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Ethics, Technology, and the Future: An Intergenerational Experience in Engineering Education

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How do engineering educators adequately and richly introduce to young engineers the perplexing ethical issues associated with the development of new technologies? Robotics, nanotechnology, cloning, cyberintelligence, and genetic engineering, for example, each hold the potential to radically alter the fundamental nature of human life. Senior citizens in our society have a lifetime of experience adopting new technologies into their lives. Through an intergenerational dialogue, undergraduate engineers can come to appreciate and understand what technological change can really mean, both in practical and ethical terms. This article explores the use of intergenerational dialogue as a learning tool, with a focus on the experience of students enrolled in a required engineering ethics course. Reactions and thoughts recounted in this article from both undergraduate engineers and senior citizens signify the immeasurable educational value of intergenerational exploration and its effectiveness in examining the ethical questions connected to the development of new technologies.

Keywords: intergenerational education, intergenerational dialogue, lifelong learning, future studies, ethics, technology studies, pedagogy

Engineering Ethics and the Technological Future

Robotics, nanotechnology, cloning, cyberintelligence, and genetic engineering are examples of newly developing technologies that hold the potential to radically alter the fundamental nature of human biological life. The quests for enhanced brains, eradication of disease, and even the indefinite extension of human life are actually imaginable today within the realm of technological ingenuity.

To some, technologies that will enable the human to radically transcend physical and mental limitations of the human body are far-fetched dreams. To others, the use of technology for such purposes is inevitable. Even if only in the realm of the imagination, recent technological developments represent very exciting possibilities for yet uncharted human experience. What would it mean if, and when, humans no longer are threatened by loss of bodily life and function due to disease and deterioration of living tissue? Clearly, it could represent the ultimate of freedom and possibility. Of course, such uses of technology would also inevitably mean formidable ethical problems to be resolved.

The teaching of engineering ethics is often focused on personal, moral choices made within the engineering professional. One common and highly effective approach to teaching professional ethics is to retrospectively use case scenarios, which recount real ethical dilemmas that were encountered inside actual organizational settings. Case studies allow for the student to engage personally inside of the roles of various players in a given scenario. With the benefit of a hindsight view, cases provide students with individual perspectives of various characters in a particular dilemma and an opportunity to understand the breadth and depth of moral complexity in everyday professional life. The case method of study, however, is not feasible for consideration of developing future technologies, such as nanotechnology, cloning, cyberintelligence, and genetic engineering technologies that hold the

potential to radically alter the fundamental nature of human biological life. To think about moral choices to be made in a year-undetermined technological future, a different pedagogical approach must be undertaken.

The Unusual Value of Intergenerational Learning

This article explores the use of intergenerational dialogue as a learning tool, which developed as a response to a retired faculty lecture. The lecture was given on the subject of engineering ethics, reflecting on the writings of Hans Moravec (1999), Ray Kurzweil (1999), and the journalists Peter Menzel and Faith D'Alusio (2000). These authors conveyed a vision of our technological future, which completely alters human life as we know it. The reaction of this audience of distinguished retired faculty and their spouses was startling. One man actually yelled out, "I'm glad I'll be dead before all of this nonsense becomes real!" The message was clear; the voices of seniors must be considered in the study of the ethics involved in the development of new technology. Even though newly developing technological capacities that arise from nanotechnology and robotics are unlikely to ever affect their lives, senior citizens are often seasoned thinkers, bringing to the discussion the wisdom of life experience, combined with the refined desire and capacity to reflect with both intelligence and concern.

From religious education in churches, synagogues, and mosques; to skill development in mathematics and reading tutorial programs in elementary schools; to enrichment activities in community centers, there are many examples of how senior citizens and young people are working in support of one another. Higher education institutions are beginning to focus on intergenerational learning. One example is the Intergenerational Service Learning Project at the Southeastern Oklahoma State University, which received a minigrant to convert an existing psychology of aging course into an intergenerational service-learning course. Ten senior citizens receive scholarships and enroll in the course with the primary stated objective being "that by interacting and working together for an entire semester, both younger and older students will develop a more realistic view of each other and create a more positive intergenerational environment in our community" (http://babbage.sosu.edu/~geron/). Another example of intergenerational learning in higher education is the Institute of

Public Law at the University of New Mexico. They believe that "the dynamic created when different age groups come together has been a powerful tool in attaining various goals" (http://ipl.unm.edu/iag/). In particular, they are interested in policy issues such as allocation of health care, social security, family, and the government's overall responsibility to the elderly. Both of these examples point to the growing trend in education to bring aged learners into a classroom environment with traditional "younger" students. Unfortunately, the technical nature of most engineering curricula seems to function well enough without such a diversion.

