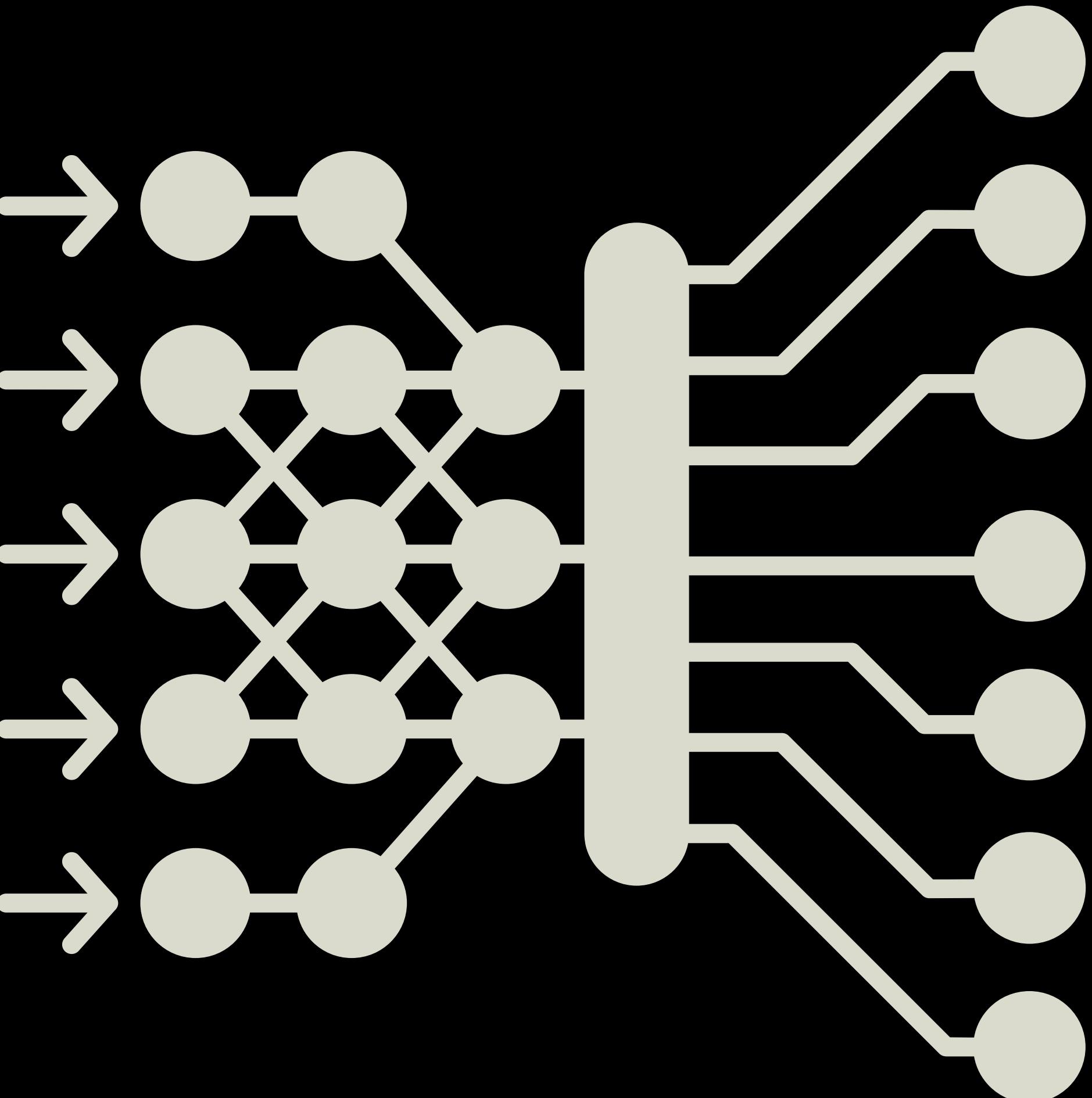
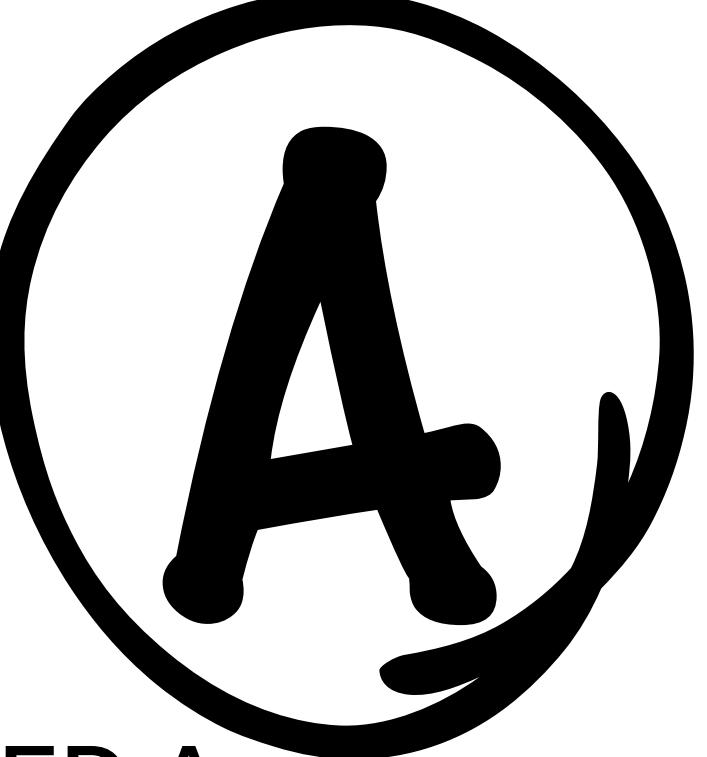


CO-DESIGNING WITH TRANSFORMERS: UNPACKING THE COMPLEX ROLE OF GENAI IN INTERACTIVE SYSTEM DESIGN EDUCATION



THE GENAI CHALLENGE IN INTERACTION DESIGN EDUCATION

- **Sudden emergence** of powerful GenAI tools
- Educators are scrambling to adapt
- Unclear when tools are helpful vs. harmful
- Risk of over-reliance and skill degradation
- Need for evidence-based approaches

79%  A

OF OUR STUDENTS ACHIEVED A GRADES (VS 61% PRE-CHATGPT)

KEY CITATIONS: BALDASSARRE ET AL. 2023 [3]; COTTON ET AL. 2024 [6]; LAU & GUO 2023 [23]; LI ET AL. 2024 [24]; SULLIVAN ET AL. 2023 [41]

COURSE CONTEXT: STUDENT PROJECTS

Interactive Device Design Course

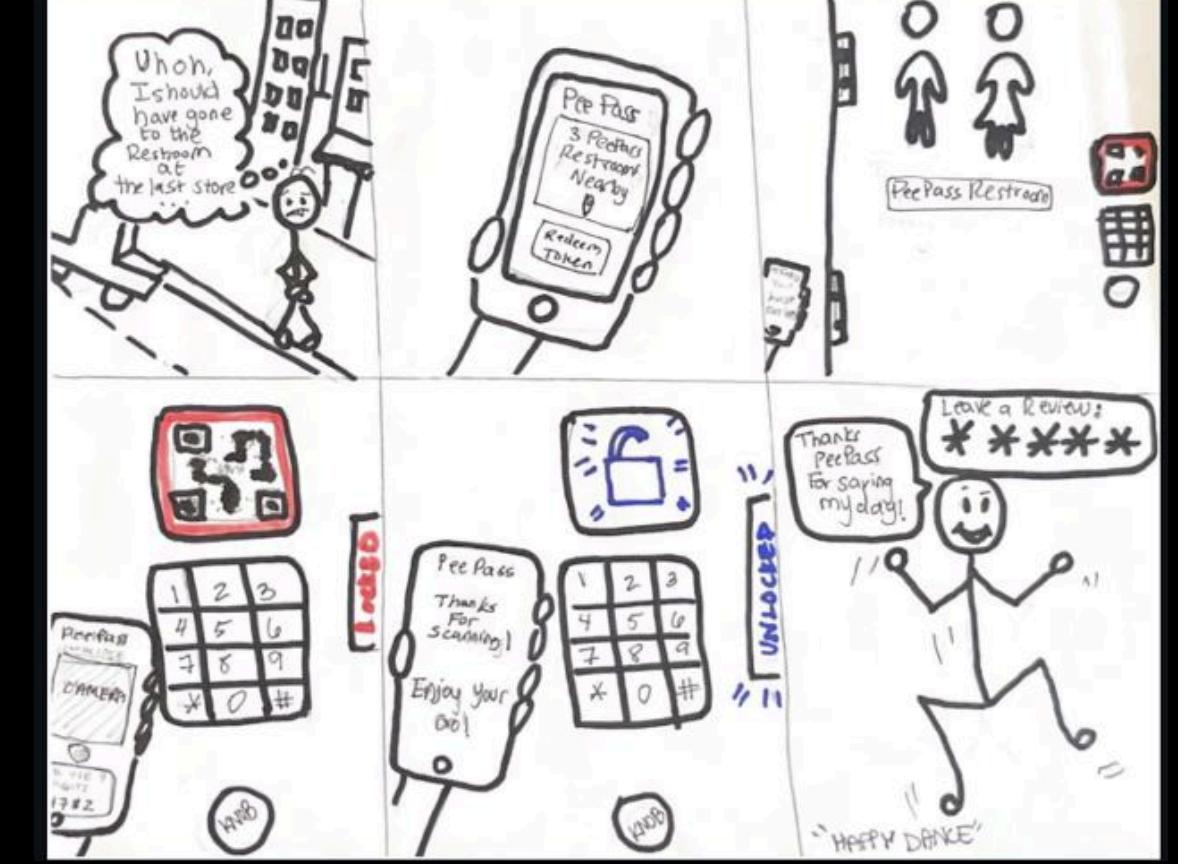
- **48 graduate students** from diverse backgrounds
- **6 two-week sprints** + final project
- Focus on **prototyping & interaction design**
- Hardware integration (Raspberry Pi, sensors)
- User-centered design methodology

