Cultivating Curiousity

Pedalogical Tools and Student-Led Projects

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How can we create educational experiences that resonate long after the lesson ends? In this talk, Dr. Lucas Cordova invites you to explore his lab's journey in designing Pedalogical, an AI-powered platform that empowers students to reflect deeply and claim ownership of their learning, and Testing Tutor, a dynamic tool that transforms software testing practice into a gateway for heightened code security. Looking beyond the now, Dr. Cordova reveals future directions for his research—illuminating a path forward for those eager to get involved. Alongside these innovations, Dr. Cordova shines a spotlight on student-driven collaborations, from building niche social networks that nurture authentic connections, to engineering smart agricultural technologies that help even the boldest pumpkin growers chase new heights. Together, these projects reveal how human-centered design makes learning moments not just memorable, but lasting.

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0.1 About Me

0.1.1 Teaching Areas

- Intro to Programming
- Data Structures
- Algorithms

- Software (Mobile Dev, Game Dev)
- SQL & Data Engineering
- CS Capstone & DS Capstone

0.1.2 Research Areas

- Educational Technology & AI-Powered Learning
- Software Testing & Security Education
- Human-Centered Design in Computing Education
- Student-Driven Innovation Projects

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0.2 Overview

0.2.1 1. Research on pedagogical tools

0.2.2 2. Student-led innovation projects

0.3 The Challenge

> How can we create educational experiences that **resonate long after the lesson ends**?

- Moving beyond traditional passive learning
- Empowering student ownership and reflection
- Bridging theory and practice in education
- Creating memorable, lasting learning moments
- Leveraging technology to enhance learning

0.4 The Vision

0.4.1

"Where learning *adapts* and technology *empowers*."

- Tools that adapt to individual learning styles
- Experiences that bridge classroom and career
- Technologies that empower rather than replace human connection

1 Pedalogical

1.1 Pedalogical

1.1.1 Transforming Learning Through Deep Reflection

- **AI-powered platform** for creating personalized learning experiences
- Empowers students to **claim ownership** of their learning journey
- Grounded in learning theories

1.2 Built by Students, for Students!

Developed with contributions from 6 students over the last year:

- Teo Mendoza (CS)
- Gavin Smith (Physics)
- Sam Holmes (Math/CS)
- Shouvik Ahmed Antu (CS/DS)
- Ben Webster (CS/DS)
- Derec Gregory (CS/DS)
- Josh Torres (Psychology)

1.3 Theoretical Foundations

1.3.1 Learning Theories Informing Our Design

- **Constructivism** (Bruner, 1990): Students build knowledge through experience
- **Cognitive Load Theory** (Sweller, 1988): Optimizing mental effort for learning
- **Self-Regulated Learning** (Zimmerman, 2000): Ownership drives motivation
- **Bloom's Taxonomy** (Anderson & Krathwohl, 2001): Moving from knowledge to creation

1.4 Pedagogical Strategies Enabled

1.4.1 Assessment Methods

- **Formative Assessment**: Continuous feedback to guide learning
- **Summative Assessment**: Evaluating mastery at course end
- **Self-Assessment**: Fostering metacognitive skills
- **Bloom's Taxonomy** (Anderson & Krathwohl, 2001): Moving from knowledge to creation

1.4.2 Question Types

- **Multiple Choice**: Quick checks for understanding
- **Matching**: Reinforcing connections
- **Process**: Step-by-step comprehension
- **Feynman**: Deepening understanding through explanation

1.5 Blueprints, Journeys, and Nodes

- **Blueprints**: Structured templates guiding learning paths
- **Journeys**: Personalized learning experiences crafted by students
- **Nodes**: Individual learning activities or reflections

