# A Personalized Learning Approach to Support Students with Diverse Academic Backgrounds


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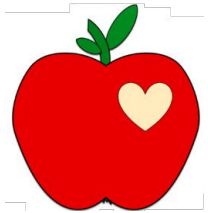
# Motivation

- Teaching goal: Improve student learning experience in HCI while considering their diverse backgrounds and interests
  - Allow experienced students to advance quickly
  - Introduce flexibility to accommodate varying pace
  - Provide opportunities for reassessment



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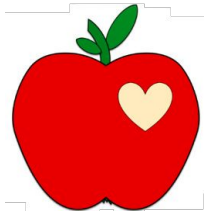

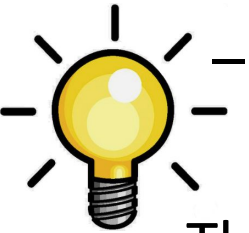

- This work: Study involving four personalization features and evaluates their impact on the student learning experience

# Related Literature

- HCI education
  - Challenges unique to teaching HCI
    - Rapid changes in technology
    - Technical students complain it's "too easy" or "too fuzzy"
    - Lack of general consensus on what to teach across 30+ countries
    - "A living curriculum" [Churchill, Bowser & Preece, 2014]

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  - Challenges unique to teaching HCI
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    - Lack of general consensus on what to teach across 30+ countries
    - "A living curriculum" [Churchill, Bowser & Preece, 2014]
  - Techniques reported in studies:
    - Involve real users or an external client
    - Change culture of individualized summative assessments
    - Focus more on design process, less on design outcomes
    - Conduct design critiques
    - Create platform to experience and explore design space
    - Rebrand HCI discipline globally

No personalized learning work

# Related Literature

- Equitable grading
  - Flexibility to accommodate students with personal constraints
  - Crucial for underserved and vulnerable populations
  - Reduce implicit bias by assessing knowledge
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    (e.g. late submissions, participation)

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- Equitable grading
  - Flexibility to accommodate students with personal constraints
  - Crucial for underserved and vulnerable populations
  - Reduce implicit bias by assessing knowledge
    avoid influences from environmental and behavioral factors
    (e.g. late submissions, participation)
- Controversy over grades have led to alternative approaches
  - Mastery learning
  - Specifications grading
  - Ungrading

# Related Literature

- Personalized learning
  - Long history of personalization based on student's skills, preferences, personality, emotional state, demographic characteristics, sociocultural context
  - Studies to examine relationships between specific learner variable, adaptations implemented, and observed learning outcomes
  - Most personalizations are developed in an exploratory way
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  - Most personalizations are developed in an exploratory way
  - Field lacks explanatory theory to guide pedagogical choices
- Overarching taxonomy of adaptivity [Plass & Pawar, 2020]
  - Adaptive elements for assessments
    - Testing frequency
    - Test item difficulty
    - Modes of responses presented
    - How test results are displayed

We add 4 personalization features

# Research Questions

1. ***Uptake:***
   Do students take advantage of the personalization features provided in the course?

2. ***Performance:***
   Does student performance improve with personalization?

3. ***Perceptions:***
   What is the student perception of the personalized learning approach in the new course design?

