Ergonomics of computer workstation
Usability

Usability
Definition
Basic principles
Testing

HCI - Human Computer Interaction
- Computer systems optimization for easy access and communication

Quality
- Utility - funcionality and technical quality
- Ergonomic - comfort of use
- Usability
  - Effectiveness
  - Efficiency
  - Safety
  - Learnability
  - Memorability
  - Ease of use
  - Accessibility
  - Usefulness, utility

Usability elements (Nielsen & Schneiderman)
- Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design?
- Efficiency: Once users have learned the design, how quickly can they perform tasks?
- Memorability: When users return to the design after a period of not using it, how easily can they reestablish proficiency?
- Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?
- Satisfaction: How pleasant is it to use the design?

Usability
- Result - ergonomic product
- Creating process (UCD - User Centered Design)
- Set of testing technics
- 5 E (efficient, effective, engaging, error tolerant, easy to learn)
5E example

- Efficient - “The user will be able to successfully complete the registration in under 3 minutes.”
- Effective - “Less than 5% of the registrations will have errors, omissions or inconsistencies requiring a follow-up contact by the staff.”
- Engaging - “At least 80% of employees will express comfort with using the online system rather than visiting the HR office.”
- Error Tolerant - “The system will validate all housing, meal and tutorial choices and allow the user to confirm pricing for these options before completing the registration.”
- Easy to Learn - “Users will be able to successfully complete a benefits calculation without needing any external instruction or help screens.”

Benefits

Usable systems can save money by helping to
- increase productivity and customer satisfaction
- increase sales and revenues
- reduce development time and costs and maintenance costs
- decrease training and support costs

Usability in ISO normalization

- ISO 9126 - one of the features of interactive product
- ISO 9241 - “The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use.”

ISO 9241

- Interact capabilities
  - goals
  - efficiency
  - satisfaction
  - effectiveness
  - usability
- System of the user
  - product
  - context of use
  - environment
  - equipment
  - task
  - user

Usability in ISO normalization
ISO 9241

- **Effectiveness**: Accuracy and completeness with which users achieve specified goals
- **Efficiency**: Resources expended in relation to the accuracy and completeness with which users achieve goals
- **Satisfaction**: Freedom from discomfort, and positive attitudes towards the use of the product

### Usability measures

<table>
<thead>
<tr>
<th>Usability objective</th>
<th>Effectiveness measures</th>
<th>Efficiency measures</th>
<th>Satisfaction measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall usability</td>
<td>Percentage of goals achieved; Percentage of users successfully completing tasks; Average accuracy of completed tasks</td>
<td>Time to complete a task; Tasks completed per unit time; Monetary costs of performing the task</td>
<td>Rating scales for satisfaction; Frequency of discretionary use; Frequency of complaints</td>
</tr>
</tbody>
</table>

#### Don Norman, The Psychology of Everyday Things

1. **Visibility**
2. **Feedback**
3. **Constrains**
4. **Mapping**
5. **Consistency**
6. **Affordances**

#### Visibility

**Better performance → higher probability of use**

#### Feedback

**Information about effects of user action**
**Constrains**

**Error reduction**
- Physical - options not available
- Logical - menu layout
- Cultural - color sets

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**Mapping**

Relations in virtual reality the same as in reality

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**Consistency**

The same objects = the same layout = the same function

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**Affordances**

Suggestions how to use a product

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**Usability testing methods most frequently used**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean Importance</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Impressions</td>
<td>2.90</td>
<td>29</td>
</tr>
<tr>
<td>User requirements analysts</td>
<td>2.80</td>
<td>7</td>
</tr>
<tr>
<td>Usability design</td>
<td>3.15</td>
<td>45</td>
</tr>
<tr>
<td>Quality evaluation</td>
<td>2.99</td>
<td>45</td>
</tr>
<tr>
<td>Help display</td>
<td>3.61</td>
<td>34</td>
</tr>
<tr>
<td>Genre analysis</td>
<td>2.79</td>
<td>34</td>
</tr>
<tr>
<td>Emotional expressiveness</td>
<td>2.96</td>
<td>35</td>
</tr>
<tr>
<td>Ease of use</td>
<td>2.90</td>
<td>35</td>
</tr>
<tr>
<td>Function without user testing</td>
<td>3.17</td>
<td>9</td>
</tr>
<tr>
<td>Usability</td>
<td>3.17</td>
<td>35</td>
</tr>
<tr>
<td>Front end review</td>
<td>3.38</td>
<td>31</td>
</tr>
<tr>
<td>Core viewing</td>
<td>3.72</td>
<td>31</td>
</tr>
<tr>
<td>Perusability design</td>
<td>3.17</td>
<td>35</td>
</tr>
<tr>
<td>Site to site directly to be categorized</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*study “The State of User Centered Design Practice”, 2008*

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**Heuristic evaluation**

- Developed by Jacob Nielsen in the early 1990s
- Based on heuristics distilled from an empirical analysis of 249 usability problems
- Heuristics have been revised for current technology
- Heuristics still needed for mobile devices, virtual worlds, etc.
- Design guidelines form a basis for developing heuristics
3 stages for doing heuristic evaluation

- Briefing session to tell experts what to do
- Evaluation period of 1-2 hours in which
  - Each expert works separately
  - Take one pass to get a feel for the product
  - Take a second pass to focus on specific features
- Debriefing session in which experts work together to prioritize problems

