

MENTORING YOUNG ADULTS IN THE DEVELOPMENT OF SOCIAL RESPONSIBILITY

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ABSTRACT

The mission, values, and objectives of engineering programs worldwide include statements about social responsibility and commitment to the development of a better society. For example,

- To instill in students a discriminating way of thinking so that they act in responsible ways to meet the needs and requirements of our changing contemporary world
- To foster tolerance and commitment to civic duties and human rights
- To contribute to the improvement of public policies, communities, companies, and social organizations
- To contribute to the development of the country and the region
- To foster the ability and passion to work wisely, creatively, and effectively for the betterment of humankind

Competencies and learning outcomes for graduates in most engineering programs address ethics, integrity, social responsibility, compassion, and living a life with purpose. Such outcomes are aligned with the *CDIO Syllabus v2.0*, particularly in CDIO 2.5.2 *Ethics, Integrity, and Social Responsibility* and CDIO 2.5.3 *Proactive Vision and Intention in Life*. While many engineering programs state objectives and learning outcomes in these areas, few have developed effective teaching and learning strategies that systemically address them. For the most part, engineering programs are not adequately addressing ethics, integrity, and social responsibility.

The central thesis of this paper is that we believe that young adults in our engineering classrooms want to live lives that matter. Although some might disagree, we believe that young adults want to contribute to the betterment of society through the pursuit of their careers. Sometimes, cultural factors present challenges to their pursuits. A culture of individualism, for example in the United States, emphasizes freedom, independence, and competition, often at the expense of others. In other cultures, for example in much of the Global South, the emphasis is less on independence and more on solidarity, collaboration, and social responsibility. In this paper, we examine the meaning and foundations of social responsibility and address ways in which engineering programs can help students to develop social responsibility. We identify key issues related to social responsibility and suggest learning outcomes and methods to address them with a new generation of university students. We begin with a description of this generation of young adults.

KEYWORDS

Ethics, social responsibility, vision, cooperative learning, service learning

A NEW GENERATION OF YOUNG ADULTS

Much has been written about the characteristics of Generation X and the Millennials, but at this point, they have been out of college for more than ten years. In this paper, we refer to university students under the age of 25 as *quarterlifers*, because they are in the first quarter of their lives. In *Helping College Students Find Purpose* (2010), Robert J. Nash and Michele C. Murray describe the quarterlife period as a tumultuous time for most students because it triggers overwhelming anxieties about the past, present, and future. [1] Many quarterlife students are plagued with worry about failure, for example, living up to others' expectations, letting go of the comfortable securities of childhood, coming to terms with the growing tension between freedom and responsibility, and constantly comparing themselves to their peers and coming up short. [2] Some quarterlifers, especially those in the United States, openly admit that they just do not want to grow up, and what they dread most is the need to return home to live with their parents after they graduate from college.

Purpose and Meaning for Young Adults

At the same time, quarterlifers look at their time in college as an opportunity to find purpose and meaning in their lives and to pursue their dreams. According to Nash and Murray, *purpose* has to do with pursuing certain goals, reaching resolutions, seeking results, and realizing particular objectives and ends in those worlds. *Meaning*, on the other hand, has to do with how we understand our lives on an ongoing basis. Meaning is about interpretations, rationales, perspectives, and belief systems that we bring to the various worlds in which we live and work. [1] Meaning involves the search for a sense of connection and significance.

What makes purposes worthwhile or justifiable to quarterlifers depends on those meanings that they attach to them and that drive their behaviors. Nash and Murray believe that too often in higher education, we insist that students achieve a whole host of academic and career purposes without first helping them to formulate systems of meaning to inform these purposes. Without developing sound and enduring *whys*, students often find their well-intended *hows* to be short-lived and directionless. [1] We believe that, in the long run, it is the *whys* that will help students experience the genuine satisfactions of making a difference in the lives of others.

