Successful Design Processes: Some Research Perspectives

PLEASE SIT WITH YOUR TEAM MEMBERS

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CELT Design Research

- What do first year students’ engineering design processes look like?
- What do senior students’ engineering design processes look like?
- What do experts’ engineering design processes look like?
- How do they compare?
What are the steps in a design process?
# Design Process Activities

Derived from analysis of 7 engineering texts

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Generic Design Model: A Linear Process?

1. Problem Definition
2. Gathering Information
3. Generating Ideas
4. Modeling
5. Feasibility
6. Evaluation
7. Decision
8. Communication
Generic Design Process: An Iterative Process

- Problem Definition
- Gathering Information
- Generating Ideas
  - Modeling
  - Feasibility
    - Evaluation
  - Decision
- Communication
Study Summary

- Data collection:
  - Participants were asked to design something.
  - Asked to speak about what they were doing while they were designing.
  - Participants were videotaped or audiotaped.

- Three levels of expertise:
  - Freshmen   (n = 26)
  - Seniors    (n = 24)
  - Experts    (n = 19)
Design Process Timelines

Freshman (Quality Score = 0.45)

PD: Problem Definition
GATH: Gathering Information
GEN: Generating Ideas
MOD: Modeling
FEAS: Feasibility Analysis
EVAL: Evaluation
DEC: Decision Making
COM: Communication
Activity Instructions

Individually, take a few minutes and do the activity on the worksheet:

- In the design process timelines shown on the worksheet, what similarities and differences do you see between the freshmen and senior engineering students?

- Do these similarities also involve the quality scores? How so?
Activity Instructions

Now, discuss the questions with the other students in your group:

- In the design process timelines shown on the worksheet, what similarities and differences do you see between the freshmen and senior engineering students?

- Do these similarities also involve the quality scores? How so?
Class Discussion

Freshman #1 (Quality Score = 0.37)

Senior One (Quality Score = 0.38)

Freshman #2 (Quality Score = 0.45)

Senior Two (Quality Score = 0.53)

Freshman #3 (Quality Score = 0.62)

Senior Three (Quality Score = 0.63)
Our Findings: Freshmen vs. Seniors

Compared to freshmen, seniors...

- have higher quality designs. (whew!!)
- scope the problem more effectively by considering a broader range of information categories.
- make more transitions among design steps.
- spend more time iterating.
- progress farther in the design process.
Expert Engineer Timelines

Expert #1 (Quality Score = 0.42)

Expert #2 (Quality Score = 0.55)

Expert #3 (Quality Score = 0.67)
Our Findings: Experts and Time

- Experts spend more time solving the problems in all design stages.
- Experts also tend to exhibit a ‘cascade’ pattern of transitions.
- Experts “scope” the problem more effectively...
  - …gathering more information.
  - …covering more categories of information.
What Engineering Faculty Say About Successful Teams

Teams that follow a more ‘complete’ design process end up having better quality design solutions.
Monitoring Your Team’s Design Process?

- Where is your team in the design process?
  - Moving towards an expert, ‘complete’ process?
  - Stuck in modeling?
  - Linear or iterating?
  - Gathering information adequately?
Request and Contact Information

We would like to take your answer sheets for use in our ongoing engineering education research:

- Completely voluntary
- Your responses will be anonymized

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