Shaping the Next Generation of Gerotechnologists: Multidisciplinary Gerontology vs. Computer Science (ISG '08)

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***Abstract*—This paper compares the pedagogical design and outcomes of two separate courses in designing prototypes in gerontechnology, "Health, Technology, and Aging" and "Pervasive Computing." Students worked in teams to develop prototypes to support the health and independence of aging adults. Outcomes analysis suggests that the increased focus on health in the multidisciplinary course led to prototypes with a greater emphasis on personal safety; whereas a focus on the user experience led to prototypes more tightly integrated into everyday life.**

I. Introduction

HOW can we best prepare the next generation of entrepreneurs and designers in gerontechnology? Does a multi- and interdisciplinary approach better equip students to understand the diverse needs of the aging population, or are they better served by a rigorous study of the technology? This paper compares the pedagogical design and outcomes of two separate courses in designing prototypes in gerontechnology. "Health, Technology, and Aging" is a multidisciplinary course designed to prepare non-business majors to develop skills in entrepreneurship in gerontechnology. "Pervasive Computing" is a computer science (CS) course which emphasizes user-centered design of technology that is embedded into everyday environments such as homes, offices and public spaces.

II. Course Design

A. Health, Technology, and Aging

"Health, Technology, and Aging" is designed to prepare non-business majors to develop skills in entrepreneurship in a gerontechnology product or service. The multidisciplinary gerontology course is taught and offered through the academic units of gerontology, applied health science, nursing, kinesiology, informatics, and computer science. In gerontology, multidisciplinary study implies different disciplines working independently alongside each other toward a shared solution to a problem whereas interdisciplinary study infers that the different disciplines work together interdependently in search of a solution to a problem [1]. Students form interdisciplinary teams to design a prototype of a technology that would be effective, appropriate, and acceptable in supporting the health and independence of older adults. The first half of the course introduces students to the universe of issues associated with aging and ethical use of technology to support aging well.

1) *Multidisciplinary Topics*

- Demographics of the aging population
- Overview of gerontechnology
- Demonstration of existing products and services
- Physical, cognitive, and social health in later life
- Technology and health care needs of older adults
- Fitness and physiology in later life
- Assessing fitness and health in older adults
- Use of technology in health care
- Technological approaches to functional training of older adults
- Technology, fitness centers, and older adults
- Models and prototypes of gerontechnology
- Human computer interaction and human-centered computing
- Use of ubiquitous computing and pervasive technologies and older adults
- Privacy and security
- Social networking and virtual communities

The second half of the course was devoted to the development of business plans for the prototypes, empowering students to become future entrepreneurs in gerontechnology. Many of the course sessions in the second half of the course were in laboratory rather than lecture format. Topics in the second half of the course prepared students to develop entrepreneurial start-up business plans.

2) *Entrepreneurship Topics*

- How to be a good team member
- Elements of a business plan
  - Cover sheet
  - Mission statement
  - Details of the business
  - Marketing
  - Financial documents
- Business ethics
- Writing a privacy statement
- Researching the competition
- Marketing for the silver market
- Student research with focus groups
- Creating financial documents

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After each section of the business plan was completed it was submitted for review by the faculty and/or or external consultants. The course concluded with formal business plan presentations to a forum of entrepreneurs, venture capitalists, business professionals and faculty.

The development of the course was funded by the Johnson Center for Entrepreneurship and Innovation to motivate and empower students to develop business plans for start-up companies in gerontechnology: consumer applications of technology for improving the health of the burgeoning aging population. The funding was intended to stimulate the local economy by encouraging new entrepreneurs to capitalize on the multitude of new business opportunities will emerge in the next decade. It is predicted that retiring boomers, already comfortable with technology, will look for new ways to improve, maintain, or rehabilitate their health that are less costly and intrusive than direct personal or institutional care.

