

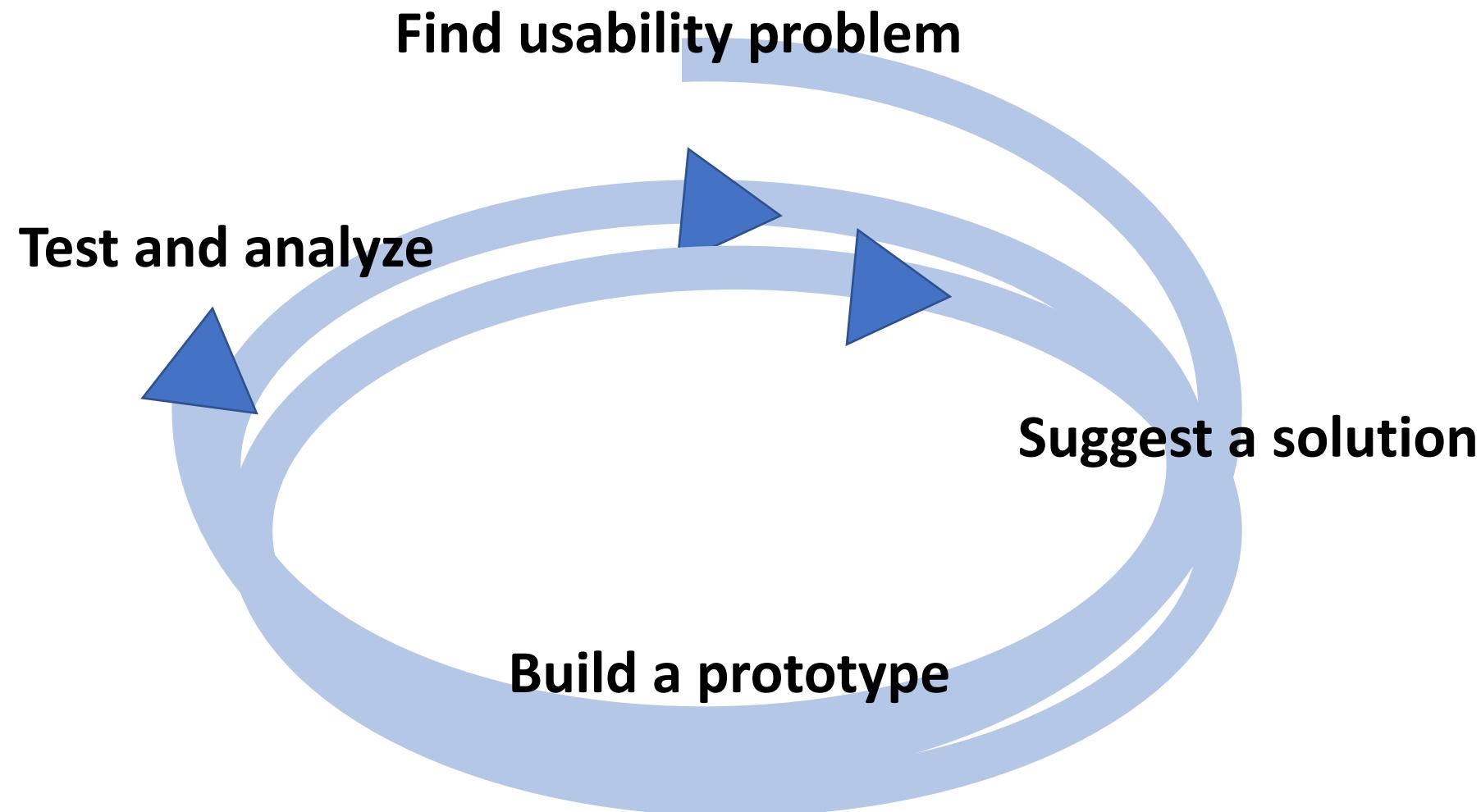
Interaction Design

CSE333: Introduction to Human-Computer Interaction

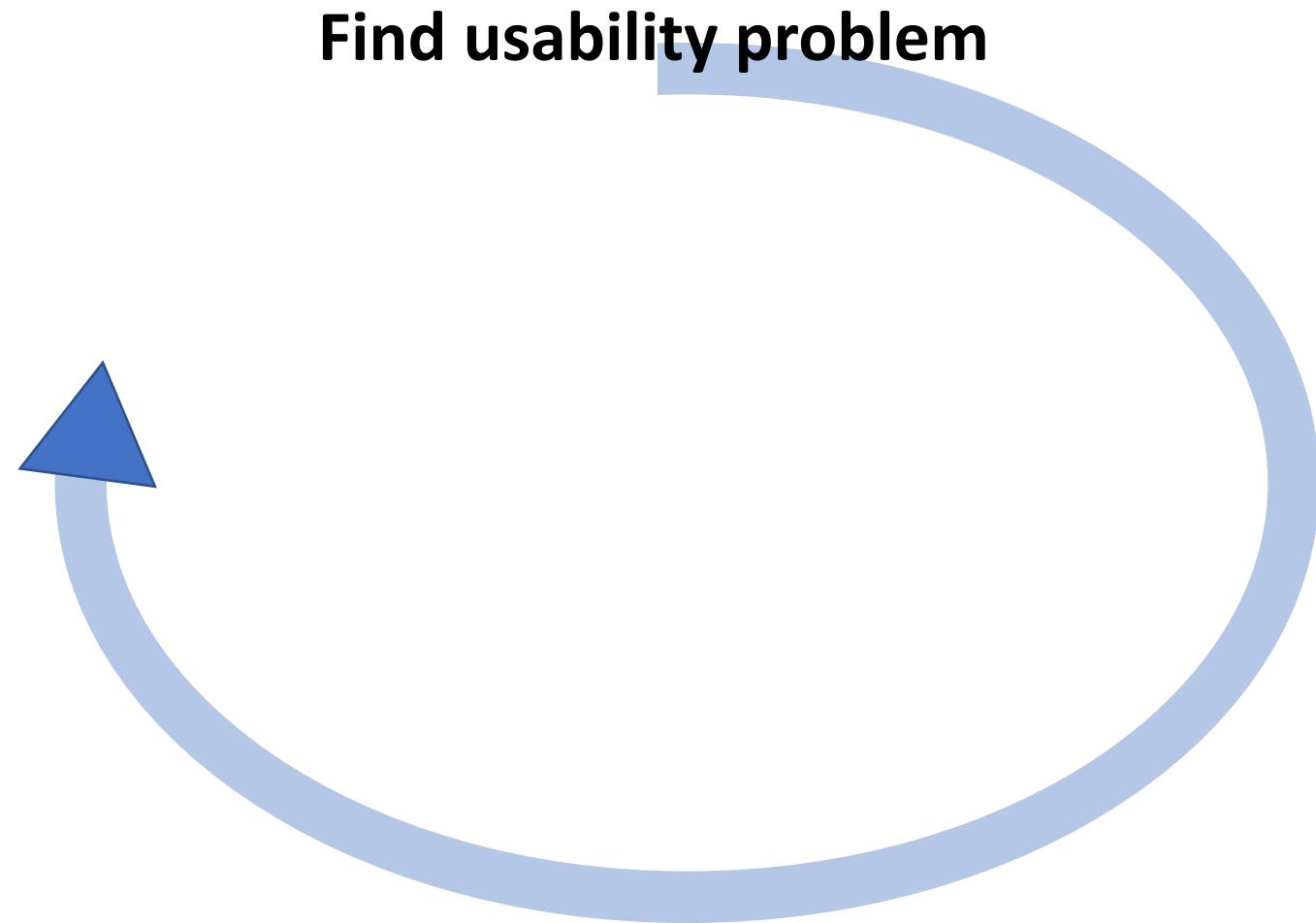
Jaeyeon Lee

Spring 2023

User-centered Design Process



User-centered Design Process

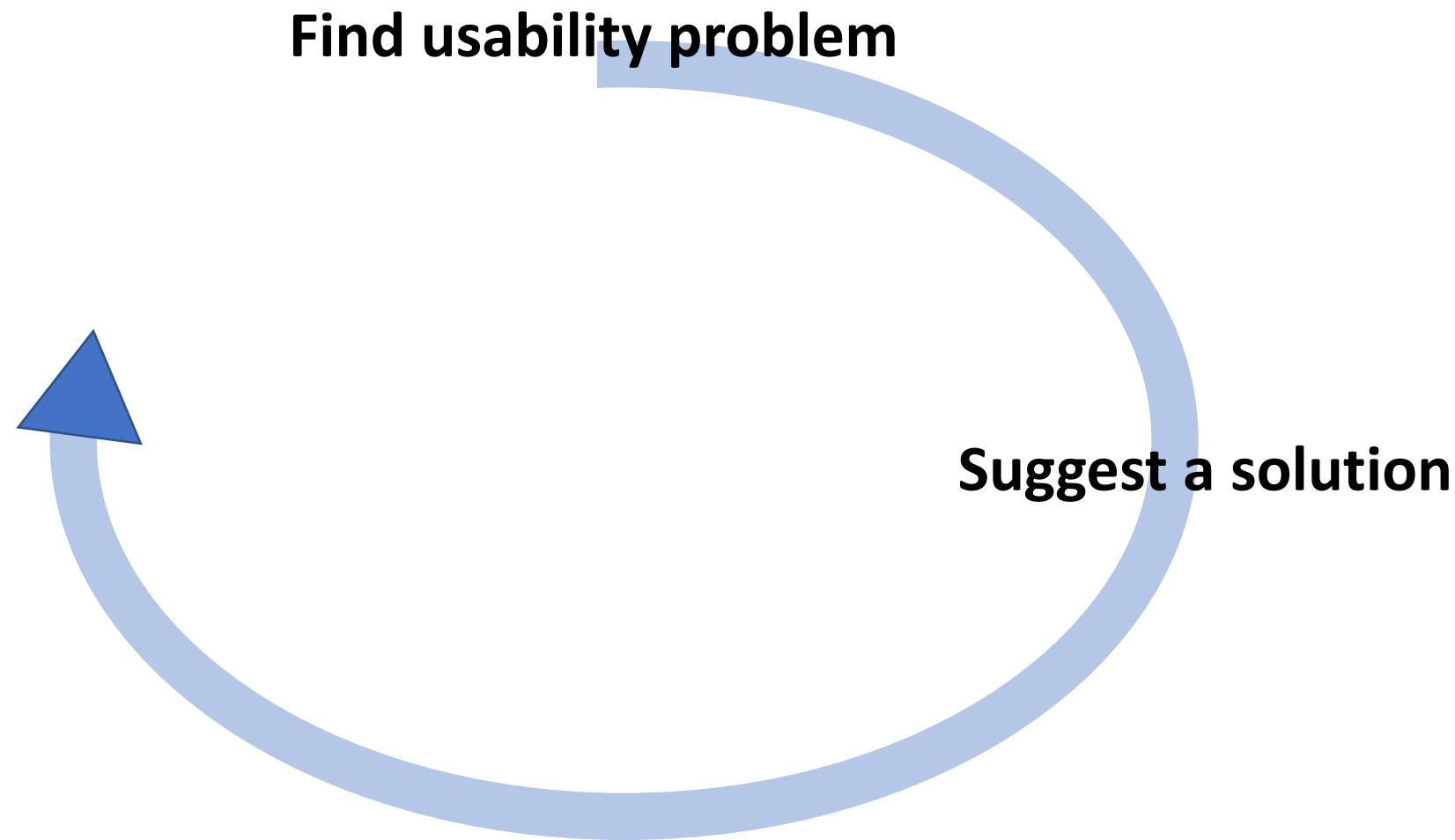


Primary phone number*:

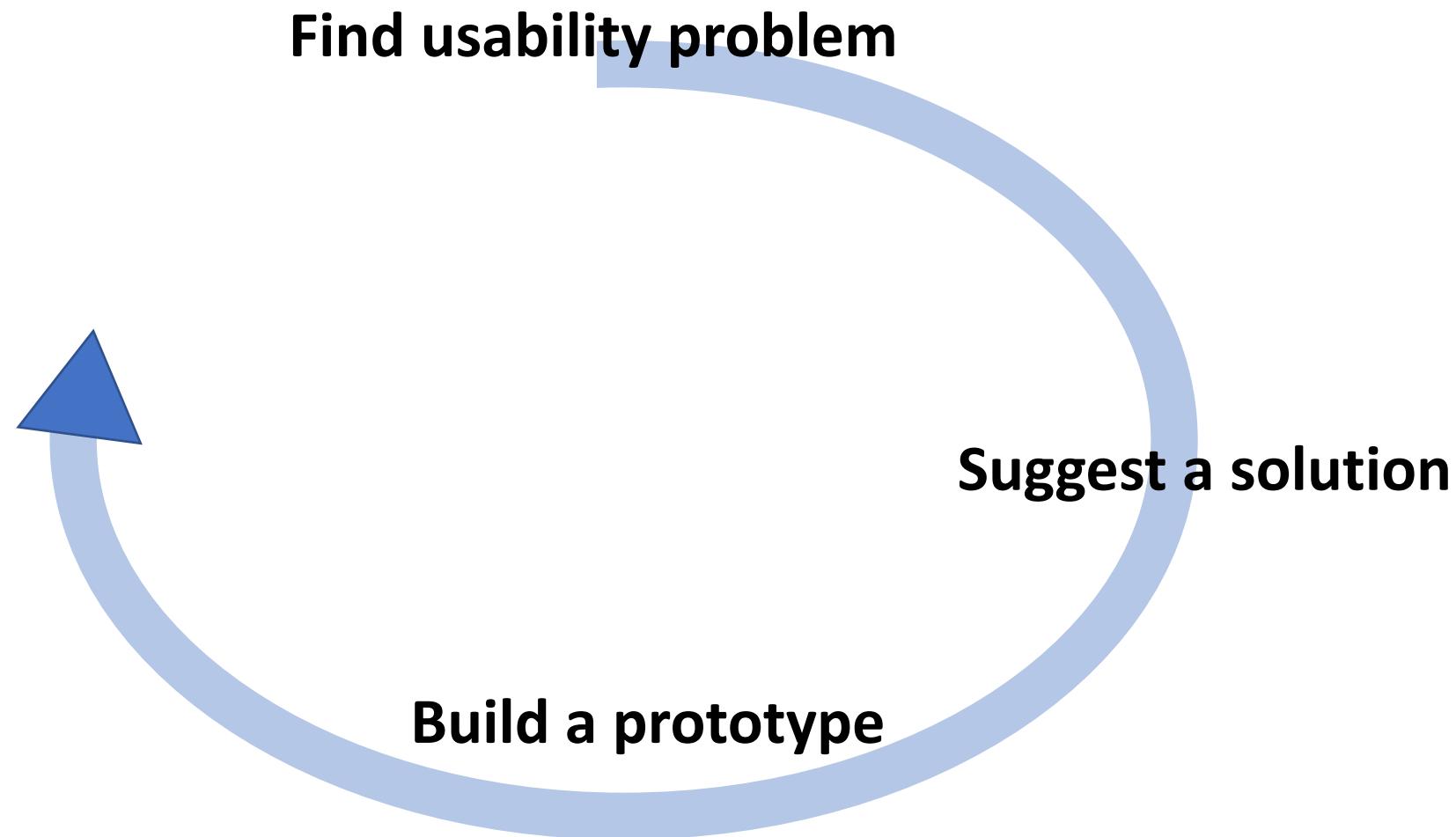
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Fields w	review	Make s	reject y	asterisks are required. You can	application and will email you on the progress.	you have read and understood the terms and a	blication in cases outlined in terms and agree

- What is the **current solution**?
- What is the **problem** with the solution?
- What are your **assumptions**?
- What are your **claims**?

User-centered Design Process



User-centered Design Process



What is a prototype?

- In interaction design, it can be ...
 - a series of screen **sketches**
 - a **Storyboard**, i.e. a cartoon-like series of scenes
 - a **cardboard** mock-up
 - a Powerpoint **slide show**
 - a **video** simulating the use of a system
 - a ***lump of wood***
 - a **piece of software with limited functionality** written in the target language or in another language

Lump of wood?



- Jeff Hawkin (founder of PalmPilot) used to carry this piece of wood around with him and pretended to enter information into it, just **to see what it would be like to own such a device**.
- It served its purpose of simulating scenarios of use.

<http://www.wired.com/science/discoveries/news/1999/10/32010>

Why prototype?

- Stakeholders can see, hold, interact with a prototype more easily than a document or a drawing
- Team members can communicate effectively
- You can test out ideas for yourself
- The activity of building one encourages reflection.

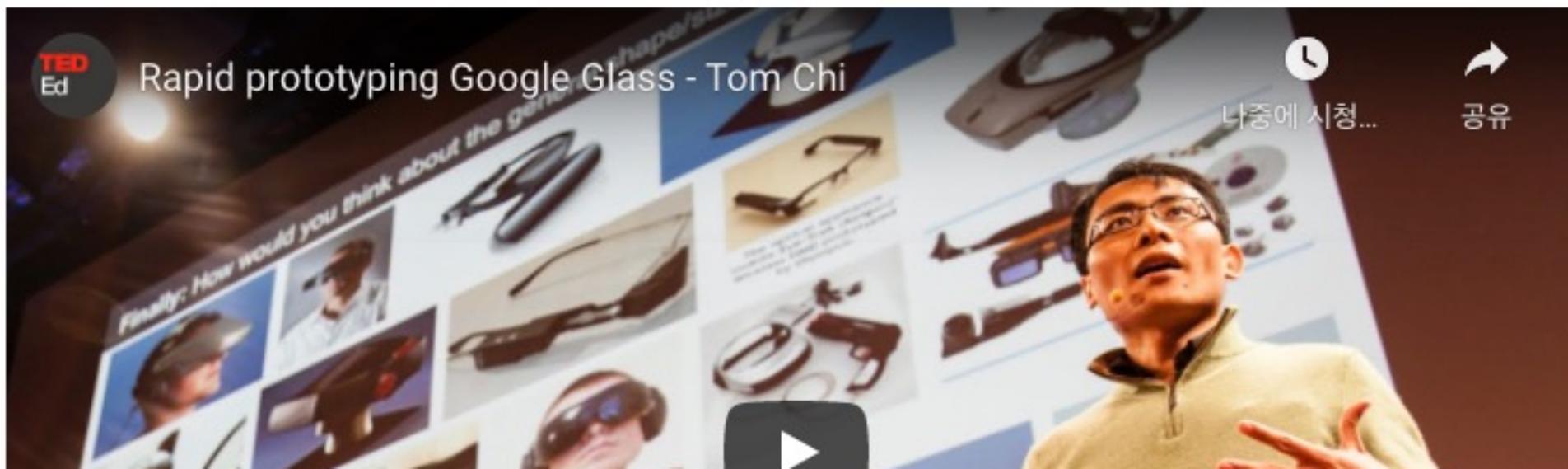
Video Break (8:08)

https://www.youtube.com/watch?v=d5_h1VuwD6g

Technology > TED-Ed

Google Glass: prototyped using binder clips and clay

📍 Posted by: Shirin Samimi-Moore February 1, 2013 at 4:00 pm EST



Low-fidelity prototyping

Paper and Computer Prototypes

Low-fidelity prototyping

- Uses materials that are very different from the final version.
 - e.g. paper, cardboard, lump of wood, clays ...
- **Cheap** and **quick** to produce and modify
 - Should **encourage exploration** of alternative designs
 - Never intended to be kept; for exploration only!
- Paper prototype → (iterations) → Computer prototype

Paper prototype

- Interactive paper mockup
 - Sketches of screen appearance
 - Paper pieces show windows, menus, dialog boxes
- Interaction is natural
 - Pointing with a finger instead of mouse click
 - Writing instead of typing
- A person simulates the computer's operation
 - Putting down & picking up pieces
 - Writing responses on the “screen”
 - Describing effects that are hard to show on paper



https://twitter.com/RyeonQ_kemo/status/1229040968021639169/photo/3

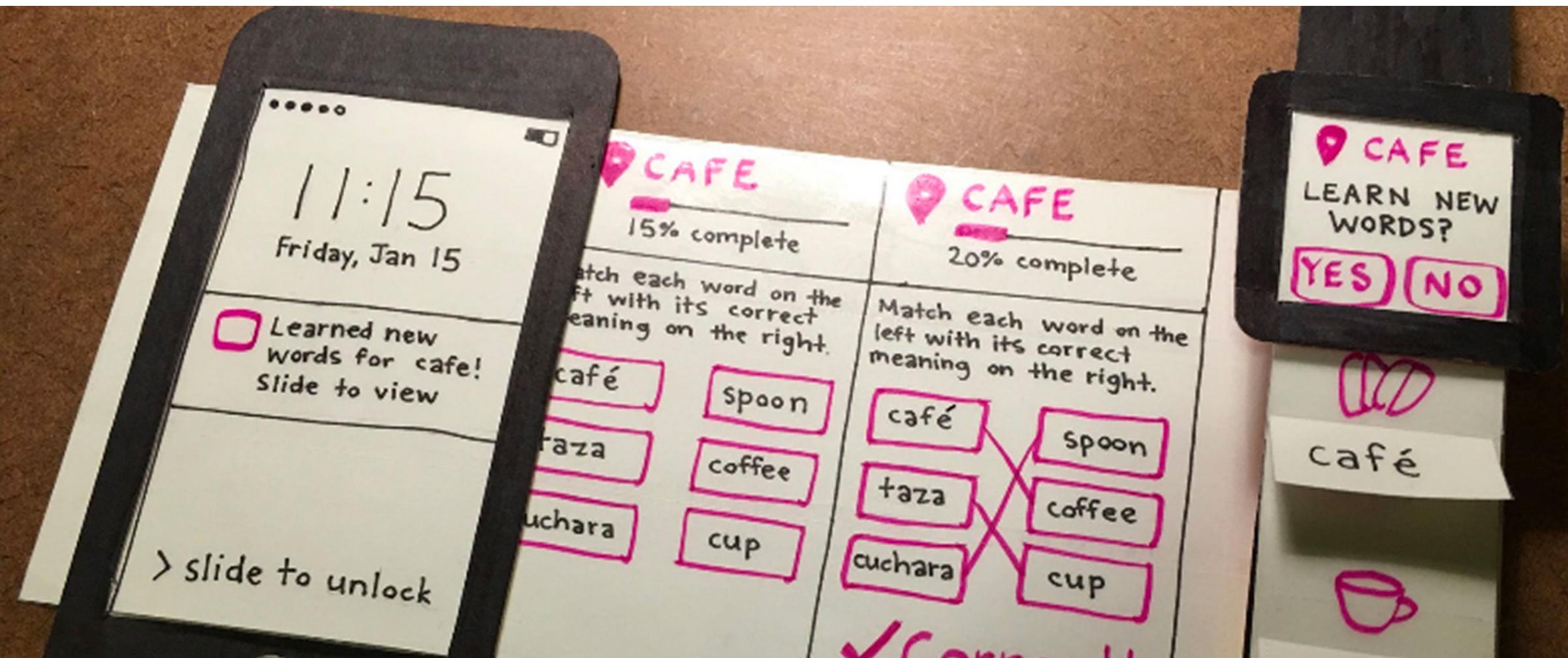
Why Paper Prototyping?

