Usability in Cognitive Science

Understanding How Humans Interact With Technology

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Cognitive Science Lecture

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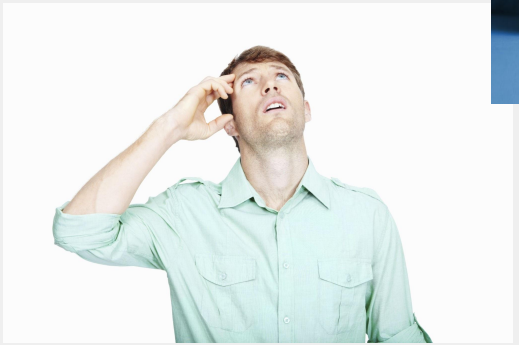
What is Usability?

- Usability refers to how easy, efficient, and satisfying a system is for people to use.
- Key components:
  - Learnability – how quickly new users understand the system
  - Efficiency – how fast tasks can be completed
  - Memorability – how easily users remember how to use it
  - Error prevention – reducing mistakes
  - Satisfaction – the overall user experience
  - Usability is often measured through **effectiveness, efficiency, and satisfaction**
  - A usable system allows users to complete goals with minimal training.
  - Poor usability can make even advanced technology fail in the marketplace.
  - Example: If users cannot figure out a website checkout process, they may leave.

Why Usability Matters

- Poor usability can cause:
  - Confusion and frustration
  - Increased mistakes
  - Slower task completion
  - Safety risks in critical systems
- Good usability leads to:
  - Better productivity
  - Faster learning
  - Higher user satisfaction



- Studies show users judge websites within seconds based on ease of use.
- In healthcare, poor usability can cause medication errors.
- In aviation, unclear controls can create dangerous mistakes.
- Businesses lose customers when apps are frustrating.

Cognitive Science and Usability

- Cognitive science studies how humans think and process information.
- Usability design applies knowledge about:

  Attention – what people focus on

  Memory – what users can remember

  Perception – how people interpret visuals

  Decision making – how people choose actions

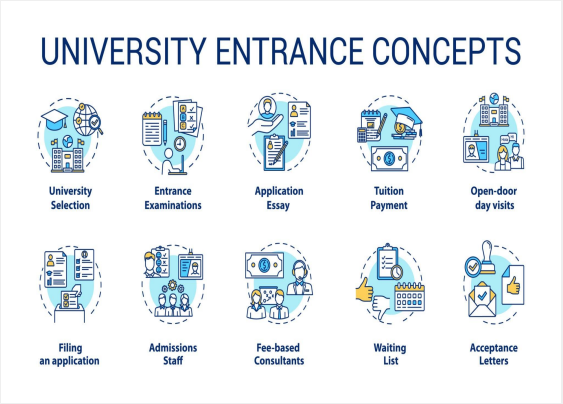
- Cognitive science combines psychology, neuroscience, linguistics, and computer science
- Designers study attention spans to reduce distractions.
- Memory research helps designers create simple navigation.
- Perception research explains why colors, spacing, and icons matter.

Human Cognitive Limits

- The human brain has limitations designers must consider:
  - Working memory can only hold about 5–9 items at once
  - Too many options increase decision difficulty
  - Visual clutter reduces comprehension
  - Multitasking reduces performance
- Short-term memory is limited, so users should not memorize many steps.
- Hick's Law states more choices increase decision time.
- Decision fatigue occurs when users make too many choices.
- Multitasking lowers accuracy and increases stress.

Cognitive Load

- Cognitive load = the mental effort required to complete a task.
- High cognitive load occurs when:
  - Too much information is presented
  - Instructions are unclear
  - Interfaces are complex
- Good design reduces cognitive load by simplifying tasks and organizing information clearly.
- Intrinsic load = difficulty of task itself.
- Extraneous load = confusion caused by poor design.
- Germane load = effort used for learning.
- Goal of designers: reduce extraneous load.



Principles of Good Usability

- Designers often follow several key principles:

  Simplicity – remove unnecessary complexity

  Consistency – similar actions produce similar results

  Feedback – systems respond clearly to user actions

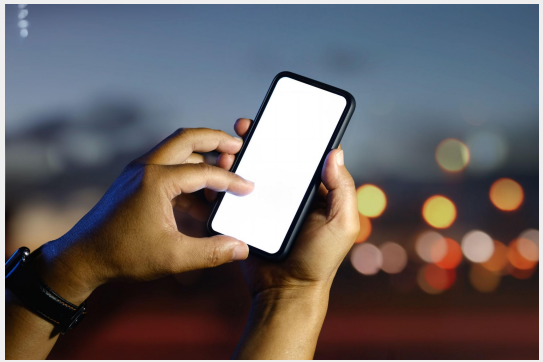
  Visibility – important information is easy to see

  Error recovery – users can easily fix mistakes

- Consistency builds trust and reduces learning time.
- Feedback examples: loading bars, check marks, confirmation messages.
- Error recovery examples: undo button, password reset, edit options.
- Visibility includes readable fonts and clear labels.