Visions and Dreams of Young Adults

The quarterlife years is also a time of discovering and following dreams. In *Big Questions, Worthy Dreams* (2000), Sharon Daloz Parks addresses the question of purpose and meaning for young adults. [3] She believes that the *Dream*, with a capital *D*, has a quality of vision, that is, it is an imagined possibility that orients meaning, purpose, and aspiration. The formation of a worthy Dream is a critical task for young adults, and in its fullest sense, is a sense of vocation. Vocation conveys calling and meaningful purpose, in which young adults recognize that what they do with their time, talents, and treasure is most meaningfully conceived not as a matter of mere personal passion or preference but in relationship to the whole of life. [3] They look to those of us who are beyond our quarterlife years for inspiration and guidance.

Enhancing the Inner Lives of Young Adults

Researchers at the Higher Education Research Institute (HERI) at the University of California at Los Angeles conducted a seven-year study of university students to examine the role that college plays in facilitating the development of students' inner lives, including their search for meaning and the pursuit of their dreams. [4] Researchers Astin, Astin, and Lindholm (2010) organized the findings around ten spiritual and religious measures. Two of these measures are relevant to the development of social responsibility in young adults: spiritual quest and ethic of caring.

Spiritual Quest

In the HERI study, Spiritual Quest reflects the degree to which the student is actively searching for meaning and purpose in life, to become a more self-aware and enlightened person, and to find answers to life's "big questions." According to the study, students who begin college with high Spiritual Quest scores say that a major reason they enrolled in college is to find their life's purpose and that they expect the college experience to enhance their self-understanding and contribute to their emotional and spiritual development. [4] According to the researchers, students' inclinations to engage in spiritual quests grow significantly during the college years. This growth can be facilitated by

- meditation and self-reflection
- instructors who are willing to explore questions of meaning and purpose
- involvement in religious activities, and
- participation in charitable activities.

Ethic of Caring

Ethic of Caring reflects our sense of caring and concern about the welfare of others and the world around us. These feelings are expressed in wanting to help those who are troubled and to alleviate suffering. It includes a concern about social justice issues and an interest in the welfare of one's community and the environment, as well as a commitment to social and political activism. [4] According to the HERI study, Ethic of Caring shows substantial growth during the college years. Positive growth in Ethic of Caring can be accelerated by

- participation in study-abroad programs
- interdisciplinary courses
- service learning, and
- campus life that places a high priority on diversity and multiculturalism.

Despite the skeptics, we believe that the generation of young adults now in our engineering programs are interested in the "big questions": the purpose and meaning of their lives, the development of an inner or spiritual life, caring about others, and broadening their perspectives beyond themselves and campus life. Some universities, for example, Carnegie Mellon University, have conducted "Big Questions Programs" in which faculty conduct seminars with students in residence halls to encourage students to explore these issues. It is important to help quarterlife students establish a foundation of reflection and questioning in order to address ethics and social responsibility in their personal and professional lives. We now look at the general principles and issues that

define social responsibility. In a later section, we address the ways in which these principles are connected with engineering education.

PRINCIPLES OF SOCIAL RESPONSIBILITY

Social responsibility is an ethical ideology that proposes that an individual or an organization has an obligation to act to benefit society at large. With respect to the natural world, for example, social responsibility is a duty every individual or organization has to perform so as to maintain a balance between the economy and the ecosystem. Social responsibility can be passive, by avoiding engaging in socially harmful acts, or active, by performing activities that directly advance social goals. Our position is that passive social responsibility is not sufficient. It is important to help our students to take active roles in advancing social goals that benefit the common good.

From our viewpoint, there are four key principles that underlie the definition of social responsibility: 1) compassion, 2) an ethic of care, 3) solidarity, and 4) a preferential option for the poor. Paraphrasing Paul Farmer, Professor of Medical Anthropology at Harvard Medical School, in *Pathologies of Power: Health, Human Rights, and the New War on the Poor* (2005), I am openly on the side of promoting compassion, caring, solidarity, and a preference for the poor, and do not seek to represent myself as a neutral party. [5]