- Faster to build
 - Sketching is faster than programming
- Easier to change
 - Easy to make changes between user tests, or even *during* a user test
 - No code investment - everything will be thrown away (except the design)
- Focuses attention on big picture
 - Designer doesn't waste time on details
 - Customer makes more creative suggestions, not nitpicking
- Nonprogrammers can help
 - Only kindergarten skills are required

Tools for paper prototyping

- White poster board (11"x14")
 - For background, window frame
- Big (unlined) index cards (4"x6", 5"x8")
 - For menus, window contents, and dialog boxes
- Restickable glue
 - For keeping pieces fixed
- White correction tape
 - For text fields, checkboxes, short messages
- Overhead transparencies
 - For highlighting, user "typing"
- Photocopier
 - For making multiple blanks
- Pens & markers, scissors, tape





<https://ergomania.eu/paper-prototype-fidelity/>



mobile app



website



user interface



testing



iphone



game



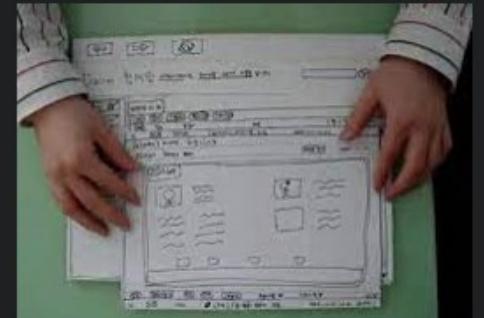
wireframe



low fidelity



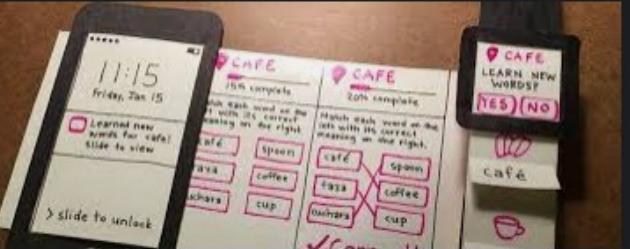
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Hanmail Paper Prototype UX (User ...
youtube.com



Smart paper prototype | Ergomania UX ...
ergomania.eu



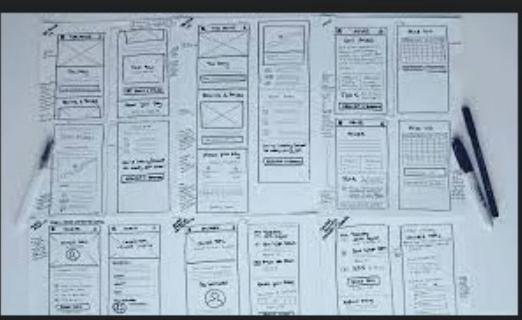
Paper prototype fidelity | Ergomania UX ...
ergomania.eu



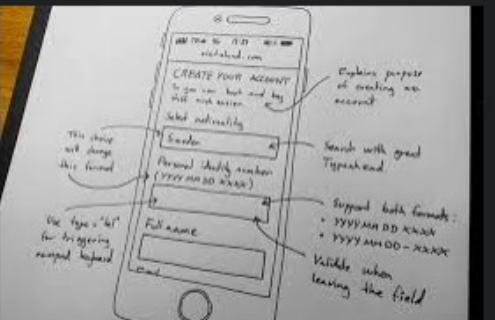
Mobile Application Design : Paper ...
youtube.com



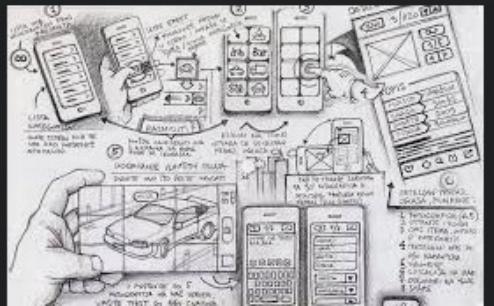
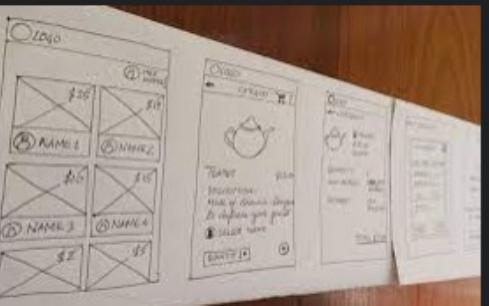
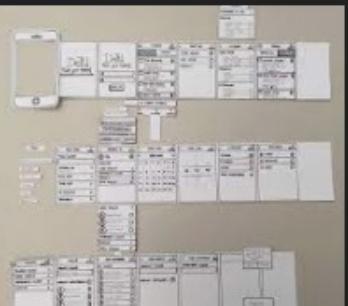
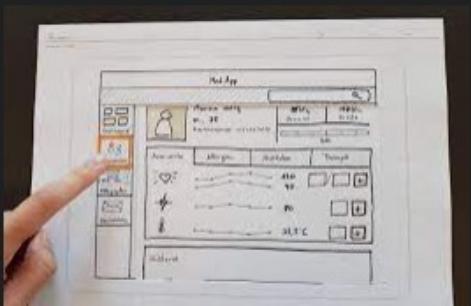
Complete guide to paper prototyping ...
justinmind.com



Paper Prototyping in Practice | Martha ...
martha-eierdanz.com



Complete guide to paper prototyping ...
justinmind.com



What you can learn from a paper prototype

- Conceptual model
 - Do users understand it?
- Functionality
 - Does it do what's needed? Missing features?
- Navigation & task flow
 - Can users find their way around?
 - Are information preconditions met?
- Terminology
 - Do users understand labels?
- Screen contents
 - What needs to go on the screen?

What you can't learn

- Look: color, font, whitespace, etc
- Feel: efficiency issues
- Response time
- Are small changes noticed?
 - Even the tiniest change to a paper prototype is clearly visible to user
- Exploration vs. deliberation
 - Users are more deliberate with a paper prototype; they don't explore or thrash as much

Computer Prototype

- Interactive software simulation
- High-fidelity in look & feel
- Low-fidelity in depth
 - Paper prototype had a human simulating the backend; computer prototype doesn't
 - Computer prototype may be **horizontal**: covers most features, but no backend

What You Can Learn From Computer Prototypes

- Everything you learn from a paper prototype, plus:
- Screen layout
 - Is it clear, overwhelming, distracting, complicated?
 - Can users find important elements?
- Colors, fonts, icons, other elements
 - Well-chosen?
- Interactive feedback
 - Do users notice & respond to status bar messages, cursor changes, other feedback
- Efficiency issues
 - Controls big enough? Too close together? Scrolling list is too long?

Computer prototyping techniques

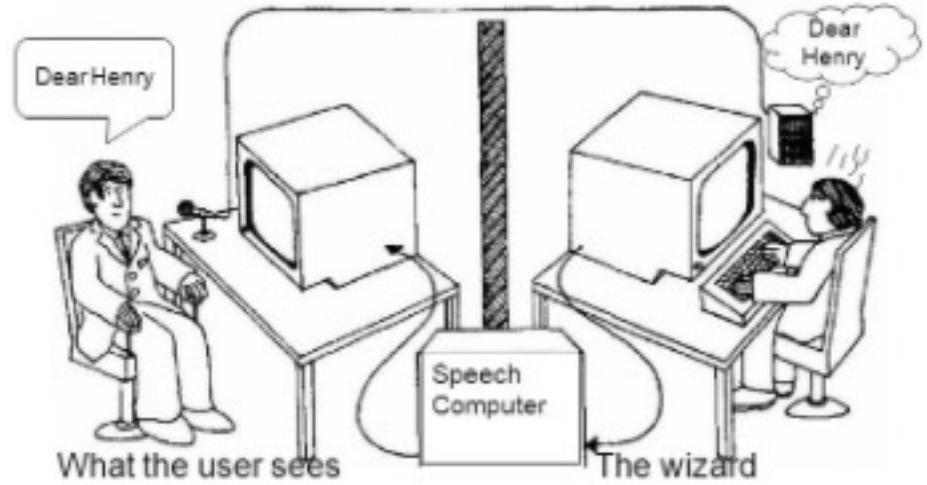
- Storyboard
 - Sequence of painted screenshots
 - Sometimes connected by hyperlinks
- Form builder
 - Real windows assembled from a palette of widgets (buttons, text fields, labels, etc.)
- Wizard of Oz
 - *Computer frontend, human backend* – a hybrid of computer and paper prototype

Storyboarding vs. Form builder

- Pros
 - You can draw anything
 - Cons
 - No text entry
 - Widgets aren't active
 - “Hunt for the hotspot”
-
- Pros
 - Actual controls, not just pictures of them
 - Can hook in some backend if you need it
 - But then you won't want to throw it away
 - Cons
 - Limits thinking to standard widgets
 - Less helpful for rich graphical interfaces

Wizard-of-Oz

- Software simulation with a human in the loop to help
- “Wizard of Oz” = “man behind the curtain”
 - Wizard is usually but not always hidden
- Often used to simulate future technology
 - Speech recognition
 - Learning
- Issues
 - Two UIs to worry about: user’s and wizard’s
 - Wizard has to be mechanical



Gould, Conti & Hovanecz, Comm ACM 26(4) 1983.

Some examples from Youtube

Navigation system of visual impaired people

https://www.youtube.com/watch?v=_ao0_N-7AYk

Mobile application

<https://www.youtube.com/watch?v=YmcuN3NlnDU>

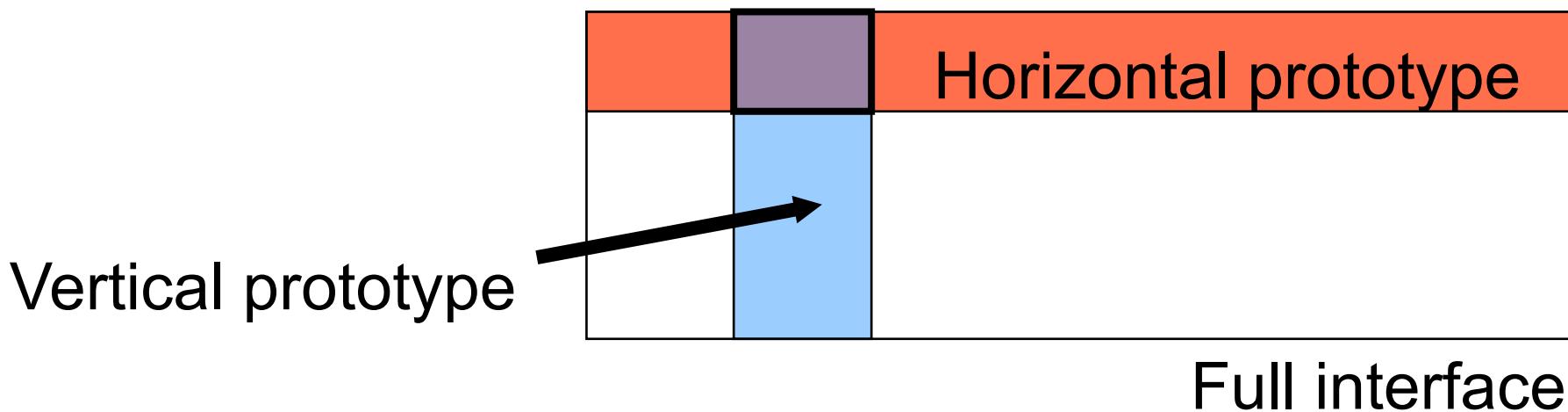
High-fidelity prototyping

High-fidelity prototyping

- Uses materials that you would expect to be in the final product.
 - Looks **more like the final system** than a low-fidelity version.
- Problems of high-fidelity prototyping:
 - It takes too long to create
 - Reviewers and testers **tend to comment on superficial aspects** rather than content.
 - Developers are **reluctant to change** something they have crafted for hours.
 - A software prototype can set expectations too high.
 - Just one bug in a high-fidelity prototype can **bring the testing to a halt**.