1.6 Feynman Technique

1.6.1 Explaining concepts in one's own words enhances retention and comprehension

1.7 Unstructured Chatbot

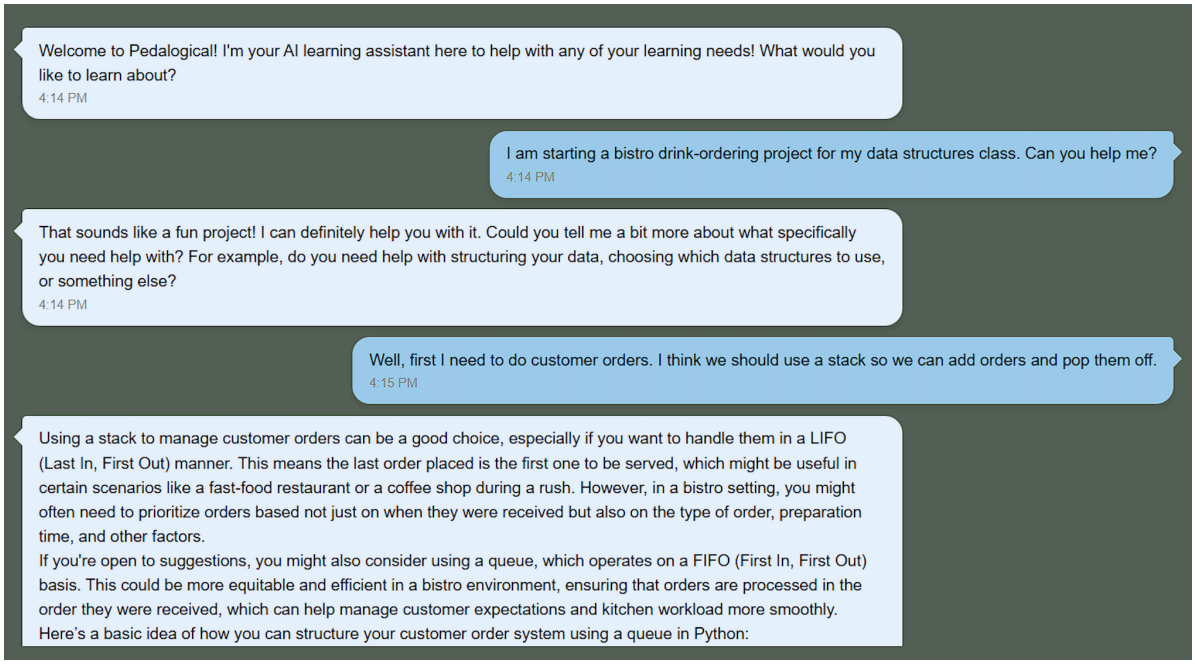

Figure 1: Figure: Unstructured Chatbot

1.8 Pedalogical Chatbot

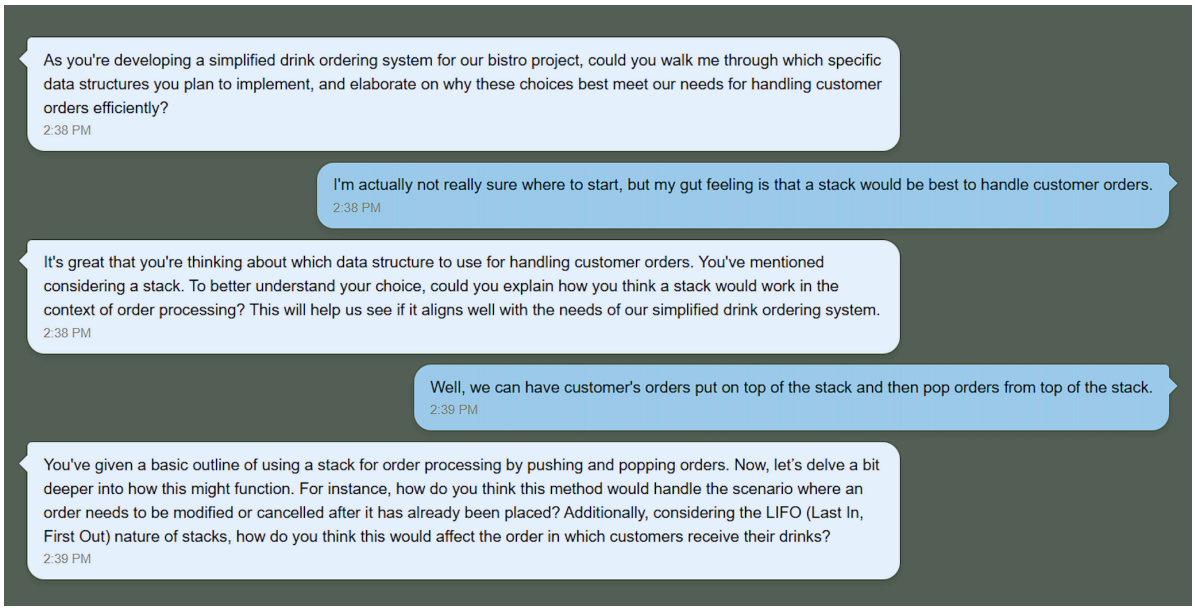

Figure 2: Figure: Pedalogical Chatbot

1.9 Demonstration

1.10 Pedalogical in Action

1.10.1 Willamette University - Data Structures Study

- **Focus**: Evaluating the effectiveness of a structured versus unstructured chatbots
- **Context**: Students were asked to use the chatbot to design a medium-sized data structures project
- **Key Finding**: Students using the structured chatbot performed 20% better on project outcomes suggesting increased metacognitive awareness and problem-solving strategies
- **Status**: Publication under review