Compassion

Maureen O'Connell of Fordham University defines compassion as 1) the ability to perceive our connections to the causes of others' suffering, 2) the willingness to interpret contexts of injustice from the perspective of those who suffer, and 3) an active commitment to create new structures with the capacity to transform social reality. [6] Compassion is not just an attitude or feeling; it is an active response with the following characteristics:

- Honest assessment of what might be required to restore suffering groups of people to a state of flourishing
- Self and institutional awareness of our collusion in the causes of suffering
- Active commitment to human flourishing rooted in empowerment and resistance to the causes of suffering [6]

The themes of interpreting contexts from the perspective of those who are suffering, the admission of our personal and institutional collusion in others' suffering, and the importance of changing the social structures that cause suffering recur in the descriptions of caring and the preferential option for the poor. O'Connell believes that we must be compassionate not just in times of social crisis but also in all the times in between.

An Ethic of Care

The second key principle is an ethic of care. Many of those writing about care and caring agree that the care that is relevant to social responsibility must at least be able to refer to an activity, as in *taking care* of someone. Caring relations extend well beyond the sorts of caring that take place in families and among friends to the social ties that bind groups

together, to the bonds on which political and social institutions can be built, and even to the global concerns that citizens of the world can share. Virginia Held, Distinguished Professor of Philosophy at the City University of New York Graduate School defines *caring for* as the meeting of the needs of one person by another person, where face-to-face interaction between caregiver and cared-for is a crucial element of the overall activity and where the need is of such a nature that it cannot possibly be met by the person in need herself. [7] The face-to-face aspect of care is central. This has been thought to make it difficult to think of our concern for more distant others in terms of caring – difficult, but not impossible.

According to Held, care must concern itself with the effectiveness of its efforts to meet needs, and also with the motives with which care is provided. Even if a certain program were to meet the requirements of justice and equality, one could still find the program callous and uncaring if it did not concern itself with the actual wellbeing brought about by the program. A caring program

- meets the bare requirements of justice
- fosters concern for the actual needs of recipients
- offers the needed services or jobs to meet them, and
- expresses the morally recommended care and concern of the society for its less fortunate and more dependent members. [7]

It is on the grounds of care rather than justice that one can identify with others enough to form a political entity and develop a civil society. Both men and women need to acknowledge the value of the caring activities on which society relies and should be willing to share these activities fairly.

Some would suggest that caring is close to the Christian virtue of charity. Care, however, is not the same as charity and being caring is not the same as being charitable. For example, when we take care of our children, we are not being charitable. Valuing care is entirely independent of any religious foundation, and is the stronger for this, since those not sharing a given religious tradition would have few reasons to attend to arguments that appeal to that tradition. In *The Ethics of Care* (2005), Held compares an ethic of justice with an ethic of care as the basis for social responsibility. [7] She suggests keeping these concepts distinct and delineating the domains in which each should have priority.

Table 1
An Ethic of Justice vs. an Ethic of Care

An Ethic of Justice	An Ethic of Care
<ul style="list-style-type: none"> • Focuses on questions of fairness, equality, individual rights, abstract principles, and the consistent application of them • Seeks a fair solution between competing individual interests and rights • Protects equality and freedom • Gives priority to the values of equality, impartiality, fair distribution, and noninterference 	<ul style="list-style-type: none"> • Focuses on attentiveness, trust, responsiveness to need, narrative nuance, and cultivating caring relations • Sees the interests of caregivers and cared-for as importantly intertwined rather than as simply competing • Fosters social bonds and cooperation • Gives priority to the values of trust, solidarity, mutual concern, and empathetic responsiveness

<ul style="list-style-type: none"> • In practice, individual rights are protected, impartial judgments are arrived at, punishments are deserved, and equal treatment is sought 	<ul style="list-style-type: none"> • In practice, relationships are cultivated, needs are responded to, and sensitivity is demonstrated
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Most people in the United States, and perhaps in all of the Global North, base their obligation of social responsibility on an ethic of justice. We agree that this is an important and necessary starting point. However, to get to the kind of social responsibility advocated in this paper, it is necessary to develop a sense of caring over and above a sense of fairness.