B. Pervasive Computing

"Pervasive Computing" is a graduate level course in Computer Science that introduces students to a post-desktop paradigm of computing, discussing the latest research in how to integrate technology into our everyday lives, including homes, workplaces and public spaces. Topics include those that are very technical, such as what kinds of sensors exist, how they work and how to program them, to issue of human-computer interaction, such as how to design and evaluate applications that integrate into people's existing lives. Students from the Human-Computer Interaction and Design (HCI/D) program team up with students from the Computer Science department to design, implement and evaluate a pervasive computing application over the course of the semester. In the past, a variety of topics have been explored, such as developing a mobile learning tool for environmental restoration sites, and designing a mobile game to encourage teenage girls to increase their physical activity. For the purpose of this project, student teams were instructed to work on an application targeting the elder population.

In the "Pervasive Computing" course, lectures focused on discussing the seminal and recent work in the area, with an emphasis on getting a broad overview of the field. Students were encouraged to think critically about the trajectory of the field as a whole. There were two different labs for the course. One lab covered the human-computer interaction (HCI) skills required to complete the project, including how to conduct interviews, write surveys, perform usability studies and analyze both quantitative and qualitative data. The second lab introduced different technologies the students could use for prototyping, ensuring that they all could program the various sensors and devices. Only one lab meeting of the HCI lab was devoted to elder-specific issues. Students were expected to obtain more information through a literature review, and interviewing elders and their caregivers. In this way, we were able to frame the problem in terms of supporting healthy aging, but students were free to explore any aspect of aging they felt was compelling.

The bulk of the student grades was determined by the course project on using pervasive computing to support elders as they age. The students formed teams of 3-5, with at least one student from HCI/D and one from CS. Over the span of the semester, teams performed a needs analysis, resulting in a requirements document, submitted a design document, implemented a working prototype and assembled an evaluation plan. Several of the students continued with their projects the next semester, carrying out the evaluation.

III. THE TEAM APPROACH

Both courses required students to form teams to design a new gerontechnology product or service. Group projects are a way for students to work with broad, global issues by drawing on individual strengths and interests. They are also a way for students to be involved in creating a deliverable more consequential than could be developed by one student working alone. Through a team-based approach, students can be involved in the creation of a project larger and grander than they could imagine or produce when limited by their own time, abilities, and understanding. Group projects help students develop important leadership, delegation, and communication skills [2].

Many disciplines encourage students to work in teams, in recognition of the success of the team approach in many professions and industries. In geriatric health care, the multidisciplinary team is used in long term care, home care, and case management to assure effective and efficient coordination of care in all areas of a patient or client's concerns. The Association of American Medical Colleges [3] and the Pew Health Professions Commission [4] are among a number of organizations that have identified the ability to work in teams as critical for 21st century health care professionals.

In many areas of gerontology and geriatrics, the literature suggests that multi- and interdisciplinary education is critical for preparing students to serve and care for the diverse needs of aging adults. In institution or home health care, an interdisciplinary approach leads to increased efficiency, reduced costs, greater patient satisfaction, and an overall reduced use of medical services [5] [6].

The interdisciplinary nature of the Health, Technology, and Aging course provided an opportunity for students to work in interdisciplinary teams. The students were asked to form teams with students from at least two different majors. The value of the interdisciplinary approach quickly became evident; students with a health or fitness background could contribute to a design that was informed by an understanding of the needs of aging adults while students with an informatics background contributed an understanding of how to design ethical, effective technologies.

The faculty for the course also represented diverse disciplines. Faculty met four times before the course began to design the syllabus and course requirements. Each faculty member contributed "best practices" in course design. As the course developed, each faculty member had the opportunity to share and learn "best

TABLE 1: DISTRIBUTION OF PROJECTS

Course	Social Support or Networking	Healthy Lifestyles	Personal Safety	Health Monitoring	Support for Daily Activities
Multidisciplinary Gerontology n=4	**2**	**3**	**3**	**2**	**3**
Cookwise			1		1
Classic Fitness	1	1	1	1	
Bright Track		1		1	1
Interactive Calendar	1	1	1		1
Computer Science n=4	**3**	**2**	**0**	**1**	**4**
Ambient Plant	1				1
Mirror Motive	1	1			1
Social Bookmarks	1				1
Nutrition		1		1	1

practices" in teaching from other members of the faculty team.