Heuristic Evaluation

- Evaluators go through UI several times
  - inspect UI
  - compare with list of usability principles
  - consider any additional principles or results that come to mind
- Usability principles
  - Nielsen’s “heuristics”
  - supplementary list of category-specific heuristics
- Use violations to redesign/fix problems

Usability Heuristics – from Nielsen

1. Simple and natural dialogue
2. Speak the user’s language
3. Minimize the user’s memory load
4. Consistency
5. Feedback
6. Clearly marked exits
7. Shortcuts
8. Good error messages
9. Prevent errors
10. Help and Documentation

(Nielsen & Molich, 1990)

1. Simple and Natural Dialogue

- Exact information provided at the exact moment
- Graphic Design and Color
  - Appropriately direct attention (test with mumble text)
  - Group related objects
  - Alignment
  - Balance and white space
  - Few fonts and colors (5 to 7 colors max.)
  - Some people are color blind (8% of males)
- Less is More

2. Speak the User’s Language

- May accommodate specific vocabulary for users
- View from users’ perspective, not of a system.
- Adopt words as suggested by users (problematic)
Mappings

- Good mappings between the conceptual model and the user's mental model.
  - Understand how a user views a task
  - Use associations with reality

Metaphors

- Employ real-world reference system
- Beware of metaphor short-comings
- Beware of cultural differences

3. Minimize User Memory Load

- Use recognition, not recall.
- Exploit visibility.
- Provide implicit clues and rules for required input.

4. Consistency and Standards

- Dialog consistency
- Language and graphic consistency

5. Feedback

- Continuous information on user’s actions and their interpretation, including positive and partial feedback
- Avoid abstract, generalized feedback.
  - Rephrase the specific affect of the action.
- Various levels of persistence of feedback information.
5. Feedback
- Response Times
  - Very sensitive - 0.1 sec. (instant)
  - 1.0 sec. (delay noticed)
  - >=10 sec. (attention decays)
- Variable response times frustrating.
- For >=10 sec. provide progress indicators
- System Failure
  - Provide for eventualities.
  - Windows “Blue Screen of Death”!

6. Clearly Marked Exits
- Empower users and promote exploratory learning
- Strategies
  - Cancel
  - Interruption of lengthy processes
  - Universal Undo
  - Quit
  - Default reset
- Exits must be visible not ‘taught or sought’.

7. Shortcuts
- Support expert use beyond novice.
  - Accelerators, templates (styles), macros.
  - Type-ahead

7. Shortcuts
- Bookmarks (Web, Explorer shortcuts, Photoshop actions.
- Reuse of interaction history.
  - 60% of WWW pages are revisits.
  - Judicious use of default values.

8. Good Error Messages
- Mistakes and slips
  - Opportunity for a system to assist and educate a user.
  - Phrase messages in a clear language. (E.g. Error 404)
    - That is, speak the user’s language!
  - Precise rather than vague or general.
  - Help in the resolution of a problem.
  - Polite, non-intimidating messages.
    - “Wrong Input: Do Again!”
  - Provide good recovery.
  - Multiple-level messages.

8. Good Error Messages
- mistakes - bad understanding and bad solution
- slips - unconscious behavior and bad solution
9. Error Prevention
- Recognition, not recall. (Select from list.)
- Use ‘Confirmation’ boxes sparingly.
- ‘Capture errors’ due to automatic behaviour.
- Avoid modes
  - Feed information regarding current mode.

10. Help and Documentation
- Utmost goal: No help
- Online help extends the breadth of the interface.
- Online help should be context sensitive.
- Quality of help text more significant than the access mechanism.
- ‘Search, Understand, Apply’ user strategy.
  - Search: provide rich indexing of terms.
  - Understand: self-contained examples.

Evaluation examples
- Can not copy info from one window to another
  - violates “Minimize the users’ memory load” (H3)
  - FIX: allow copying
- Wrong key accelerators used (EXIT)
  - violates “Consistency and standards” (H4)
  - slows users down, propagates errors
  - FIX: use industry standard accelerators

HE vs. User Testing
- HE is much faster
  - 1-2 hours each evaluator vs. days-weeks
- HE does not require interpreting users’ actions
- User testing is far more accurate
  - takes into account actual users and tasks
  - HE may miss problems & find “false positives”

Examples of Heuristic evaluations
- Groupware:
- Games:
  - [http://www-personal.umich.edu/~dinoa/portfolio/](http://www-personal.umich.edu/~dinoa/portfolio/)
Sitting by a computer workstation. How to do it properly?

Humans are not designed for sitting

Spine anatomy
- 33 bones
- 24 intervertebral discs
- Spinal cord

Spine anatomy
- 33 bones → construction durability
- 24 intervertebral discs → motion ability
- Spinal cord → neural transmission

Function of intervertebral discs
- Shake absorption
- Spine bending and twisting

Intervertebral discs
- No blood vessels
- Very few nerve cells
- Are fed in a process of absorption
Why is it important to sit properly at a computer workstation?

- To feed our intervertebral discs
- To avoid static overload
- To avoid pain after sitting

Typical postures at a computer workstation

Basic rules of sitting at a computer

- Obtuse angles instead of right angles
- Fitting to a desktop height
- Elbow height

Dynamic sitting

Space for a computer workstation

http://www.ontimesupplies.com
Computer workstation parameters

http://www.ergotron.com/

Summary

- Adjust a workstation to your personal needs
- MOVE when working
- Defrost your body