Why This Course?

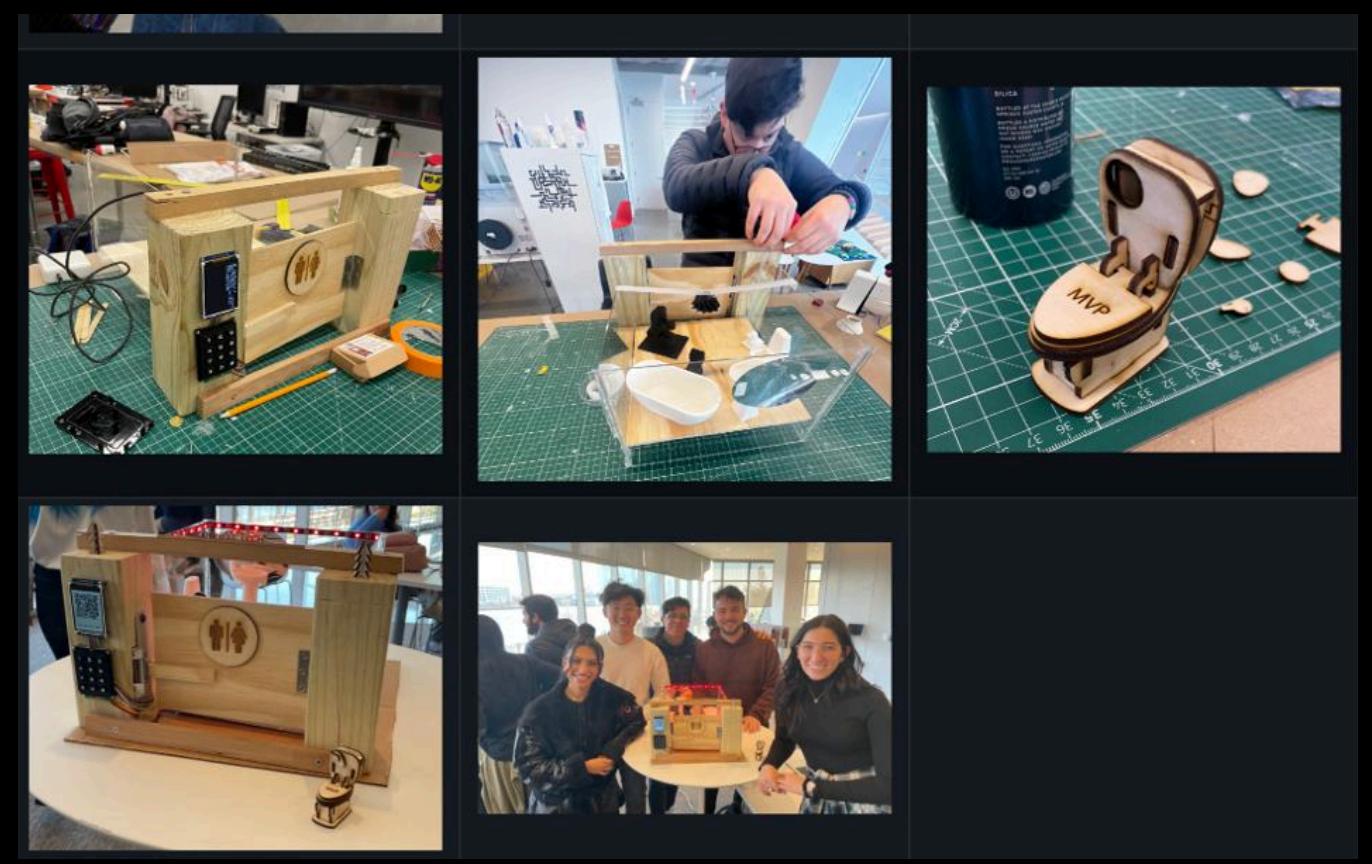
Perfect testing ground for GenAI impact:

- Mix of **creative ideation** and **technical execution**
- Similar classes are taught at other institutions
- **Repeated opportunities** to try GenAI across different tasks
- Real prototyping challenges with hardware constraints
- Diverse student backgrounds (CS, Design, Social Sciences, Law, Medicine)