# Course Context and Redesign

- Third-year undergraduate HCI course offered in CS
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    - Synchronous classes to align progress and expectations
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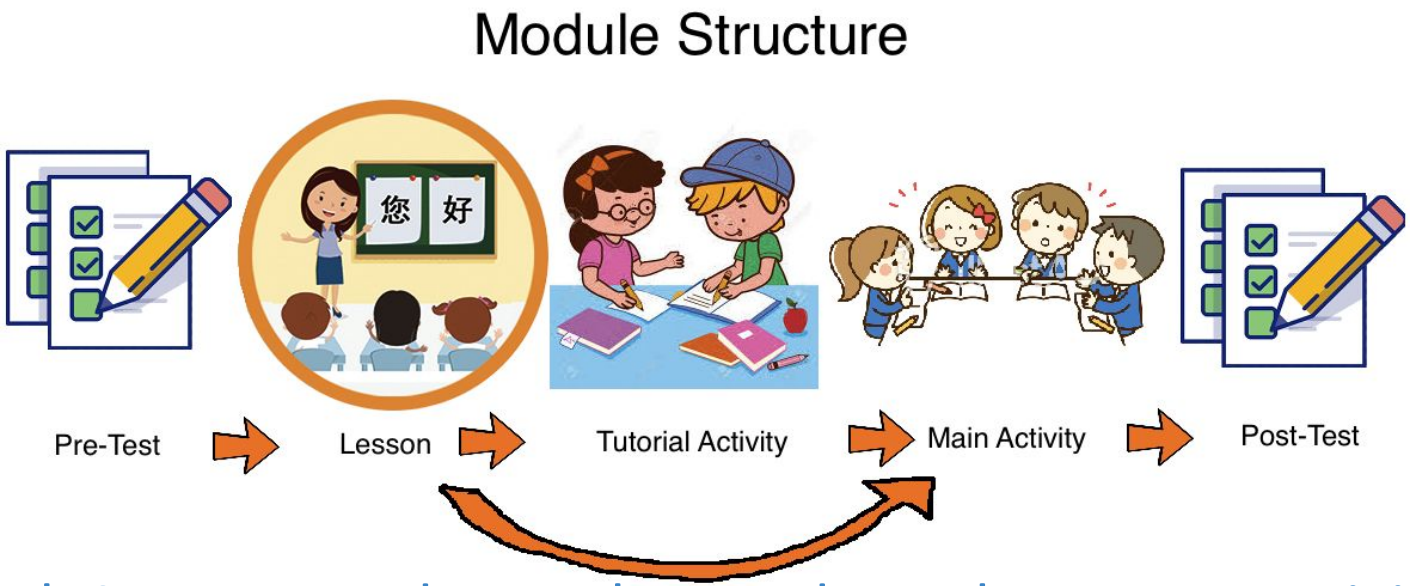
- Goal: Incorporate flexibility to give students control over their pace of learning and what they want to learn
  - 4 personalization features

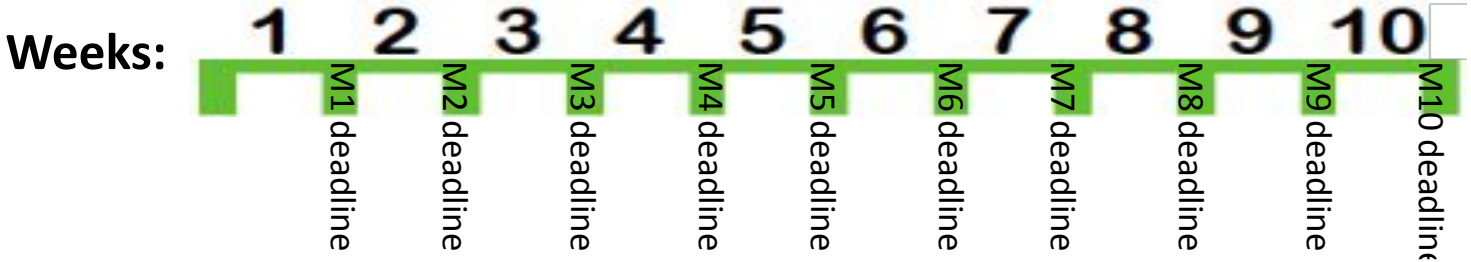
# #1: Alternate Pathway




- Goal: Support students who need supplementary activity; provide students with alternative to assessment to a test

# #2: Flexible Timing

- Intended post-test due date with no penalty over 3-weeks
  - Students can get help during this period