Compromises in prototyping

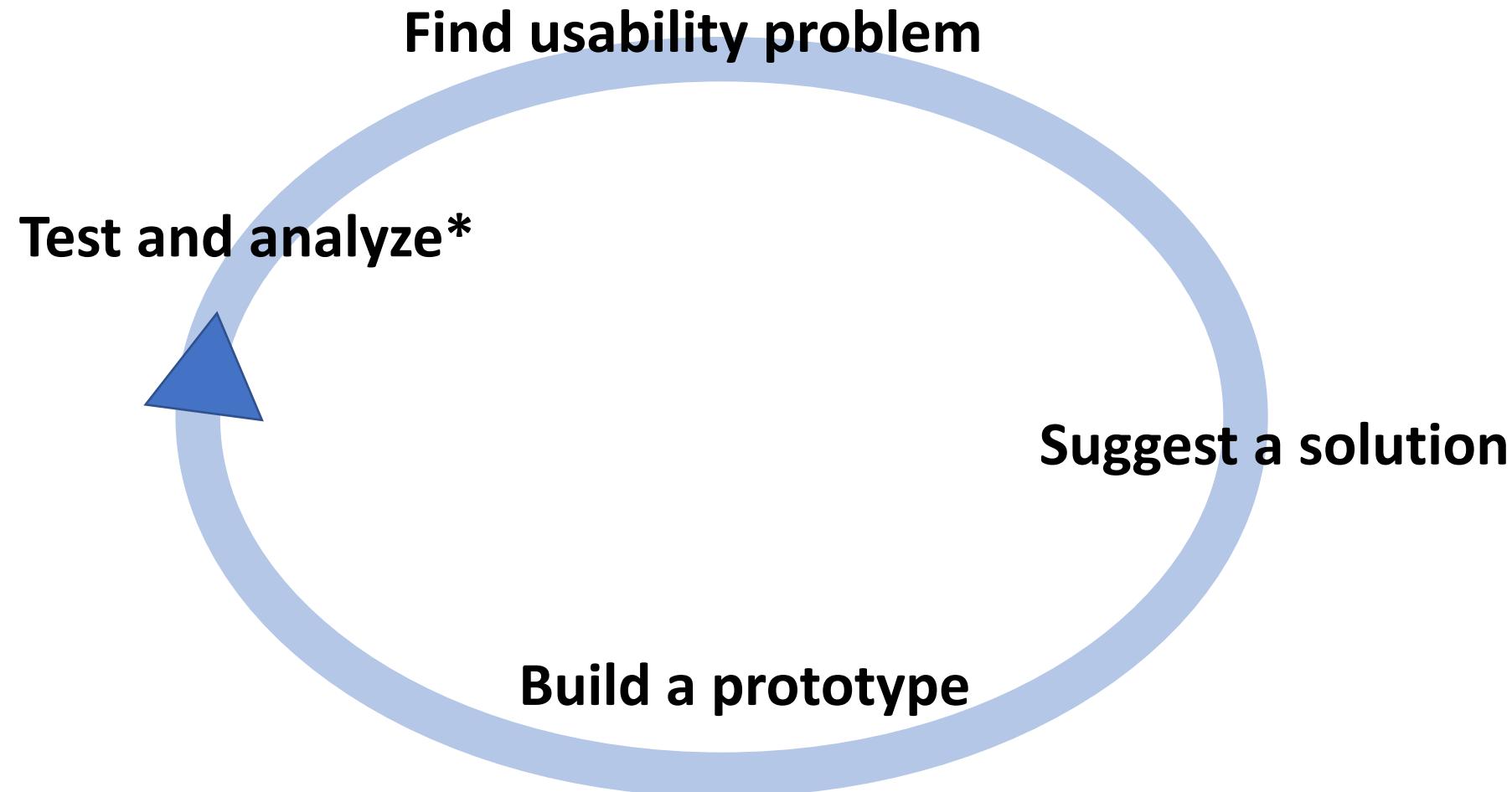
- All prototypes need compromises.
 - For software-based prototyping, these may be a slow response, sketchy icons, limited functionality, and so on.
- Two common types of compromise
 - ‘horizontal’: provide a wide range of functions, but with little detail
 - ‘vertical’: provide a lot of detail for only a few functions



From design to implementation

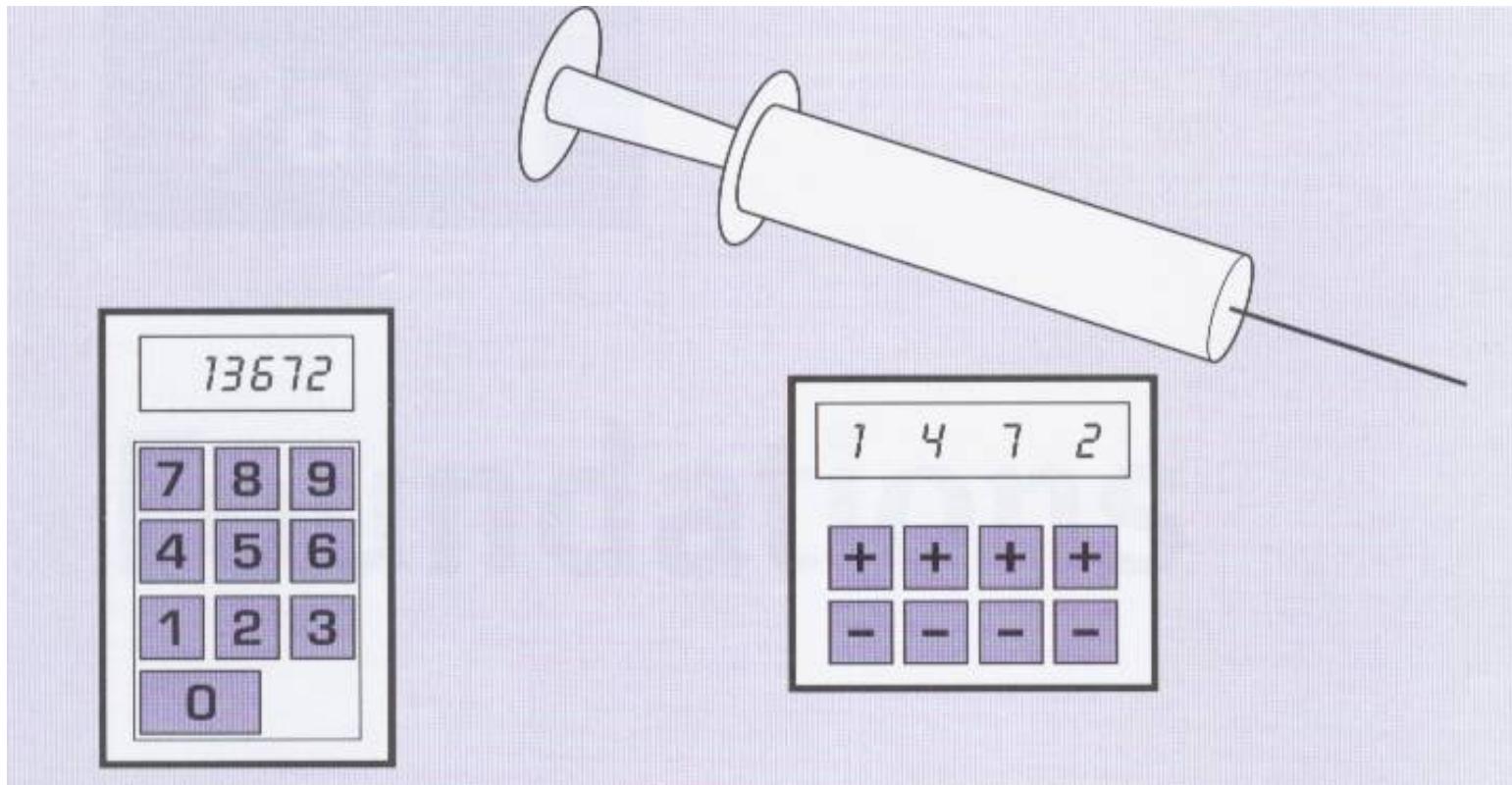
- Two different philosophy
 - **Evolutionary** prototyping
 - A prototype evolves into a final product
 - **Throwaway** prototyping
 - Final product is built from scratch
- In principle, a prototype is to be thrown away
- In practice, we often do not have time to start again from scratch.

User-centered Design Process



Interaction Design Goals and Principles

Automatic syringe panel



- Q: Which one is better?
- Q: In what respect?

To design a usable interactive product

- Be clear about the **primary goal** of developing an interactive product for users
- The first things to know:
 - Who the **users** are
 - What **activities** are being carried out (**task**)
 - Where the interaction is taking place (**context**)
- You need to
 - **Study** them by asking, consulting, and observing.
 - Let them **participate** in design process
 - Verify (evaluate) the final design **with** them

