A Novel Interdisciplinary Course in Gerontechnology for Disseminating Computational Thinking

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Motivation

• Contemporary problems are often complex and cross-disciplinary in nature, and yet students receive little if any training in interdisciplinary collaboration
• Computer systems are everywhere, but most students are merely end-users, and know very little about computers and the critical thinking behind them
• Reach out to non-CS students by encouraging them to work on projects that can actually help people addressing real problems and be used by real users
Interdisciplinary Teamwork

• It’s there… on the screen
• Stereotypes about engineers being nerds without social skills
• We trained students to collect and analyze data, but never asked for real solutions
• A booming ring

Most of time, knowing how to work in interdisciplinary teams does not come naturally, but must be taught

Plus, we try to disseminate non-CS major students computational thinking
U. S. 65+ population
1990 31.1 mil
2020 54.0 mil
2050 79.0 mil

U. S. 85+ population (mil)

Iowa has the highest percentage of people age 85 or older in the U.S. (2.1% 1996 to 3.1% 2025)
Cost of Senior Care

- Nursing homes (50,000/annual, 115/day)
- Home health care (85/visit, 100/day)
- Assisted living facilities or retirement housing (1000-5000/month, 12000-60000/annual, average 72/day)
- Adult day care (10 – 50/day depend on the kind of care)

Other senior care services
- Geriatric care manager (40 – 100/hour)
- Emergency response service (35 – 100/month)
- Medication reminder service (20/month)
- Meal delivery service (2 – 5/meal)
- Transportation service (50-100/round trip)
- Senior Center

By 2050, the overall cost of senior care will be in the range of 600 billion USD annually
About the Course

• ComS/Geron 415x
  Gerontechnology in Smart Home Environments
• Pre-requisite:
  – for ComS 415x: Programming I/Intro to OOP
  – For Geron 415x: Aging and the Family
• Objective
  To train next generation of gerontechnologists (scientists, engineers and designers) that can identify opportunities, assess options and create new solutions which utilize technology to improve older users’ real needs
• Challenge
  – New area: very few courses have been offered, no suitable textbook, and very little precedence to guide the course development
  – Must be developed collaboratively by an interdisciplinary team of faculty, since no one has enough expertise to develop new course materials in all areas
Course Development Process

- Brainstorming
- Identify cross-cutting themes
- Learning module design
- Integration and scheduling
- Refinement
- Variation
Interdisciplinary Collaboration

HCI/Design

Computer Science

Gerontology

Gerontotechnology
Pedagogy

- Dr. Repinned
- Computation Thinking (CT)
- Inquiry
- Universal Design (UD)
- Interdisciplinary Teamwork
- Social Pedagogy

User Study and Ethics
- Direct Instruction
- Guided Discovery

Software Engineering
- Direct Instruction
- Guided Discovery

System Modeling & SOA
- Direct Instruction

Assistive Tech
- Direct Instruction
- Guided Discovery

Design Guideline for Seniors
- Inquiry

Aging Process
- Inquiry

Computational Thinking (CT)

Inquiry
Learning Activities

- Guided Discovery
- Direct Instruction

Interdisciplinary Learning Activities Design

- Lectures
- Term Projects
- Student In-Class Presentations
- Critique Session
- Field Trip
- Group Discussions
- Peer Review
- Hands-on Workshop
- Mentorship
- Crash-course
- Competition
- Joint Lectures
Peer Learning

• In-class presentation
• Semester-long team project
• Peer reviews
• In-class discussions
• Online discussions
Protocol of User Study

• Use of IRB-approved 37-question 4-point Likert scale survey instrument

• Focus on self-reported confidence, knowledge level and attitude towards various aspects of computational thinking, interdisciplinary teamwork and gerontology

• Students in ComS 415x (fall 2010) are invited to voluntarily participate in the study. Those participated took the survey in the second and the last lectures of the semester

• The delta of pre- and post-test data from the same participant is used to measure the effectiveness of the course

Plus, the outcomes from the class are used to gain additional insights into the effectiveness of the course design and pedagogy
Student Demographics

Student Gender Distribution

- Male: 6
- Female: 5

Ethnicity Distribution

- Caucasian: 6
- Asian: 3
- Hispanic: 1
- Others: 1
Gerontology

Δ4-pt Likert Scale

Comfortable with Gerontology
Understanding of Aging Issues
Knowledge about Aging
Knowledge about disabilities
Interest in helping people
Service learning

-0.14
0.00
0.00
0.29
0.14
0.08
Ongoing Work and Future Plan

Focus group

Data collection & processing

Distance education opportunities
Conclusion

• Interdisciplinary teamwork and computational thinking are critical skills for successful professionals in the 21st century

• Through careful, collaborative, and innovative course design, ComS 415x shows great results in enhancing both skills in its first offering while reaching underrepresented student demographic

• Mixed pedagogical approaches in one class/one semester is doable and can be effective
Thank you

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Related Work

Courses in Gerontechnology
• ISG Gerontechnology Masterclasses
• Washington State University (Cook et al.)
• Gerontic Undergraduate Program in Taiwan
• Inter-university gerontechnology program in France

Courses about Smart Homes
• Smart Home Courses (Kim and McNair)

Previous Effort
• REACH platform for distance, introductory computer lab (Chang et al., FIE 2010)
Interdisciplinary Teamwork

- With tech Expert
- With non-tech Expert
- With end users

Pre-F10
Post-F10
• Computational Thinking/Service computing
• Gerontology and Aging
• Assistive Technology
• Design Principles
• Software Engineering
• Product Evaluation and User Study
3 Cross-cutting Themes

• Interdisciplinary Collaboration
• Computational Thinking
• Universal Design
• Gerontotechnology
Pedagogies

- Social Pedagogy
- Direct Instruction
- Guided Discovery
- Inquiry
Data Analysis III

• Findings of interest: uniformed response across the board
• Recruitment
REACH Platform

• **Remote Access** to Smart **Home** Facility Based Computer Science Laboratory

High-level Objectives:

• Hands-on experience

• Generate observable, physical effects in a familiar environment

• Real outcome with real use

• Underscore the critical computational thinking (CT)
REACH (pedagogically speaking)

- Computer Laboratory for new and cross-disciplinary students
- Support asynchronous distance education
- Enable usability and user studies
- Enable interdisciplinary group work
- Promote interests in computer science in female/minority students by
  - Putting computer system in a real-world context (e.g. senior care or home automation)
  - Align lab activities with students’ majors and prior interests, experience and knowledge
REACH (technically speaking)

• Virtualization
  – Packed lab kits (middleware, software tools, libraries, collaboration tools, manuals and useful links to references)
  – Individually customized environment and suspend-resume
  – Encourage trial and error → disposable images (sandboxes)

• Remote observation and intervention
  – Web cam/Sensor logs/ web-service interface to Actuators

• Scalable Solution
  – Encourage self-exploration via well defined API and well-structured programmers’ manual with step-by-step lab instruction
  – Separated development and experimental environments
  – Maximize utilization of the smart home lab facility
  – Minimize interference between different projects

• Service-oriented development environment
  – Improved flexibility and reduced complexity
  – Allows students to focus on logical composition using existing services rather than detailed implementation
- SHADE image
- Binding and switching
Remote Observation and Intervention
Support for the Students

• Smart Home Programmer’s Manual
• CPATH server using Redmine
  – Project Repository
  – Collaborative tools
• New development lab
  – Three new workstations
  – REACH (VM, remote observation and intervention)
• Hardware checkout program
  – New inventory management allows students to checkout sensors and actuators for development and testing
  – Expanded number and diversity of sensors and actuators
• Mentorship and technical support