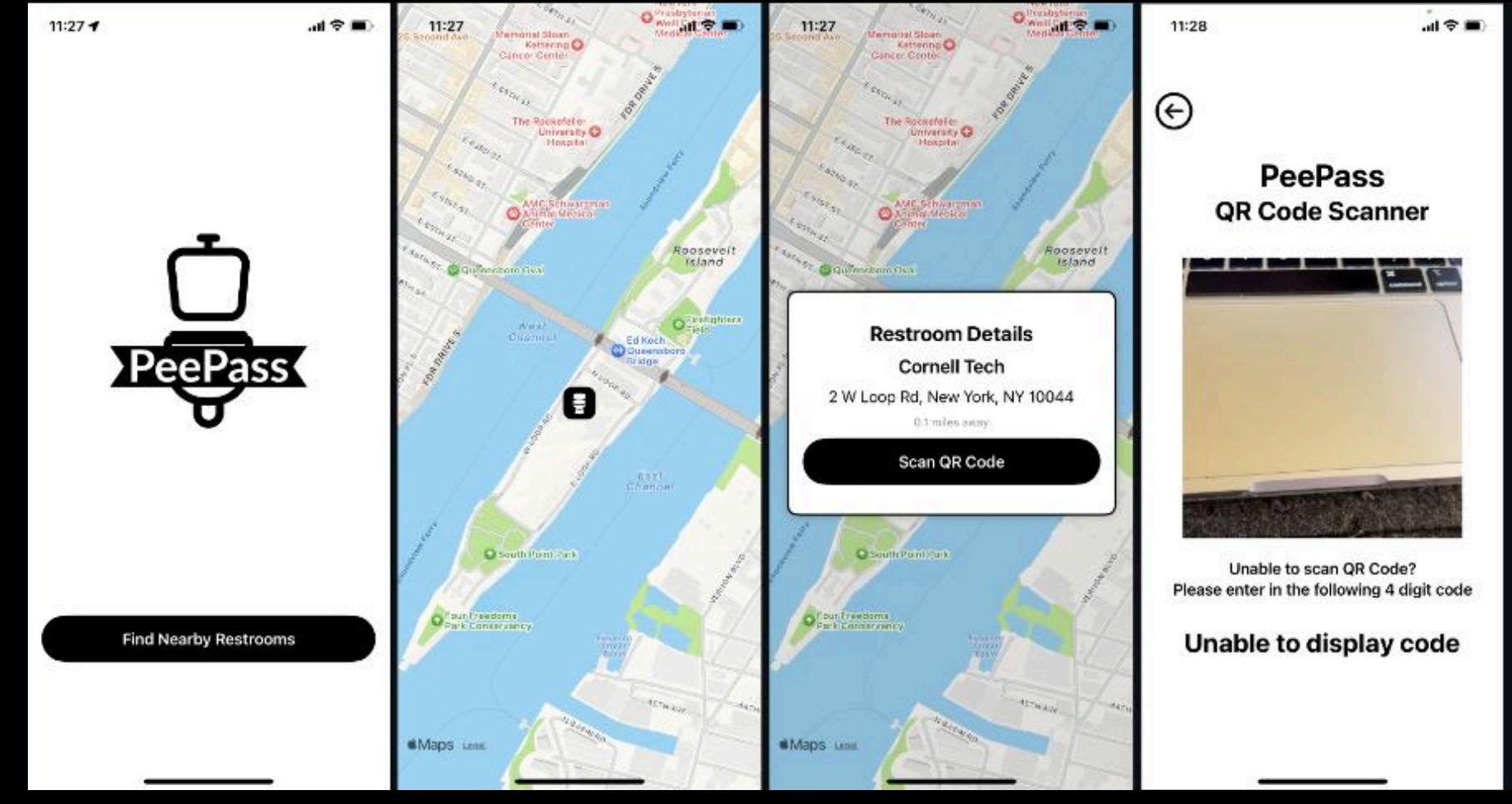
STORYBOARDING



RAPID PROTOTYPING



DEVELOPING



SOURCE: GROUP 1 [HTTPS://GITHUB.COM/IRONCLOCK/DEVELOPING-AND-DESIGNING-INTERACTIVE-DEVICES/BLOB/2023FALL/FINALPROJECT.MD](https://github.com/IRONCLOCK/DEVELOPING-AND-DESIGNING-INTERACTIVE-DEVICES/blob/2023FALL/FINALPROJECT.MD)

MOTIVATING QUESTIONS

RQ1: WHAT DO STUDENTS USE GENAI IN HCI DESIGN AND PROTOTYPING FOR?

RQ2: WHAT ARE STUDENTS' PERCEPTIONS ON GENAI AND INFLUENCING FACTORS?

RQ3: WHAT ARE POTENTIAL LONG-TERM IMPACTS ON HCI EDUCATION?

RELATED WORK:

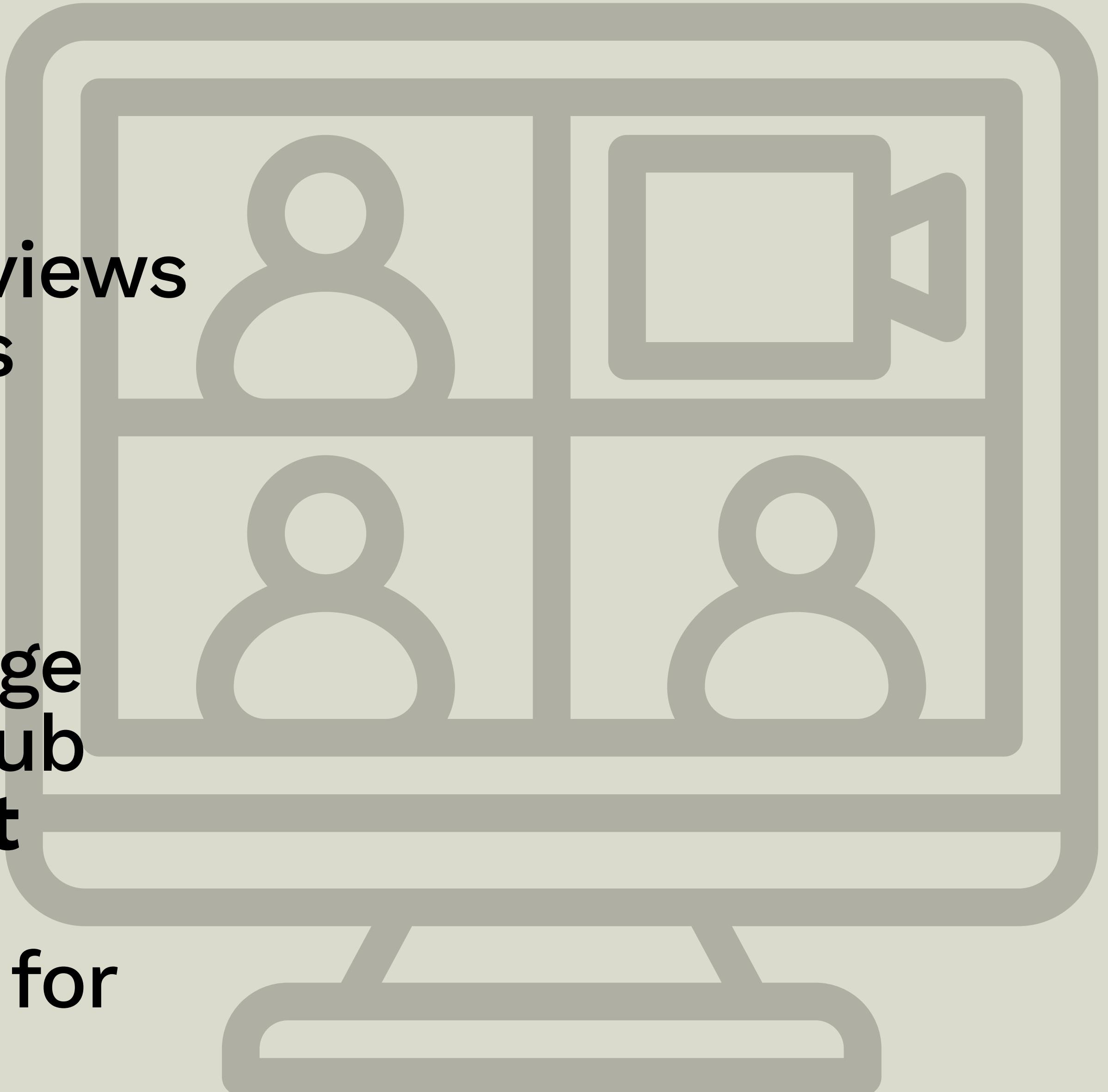
KHARRUFA & JOHNSON 2024 [18]; TAKAFFOLI ET AL. 2024 [43]

WEISZ ET AL. 2024 [51]; SANDHAUS ET AL. 2024 [37]

MACELI ET AL. 2024 [30]; ZHENG. 2023. [57]; SULLIVAN ET AL. 2023 [41]

METHOD

- 12 post-course group interviews
- 17 students from 10 groups
- Interviews conducted **after grades posted**
- Screen sharing to review submissions and GenAI usage
- Collection of students GitHub **repositories** and GenAI **chat history**
- Multi-stage coding process for analysis



COURSE STRUCTURE & GENAI POLICY

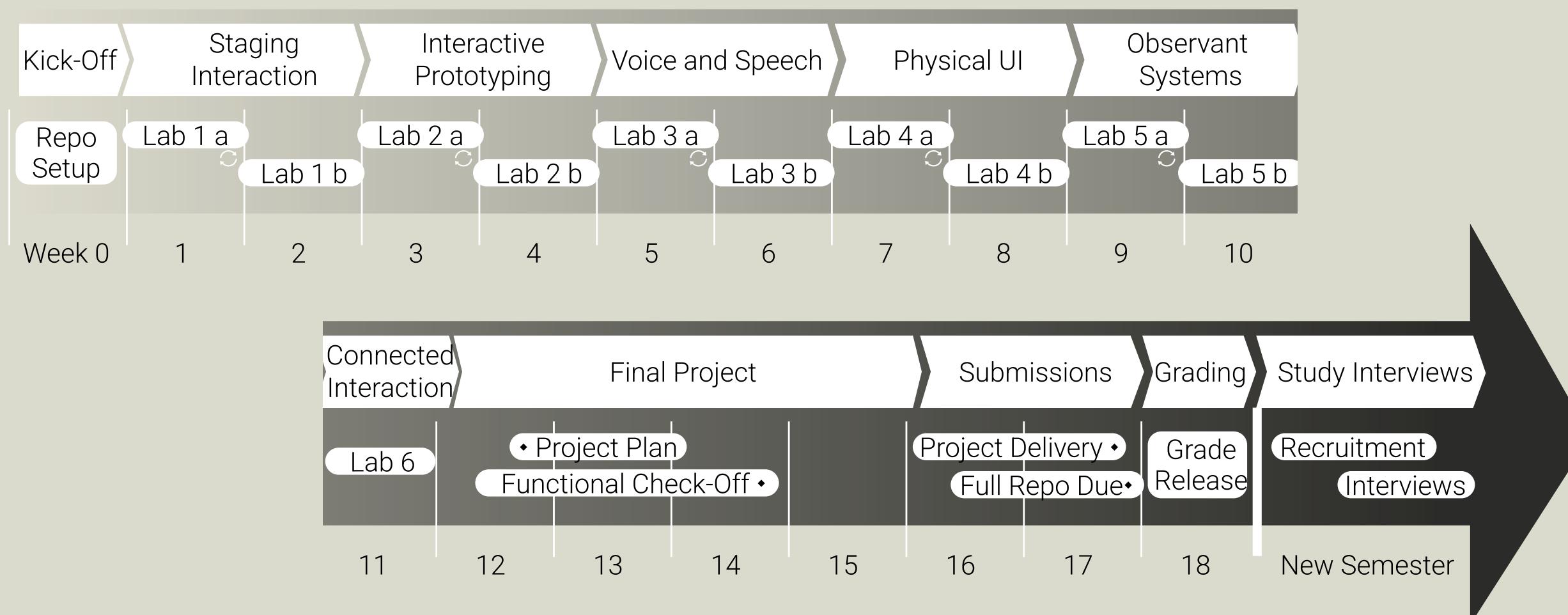


FIG 2: 18-WEEK COURSE WITH 6 ITERATIVE LABS + FINAL PROJECT

Academic Integrity

Each student in this course is expected to abide by the Cornell University's Code of Academic Integrity. Any work submitted by a student in this course for academic credit must be the student's own work. The policy can be found on the [University's website here](#).