Real-World Example: Smartphones

- Smartphones demonstrate strong usability design:
  - Touch gestures feel natural
  - Icons simplify recognition
  - Predictable layouts reduce confusion
  - Voice assistants reduce manual interaction
- Face ID and fingerprint login improve convenience.
- Swipe gestures reduce button clutter.
- Notifications provide real-time feedback.
- App icons rely on recognition instead of recall.



Usability Testing

- Usability testing evaluates how real users interact with a product.
- Common methods include:
  - Observing users complete tasks
  - Measuring time and error rates
  - Asking users for feedback
  - Recording where users become confused

- Testing may occur many times before releasement
- Testing should begin early in product development.
- Even 5 users can reveal many usability issues.
- Think-aloud testing asks users to describe thoughts while using product.
- Heatmaps show where users click most.

Why Testing Matters

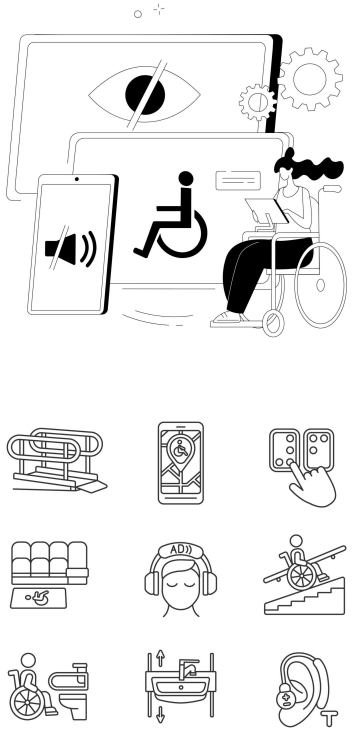
- Gives creators a chance to fix any issues with the product
- Improves user experience
  - Saves time
  - Easy to use and navigate
  - Smooth operating
  - Eliminates confusion
  - Easy to understand
- Meets needs of users
  - More efficient
- Reduces costs and time for producers
  - Cheaper and more efficient to fix issues before releasement vs fixing issues after launch
- Better usability increases customer loyalty.
- Fewer support calls and complaints.

Examples of Testing

- Coffee machines
- Before testing
  - Complex controls
  - Confusing to navigate
  - Too many steps
  - Takes too long
- After testing
  - Simple buttons
  - Straight forward actions/controls
  - Fewer steps
  - Much quicker process
- Results
  - Users enjoy product
  - Increased production sales

Usability and Accessibility

- Good usability overlaps with accessibility.
- Design should support people with:
  - Visual impairments
  - Motor limitations
  - Cognitive differences
  - Learning disabilities
- Accessible design makes technology usable for the widest range of people.
- Accessibility laws include the Americans with Disabilities Act (ADA).
- Examples: screen readers, captions, larger text, voice controls.
- Good accessibility often improves usability for everyone.



Future of Usability

- Emerging technologies will require strong usability design:
  - Artificial intelligence assistants
  - Virtual and augmented reality
  - Healthcare technology
  - Brain-computer interfaces
- As technology becomes more complex, usability will become even more important.
- AI systems must explain recommendations clearly.
- VR must avoid motion sickness and confusion.
- Healthcare tech must prioritize safety and speed.
- Brain-computer interfaces require ethical and intuitive design.

Trends Shaping the Future of Usability

1. Artificial Intelligence (AI) Integration

* Interfaces adapt to user behavior in real time

* Predictive features improve efficiency and decision-making

2. Voice & Conversational Interfaces

* Increased use of voice assistants (hands-free interaction)

* More natural, human-like communication with technology

3. Personalization & Adaptive Design

* Systems tailor experiences to individual preferences

* Dynamic layouts and content based on user data

4. Augmented Reality (AR) & Virtual Reality (VR)

* Immersive environments enhance user engagement

* Expanding in healthcare, education, and training

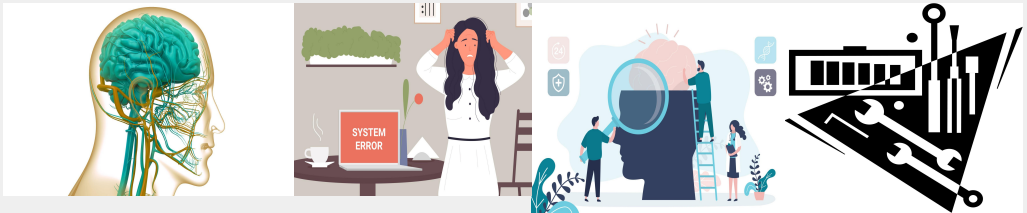
5. Touchless & Gesture-Based Interaction

* Reduced reliance on physical contact

* Important for accessibility and hygiene (post-COVID impact)

Key Takeaways

- Usability connects psychology with technology design
- Systems should match human cognitive abilities
- Good usability reduces errors and frustration
- Cognitive science helps designers build intuitive tools
- Technology should adapt to humans—not humans to technology.
- Cognitive science gives evidence-based design strategies.
- Simplicity often creates the most powerful experiences.



Discussion Question

- How can designers balance advanced technology with simplicity so that systems remain easy for everyday users?