Design Reasoning Improves Software Design Quality

CSC 3380 Honors Option Presentation

Margaret (Maggie) Stewart

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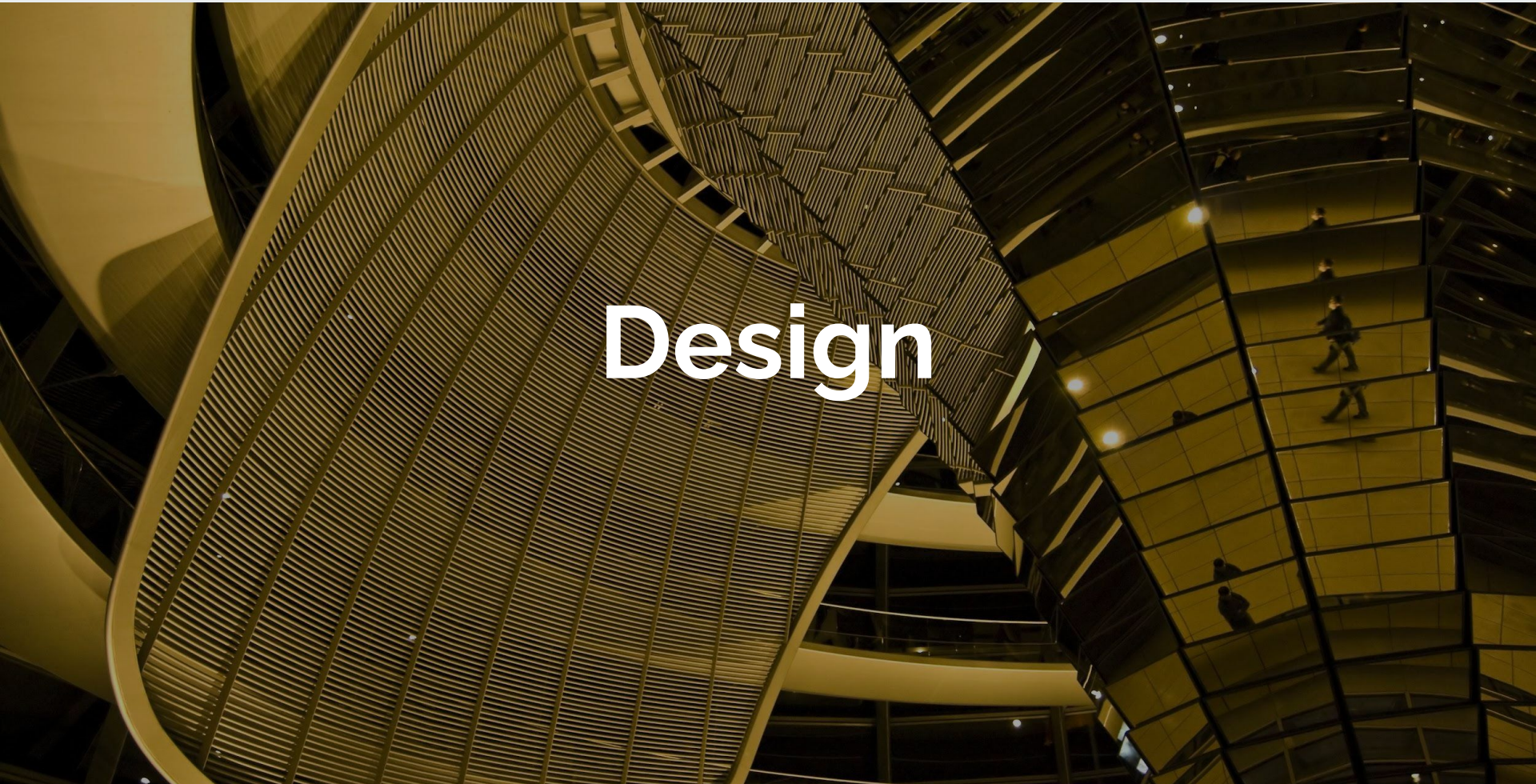
Overview

1. Design
2. Design Reasoning
3. Usability
4. Study conducted by Antony Tang, Minh H. Tran, Jun Han, and Hans van Vliet
    a. Procedure
    b. Findings / Results
    c. Limitations / Bias


Design

Key Elements of Design

1. Design Concern
   - Cause to create a design solution
   - Ex. System requirements, business goals, improvements

2. Design Decision
   - Reasoning why a specific design is created or chosen
   - Justification for those who aren't creating the design (user, tester, etc.)