1.11 Preliminary Results Barchart

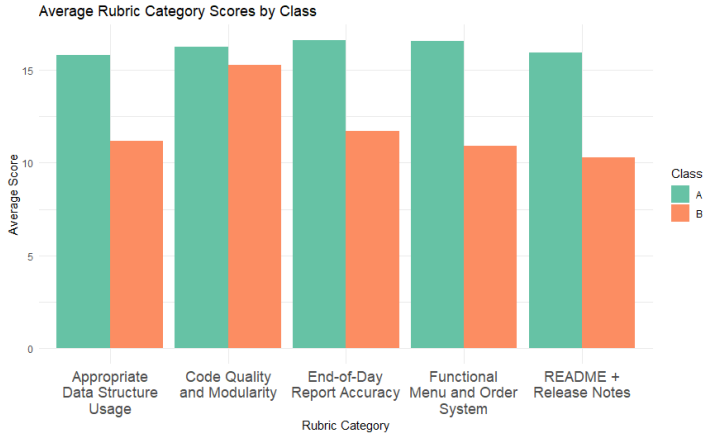

Figure 3: Figure: Barchart comparing project scores between structured and unstructured chatbot users

1.12 Preliminary Results Boxplot

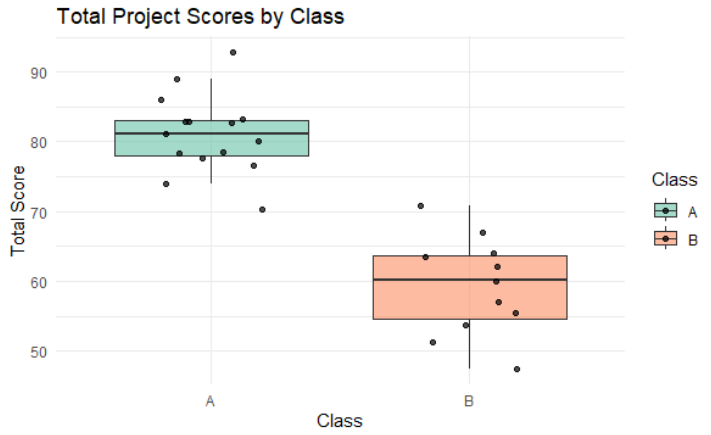

Figure 4: Figure: Boxplot comparing project scores between structured and unstructured chatbot users

1.13 Future Directions

1.13.1 Expanding Pedalogical's Impact

- Integrating AI-driven adaptive learning paths

- Collaborating with educators for diverse applications
- Conducting longitudinal studies on learning retention
- Open-sourcing the platform for broader access

2 Testing Tutor

2.1 Testing Tutor

- Focus of an NSF grant awarded
- Dynamic tool transforming software testing practice by focusing on conceptual feedback over detailed feedback
- Validated previously through studies at Western Oregon University, Oregon Institute of Technology, University of Alabama, and Augusta University

2.2 From Testing Practice to Security Mindset

- Expanded focus to include security vulnerability identification
- Encourages students to think like attackers, enhancing defensive coding skills
- Promotes deeper understanding of software security principles
- Integrates experiential learning theory (Kolb, 1984)
- Utilizes Pedalogical's backend

2.3 Current Testing Tutor Studies

2.3.1 Augusta University

- **Focus**: Vulnerability Analysis
- **Status**: Publication accepted
- **Impact**: Students identified 40% more security vulnerabilities after training

2.3.2 University of Alabama

- **Focus**: Software Testing Concepts
- **Status**: Publication under review
- **Application**: Full semester integration in testing courses

3 Student-Driven Innovation

3.1 Student-Driven Innovation

3.2 Rae's Room: Authentic Connections

3.2.1 A Social Network for Chinese American Adoptees

Project Overview

- Niche social networking platform
- Focus on authentic cultural connections
- Built with React Native
- Students: Sam Holmes, Saul Ifshin, Rae Ota

Research Angles

- Cultural usability
- Social networking dynamics
- Privacy considerations
- Cross-platform development

Join Our Team!

We're looking for interested students to contribute to this meaningful project

3.3 Giant Pumpkin Soil Amendment Solver

3.3.1 Pumpkin Growth Optimization System

- **Innovation**: Determines precise nutrient values for award-worthy giant pumpkins
- **Impact**: Helping growers "chase new heights"

3.4 Upcoming Events

Don't Miss!

Join us for Ellann Cohen's talk
September 18th
Learn how technology meets tradition in competitive pumpkin growing!

3.5 Ellann's 2025 Harvest

Figure 5: Figure: Ellann Cohen with her giant pumpkin

3.6 Future Directions

3.6.1 Illuminating the Path Forward

- Expanding AI integration in educational tools
- Cross-institutional collaborations
- Open-source educational technology development
- Student-led research initiatives

3.7 Get Involved!

3.7.1 Opportunities for Collaboration

For Students

- Join Rae's Room development team
- Contribute to Testing Tutor modules
- Propose new research projects

For Educators

- Pilot our tools in your courses
- Collaborate on research studies
- Share feedback and insights

3.8 Thank You!

3.8.1 Questions & Discussion

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Current Projects:

- Pedalogical Platform
- Testing Tutor
- Rae's Room
- Smart Agriculture Systems

3.9 References

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