What is not understood is the importance of the voices of seniors in the development of new technologies and, particularly, in the ethical issues that they raise. Young engineers who think about the future in age-segregated classrooms simply cannot have the perspective needed to deeply understand and appreciate the ethical issues at stake. And senior study groups are isolated from the dialogue, which is taking place among the next generation of engineers and scientists. In seeking to explore together the ethical issues of developing technologies, a dynamic exchange between undergraduate students at the University of Virginia School of Engineering and Applied Science (SEAS) and seniors enrolled in a lifelong learning course on technology demonstrated how intergenerational learning could enliven and enhance moral deliberation about the future.

The Jefferson Institute for Lifelong Learning (JILL)

The course that I taught for the JILL educational program for senior citizens, titled "Ethics, Technology and the Future," used many of the same readings as my undergraduate engineering ethics course: Kurzweil's (1999) *The Age of Spiritual Machines*, Halperin's (1998) *The First Immortal*, and Bill Joy's (2000) article "The Future Doesn't Need Us." The students also viewed the science fiction films *A.I. Artificial Intelligence*, *Bicentennial Man*, and *Vanilla Sky*. These readings and films raise difficult and somewhat troublesome questions about what life might be like in the future and what it means to precede without hesitation.

Each of the two student groups was curious about the other's reaction to the ethical questions raised in these materials. Without my prompting, one of the senior citizens asked how my undergraduate engineering students reacted to visions such as Kurzweil's

human-machine coevolution. In particular, he wanted to know if young engineers are optimistic and excited or if they have concerns about a potential future where humans and machines have merged with technology, and where human life is extended through life-supporting/extending technologies. Likewise, the engineers wondered about what the seniors were saying. A student suggested that the two classes get together. Thirty-five undergraduate engineering students then voluntarily attended JILL classes, curious about the perspectives of these elders.

An Intergenerational Dialogue on Our Technological Future

Thirty JILL students sat in chairs forming a large circle in the library of a local retirement community. Some were residents of the senior home where the class was held. Others drove to the classes. The visit of the engineers was a surprise to the senior citizens, as there had not been an opportunity to warn them of the visit. Fortunately, the senior citizens were excited and expressed gratitude and enthusiasm for having the engineers with them in the classroom.

The topic of the 1st hour was Kurzweil's (1999) *The Age of Spiritual Machines*, in which he argued that evolution suggests that our technological inventions will become smarter than us and will dominate existence on earth. Kurzweil further predicted that we will become the machines we create, merging with technology for life-enhancing experiences, to overcome the limitations of the mortal, physical body. We began class with the engineering students asking questions of the JILL students, followed by JILL students questioning the engineers. An excerpt of that exchange follows:

Engineer: Do you believe that technology will overtake human life?

Senior Citizens: Technology already has moved much faster than we ever imagined. So much has changed so fast. On the other hand, I remember the World's Fair of 1939 in New York City. Some of the predicted developments came to pass, but many were overblown. The notions of all the U.S. cities being connected with elevated superhighways never happened. But, I was taken with Kurzweil's predictions. I can see them coming true.

Years ago, I met Bernard Hillman of NASA. He said, "I believe good will come from trying to go to the moon. Even if we don't make it." He was a man of faith, a believer. I like to think that we will be one step ahead of what we create.

But, when have we ever turned away from technology?

Engineer: We pulled away from the nuclear technology when it was too threatening. Same with the atomic weapons we developed. Ethics is inherent in our system as a checking device. We will know when it is time to stop.

Senior: But don't you think that the ceiling of where we say "stop" keeps going up? We keep thinking, "I've got to get this; this new thing is better than the old." New intelligent technologies like what Kurzweil describes are different from the bomb. New technologies make things easier and faster.