Solidarity

Solidarity, the third key principle, is the integration shown by a society or group with people and their neighbors. It refers to the ties in a society that bind people to one another. What forms the basis of solidarity varies between societies. Solidarity consists of activities intended to benefit the welfare of others. These activities span a continuum from individual to interpersonal to organizational to global. They include generosity, forgiveness, love, virtue, philanthropy, and intergroup cooperation. Pragmatic solidarity is different from, but nourished by, solidarity per se, that is, the desire to have a common cause with those in need. People enduring great hardship often remark that they are grateful for the prayers and good wishes of fellow human beings. However, when the goods and services that might diminish unjust hardship accompany these sentiments, solidarity is enriched and becomes meaningful. [5] To those in great need, solidarity without the pragmatic component can be just empty words.

Preferential Option for the Poor

Finally, the fourth key principle underlying our definition of social responsibility is a preferential option for the poor. The phrase *preferential option for the poor* originated in the Latin American Catholic Church in the last few decades of the 20th century, but the spirit of this *option* is as old as the Hebrew prophets and the Christian gospels. [8] According to this belief, God is not neutral about the plight of the poor. Rather, God prefers the poor and takes their side in their struggles against unjust poverty and oppression. The *poverty* to which the option refers is material poverty, which, for many, means premature and unjust death. The poor person is someone who is treated as a non-person, someone who is considered insignificant from an economic, political, and cultural point of view. The poor count as statistics; they are the nameless.

The poor person does not exist as an inescapable fact of destiny. His or her existence is not politically neutral, and it is not ethically innocent. The poor are a by-product of the system in which we live and for which we are responsible. They are marginalized by our social and cultural world. They are the oppressed, exploited proletariat, robbed of the fruit of their labor and despoiled of their humanity. Hence the poverty of the poor is not a call to generous relief action, but a demand that we go and build a different social order.

Gustavo Gutiérrez, *The Power of the Poor in History* [9]

John Neafsey of Loyola University in Chicago believes that all of us are called to opt for the poor, to open our hearts to the poor, to do something with our lives that will make a difference for the better in theirs. The secret to realizing our full humanity is to find our own way to exercise this option in a meaningful way. All of us are called to be mindful of the poor and to respond to the call to translate our compassionate feelings and good intentions into concrete actions on their behalf. [10] This could be through some form of regular personal contact with the poor, through contributing money or raising funds for projects that benefit the poor, through efforts to raise consciousness about issues of poverty and social justice in our families, schools, churches, and communities, or through political advocacy to advance public policy initiatives that help the poor or that change social structures that keep people poor.

Neafsey suggests that another concrete way that privileged North Americans can opt for the poor is through simplifying our lives and by making more discerning choices about how we use our money. [10] This is good for our spiritual health, of course, because it helps us to live more centered and less cluttered and materialistic lives. Even more importantly, it is good for our moral health because by living more simply we are less likely to unwittingly participate in mindless, wasteful cultural habits of overconsumption that exploit and hurt and deprive the poor. The point is to be ever mindful that people all over the world are desperately in need of our help at every moment. If we take the option for the poor seriously, it will cost us financially because we will be continually challenged to think of creative ways to transfer resources to people who need them much more than we do. There is an emotional as well as financial cost to involvement with the poor.

Paul Farmer, Founding Director of Partners in Health, cited earlier, echoes the principle of a preferential option for the poor in his work in Haiti, Cuba, Mexico, and Russia. [5] He believes that human rights abuses are best understood from the view of the poor and conducts his medical practice based on this belief. Although Farmer works in the medical field, his work and his writing have applications in the engineering profession. He compares three approaches to addressing social responsibility: charity, development, and social justice.