In this class, substantial use of online materials and open-source software is encouraged. You are welcome to utilize found code and online examples, and collaborate as part of an open-source community. However, proper attribution of all work, assistance, and collaboration is essential.

You must document and notify the teaching team in advance if you plan to use:

- Work from other concurrent/prior courses,
- Assistance from outside students or people,
- Assistance from ChatGPT or other online services.

This is permitted, but the net amount of work in this and other courses should be equivalent to pursuing different projects independently. The faculty may impose grade penalties for unattributed copying. Penalties for willful and egregious violations can include course failure and University disciplinary action.

FIG 3: THE COURSE POLICY TREATED GENAI AS A REFERENCE SOURCE REQUIRING CITATION RATHER THAN PROHIBITING ITS USE.

KEY FINDING: UNIVERSAL ADOPTION

Reality Check

Students used GenAI far more than disclosed:

- Many initially denied usage in interviews
- Memory prompted when reviewing submissions together
- Viewed GenAI as "auxiliary tool" like Google or calculator

"We don't necessarily just copy and paste whatever it has generated over. So it does have some credits. But the thing is you don't give credits to Google." - (16)

100%
of groups used
GenAI despite no
encouragement

9
distinct use
cases identified

Students attempt to use GenAI for most design tasks assigned.

Most Popular Tools:

- ChatGPT 3.5/4.0: Primary tool for most tasks
- DALL-E: Image and storyboard generation
- GitHub Copilot: Coding assistance
- Google Bard, Bing Chat: Alternative text generation

9 GENAI USE CASES IN INTERACTIVE SYSTEM DESIGN



Brainstorming

Here are five fun and clever ideas for using your sensors: ...



Use Case Development

Your product can also be utilized in a range of scenarios, such as....



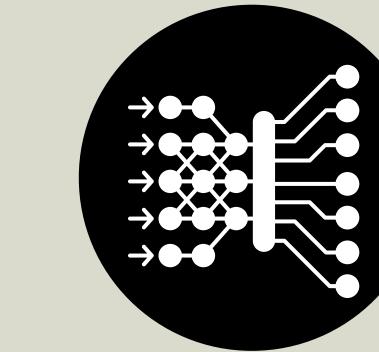
Asset Generation

The laser-cut pattern has been generated for you.



Storyboard Generation

The storyboard is generated based on your descriptions.



Large Text & Image Transformer Models

Prototype Coding



Here is a simple Python code example.

```
# Example usage
time_in_words = "i would like to wake up at nine forty five am"
result = convert_words_to_time(time_in_words)
print(result)
```

Hardware Integration



To integrate a temperature sensor, you need to do: 1. 2. 3. 4. 5...

Learning Support

Documentation



Here is a concise documentation of the provided process: ...

Design Reflection



Here is the study reflection for you: ...One major takeaway is the complexity involved in...

Learning Support



To ensure the 3D model prints well, you need to do:
1. 2. 3...

9 GENAI USE CASES IN INTERACTIVE SYSTEM DESIGN

Students attempt to use GenAI for most design tasks assigned in creative and surprising ways

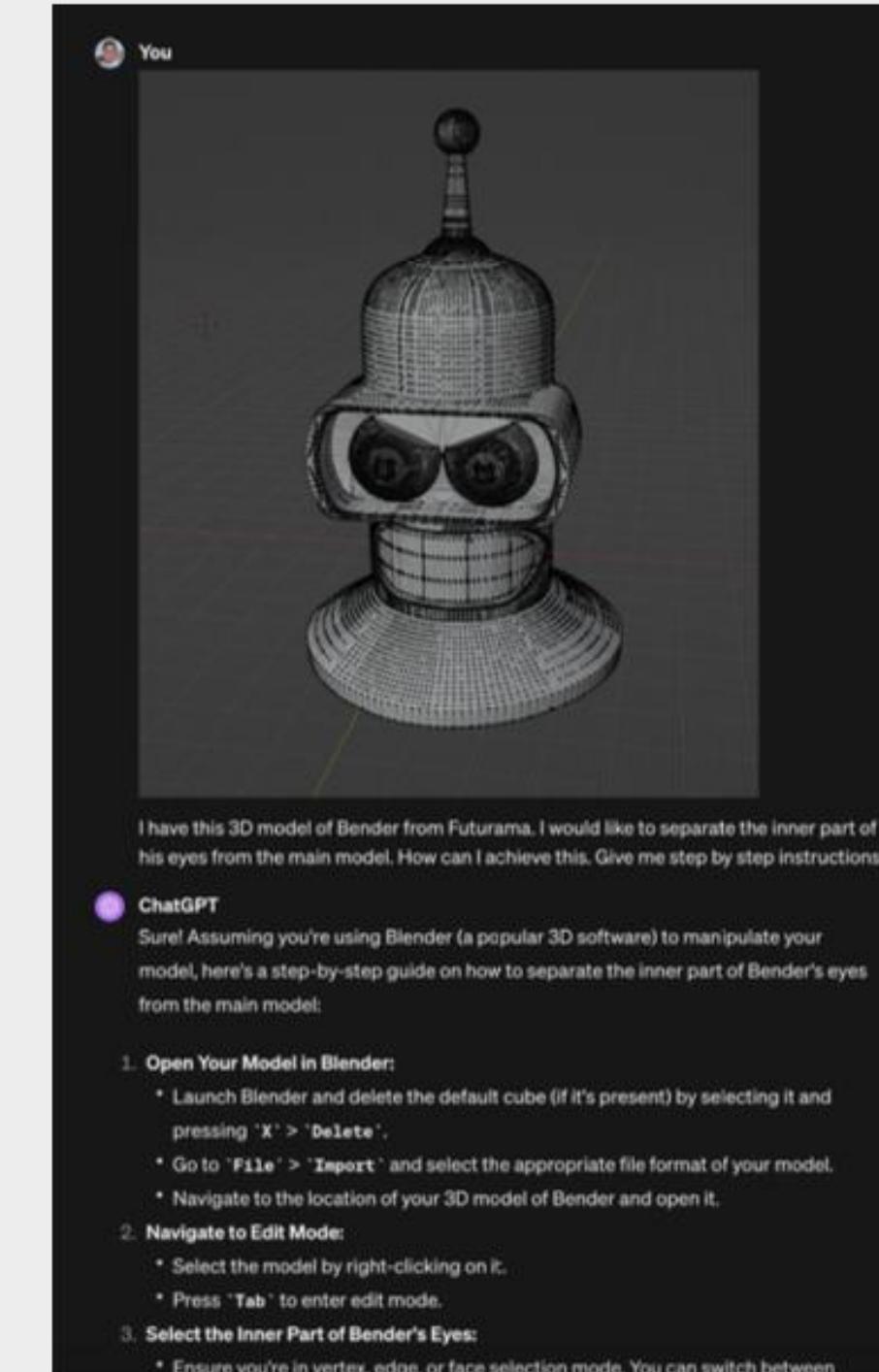


Figure 5: 3D model of Bender from Futurama, with hardware integration instructions generated by ChatGPT (I1).