The opportunity to learn practical and professional information about a common field but from a different perspective was valued by all faculty. An informatics professor learned that it would be better to wear shoes while she worked out. A fitness faculty learned to better safeguard her online privacy. Interdisciplinary faculty teams have been viewed as beneficial in other campus settings. Ninety-six percent of faculty in one study indicated that interdisciplinary team teaching increased their appreciation of other faculty [7].

I. PROJECT DESCRIPTIONS

Technologies that support aging adults can be designed to respond to the changing needs of later life [8]. Technologies can also be designed to proactively support and encourage active aging [9]. Either design goal motivates technologies which can be categorized into common functional needs specific to later life. Previous research categorizes gerontechnologies into categories including social support or networking, healthy lifestyles, personal safety, health monitoring, and support for daily activities [10]. The prototypes from these two courses varied in their focus on addressing these common functional needs, as seen in Table 1.

Projects in Health, Technology and Aging were nicely distributed across all of the major functions:

1. Cookwise: The Cookwise prototype uses motion and moisture sensors in the oven and on the stovetop to improve safety in the kitchen. The moisture sensors help determine boil over and turn the burner down. Motion sensors turn the stove or oven off if left unattended for a specified period of time. Built in alerts dial emergency numbers in case of smoke or fire.

2. Classic Fitness: Classic Fitness uses pedometers and a RFID system to wirelessly record users' steps. Data can be viewed real-time on the pedometer or on a small LCD display in the home. Besides the aggregation of steps the system allows users to track statistics over time and compare statistics against other users as means of 1) competition through social motivation and 2) provide data to show health care providers.

3. Bright Track: A touch-screen that allows users to monitor their nutrition intake and offers them personalized solutions to meet their nutritional goals. Features include recipe suggestions, recipe sharing, personal shopping lists, and access to a nutritional coach. A USB port allows users to load photos so that the device can serve as a digital photo frame. It can stand alone or be networked providing social networking and data sharing capabilities.

4. Interactive Calendar: The LCD touch screen looks like a typical calendar, but has the capability to receive and transmit audio and video messages. Message reminders about medications, daily events and future planning can be recorded on the device or sent from a second location. It also allows a form of visual communication and non-invasive health monitoring between older adults and their distant family.

Projects in Pervasive Computing had an emphasis on supporting daily activities and social networking, neglecting personal safety completely:

1. Ambient Plant: The ambient plant augments a plant pot with sensors and lights to facilitate awareness between remote family members through an everyday object in the home. When a person tends to their plant, the remote pot conveys this activity by turning on its lights. (Fig. 1)

2. Mirror Motive: A mirror augmented with sensors and a backlit display that when approached, reminds elders of activities and displays pictures of common areas if the elder lives in a retirement community. Elders can accept or ignore invitations to events with a simple hand gesture. (Fig. 2)

3. Social Bookmarks: A book club in which members reading the same book become aware of others' reading activities through lights on their special bookmarks. Increasing awareness of acquaintances' reading habits can encourage more individual reading and deepen bonds between participants. (Fig. 3)