Charity

According to Farmer, those who believe that charity is the answer to the world's problems often have a tendency to regard those needing charity as intrinsically inferior. There is an enormous difference between seeing people as the victims of innate shortcomings and seeing them as the victims of structural violence. The approach of charity further presupposes that there will always be those who have and those who have not. [5] Charity medicine, for example, too frequently consists of second-hand, castoff services, doled out in piecemeal fashion. The notion of a preferential option for the poor challenges us to believe that the homeless poor are *more* deserving of good medical care than the rest of us. "Whenever medicine seeks to reserve its finest service for the destitute sick, you can be sure that it is option-for-the-poor medicine." [5, p. 155]

Development

Farmer believes that progress for the poor is not likely to ensue from development approaches because developers often place the problems with the poor themselves, that is, they believe that poor people are backward and reject the technological fruits of

modernity. Developers believe that with assistance from others, underdeveloped societies too will, after a while, reach a higher level of development. These beliefs assume a linear process, that is, that development will occur if the right steps are followed. Developers report success in overall statistics without looking at the effects on specific populations. [5] The rich, even in underdeveloped societies, get richer, at the expense of the poor who do not have access to the benefits of development.

Social Justice

People who work for social justice see the conditions of the poor not only as unacceptable but also as the result of structural violence that is human-made. [5, p. 157] Making an option for the poor inevitably implies working for social justice, working with poor people as they struggle to change their situations.

We defined social responsibility and set its foundation on four key principles: compassion, an ethic of care, solidarity, and a preferential option for the poor. We now examine social responsibility in the engineering curriculum; give examples of methods that help facilitate its development in quarterlife students; and, suggest resources for engineering faculty.

SOCIAL RESPONSIBILITY IN THE ENGINEERING CURRICULUM

Some would argue that helping students to find meaning in their lives and develop a sense of responsibility for others is not the business of engineering education, but that its proper task is discovering and teaching empirical truth, and preparing students for the tasks of engineering. They would argue that issues of purpose and meaning are more appropriately dealt with elsewhere in the university or in society. We believe that every subject, discourse, and methodology in the curriculum of higher and professional education, including engineering education, potentially contributes to the formation of students in their efforts to find purpose and meaning in their lives. Others believe that the engineering curriculum must go beyond technical skills and be guided by principles that support social responsibility. [11] Student attitudes toward an engineer's roles and responsibilities are essential dispositions to be developed during undergraduate study if the goal is to produce engineers who are able to solve problems in socially and environmentally conscious ways.

Defining and Validating Program Outcomes

The *CDIO Syllabus v2.0* delineates the topics of ethics and social responsibility in section 2.5 *Ethics, Equity and Other Responsibilities*. Table 2 lists the topics included in CDIO 2.5 at the fourth level of detail. The topics that are most relevant to this paper are highlighted in yellow and underlined.

Table 2
Social Responsibility in the CDIO Syllabus v2.0

<p>2.5 ETHICS, EQUITY AND OTHER RESPONSIBILITIES</p> <p><i>2.5.1 Ethics, Integrity and Social Responsibility</i> One's ethical standards and principles The moral courage to act on principle despite adversity The possibility of conflict between professionally ethical imperatives A commitment to service Truthfulness A commitment to help others and society more broadly</p> <p><i>2.5.2 Professional Behavior</i> A professional bearing Professional courtesy International customs and norms of interpersonal contact</p> <p><i>2.5.3 Proactive Vision and Intention in Life</i> A personal vision for one's future Aspiration to exercise his/her potentials as a leader One's portfolio of professional skills Considering one's contributions to society Inspiring others</p> <p><i>2.5.4 Staying Current on the World of Engineering</i> The potential impact of new scientific discoveries The social and technical impact of new technologies and innovations A familiarity with current practices/technology in engineering The links between engineering theory and practice</p> <p><i>2.5.5 Equity and Diversity</i> A commitment to treat others with equity Embracing diversity in groups and workforce Accommodating diverse backgrounds</p> <p><i>2.5.6 Trust and Loyalty</i> Loyalty to one's colleagues and team Recognizing and emphasizing the contributions of others Working to make others successful</p>

The highlighted topics in CDIO Syllabus 2.5 are easily translated into program outcomes, for example,

- 2.5.1 Students demonstrate a commitment to service
- 2.5.3 Students have developed and communicated a vision for their future
- 2.5.5 Students are committed to treating others with equity.