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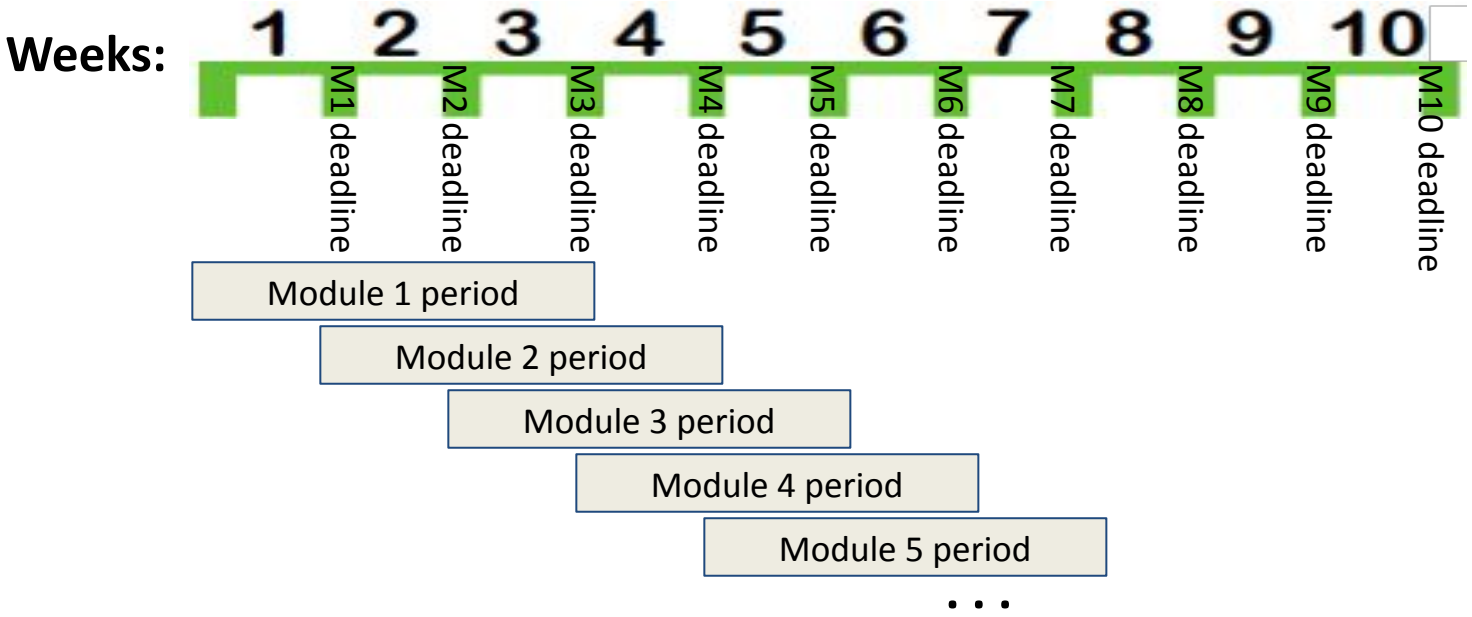

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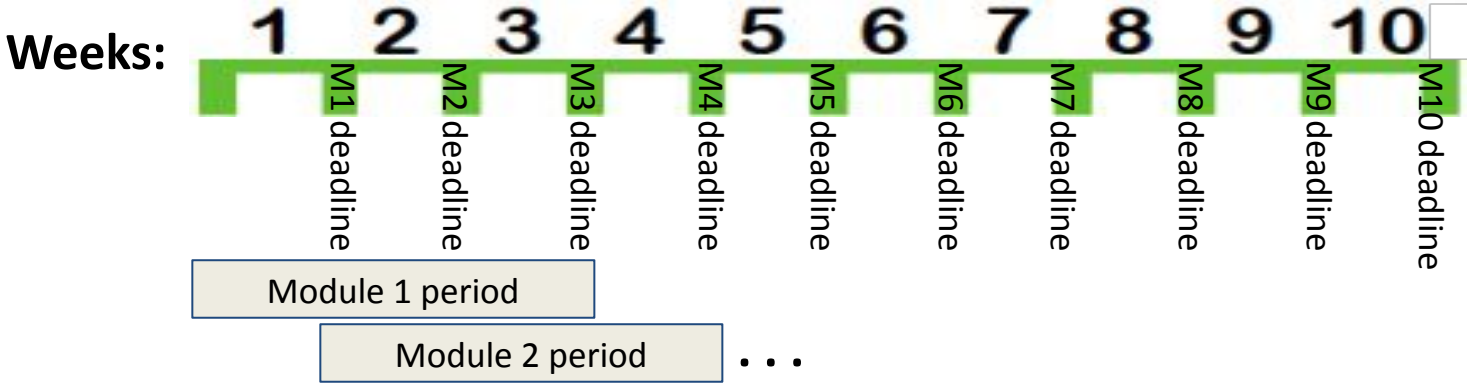


- Advance to next module once prereq module is completed
  - Students can do work in advance if desired
  - Minimize conflicts with other course deadlines
- Goal: Accommodate varying abilities/pace to achieve mastery

# #3: Mastery Learning and Deliberate Practice

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  - Unlimited attempts lead to over-submission
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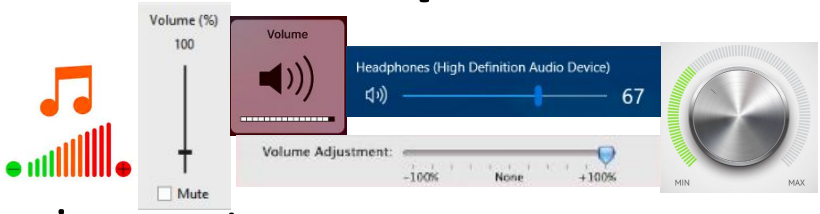
- Our work:
  - Maximum 3 attempts, keep best score
  - Alignment between pre-test and post-test questions