Learning Support



GENAI USAGE ACROSS DESIGN PROCESS

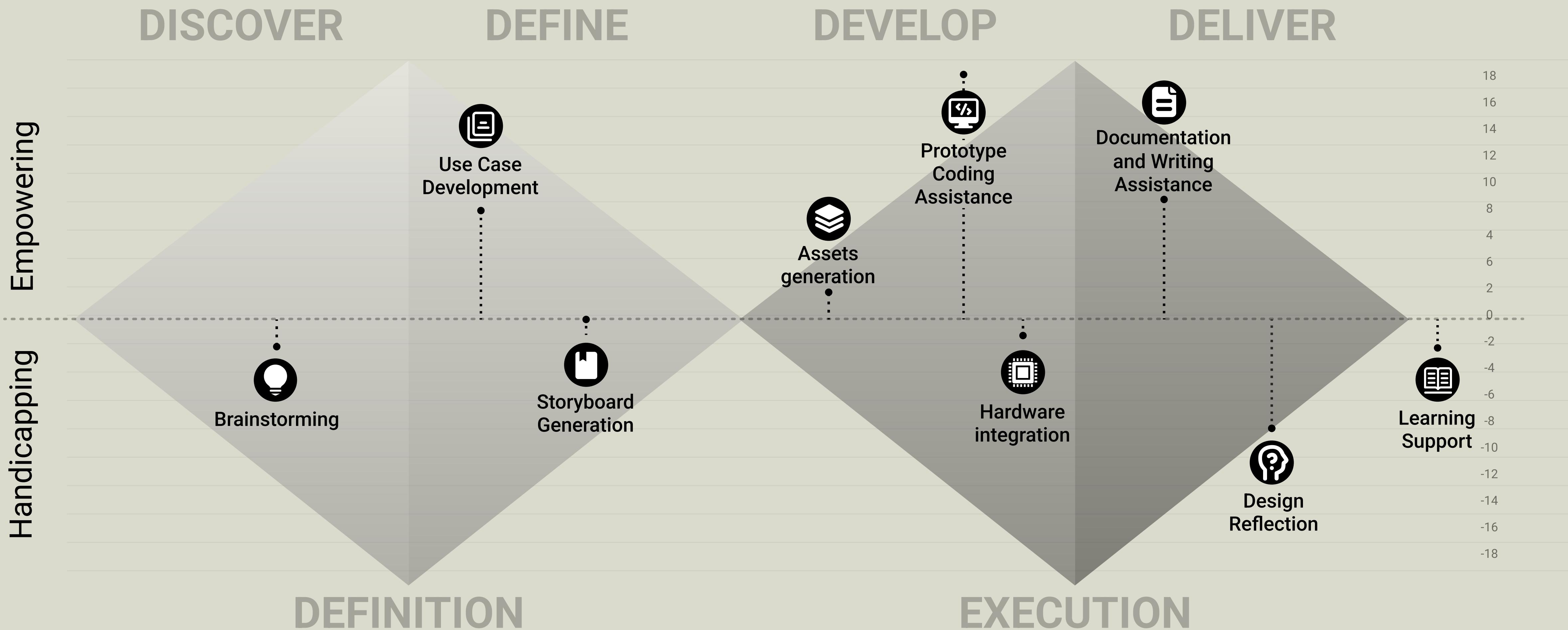
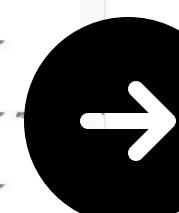


Figure A1: Students' use of generative artificial intelligence mapped to the Double Diamond technology design process [8].
Students' ordinal sentiment about these use cases is quantified from Table A1 student sentiment codes.

STUDENT SENTIMENTS TO GENAI VARIED STRONGLY

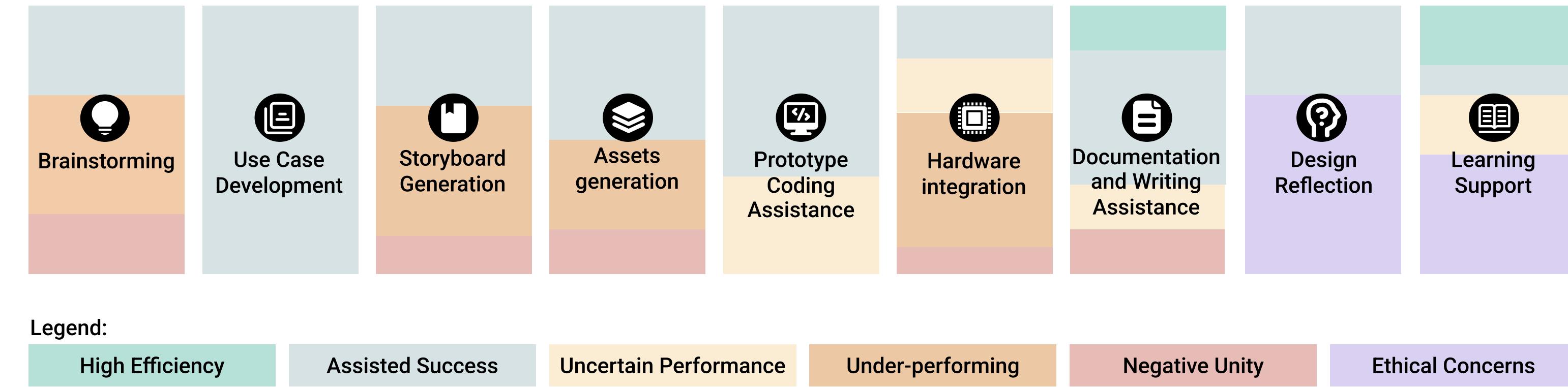


Design Phase	Discover	Define		Develop						Learning		
Use Case / Interview:	Brain-storming	Use case development	Storyboard generation	Assets generation	Prototype coding assistance	Hardware integration assistance	Documentation assistance	Design reflection	Learning support			
1	Under-performing	Assisted Success	Assisted Success	Assisted Success	Assisted Success	Uncertain Performance	Ethical Concerns	Uncertain Performance	Ethical Concerns	Ethical Concerns		
2			Under-performing	Assisted Success								
3	Assisted Success		Under-performing	Under-performing	Assisted Success	Under-performing	Assisted Success					
4	Negative Utility	Assisted Success			Assisted Success		Assisted Success					
5	Negative Utility		Assisted Success	Negative Utility	Uncertain Performance	Negative Utility	High Efficacy	Assisted Success				
6*	Assisted Success	Assisted Success			Assisted Success	Under-performing	Under-performing	Assisted Success				
7*			Under-performing		Assisted Success	Under-performing	Assisted Success					
8	Under-performing				Assisted Success	Under-performing						
9†	Assisted Success	Assisted Success	Negative Utility	Under-performing	Uncertain Performance	Assisted Success	Ethical Concerns	Ethical Concerns				
10	Under-performing	Assisted Success	Assisted Success	Assisted Success	Uncertain Performance	Under-performing						
11					Assisted Success	Assisted Success						
12†	Under-performing		Under-performing		Uncertain Performance	Uncertain Performance	Uncertain Performance	Ethical Concerns				

Table A1: Interviewees' sentiments on using Generative AI for HCI use cases. Asterix^{*} and dagger[†] indicate interviews with students from the same final groups. The spreadsheet containing interview transcript excerpts for assessing student sentiment is accessible in the Open Science Foundation repository [36].

Sentiment coding, with quotes, GenAI chat logs and full transcripts publicly available in the Open Science Foundation Repository: Hauke Sandhaus, Quiquan Gu, Maria T Parreira, and Wendy Ju. 2024. Students' Use of GenAI in HCI Education. osf.io/wt742

STUDENT SENTIMENTS TO GENAI VARIED STRONGLY



Most Positive: Execution Tasks

- Documentation:** High efficacy, streamlined workflows
- Coding:** Excellent debugging and code generation
- Learning Support:** Good for explanations (with caveats)

Most Challenging: Creative Tasks

- Brainstorming:** Mixed results, many stopped using
- Design Reflection:** Ethical concerns about shallow thinking

Common Student Experience

Assisted Success:

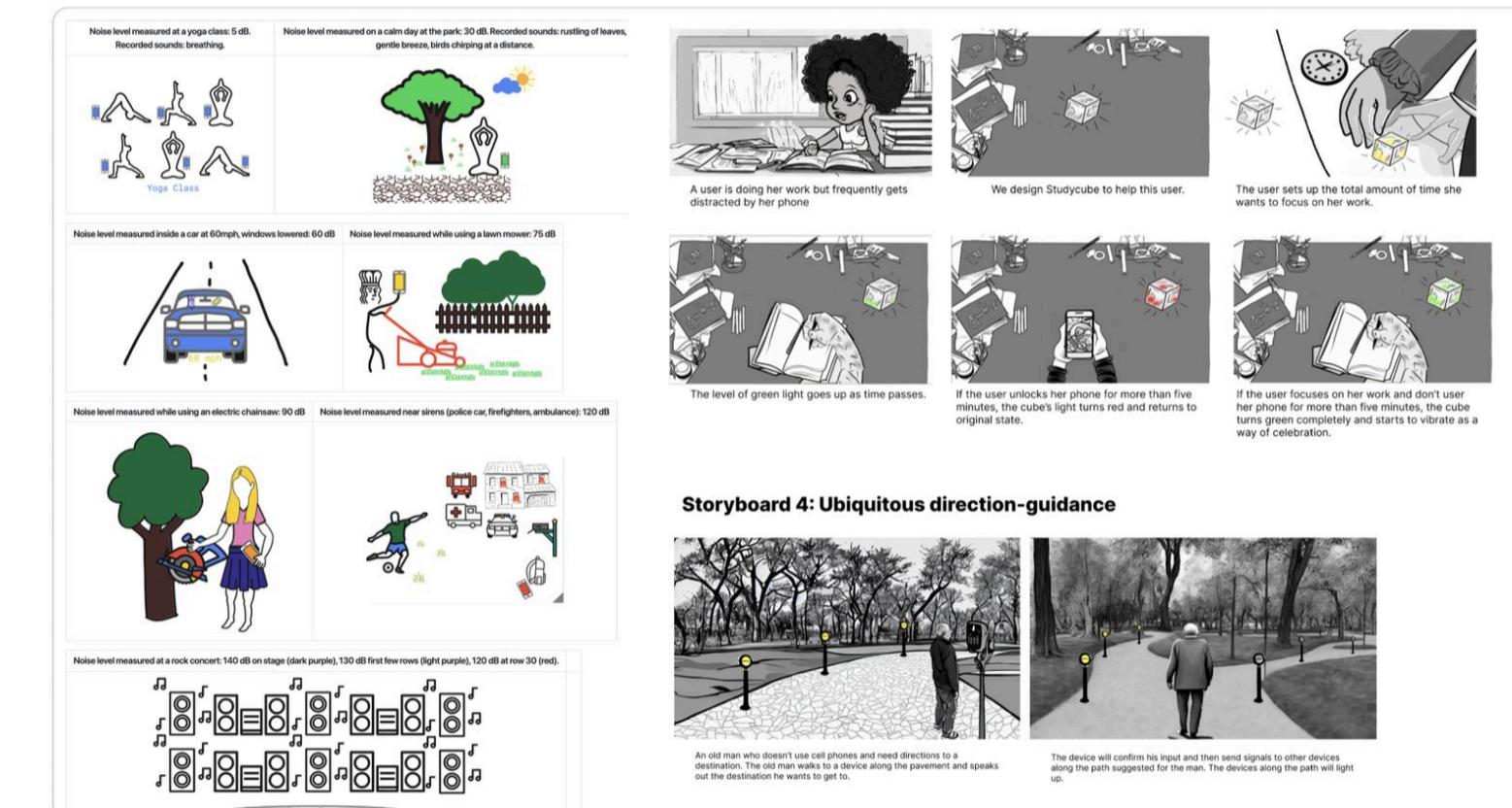
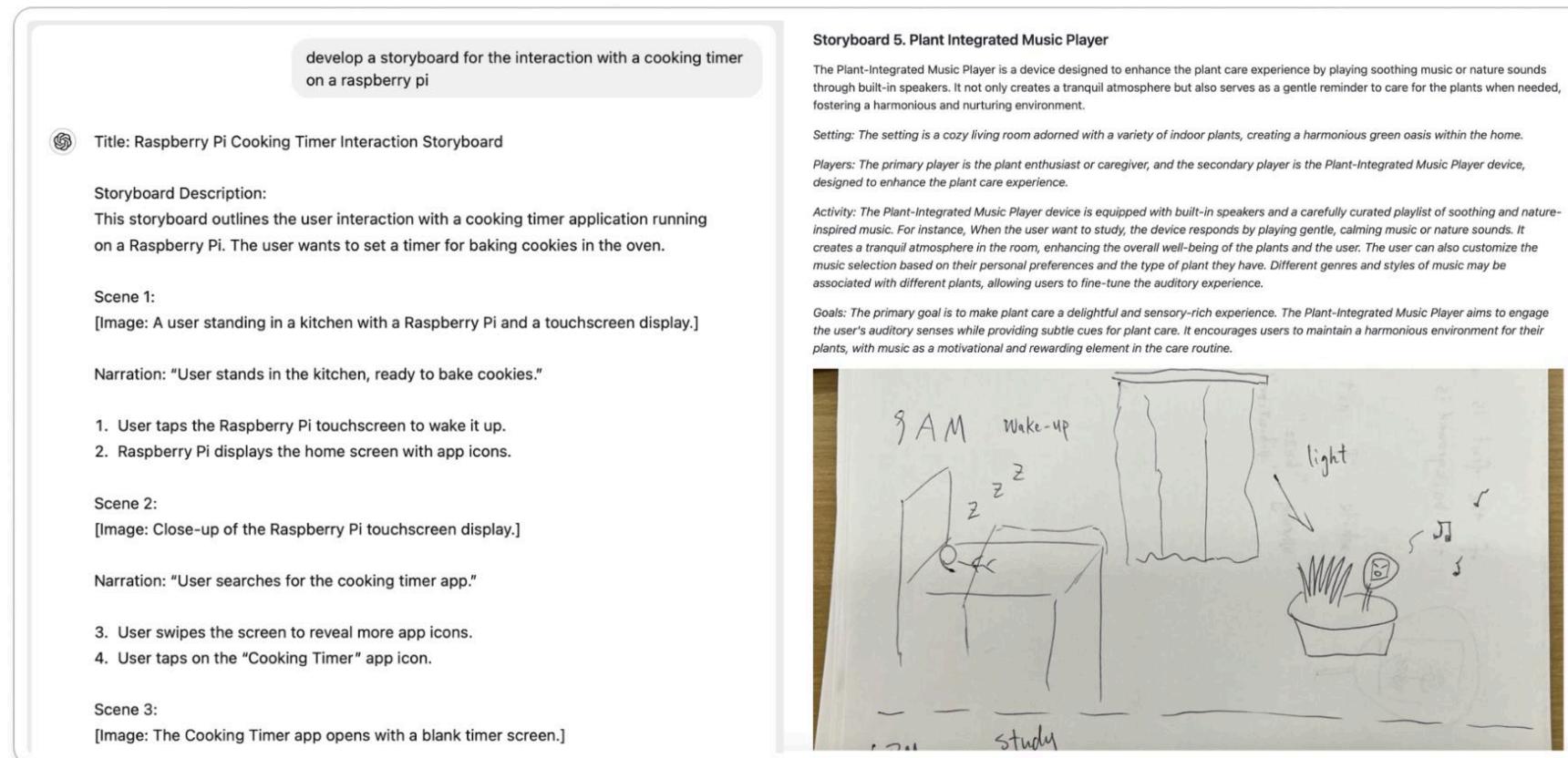
Throughout all use cases
"There was a lot of cursing going on, a lot of yelling with GPT, but again, there is nothing else out there like it" (I1)

Ethical Concerns:

Learning & Reflection
"It could take away the thinking process... You're paying so much to learn" (I1)