Engineer: All of our research and development is innocent now. The advantages are still outweighing the disadvantages. When it's no longer clearly that way, we will stop what we are doing.

Senior: But when is Jack no longer human?

By this statement, the JILL student was referring to the passage in Kurzweil's (1999) book where he uses "Jack" as an illustration to question at what point, if ever, does technology's increasing use in the human body compromise the person's identity?

Jack begins with a cochlear neural implant for auditory enhancement, he then adds memory implants, and eventually he has his entire brain and neural system replaced with electronic units of greater capacity, speed, and reliability. The question posed is whether Jack is lost somewhere in the process of bringing technological enhancement into his human body.

It was acknowledged that different senior citizens in the room had various implants of one sort or another—hearing aids, new hips, heart valves and pumps, knees, and so forth. The question on the floor was whether at some point the technological replacement of body parts and enhancement of bodily functions would compromise their personhood. Responses from both undergraduates and senior citizens indicated that such a slippery slope result would not be a threat as long as there remained self-consciousness.

Engineer: With these technologies, it is not at all clear where to stop because their use is so gradual, and so beneficial.

Senior: What if today, you had the choice to have the entire contents of your brain, and thus "you," downloaded into a more permanent form? Would you do it?

Engineers: If, as Kurzweil suggests, we are really just software and can be downloaded, what happens to the meaning of life? I think we are getting in over our heads.

But what is the difference between downloading and genetic engineering, or cloning?

There is a huge difference. Enhanced bodies still have a sense of urgency, of life and death. Software does not.

No matter what, life will find a way to end itself. And what about faith? Isn't there something greater? Kurzweil doesn't bring up faith at all. What about God? What about afterlife? Does downloading yourself for everlasting life take away the element of afterlife in the hereafter?

Senior: Are some of you students wanting to stop the development of such technologies or are you anxious to go forward?

Engineers: Kurzweil frightens me.

I am excited. I have less of a connection to my body, not so much of a need for it. To me, it is not so weird that our minds will go into a computer. It is kind of cool, exciting.

Senior: Would you download your subconscious, too?

Engineer: I don't believe there really is a subconscious.

After a break, and an opportunity for the senior citizens to socialize informally with the undergraduate students, we returned to discuss *The First Immortal* (Halperin, 1998). This is a science fictional treatment of the pursuit of extended life through cryonics and nanotechnology. The novel recounts the choice of a physician and his extended family to deep-freeze their bodies until such time as technology could cure them of their life-threatening illnesses. The book spans 200 years from the first freezing, to the revival of those once frozen, to their new lives inside of a vastly changed world.

The class discussion opened again with the question, "If you could be frozen today, knowing that one day you would be revived to continue living in this body, would you chose do so?" First, the senior citizens were polled. Twenty out of 28 said, "Yes!" Then the young engineering students were polled. Seven said, "Yes!" Twenty-eight said, "No!"

Written Reflections

The engineers who attended the classes were required to write a one-page reflection on their visit to the JILL class. Many of them chose to write about this disparity in the poll results. They wondered why relatively few engineers would be interested, in contrast to so many of the senior citizens, in using technology to prolong the inevitability of bodily death. One engineering student wrote, "Many of the general ideals that both groups expressed surprised me in that the older generation seemed more willing to experiment with new technologies." Another wondered about religious belief and what role that might play in the differences.

What disturbs me is the low number of undergraduate students who expressed an interest in cryonics. Why do the senior citizens' concerns only show in faint glimmers in the younger generation? It may be our inability to imagine ourselves on our deathbeds at the final moment where the choice between extinction and a glimpse into the future is plausible. It could have something to do with religious beliefs telling us that there is something better waiting for us. That argument would imply that the younger students have stronger beliefs than the older group, which would be a surprising conclusion, considering the common belief that organized religion is weakening with each passing generation.

Most notable was the essay that questioned the implicit insatiability of the human heart. The writer remembered the words of the senior citizens who desired to be frozen and revived just to see what will come of the world, and of their grandchildren:

One senior motivation for freezing oneself was to preserve the ill until an ailment was found for their sickness. Another motivation that seemed oddly basic was the curiosity of what lies ahead. I think this portrays the endless pit within man's heart, a never ending chasm that absorbs all that is around it, and still seeks to absorb more until inevitably it sucks itself inside out! A curiosity that leads us to abandoning our loved ones and responsibilities, is a perverted obsession that could only be fed to a certain extent before it dies and leaves its followers in utter disdain.

