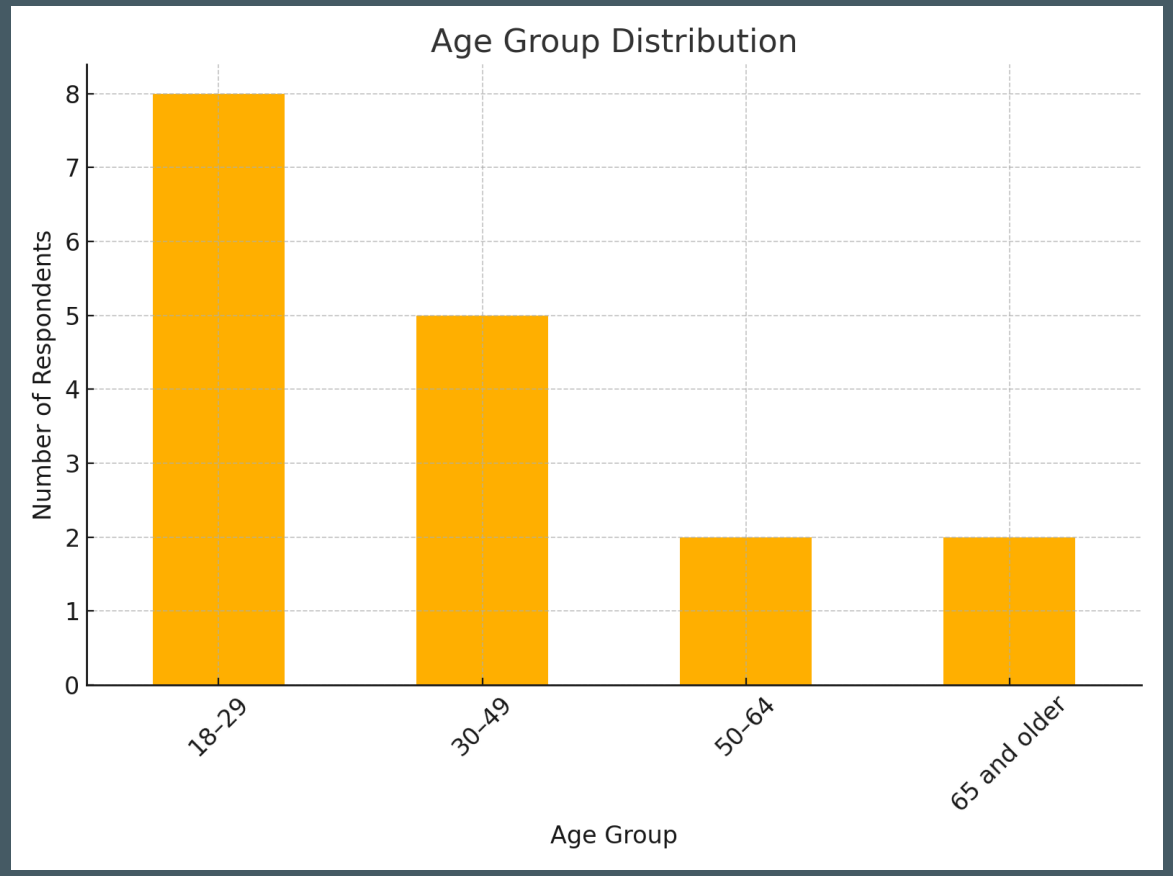
Data Collection & Analysis

3. **Data Collection**
   - Physical measurements
   - Survey distribution
   - Environmental documentation
   - Interface workflow

4. **Analysis Protocol**
   - ADA standards review
   - Statistical analysis
   - Correlation studies
   - Cost-benefit evaluation

Tools & Equipment

- Standard measuring tape (physical dimensions)
- Digital level application (screen angles)
- Survey instruments (user feedback)
- Documentation templates (standardization)



Participant Demographics

- Medical office setting providing diverse sample
- Natural inclusion of mobility device users
- Age range: 18-65+
- Multiple accessibility needs represented