Usability Goals

Usability Goals

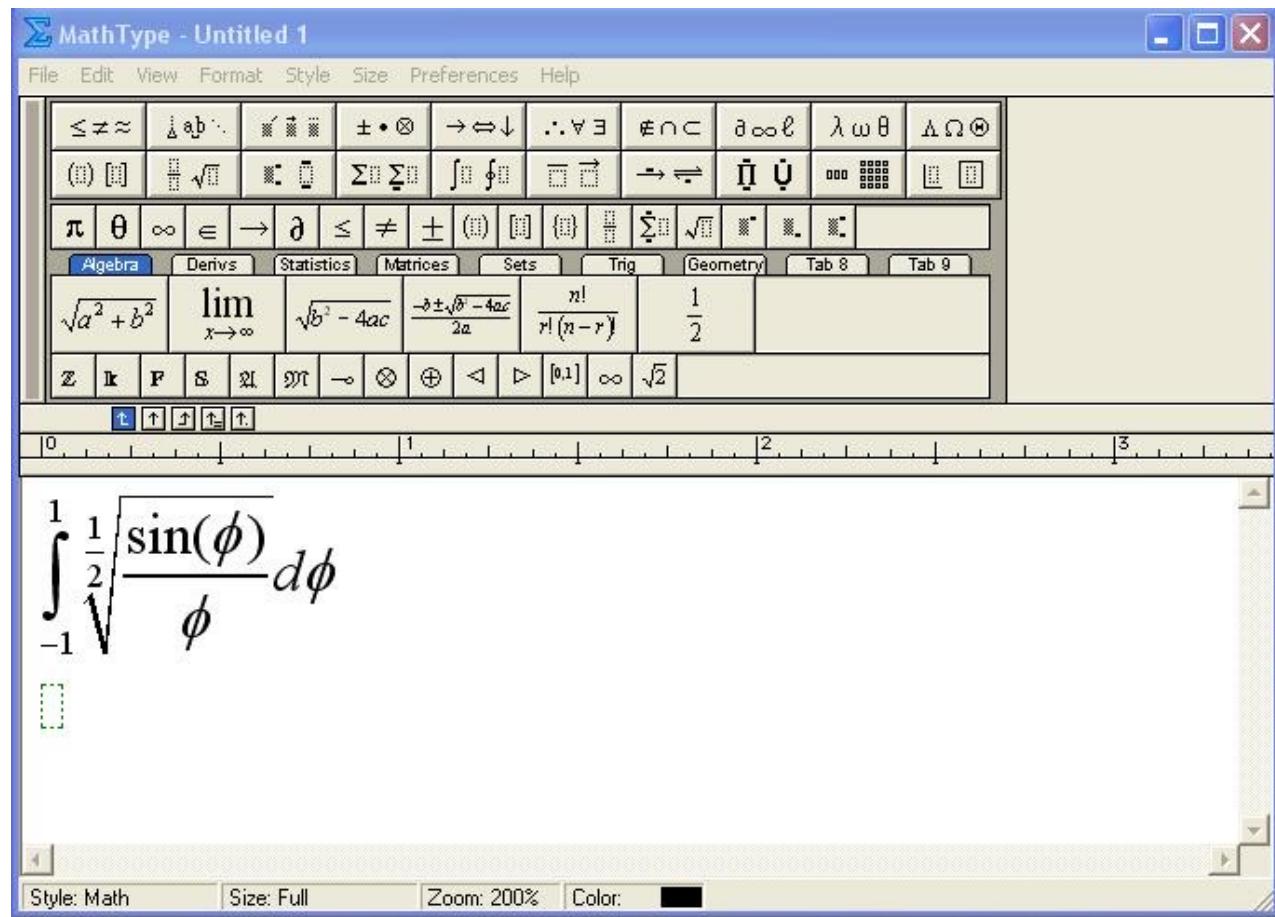
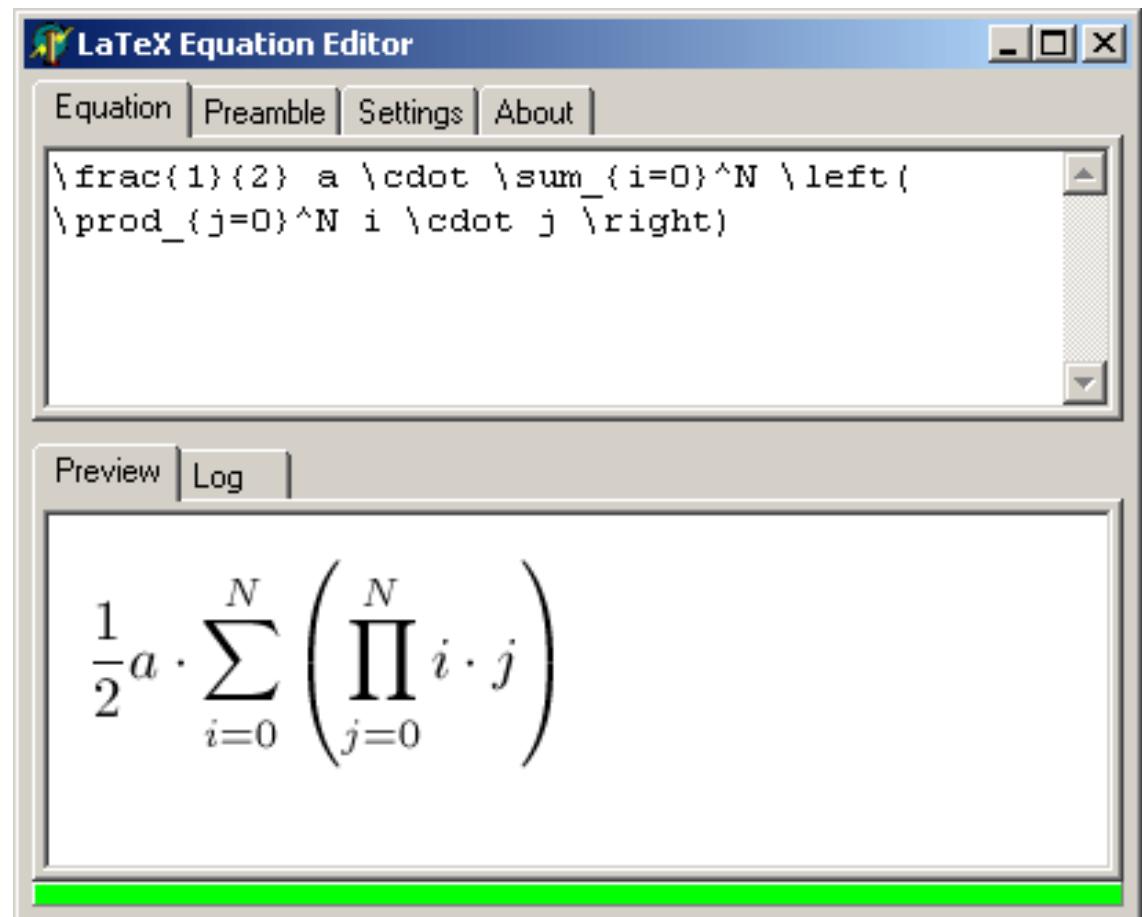
- **Effectiveness:** effective to use
- **Efficiency:** efficient to use
- **Utility:** have good utility
- **Learnability:** easy to learn
- **Memorability:** easy to remember how to use
- **Safety:** safe to use

By Preece, Rogers and Sharp, in our textbook, <Interaction Design>

Effectiveness

- How good a product is at doing what it is supposed to do
 - Specifically, the degree to which errors are avoided and tasks are successful, measured by “**success rate (or number of errors)**” or “**task completion rate**”.
- Question:
 - “Can users use the system to do the work they need to do?”

* Equation Editors

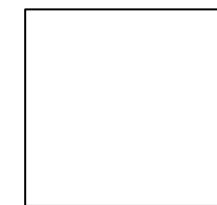
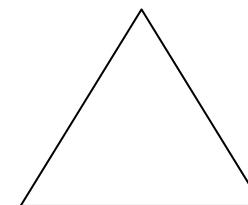


Efficiency

- The way a product supports users in carrying out their tasks.
 - Specifically, **the rate or speed** at which a product enables a user to accurately and successfully complete a task.
- Question:
 - ” Can experienced users be productive using the system?”

Utility

- The **extent** to which the product provides **the right kind of functionality** so that users can do what they need or want to do.
- Question:
 - “Does the system provide all the functionality that users needs?”
- Ex) Drawing tool
 - A triangle, a rectangle and so on can be created using a line function, but there should be a better way.



Learnability

- How easy a system is to learn to use.
 - Time to learn a task, Time to reach an expert level for novice users
- Question:
 - “Can users figure out what to do by exploring the interface?”
- Ex) Equation editors
 - Is it possible for a user to create an equation without consulting a help page or a manual?

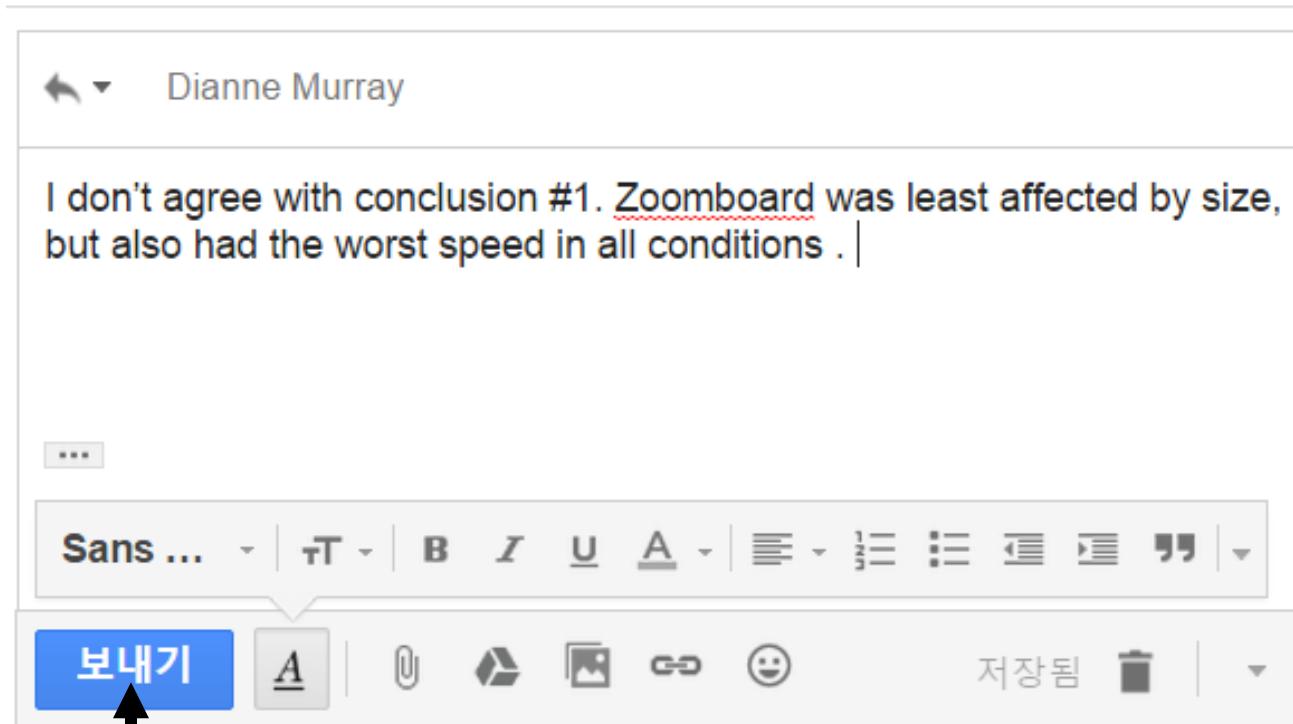
Memorability

- How easy a product is to remember how to use, once learned.
 - number of errors when carrying out a given task over time
- Question:
 - “What kind of support does the system have for remembering how to do tasks, especially infrequent tasks?”

Safety

- Protecting the users from dangerous errors, for example losing all the user's data or protecting the user's confidential information.
- Also refers to how users recover from errors.
- Question:
 - “What kind of errors can users make and how can they recover from the mistake?”

* Exit vs Send (e-mail)



Send
(Cmd-Enter)

User Experience Goals

User Experience

- How a product **behaves** and is used by people in the real world.
- “all aspects of the end-user’s interaction with the company, its services, and its products”
 - Nielson and Norman (2014)
- One cannot design a user experience, but only design *for* user experience.
 - It’s subjective!

User Experience Goals

- Satisfying
- Aesthetically pleasing
- Enjoyable
- Engaging
- Supportive of creativity
- Pleasurable
- Rewarding
- Exciting
- Fun
- Entertaining
- Provocative
- Helpful
- Surprising
- Motivating
- Enhancing sociability
- Emotionally fulfilling
- Challenging
- Boring
- Annoying
- Frustrating
- Cutesy

User Experience Goals

- **Subjective qualities** and concerned with how a system feels to a user.
- **Terms to convey a person's feelings, emotions, etc.,** in the description of the interaction
- **How to assess** whether the goals are achieved?

How to assess user experience?

- Virtual sales agent
 - How long do users interact with the virtual sales agent?
 - What is the user's immediate response to the agent's appearance? Is it one of mockery, dismay, or enjoyment?
 - Do they smile, laugh, or scoff?