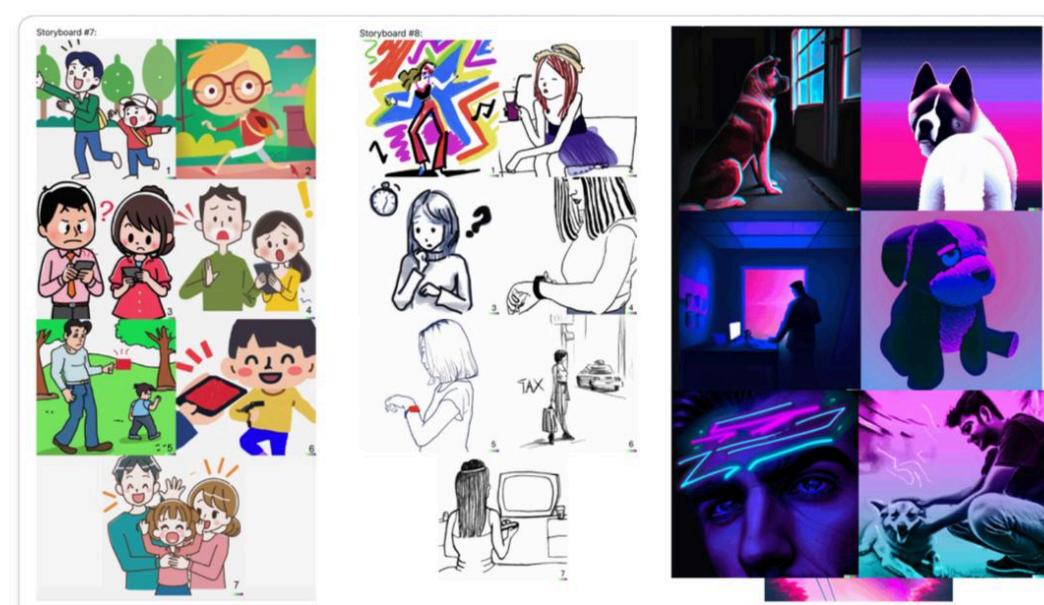
KEY FINDING: DIFFERENT USAGE APPROACHES MEDIATE STUDENTS' SUCCESS AND SENTIMENT

EXAMPLE: STORYBOARD GENERATION APPROACHES

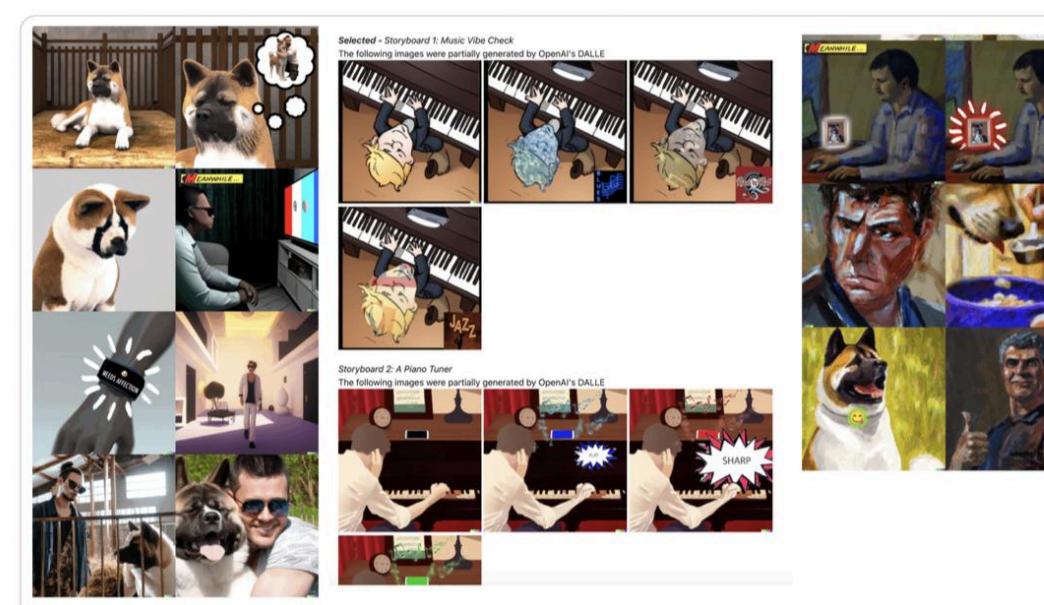


(a) Generating text for an overall storyboard narrative (I9, left) and descriptions for individual frames (I5, right).

(b) Generating individual assets to compose into storyboards: icons (I9, left) and styled image assets (I10, right).



(c) Generating individual frames one by one (I1).



(d) Generating background frames with device and user interactions drawn on top manually (I1, I3).



(e) Generating the entire storyboard at once (I5).

IMAGE CREDIT: JIAO AND WANG, ZHENG, BHANSALI AND REID, AARONS, BHIGROOG, CACERES, MINKOWITZ AND XU, SUBERVIOLA, NIKITOVIC AND PATIL, WU AND SUN.

CONTRAST TO: ZAMFIRESCU-PEREIRA ET AL. 2023 [56], YANG ET AL. 2020 [55]

KEY FINDING: DIFFERENT USAGE APPROACHES MEDIATE STUDENTS' SUCCESS AND SENTIMENT

EXAMPLE: STORYBOARD GENERATION APPROACHES

Assisted Success: “ChatGPT would just give you text descriptions of it, and we would pick the ones that we think are good and then draw it out.” - (I10)

(a) Generating text for an overall storyboard narrative (I9, left) and descriptions for individual frames (I5, right).

(b) Generating individual assets to compose into storyboards: icons (I9, left) and styled image assets (I10, right).

(c) Generating individual frames one by one (I1).

(d) Generating background frames with device and user interactions drawn on top manually (I1, I3).

(e) Generating the entire storyboard at once (I5).

Negative Utility:
“When I drew, it made me explore deeper in design. Physically as I’m drawing, I’m physically imaging why am I drawing it here? Generating is- like too many questions at once.” (I9).

USAGE TAXONOMY: FOUR PATTERNS



BENCHMARK

Compare and improve own work

*"We used GPT for brainstorming
but had many good ideas
ourselves" (I1)*



EXECUTOR

Delegate entire tasks

*"We used ChatGPT to generate
ideas for Raspberry Pi
development" (I9)*



BOOSTER

Overcome specific challenges

*"AI guided us through problem
spaces and suggested overlooked
ideas" (I3)*



AMPLIFIER

Generate beyond capabilities

*Produces results students couldn't
achieve independently*

The same task (e.g., brainstorming) could be Benchmark, Booster, or Executor depending on how students approached it.

Learning outcomes depend more on the relationship between student and AI than the specific application.

CHALLENGES AND NEGATIVE EXPERIENCES

EXAMPLE: STUDENT STRUGGLE WITH REPEATED GENAI PROMPTING

OLED screen.

TypeError: color must be int or single-element tuple

I apologize for the error. The `fill` parameter in the `draw.text` function should indeed take a single integer value, not a tuple. To set the color to (223, 197, 141), you need to convert it to a single integer value. You can use the following code to set the text color correctly:

```
python
# Calculate text size and position.
text_width, text_height = draw.textsize(current_time, font=font)
x = (oled.width - text_width) // 2
y = (oled.height - text_height) // 2

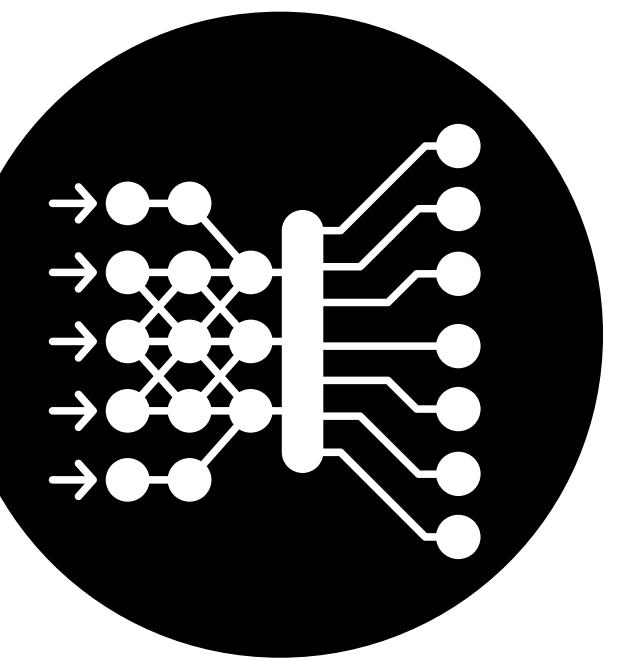
# Convert the RGB color (223, 197, 141) to a single integer value.
text_color = 0 # Initialize as black (0), which is the default background color.
text_color |= (223 << 16) # Set the red component.
text_color |= (197 << 8) # Set the green component.
text_color |= 141 # Set the blue component.

# Draw the current time on the OLED display with the specified text color.
```

"RESPONSES BECAME REPETITIVE AND LESS HELPFUL, PARTICULARLY WITH BUG FIXES IN CODE" (I10).



Teaching assistant



Large Text & Image Transformer Models

Fig. 7 **Cycle of Back-and-Forth Without Resolution.** Student repeatedly submits complete code and error messages. Ultimately fails to address what revealed to be a minor issue. More GenAI interactions archived on OSF [36].

CHALLENGES AND NEGATIVE EXPERIENCES

THREE KEY FACTORS IN STUDENTS INFLUENCING SUCCESS



EXPERIENCE

Prior task knowledge and skill

"I try to tackle the problem myself first and only use it for small technical things like libraries and syntaxes that I don't know." (18)



ENGAGEMENT

in task and learning objective

"We didn't think about using GPT to do that. Maybe we should do that, but no, it's just talking to each other and trying brainstorming." (12)



PROCESS

Comparing to conventional HCI design

Often students prefer alternative not turn based interaction methods, more suitable for slow reflective practices and collaboration.