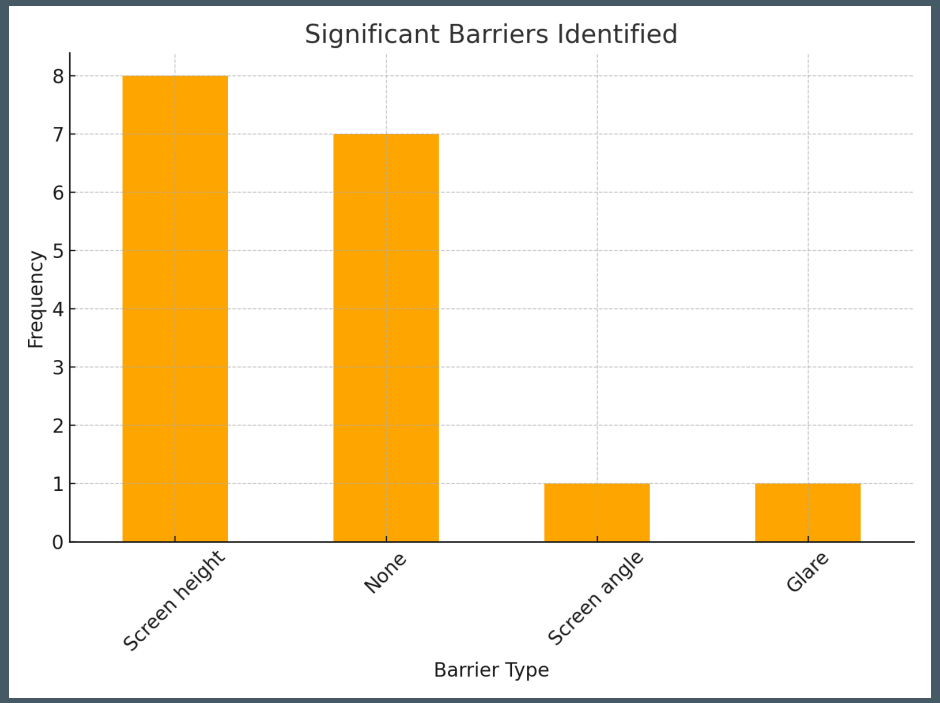
Mathematical Validation

Fitts' Law Application

$$ID = log_2(\frac{2D}{W})$$

where:

- D = effective distance (cm)
- W = target width (cm)



Kiosk Configuration Analysis

$$D_{effective} = \sqrt{172^2 + reach^2} * \cos(\theta)$$

Comparative Results:

- Standing (50cm reach): ID = 8.48 bits
- Seated (70cm reach): ID = 8.54 bits
- *Additional cognitive load from non-optimal viewing angle*

Physical Analysis

Measurement Results vs Standards

Component	Measured	ADA Requirement	Citation	Impact
Total Height	172cm	121.9cm max	§308.2.1 Forward Reach	❌ Exceeds by 50.1cm
Screen Center	80cm	38-121.9cm	§308.2.1-2 Reach Ranges	⚠️ Fixed at median
Payment Zone	68-92cm	38-122cm	§308.3.1 Side Reach	⚠️ Upper range violation
Clear Space	~50cm	76cm min	§305.3 Clear Floor	❌ 34.2% below min
Screen Angle	Fixed -1°	Adjustable	§309.4 Operation	❌ No accommodation

Accessibility Conflicts: Physical Design

1. **Height vs Visibility**
   - Lower placement helps wheelchair users
   - Creates strain for standing users
   - Current "solution" ignores principles
   - No single fixed height optimal