3. Design Outcome
   - Result of design decision
   - Includes design elements that will be implemented


Design Reasoning

Design Reasoning

- Explicitly models design rationale
- Determines a solution that adheres to the design criteria
  - Uses trade-off analysis
    - Trade off analysis: weighing the benefits/drawbacks of a design or component

Rational Thinking Failure

Falls into 2 cognitive systems:

1. Heuristic System
    - Draws on personal belief/experience when forming an opinion or design
    - Intuitive
2. Analytic System
    - Logical judgement & mental analysis
    - Analytical

These systems rely heavily on **prior experiences and intuition** rather than **rational or analytical thinking**

Design Reasoning Approaches

1. Argumentation
    - Represents information & relationships through nodes and links
    - Ex. QOC, DRL
2. Rationale Template
    - Uses standard templates that are oriented towards implementation in industry
    - Ex. ADDT, V & B
3. Hybrid of Argumentation and Rationale Template
    - Used in the study
    - Ex. AREL, Archium

Importance of keeping ALL design options

- Availability
  - Shows all possible options for design
  - Allows for trade-off analysis
    - Select most appropriate design option
- Documentation
  - Easy to backtrack to previous ideas

ALL design options includes those that are rejected or alternative designs found through design reasoning processes


Usability

Usability

- Allows the user to handle the system and perform tasks in an effective, efficient, and satisfied manner
- Design Reasoning with UI (User Interfaces) have usually been considered to be assumed or intuitive rather than logical rationale

Study conducted by Tang, Tran, Han, & Vliet

Objective & Hypothesis

- In this study, researchers were studying the **effects of design reasoning on design quality**
  - Participant challenge: design a UI for a commercial system with certain tasks and usability guidelines
- Hypothesis
  - The test group who learns about design reasoning processes would produce better quality designs than the control group who doesn't learn about design reasoning processes

Participants

- ~20 participants total
- Split into the control and test group randomly
- Ranging from software industry personnel to those in academia
- Average design experience level
    - Test group: 8.95
    - Control group: 8.40

Experimental Groups' Tasks

Control Group

- Conducts tasks as normal
- Not informed about AREL design reasoning strategy

Both

- Use **Think-Aloud (aka talk amongst groupmates)** to discuss their strategies
- Use **Retrospective Think Aloud Technique**
  - Feedback on participant's design after completion
- Each individual completes their own design

Test Group

- Briefed on the AREL design reasoning strategy (without explicitly naming)
- Must explain/justify their design options, issues, and choices

How designs were scored?

Design rating:

5 point Likert Scale

- Top design scores 12 points
- Judged disregarding original experimental group

Analyzing test results

3 perspectives

1. Quality of design outcomes
2. Design Process
3. Participants' feedback

Assessing quality:

UI Design Heuristics by Nielsen

1. Consistency
2. Flexibility
3. Accessibility

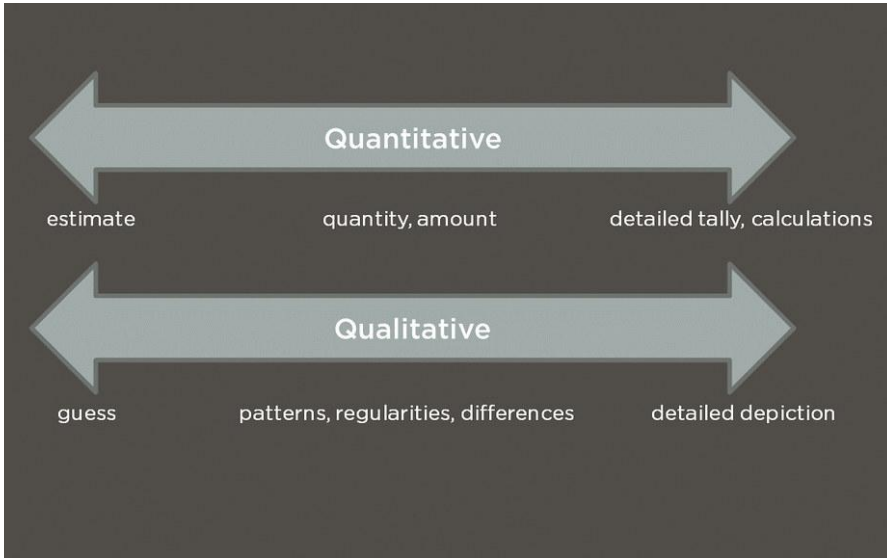
Data Collected

Quantitative:

- Participant experience
- Time allotted to complete tasks
- Participant satisfaction/confidence in design
- Quality score for design

Qualitative:

- Think aloud technique
- Assessment of design
- Observation of design process
- Participant commentary



Performance & Ideas
Control Group vs Test Group

Performance & Ideas: Control Group

Ideas

- The group had an overall more diverse and less useable design
  - UI - textual list / graphical icon / textbox / dropdown menu
- A majority of the group (6/10) chose less useable designs like the icon, textbox, etc.
  - 4/10 chose the most efficient design (textual list)

Performance

- Less cognizant of the usability specifications as the designer moved away from the design itself
- No backtracking
  - Had more confidence in what they were creating
- Wanted a complete design
  - No need to justify decisions
  - Focused on the end result / requirements

Performance & Ideas: Test Group

Ideas

- Generally each member had the same design
    - UI - used a scroll down option / button control / pop-up

Performance

- Improvement especially for younger/inexperienced designers
    - Supplied framework for deliberating
    - Supported bottom up design
    - Created a mental image of the ongoing design & specifications
- Used backtracking technique
- More conscious of choices/usability guidelines throughout the design process
    - More interaction between the designer and those justifications/guidelines

Performance Analysis

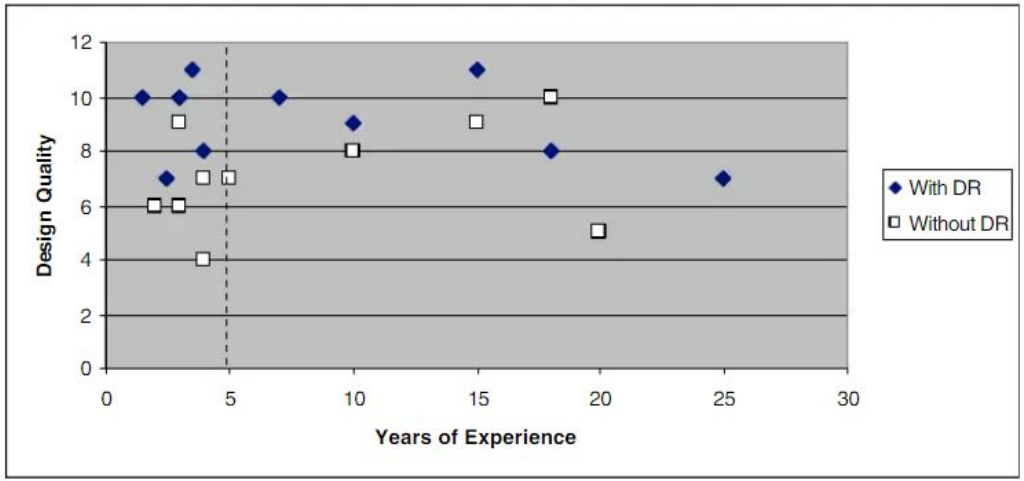


Fig. 2. Design Quality Scores and Years of Experience

- Experience in design generally correlated with an increase scores
- Comparing inexperienced designers who were in the control and test group
  - Those in the test group outperformed those in the control group
- Those with the most experience did not necessarily have the best/highest scoring design
  - In both test and control groups
- Design time was similar/negligible for both groups


Study Limitations & Bias

Limitations

- Small sample size
  - ~ 20 participants
  - Found participants who were convenient (connected to the researchers) rather than those who were random

Provisions taken to ensure unbiased data

- Test group
  - Interviewers did not give extra hints for their design during the justification period
  - Only questions to stimulate discussion:
    - What are the issues with the decision?
    - What are options to deal with the issue?
- Results / Judging
  - Cross checked all designs to account for researcher/score bias

Thank you!

Study Credit to:
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