-- Poor prompting strategies from inexperienced

++ Domain experts used GenAI more strategically

-- Low interest led to use of GenAI to get by

++ High interest tasks led to better human-AI collaboration

-- When traditional methods were faster/better/deeper, sentiment suffered

++ More natural GenAI interaction improves experience

ATTRIBUTION & ACADEMIC IDENTITY CHALLENGES

The Attribution Dilemma:

- Is GenAI a **team member** or **just a tool?**
- How much **credit** should AI receive?
- What constitutes **authentic** student work?
- When does assistance become **academic dishonesty?**

Student Struggle:

"It seems very difficult to sort of untangle... particularly the lack of tools to detect whether anything was generated by AI or not" (I1)

1/10
groups properly documented usage

GenAI Attribution Exercise:

"IF YOU HAD \$1000 TO DISTRIBUTE ACROSS YOUR TEAM AND CHATGPT, HOW MUCH WOULD YOU GIVE CHATGPT?"

GROUP	ATTRIBUTION	REASONING
I1, I3, I6, I10, I11, I12,	\$166 - \$200 (EQUAL)	"FULL TEAM MEMBER"
I2, I4, I5, I7, I8	\$1-75	"JUST A TOOL"
I9	\$350	"BETTER THAN TEAMMATE"

Core Challenge:

*Students are torn between using powerful tools that can positively impact their **grades**, but also have negative impacts on **learning**, maintaining academic **integrity**, and design **depth**.*

ADAPTATION STRATEGIES FOR HCI EDUCATION

WHY AVOIDANCE STRATEGIES FAIL:

- **Detection tools** are unreliable
- Students will use AI **professionally** - we need to teach collaboration
- Banning is ineffective and misses **learning opportunities**

EXAMPLE: HCI PAPER ASSESSMENT ATTEMPT

It seems like you're working on a task related to Design Justice. Let me help you with some suggestions for the Design Justice Hall of Fame and the Design Justice Hall of Shame.

Design Justice Hall of Fame:

Signal Messaging App:

- Why: Signal is an encrypted messaging service that focuses on user privacy. This tool empowers communities by ensuring their communications remain confidential, fostering a sense of security.
- Improvements: While Signal does a commendable job at maintaining user privacy, the

Paper-based ≠ AI-proof

EVIDENCE-BASED RECOMMENDATIONS:

1. Encourage Critical Reflection

Require students to critique, remix, and synthesize ideas with and without AI rather than just generate them.

2. Use Tangible Methods

Bodystorming, role play, card-based brainstorming - naturally AI-resistant.

3. Customization of GenAI Tools

Customize to support course specific limitations and by critical design thinking through tailored prompt strategies.

FUTURE DIRECTIONS: HORNECKER 2010 [15]; KULKARNI ET AL. 2023 [21]; THOLANDER & JONSSON 2023 [44]; VAITHILINGAM ET AL. 2024 [46]

CONCLUSIONS & FUTURE DIRECTIONS

Key Findings:

- **100% adoption** despite no encouragement
- **Execution success** vs. exploration challenges
- **Usage patterns** matter more than specific tasks
- Students need guidance on effective collaboration



Our Contribution:

- 9 use cases mapped to design process
- **4-pattern taxonomy** for educators
- Evidence-based recommendations for adaptation
- Student voice in GenAI education discourse

The Path Forward

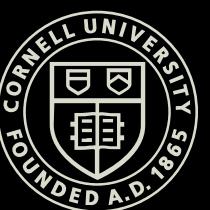
Prepare students for human-AI co-design that preserves critical thinking, ethical judgment, and human-centered design capabilities.

THANK YOU!



ARXIV PRE-PRINT:
[2410.14048](https://arxiv.org/abs/2410.14048)
DIS PROCEEDINGS:
[10.1145/3715336.3735805](https://doi.org/10.1145/3715336.3735805)

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Co-Designing with Transformers: Unpacking the Complex Role of GenAI in Interactive System Design Education

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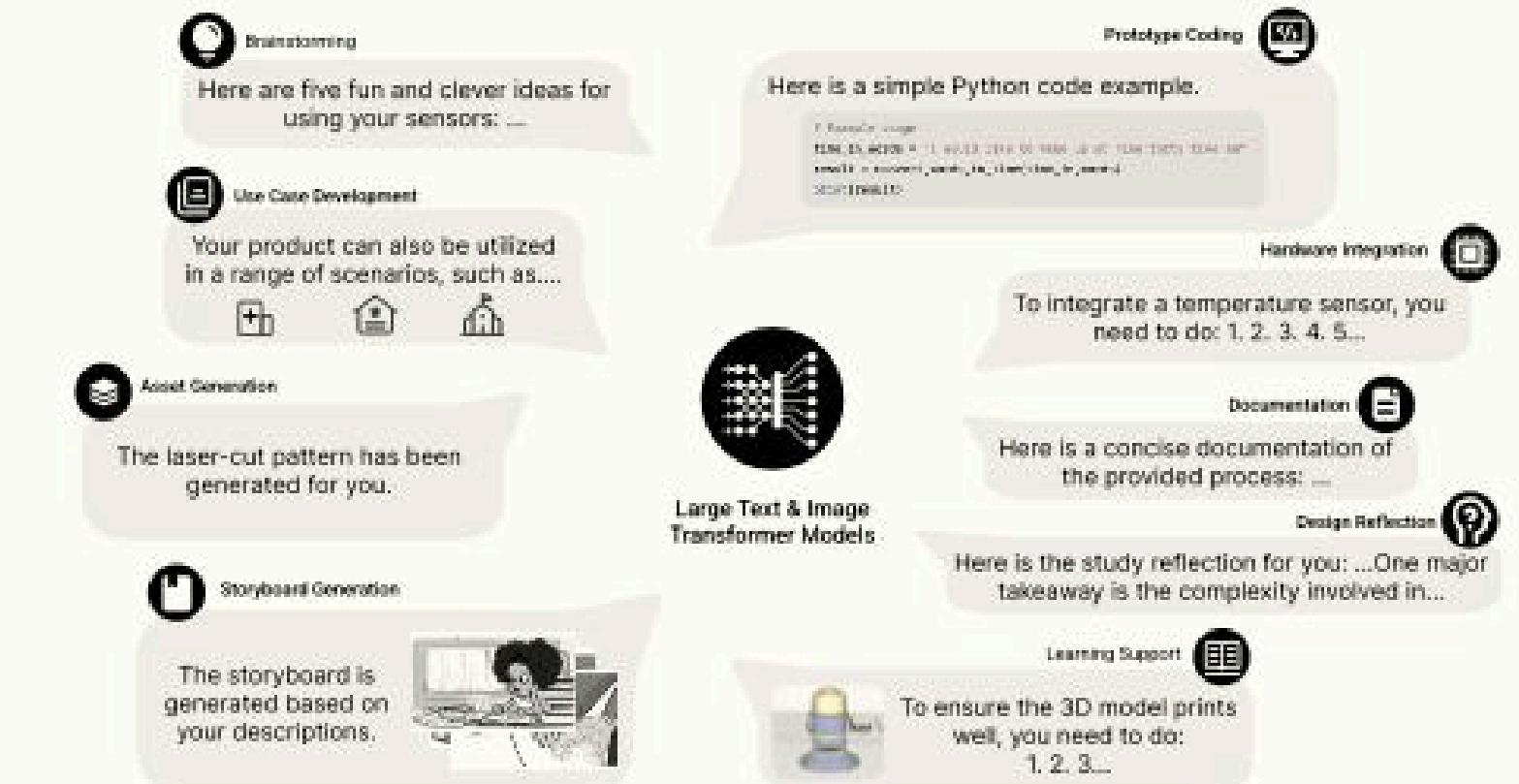


Figure 1: Identified most common use cases of GenAI in the Interactive Device Design class, exemplified by chatbot-style responses.

Abstract

Generative Artificial Intelligence (GenAI) is transforming Human-Computer Interaction (HCI) education and technology design, yet its impact remains poorly understood. This study explores how graduate students in an applied HCI course used GenAI tools during interactive device design. Despite no encouragement, all groups integrated GenAI into their workflows. Through 12 post-class group interviews, we identified how GenAI co-design behaviors present both benefits—such as enhanced creativity and faster design iterations—and risks, including shallow learning and reflection. Benefits were most evident during the execution phases, while the discovery and reflection phases showed limited gains. A taxonomy of usage patterns revealed that students' outcomes depended more on how they used GenAI than the specific tasks performed. These findings highlight the need for HCI education to adapt to GenAI's role and offer recommendations for curricula to better prepare future designers for effective creative co-design.

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CCS Concepts

• Human-centered computing → Interface design prototyping; User centered design; Empirical studies in HCI.

Keywords

LLMs, GenAI, education, prototyping, user-centered design, ethics

ACM Reference Format:

Hauke Sandhaus, Qiuquan Gu, Maria Teresa Parreira, and Wendy Ju. 2025. Co-Designing with Transformers: Unpacking the Complex Role of GenAI in Interactive System Design Education. In *Designing Interactive Systems*