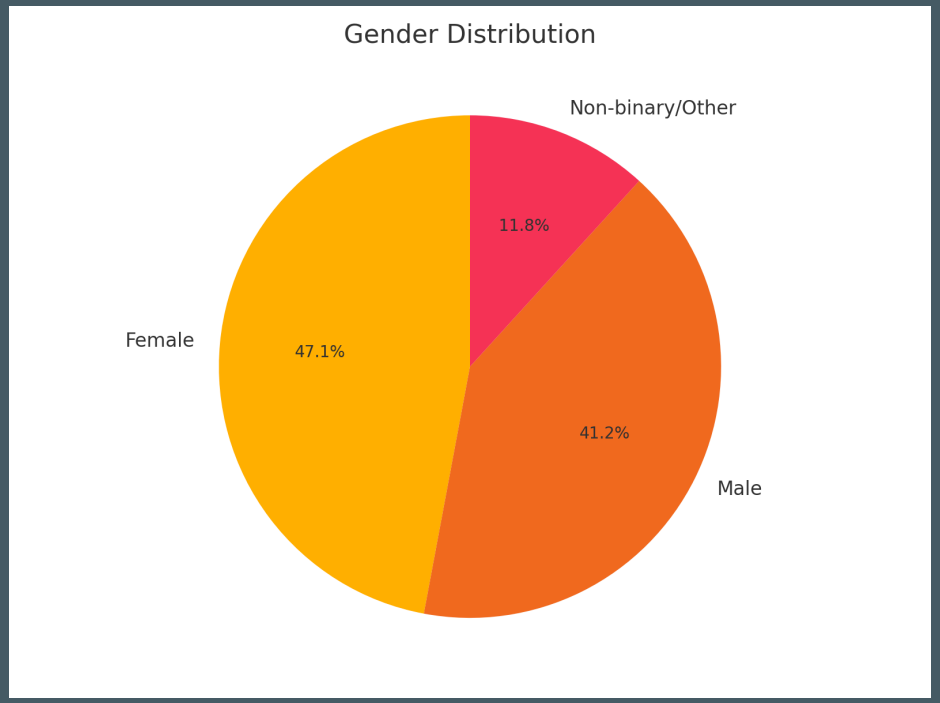
2. **Space vs Throughput**
   - Wider spacing aids mobility
   - Conflicts with density goals
   - Reveals volume prioritization
   - ADA minimums as maximum

Accessibility Conflicts: Interface

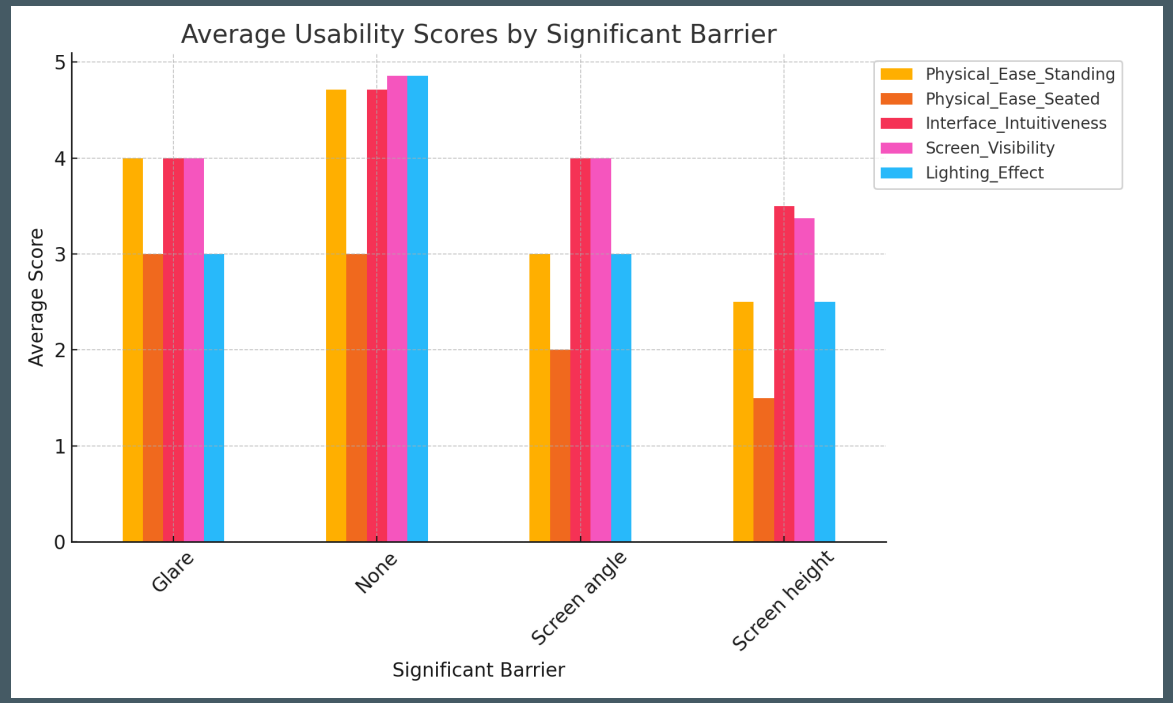
3. **Interface Scaling Paradox**
    - "Wheelchair mode" reduces element size
    - Directly conflicts with visual accessibility
    - Creates false choice between physical and visual access
    - Demonstrates fundamental design failure