Design Principles

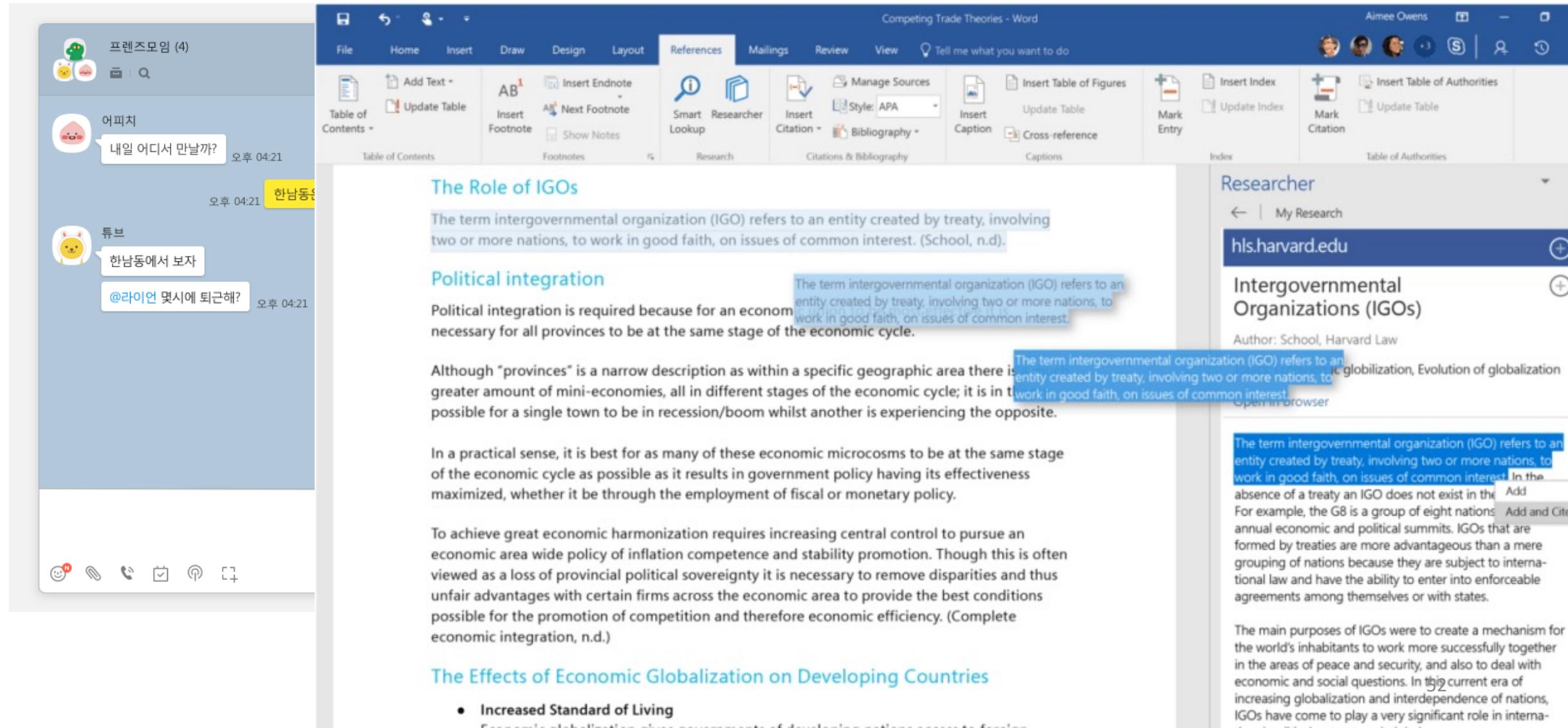
Design Principles

- Generalizable abstractions for thinking about different aspects of design
- The do's and don'ts of interaction design
 - What to provide and what not to provide at the interface
- Derived from a mix of theory-based knowledge, experience and common-sense

5 Design principles

- **Visibility**
 - **Feedback**
 - **Constraints**
 - **Consistency**
 - **Affordance**
-
- Explained in <The Design of Everyday Things> by D. Norman.

Visibility



A screenshot of a Microsoft Word document titled "Competing Trade Theories - Word". The ribbon is visible at the top, with the "References" tab selected. A red arrow points upwards from the ribbon towards the top of the screen, where a toolbar with various icons is located. On the left side of the screen, there is a sidebar for "프렌즈모임 (4)" (Friends Group) showing messages from users like "어피치", "한남동", and "튜브". The main content area contains sections on "The Role of IGOs", "Political integration", and "The Effects of Economic Globalization on Developing Countries". A research pane is open on the right, displaying information about "Intergovernmental Organizations (IGOs)" from "hls.harvard.edu". The pane includes a summary of what an IGO is, its role in political integration, and its effects on economic globalization.

The term intergovernmental organization (IGO) refers to an entity created by treaty, involving two or more nations, to work in good faith, on issues of common interest. (School, n.d.)

Political integration

Political integration is required because for an economy to work in good faith, on issues of common interest, necessary for all provinces to be at the same stage of the economic cycle.

Although "provinces" is a narrow description as within a specific geographic area there is a greater amount of mini-economies, all in different stages of the economic cycle; it is in this work in good faith, on issues of common interest, possible for a single town to be in recession/boom whilst another is experiencing the opposite.

In a practical sense, it is best for as many of these economic microcosms to be at the same stage of the economic cycle as possible as it results in government policy having its effectiveness maximized, whether it be through the employment of fiscal or monetary policy.

To achieve great economic harmonization requires increasing central control to pursue an economic area wide policy of inflation competence and stability promotion. Though this is often viewed as a loss of provincial political sovereignty it is necessary to remove disparities and thus unfair advantages with certain firms across the economic area to provide the best conditions possible for the promotion of competition and therefore economic efficiency. (Complete economic integration, n.d.)

The Effects of Economic Globalization on Developing Countries

- Increased Standard of Living

Economic globalization gives governments of developing nations access to foreign

Researcher

← | My Research

hls.harvard.edu

Intergovernmental Organizations (IGOs)

Author: School, Harvard Law

The term intergovernmental organization (IGO) refers to an entity created by treaty, involving two or more nations, to work in good faith, on issues of common interest. In the absence of a treaty an IGO does not exist in the Add For example, the G8 is a group of eight nations Add and Cite annual economic and political summits. IGOs that are formed by treaties are more advantageous than a mere grouping of nations because they are subject to international law and have the ability to enter into enforceable agreements among themselves or with states.

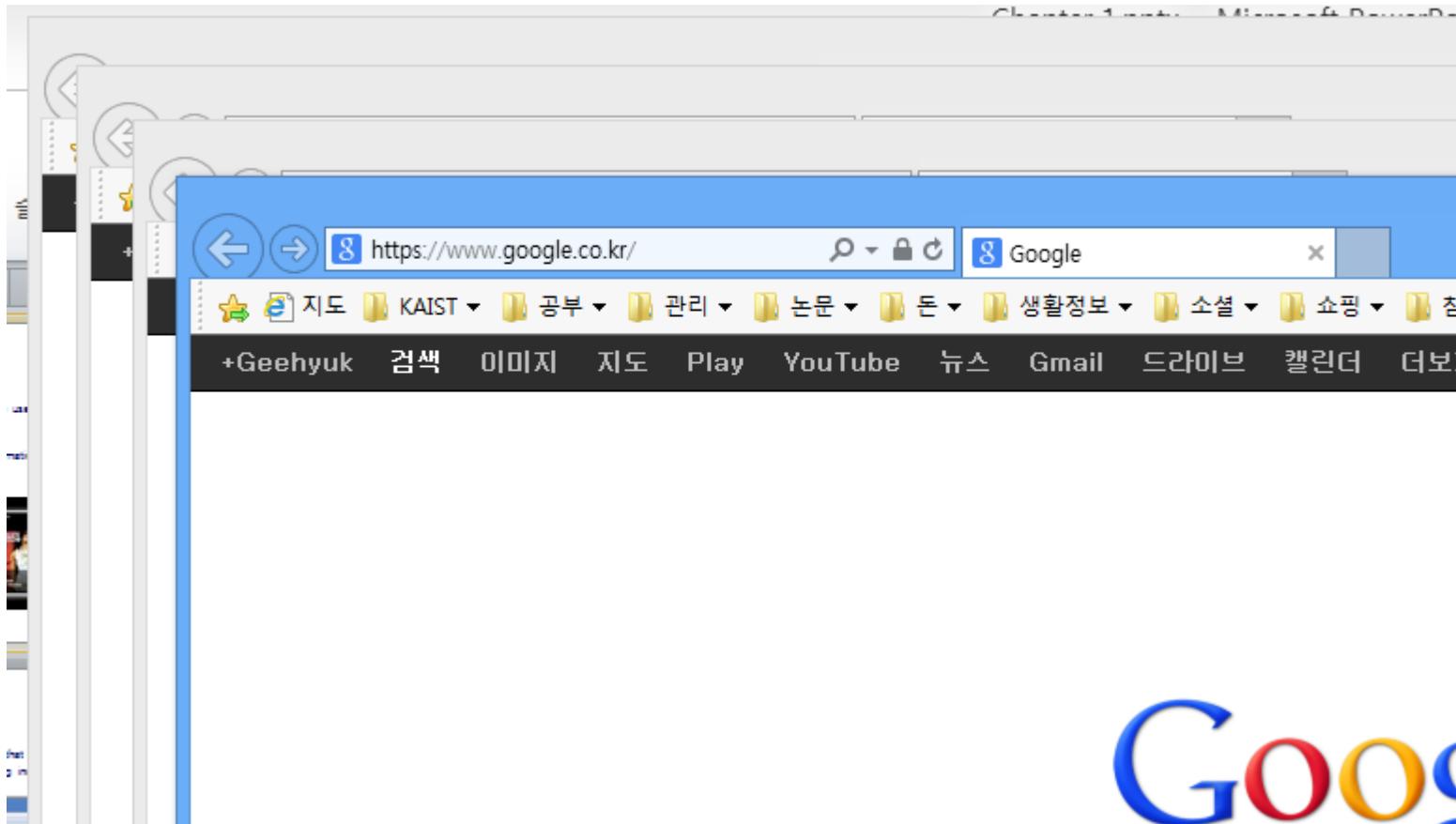
The main purposes of IGOs were to create a mechanism for the world's inhabitants to work more successfully together in the areas of peace and security, and also to deal with economic and social questions. In the current era of increasing globalization and interdependence of nations, IGOs have come to play a very significant role in international relations.

Feedback

- Sending information back to the user about what has been done
- Includes sound, highlighting, animation and combinations of these



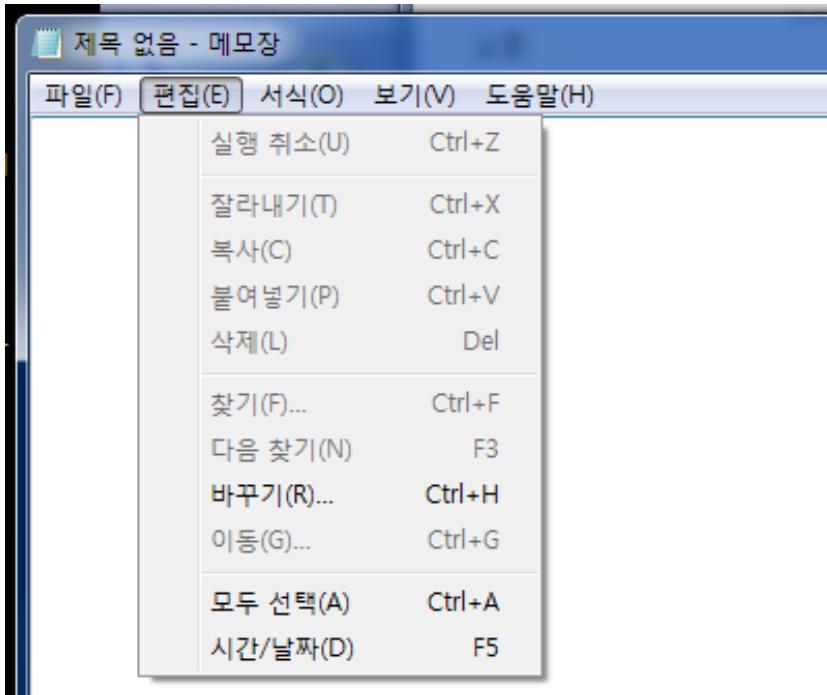
With slow feedback..