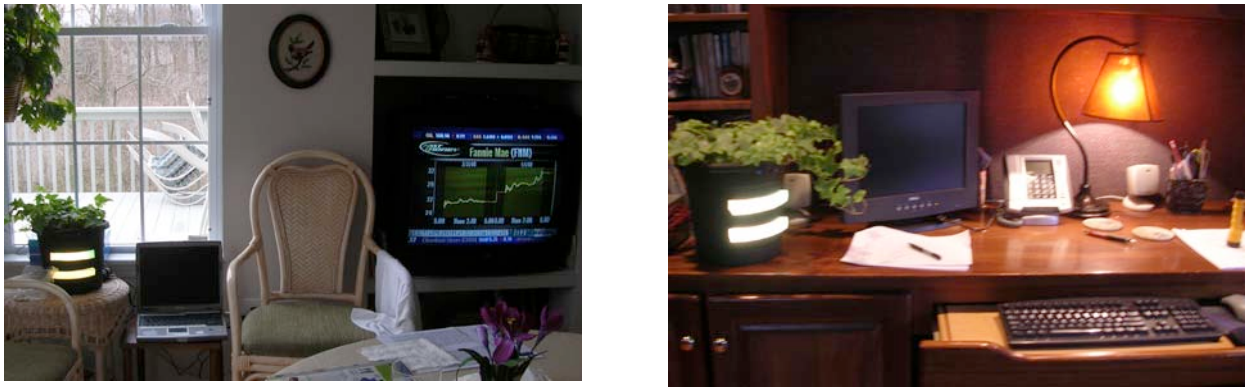

Fig 1: Ambient plant pot in two participants' homes

4. Nutrition: A nutrition monitoring system in which elders indicate the foods they are eating through a touch screen by selecting icons. The system displays overall nutrition information and utilizes a learning algorithm to suggest healthier recipes.

II. Outcomes

A discussion of the results compares the breadth and depth of functionalities of the prototypes from the two courses, the effect of grounding of both courses in the concept of successful aging rather than meeting needs of frail elderly, and a cohort/period effect which resulted in a focus on social connection over personal safety and health monitoring in the majority of the prototypes.

The interdisciplinary approach in "Health, Technology, and Aging" enabled students with a health or fitness background an opportunity to expand on the designs of students to produce non-working ideas of prototypes with multiple functionalities. The health background and more in-depth lectures on common problems associated with aging resulted in projects that had personal safety as a key component. Alternatively, the focus on user-experiences with technology in Pervasive Computing yielded working prototypes that were narrower in their functionality and did not address personal safety. Similarly, only one project in Pervasive Computing had a monitoring component; whereas two projects in the multidisciplinary gerontology course had extensive monitoring.

While the technical students seem to have neglected the key areas of personal safety and health monitoring, the gerontology projects were less integrated into everyday life. Three of the four projects in Pervasive Computing augmented existing objects in the home (plant pot, mirror and bookmarks), demonstrating the course emphasis on seamlessly integrating technology into everyday life; whereas three of the four projects in Health, Technology and Aging added new objects to the environment (pedometers and touch screens). It is believed that technology that is integrated into one's current activities is more likely to be adopted over the long term [11], showing need for the gerontology students to have a better grounding in design principles.

In both courses, grounding the introduction to the course in the concept of successful aging rather than meeting needs of frail elderly yielded projects more focused on social connectedness than monitoring health, daily activities, or personal safety.

Finally, the students in Pervasive Computing were given little specific direction for their project, and had to define their focus based on their experiences, the literature, and interviews with experts Given the emphasis on social networking, it appears they relied on their personal experiences with technologies such as Facebook and Twitter to guide their project goals more than a careful reading of the literature with respect to the challenges faced by elders. Similarly, the students in Health, Technology and Aging simply didn't have an adequate design background to conceive of technologies that could be seamlessly integrated into everyday life. While the project experiences were valuable for all of the students involved, an interesting experiment may be to combine the tow student populations for a cross-course project.

III. Discussion

What best prepares students to become entrepreneurs and designers in gerontechnology? In many fields we