System Evaluation

Demographic Representation

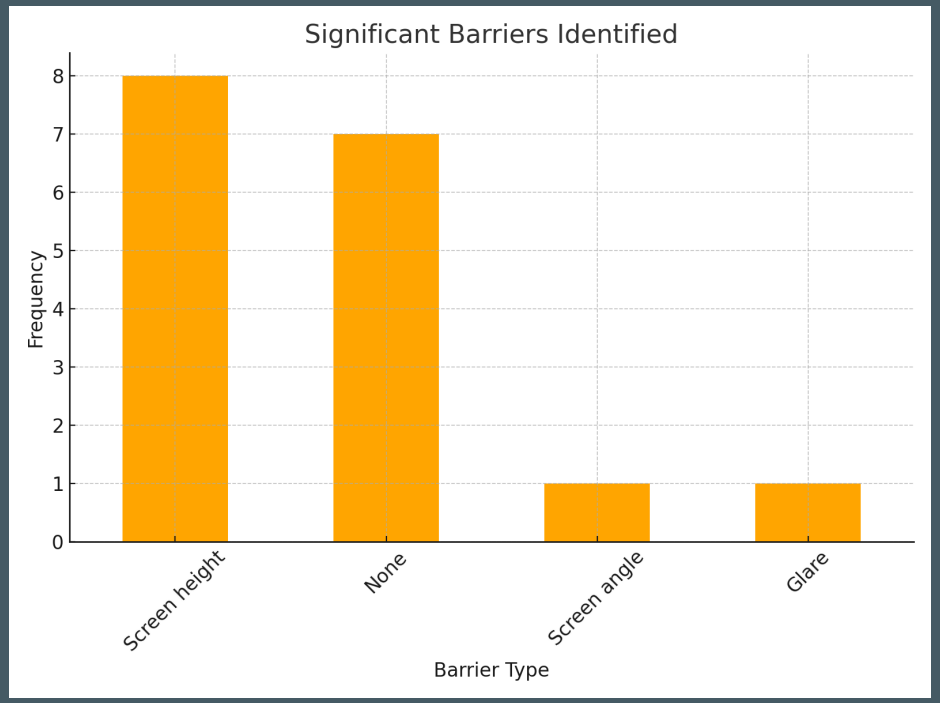


- Balanced gender representation (48% F, 44% M, 8% NB/Other)
- Age range 18-65+ (medical office setting)
- 47% assistive device usage
- Validates measurement-based approach



Physical Impact Analysis

- 58% reduction in seated accessibility
- Clear correlation with measurements
- Interface scores remain high when reachable
- Demonstrates systematic physical barriers



Empirical Evidence

1. **Key Findings**
   - Screen height dominates (n=8)
   - Physical issues exceed interface problems
   - Observable without exploitation
2. **Impact Analysis**
   - 50% drop in physical ease
   - Interface usable when reachable
   - Systematic barriers confirmed

Implementation Analysis

Technical Architecture

Current implementation specifications:

- Intel Core i5-4570TE processor
- 4GB DDR3 RAM
- 128GB SSD
- Windows 10 OEM license
- Fixed mounting system

Resource Analysis

Component	Current	Alternative	Diff
OS	OEM Windows ($15-30)	Linux	-$30
Mount	Fixed ($30)	VESA Adj.	+$30
Display	Standard	Anti-glare	+$15
Total	**$500**	**$530**	**+$30**