Although some of the senior citizens were outspoken about their fears of extinction, and their desires to fulfill their curiosity of the future, others held back. They hesitated to say yes to cryonics, for fear of having to come back alone, to lives without their loved ones.

One man joked about having to stick with the same spouse throughout eternity. Another spoke about the hardship in having to adjust to the extreme changes the future will bring. Only one of the senior citizens spoke in religious terms saying that Heaven, where God dwells, is the source of all reality. He asked, "What more could we want?" A normally reserved young engineer then felt free to agree, out loud.

Both times that the engineering students visited the JILL class, we discussed the question of what it is that makes up the human being. Kurzweil's writing is insistent on defining the human simply in terms of the acquisition and processing of information. In that way, the human being is likened to a piece of software, wherein one's life experiences can be stored, retrieved, and enhanced, simply through neurological processes. If this is so, then theoretically the person, as information, could live in any suitable container, as long as it is designed to hold the "data" that make one a person.

Many of the undergraduate essays pondered the implications of this view. Are we just information? Can we simply be uploaded and continue to live as ourselves? Is Kurzweil's prediction plausible? The following passages are representative:

> The conversation began with the idea that humans only contain downloadable information in the forms of memories, experiences, etc. In class we had talked about the same thing, and while some of us resisted being boiled down to just information, a few could grasp the idea of being downloadable. These elderly folks, a people who had lived through an age of innovation and watched technology take control of their lives, continued to cling to the idea that we are more than just information.

> I sensed a distinction between the J.I.L.L. discussion and discussion within my own generation (especially discussion among budding engineers), which often is over flowing with unoriginal, skeptical, over-*thought* and under-*felt* opinions, fabricated through the relentless pressures of this technological era. For example, when prompted to express their feelings about the quotation "who are you? Your essence is information about the unique experiences, emotions and thoughts of your life; perhaps nothing more, and unquestionably nothing less," more members of the J.I.L.L. group adamantly refuted the idea than would be the case in our classroom at the University. Whereas we students are swept away

in the mentality of and obsession with technological overthrow, the J.I.L.L. students are obviously and completely committed to the belief that heart and soul are the absolute foundation of our being.

When we first discussed going to visit the senior citizens class, I thought for sure that the senior citizens would defer to the undergraduate engineers for all the technical issues. I was very surprised when they pushed us and tried to disprove our examples and brought up new technology ideas on their own. Throughout our discussions of Kurzweil, I have often found myself thinking that, for a group of engineers, many of my classmates seem surprisingly anti-technology. Many of them are very reluctant to acknowledge that Kurzweil might be correct in his predictions, and deny that society will ever allow the creation of intelligent machines. So I was quite surprised when the senior citizens said that they think the possibility is more real than we might wish to believe.

The concept of humans beings as just information in a container was the first topic of the discussion. However, for me it was the discussion that would stay in my mind for the rest of the day. Answers filled with confusion and intrigue led me to believe that no one generation can give clear cut answers to how we should handle the future of technology. We expect the older generation to have the answers to the future of technology and vice versa. The answers will have to come from more interaction with different generations and a consensus about humanity's future role. The younger generation cannot alone determine what to do for the future.

Questionable Values

In our age-homogeneous engineering school classroom, student discussions on newly developing technologies have focused primarily on what the future may bring for the individual. Students debated one another on whether it is actually possible to merge human minds with technological creations, on what composes the essential human being, on whether we have the choice to discontinue our push toward these developing technologies, and the like. When the undergraduates joined the senior citizens, the focus of the discussion about future technologies took on an additional

concern. One senior shifted the entire conversation when she said,

> "We," the affluent of the highly technological Western world, are a miniature of this world. What is important for the rest of the world? We talk about these life-enhancing technologies and living longer or forever while most of the world still strives for the fulfillment of basic human needs. There are two classes of people: those who have and those who don't. We have the technology to provide for all the needs of the planet. Why are we putting so many resources into technologies for the comfort of the elite?