- Goal: Give students a second chance with targeted feedback

# #4: Choice in Assessment Options

- Additional programming project
  - Volume control widget
  - Divided into 6 individually graded assignments
    - Scaffolding for experiment to compare 2 techniques
    - Implement desktop interaction techniques and hand gesture recognition techniques



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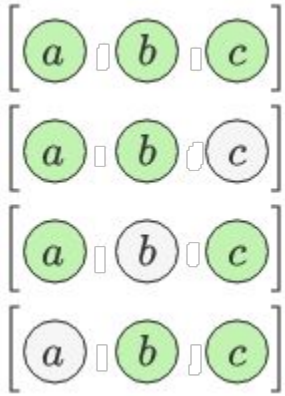
  - Overall, 3 of 6 assignments required students to choose 2 of the 3 options to complete




- Goal: Students choose to do what they like most

# Data Collection

- Over two years with N=360
  - Year 2021: With 160 undergrads and 1 grad
    - 29 females, 131 males
    - 14% non-majors
  - Year 2022: With 193 undergrads and 6 grads
    - 29 females, 170 males
    - 17% non-majors

# RQ1: Uptake of Personalization Features

- High uptake on all 4 personalization features
  - Alternate pathways
    - Up to 19% uptake
  - Flexible timing for deadlines
    - Average: -47.9 hours
    - Range: 8.5 weeks prior and 13.5 days after
  - Multiple test attempts
  - Student choice in project options
    - Least popular option with 14-43% uptake

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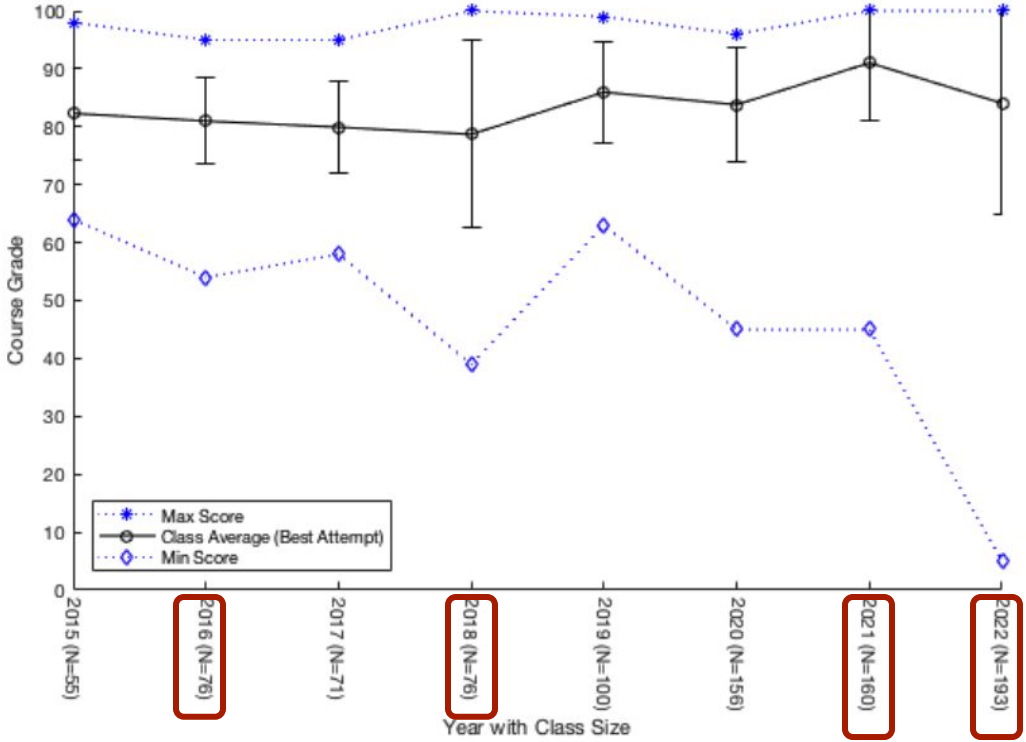
*Evidence of engagement in deeper learning

# RQ2: Changes in Student Performance

- 2021 sig. > others
- 2022 sig. > 2016,17,18
  - Suspect improvement due to multiple test attempts