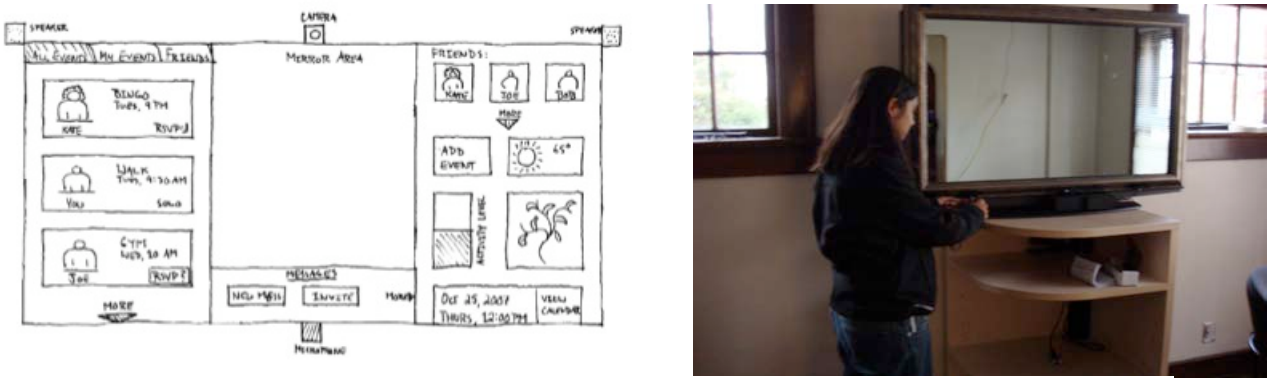

Fig 2. Sketch of Mirror Motive interface (left) and working prototype (right)

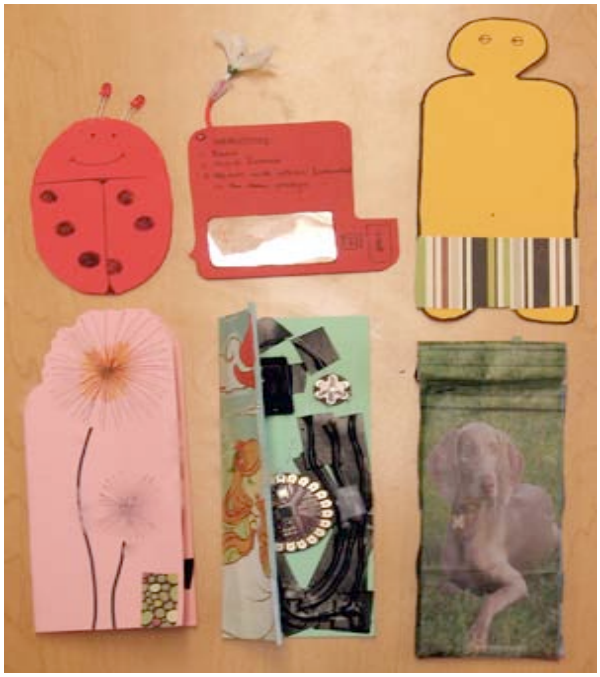

Fig 3. Social Bookmarks: 6 working prototypes

expect to see a division of labor, with graduates from Computer Science in the design department, Business graduates in marketing and accounting, and perhaps a gerontologist as a consultant. But in this very new field, students must be prepared to wear many hats. They might be called upon to be innovators, designers, marketers, entrepreneurs, and accountants all at the same time. Future gerontechnologists need a solid understanding of older adults and their caregivers' perceived benefits and barriers to using gerontechnology. This understanding is critical to all stages of innovation and entrepreneurship, from concept ideation through to sales. This understanding needs to continually re-developed and redefined as the boomer cohort enters later life.

IV. Conclusion

The comparison of the outcomes from these two courses underscores the importance of a teaching a team approach to the design of gerontechnologies. One designer is unlikely to be able to understand and address the potential of a gerontechnology. It also suggests the strengths and weaknesses of broad interdisciplinary teams. While the Multidisciplinary Gerontology course designed projects that addressed a wider range of functions than the Computer Science course, that is not necessarily a design strength for a product that is ready to enter the market. Broad interdisciplinary courses like the Multidisciplinary Gerontology course might be best required for students early in their academic career, to help students understand not only the physical, cognitive, social, and emotional needs of aging adults, but also the potential for technologies that support active aging. More focused courses like Pervasive Computing, while still drawing on the strengths of the team approach, might better equip students to bring a prototype to full development and commercialization. An analysis of the teams' understanding of defined benefits and barriers of gerontechnologies [12] would further elucidate where the courses' designs could be further improved to prepare future gerontechnologists.

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