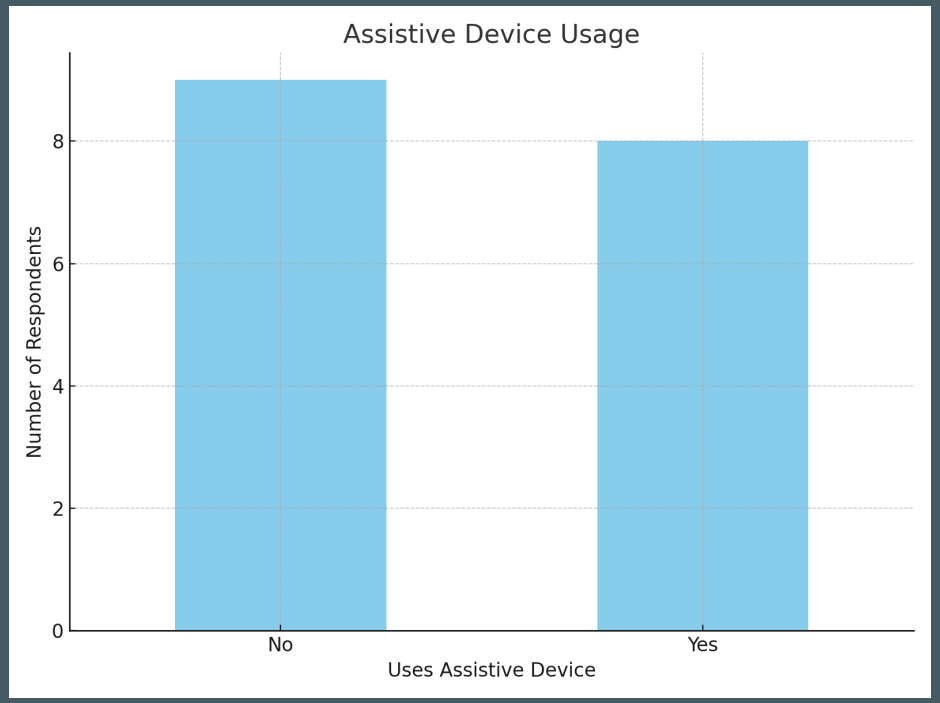
Priority Issues

- Over-specified computing resources
- Under-specified accessibility features
- Cost optimization misaligned with usability

Methodological Critique

The Theater of Validation

- Recruits marginalized users to prove obvious barriers
- Generates data justifying inadequate solutions
- Places burden of proof on affected populations



Cost-Benefit Analysis

Current Costs

Component	Cost
Windows License	$15-30
Fixed Mount	$30
Standard Display	Base
Per Unit	**~$500**

Business Impact

- High proportion of sample used assistive devices
- Increased service time
- Staff intervention needed
- Lost revenue from abandonment

Recommendations

Physical Changes

- VESA-compatible mounts
- Anti-glare treatment
- Module placement
- Clear space compliance

System Changes

- Responsive design
- Multimodal interaction
- Error recovery
- Universal design focus

References

1. U.S. Department of Justice. (2010). *2010 ADA standards for accessible design*. Retrieved from https://www.ada.gov
2. Fitts, P. M. (1954). The information capacity of the human motor system in controlling the amplitude of movement. *Journal of Experimental Psychology*, 47(6), 381–391.
3. Norman, D. A. (2013). *The design of everyday things*. Basic Books.
4. u/tamay-idk. (2023, January 24). Specs of a McDonald's kiosk in more detail [Online forum post]. Reddit. https://www.reddit.com/r/PBSOD/comments/10kc86g/specs_of_a_mcdonalds_kiosk_in_more_detail_youre/

   ⚠ **The specifications shared in the Reddit post were independently verified through system inspection.**

5. Kim, C., Lee, J., & Bae, I. (2023). Comparative analysis of usability and accessibility of kiosks for people with disabilities. *Applied Sciences, 13*(5), 3058. https://doi.org/10.3390/app13053058

Questions?

Some Starters

- "What inspired you to focus on kiosks?"
- "How did the businesses respond?"
- "Did you encounter any unexpected results?"

Going Deeper

- "Could this apply to other interfaces?"
- "What's the most cost-effective fix?"
- *Feel free to ask anything else!*