Goog

Constraints

- Restricting the possible actions that can be performed
- Helps prevent user from selecting incorrect options



* Physical constraints

- Refer to the way physical objects restrict the movement of things



* Natural mapping
= Constraining using common sense

- You do not have to create constraints.
- Our thinking is in fact very constrained (by common sense)



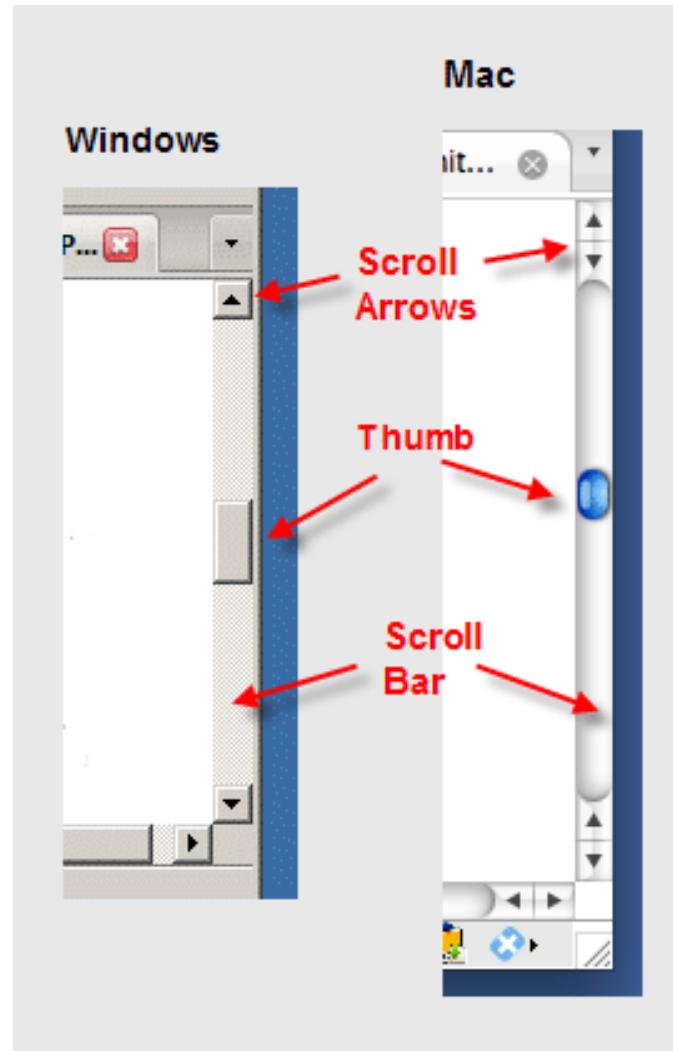
Consistency

- Design interfaces to have similar operations and use similar elements for similar tasks
 - e.g., Always use ctrl key plus first initial of the command for an operation – ctrl+C, ctrl+S, ctrl+O
- Main benefit is consistent interfaces are easier to learn and use (**simpler rules**)
- Difficult to be consistent when a design becomes complex.
 - e.g. short-cut keys for save, spelling, select, style?

- * Number keypads - inconsistency



* Scroll – inconsistency

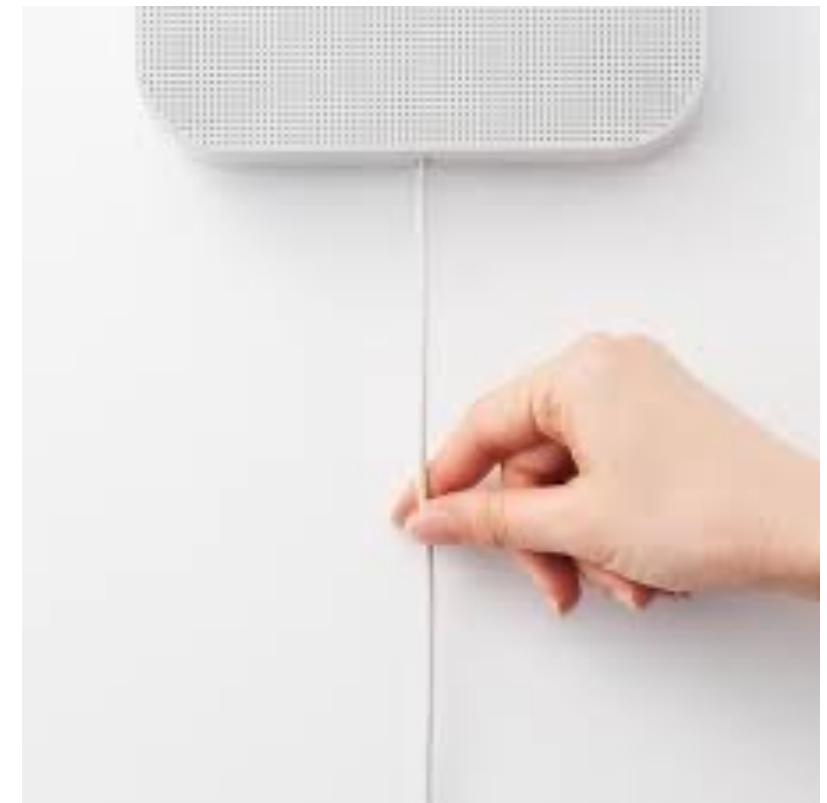


Affordances: to give a clue

- **An attribute of an object that allows people to know what to do with it.**
 - Button invites pushing
 - Door handle prompts pulling
 - Chair invites sitting
- How about the virtual objects on the screen?
 - Scrollbars afford moving up and down
 - Icons afford clicking on
 - Hyperlinks afford clicking on

* Physical Affordance

- What actions do the following physical objects invite?



inFORM: Dynamic Physical Affordances and Constraints through Shape and Object Actuation

Sean Follmer* Daniel Leithinger* Alex Olwal Akimitsu Hogge Hiroshi Ishii

MIT Media Lab

75 Amherst Street, Cambridge, MA 02139, USA

{sean, daniell, olwal, ishii}@media.mit.edu

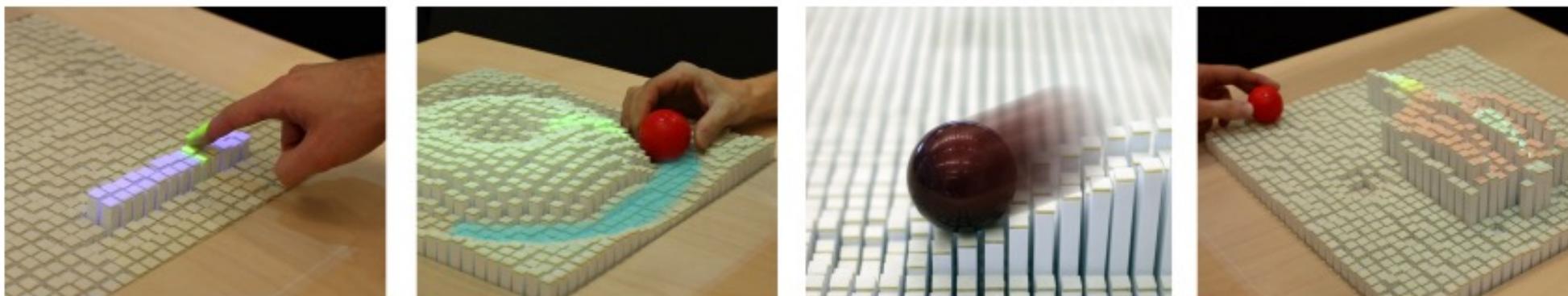


Figure 1: inFORM enables new interaction techniques for shape-changing UIs. *Left to right:* On-demand UI elements through *Dynamic Affordances*; Guiding interaction with *Dynamic Constraints*; Object actuation; Physical rendering of content and UI.

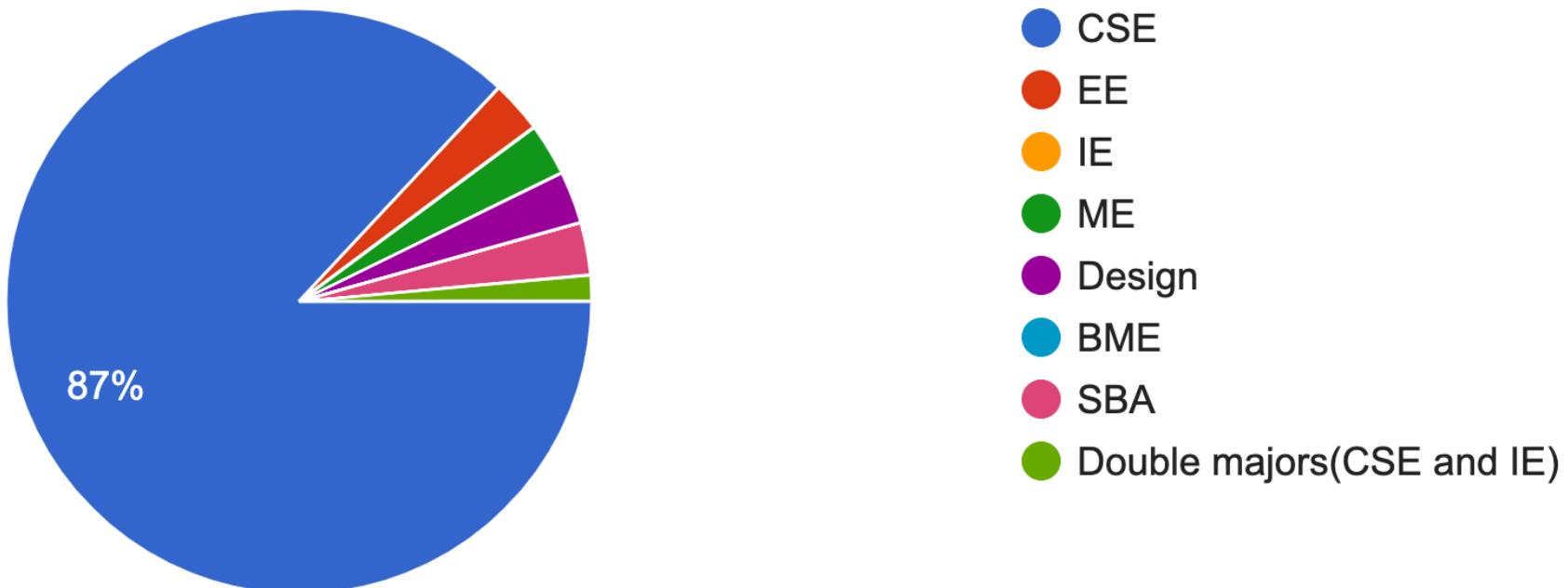
Now you are familiar with

- Usability goals
 - Effectiveness, efficiency, utility, learnability, memorability, safety
- User experience goals
- Design principles
 - Visibility, feedback, constraints, consistency, affordance