From there, the senior citizens and engineering students launched into an intense dialogue about who is responsible for whom and about the hatred much of the world feels toward "us" because of what we have, what we consume, and our exclusive, market-driven economic policies. Questions of moral responsibility were raised but so were the complexities of introducing new technologies to existing, pretechnological cultures. One octogenarian, a former Peace Corps volunteer, shared his memories of the villagers who returned to retrieving water the old way, rather than to repair the pump they were provided by the project funds. With compassion in his voice, he expressed frustration over the difficulties of introducing new technologies to pretechnological cultures. The practical and moral dilemmas of doing so were apparent to both JILL and SEAS students, who became sober in acknowledging the moral imperatives of if, when, and how to extend to others the technologies we enjoy. Questions of whether to use technology to upload and merge our minds into new, more lasting techno-bodies took on a whole new perspective in light of more global issues of access and need. It was over this concern that the intergenerational encounter became so rich.

As the following excerpts from SEAS student essays reveal, profound learning had taken place in the intergenerational exchange—learning that may never have happened otherwise.

> Should we use our existing technology to address humanitarian issues before we try to improve it? Can technology help close the gap between the have and the have-nots? A large part of our class with the senior citizens was spent addressing these two questions. What made this particularly interesting to me was the fact that none of the questions have come up in our own class discussions. In class we spent time thinking about how technology may effect us as individuals, when with the senior citizens, technology's effect on humanity was almost the primary topic.

> I think that the senior citizens have much higher expectations for the human race than the younger generation does. They seemed to think that life would be there for them in 100 years when I am not sure that it would be. They seem to have an optimistic view of humanity. It surprises me because they have seen so much more hatred and bloodshed than we have. And they still have faith in humankind.

> When technology is introduced to any environment/society, the environment/society must adapt. So we have to be careful about all our actions no matter how seemingly harmless they may be. It's probably a stretch, but fixing a pipeline can lead to problems just as genetic engineering, nanotechnology, and robotics eventually will.

Conclusion

Practically speaking, an ongoing intergenerational curriculum in an engineering school is an unlikely goal. But as a field trip, the intergenerational experience provided a way to go deeper and beyond what is normally possible in the engineering ethics classroom. Sitting together with intelligent, well-read senior citizens was an experience the undergraduate engineers continue to refer to again and again. In a culture of pervasive generational isolation, such as ours, intergenerational pedagogy offers an element of learning that can, to some degree, compensate for the social isolation that persists.

> Contrary to my stereotype of all elderly being traditional and stubborn minded, I was surprised to find that the senior citizens we were talking to were open-minded, welcomed new ideas, and possessed great interest in what would lie in front of mankind under the rapid growth of technology, even though they might not be able to see it happen.

> I am still not certain whether I ought to be hesitant or thrilled to admit that I was more engaged by our discussion at the Jefferson Institute for Life Long Learning last Wednesday morning

than I am by a typical class discussion here in the engineering school.

My mind was certainly opened by the J.I.L.L students. They were as bright and insightful as we were even though it seemed that our generation had an advantage because of our personal experience with current technology. Age proved not to be a major factor when we tried to predict future outcomes of humans and technology. Neither the wisdom of our elders nor the new imaginings of the present generation could accurately predict how the imminent merge of life and technology will happen.

And that, perhaps, was the point of the entire exercise. When engineering students joined retired senior citizens to discuss technology and the future, what was revealed was the nearly insurmountable complexity we face in trying to imagine, and untangle, the life we are creating tomorrow with the development of technology today. Where do we find the answers to questions of what is right, what should happen and should not, relative to the way we will use and adapt to, and perhaps depend on, technological developments to come? Alone, the young engineers can fantasize and debate over what might be real but do not have the breadth of experience, the depth of wisdom, or the near-to-death perspective to truly understand. Alone, the senior citizens can reflect, discuss, and lament over what their grandchildren's lives may bring. But they have no sense of influence, creative ability, or skills to help direct the path of technology. Perhaps most important for the senior citizens, their optimism and hope for the future were reinforced as a result of hearing and exchanging fears, ambitions, and perplexities with undergraduate engineers who will soon begin to build the future the senior citizens will never know. Only together could both groups fully explore the ethical implications of our technological destiny.

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