Boxes = Same instructor

# RQ2: Changes in Student Performance

- 2021 sig. > others
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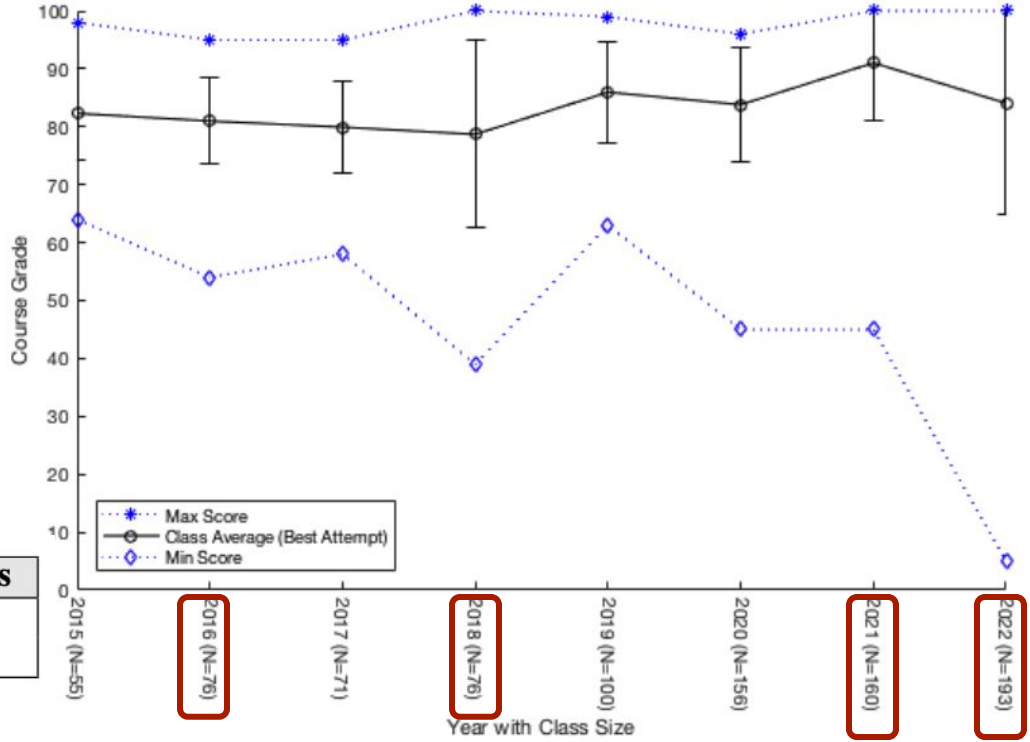
  - Suspect improvement due to multiple test attempts
- No stat. sig. differences in subgroup averages

| Year | CS Majors | Non-Majors | Graduate Students |
|---|---|---|---|
| 2021 | 91.2 | 90.1 | NA |
| 2022 | 84.4 | 83.7 | 87.3 |

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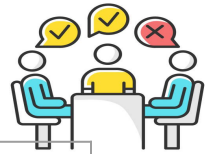
# RQ3: Student Perceptions from Teaching Evaluations

- Drastic improvement in student evaluations



old | new

| | 2016 | 2018 | 2021 | 2022 |
|---|---|---|---|---|
| **Enrolment** | 76 | 76 | 160 | 193 |
| **Num. Responses** | 34 | 59 | 90 | 106 |
| **Overall Instructor Rating (Max. 5.0)** | 3.4 | 3.5 | 4.94 | 4.60 |

old design: 138 strengths from 93 students (~1.5 strengths/response)
new design: 449 strengths from 196 students (~2.3 strengths/response)

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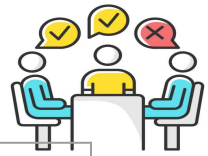

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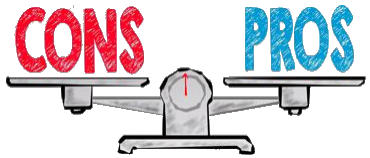
- Thematic analysis on responses from "What were the strengths of this course?"
  - Organization (79), content (66), professor (42), new test approach (27), everything (23), teaching style (19), project (16), self-pace (15), online format (15), flexibility (14), fair eval (14), clarity (13), asynchronicity (12), design (11), application (10), second chance (8), difficulty (8), support (8), relevance (7), student interest (7), low stress (6), maintain progress (6), redesign effort (5), alternate pathway (3), …

# Discussion and Future Work

- Design consideration
  - Similar levels of success across subgroups: majors, non-majors, grad students
  - Some features have higher development overhead and/or higher administrative overhead



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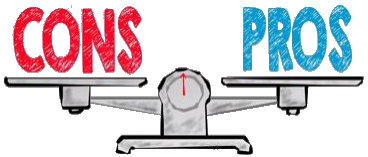


- Limitations
  - Positive perceptions could be due to improvement in instructor
  - Thematic analysis does not have full coverage; students wrote what they wanted to focus on
  - Future controlled study to relate learner variable to impact of personalization