Design Project

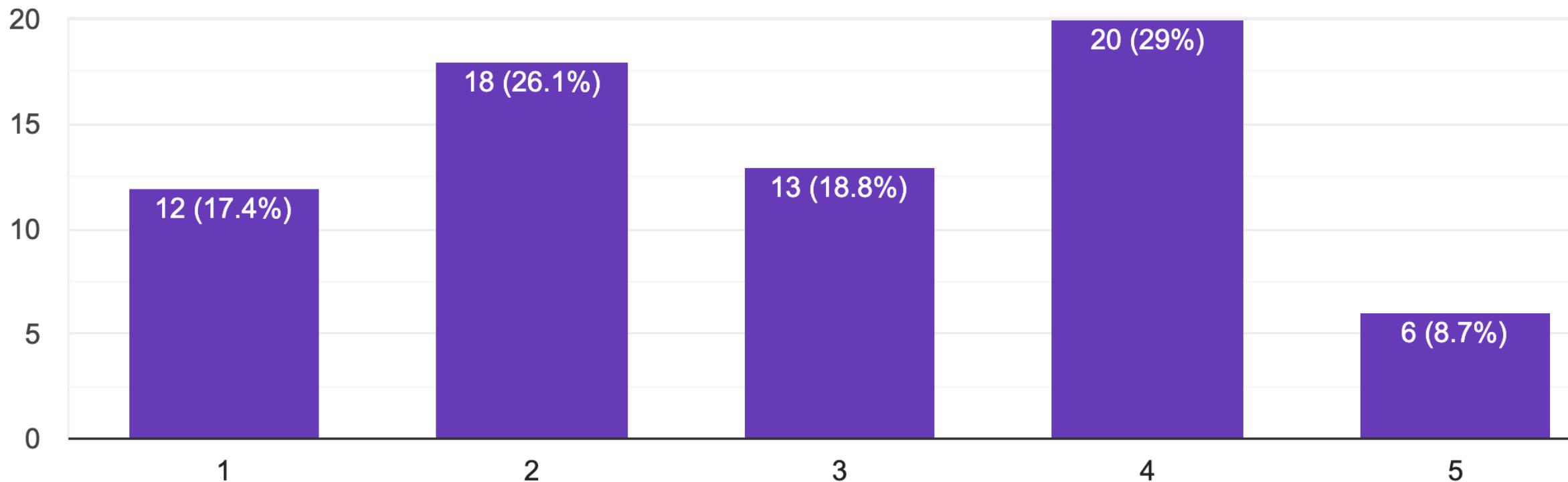
Your Major

응답 69개



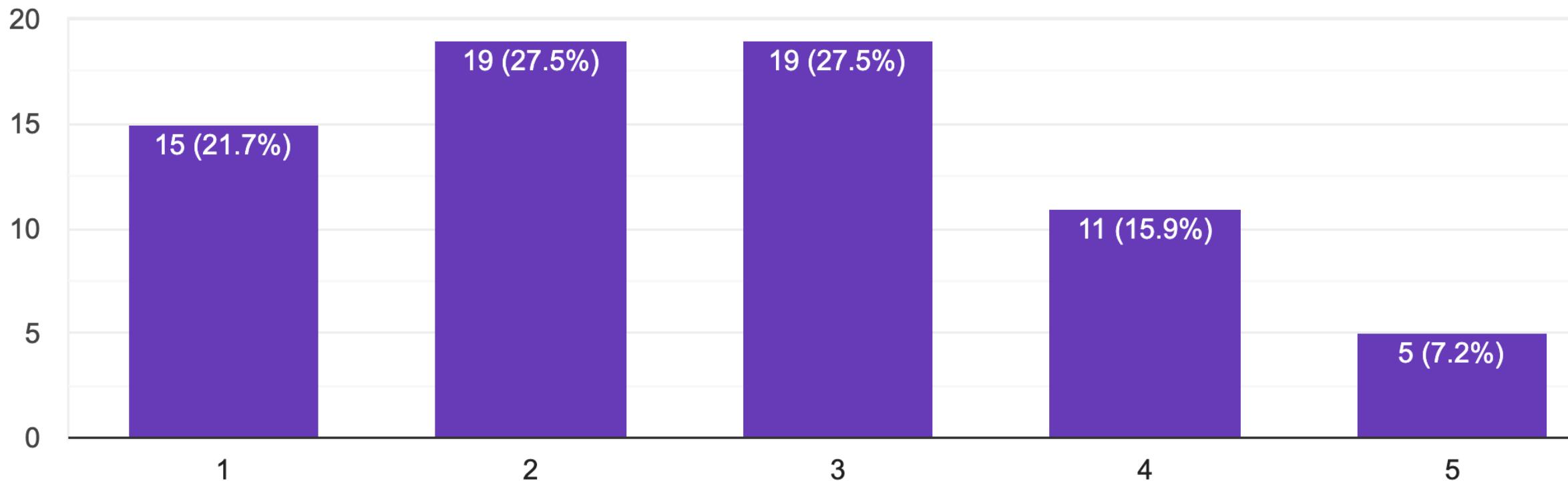
I am confident in software prototyping (Web/App)

응답 69개



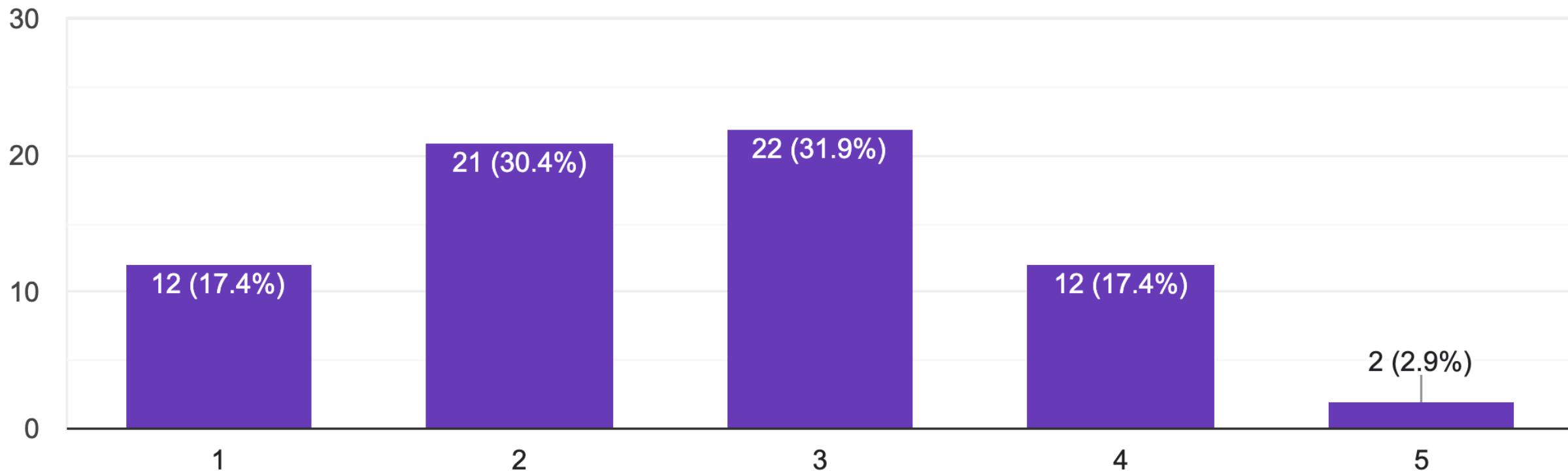
I am confident in physical computing

응답 69개



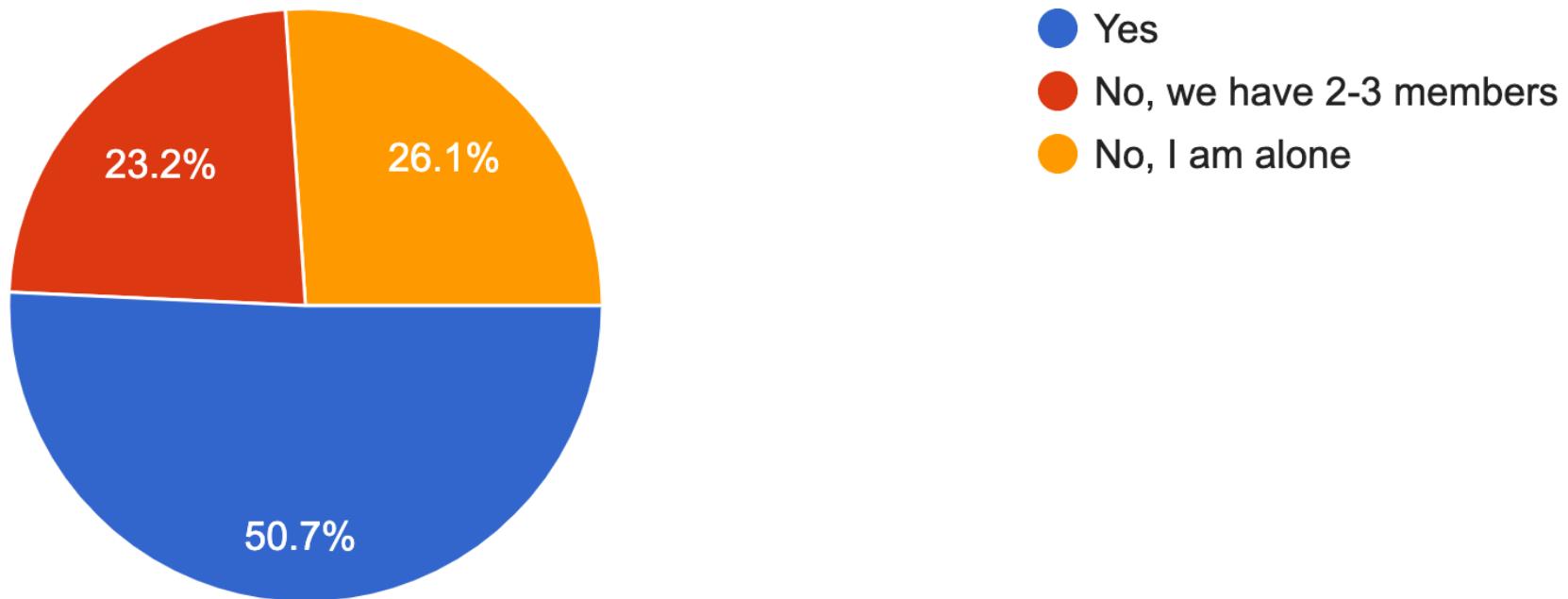
I am confident in visual design

응답 69개



Do you have a team of 4-5 members for design project?

응답 69개



<https://join.slack.com/t/i2hci-s23/signup>

- If you are a team of size smaller than 4 (including one person team), find your members at #findteammates channel!



Jaeyeon Lee 12:30 PM

(Example) Hello all, I am Jaeyeon Lee, an HCI researcher/professor at CSE. I am interested in physical user interfaces and I want to do a project related to wearable or tangible things. Still, I am open to other topics as well. Please let me know if you are interested in working with me!

Design Project Goal

- To experience a full cycle of user-centered design process.
 - Find usability problem, suggest a solution, build a prototype, user testing, iteration, user testing, iteration, user tes..
- I expect at least *one* iteration with a paper prototype (low-fi) and *another* iteration with a computer prototype (low-fi).
 - ← same with the last year!
- The more iterations and interesting insights from study results get higher score.

Extra points

- If a team conducted a user study with high-fi prototype in addition to *two* iterations with low-fi prototype, they get extra points.
- But, creating high-fi prototype and conducting user study will be very challenging...

Web/mobile/physical interfaces?

- It's your choice!
- If you want to work on physical interfaces, make sure that you have all prototyping tools and devices with you.

Design Project Milestones (1)

- W2: Team-up
- W3-4: Finding usability problem, suggesting alternative solutions
- W4: Pre-proposal submission
 - usability problem to solve
 - alternative solutions
 - sketch of interfaces
- W5: Pre-proposal meeting with the instructor
- W5-6: Working on paper prototype (low-fi) and iterating once
 - it should be quick and cheap!

Design Project Milestones (2)

- W7: Proposal Presentation on..
 - Usability problem, proposed solution, prototyping plan
- W7-10: Working on computer (low-fi) prototype
- W10: Half Report
 - Prototyping progress, user study plan

Design Project Milestones (3)

- W10-15: Iterating computer prototype with user study, working on high-fi prototype and conducting user study with it (extra point)
- W15: Video Showcase
- W16: Final Video and Final Report on..
 - The whole design process from usability problem to final design
 - Re-use half report and extend it

Upcoming

- 3/9 (Thu)
 - (Last minute) Team Formation, Team meetings
- 3/14 (Mon)
 - Quiz 1 on Interaction Design,
 - Lecture on Human Factors 1