Many of the program outcomes related to social responsibility can be classified as affective, based on the domain described by Krathwohl, Bloom, and Masia in their *Taxonomy of Educational Objectives: The Affective Domain* (1964). [12] The affective domain relates to the emotional component of learning. It emphasizes a feeling tone, an emotion, or a degree of acceptance or rejection. Affect encompasses a range from

simple attention to organization and characterizations of complex, but internally consistent, qualities of character and conscience. Knowing the classification level of a program outcome helps to determine relevant teaching methods and provides criteria for expected levels of student performance, or in this case, the extent to which social responsibility is demonstrated and internalized. There are five levels of objectives in the affective domain:

1. **Receiving** (*attending*) speaks to an awareness that a learner is conscious of as he/she takes into account a situation, phenomenon, or state of affairs. It also addresses the learner's willingness to receive information, for example,
 - Accepts the need for a commitment to service
 - Recognizes the goals and roles of the engineering profession
2. **Responding** means that students are sufficiently motivated that they are not just willing to attend, but are actively attending. It involves a continuum from acquiescence in responding, to willingness to respond, to satisfaction in response, for example,
 - Discusses the motivation for contributing to society
 - Considers the social and technical impact of new technologies and innovations
3. **Valuing** means that something has value or worth. At this level, behavior is sufficiently consistent and stable as to be characterized as a belief or attitude. The student is perceived as holding a value. This level ranges from acceptance of a value, to preference, to commitment to a value, for example,
 - Acts on principle despite adversity
 - Values a willingness to work independently
4. **Organization** refers to the process learners go through after they internalize values and are faced with situations for which more than one value is relevant. This necessitates the organization of values into a system, determining the relationship among them, and establishing dominant and pervasive values, for example,
 - Integrates the potential benefits and risks of an action
 - Commits to the service of others and society more broadly
5. **Characterization by a Value or Value Complex** refers to the levels at which the individual acts consistently in accordance with the values he/she has internalized. A behavior is pervasive, consistent, predictable, and characteristic of the student. Student beliefs, ideas, and attitudes are integrated into a total worldview, for example,
 - Resolves conflicting issues in the balance between personal and professional life
 - Acts consistently in ways that treat others with equity and caring

When asking stakeholders to validate program outcomes in the affective domain, it is helpful to use a scale that is related to a hierarchy that addresses development from simple awareness to long-term commitment, aligned with the levels of the affective domain. Some engineering programs in Latin America use a scale for affective program outcomes separate from that used for knowledge and skill outcomes. The 5-point scale for affective outcomes represents the level of internalization of a value or an attitude from awareness to complete commitment:

1. Is aware of
2. Motivated to accept the value of
3. Internalizes the value of
4. Acts consistently in accordance with the value
5. Can persuade others to accept the value

Admittedly, there may not be many, or any, program outcomes whose expected levels are 4 or 5, but it is important to recognize the full development of an attitude or value even if that development is beyond the scope of a university program.

Alverno College in Milwaukee, Wisconsin offers an alternate way of setting criteria for outcomes related to social responsibility and other attitudes and values. The College defines a curriculum that requires all students to demonstrate eight core abilities in the context of their study across various disciplines. Three are relevant to our discussion here: Valuing in Decision Making, Social Interaction, and Developing a Global Perspective. [cited in 13] Alverno has also articulated six levels of performance for each and continually revises them to respond to an increasingly diverse student body and new insights from teaching, scholarship, and individual differences in student learning and performance. For example, Valuing in Decision Making has five performance levels:

Beginning

1. Identifies own and others' values and some key emotions they evoke
2. Connects own values to behavior and articulates the cognitive and spiritual dimensions of this process

Intermediate

3. Analyzes the reciprocal relationship between own values and their social contexts and explores how that relationship plays out
4. Uses the perspectives and concepts of particular disciplines to inform moral judgments and decisions

Advanced

5. Uses valuing frameworks of a major field of study or profession to engage significant issues in personal, professional, and civic contexts. [13]

This scale could be adapted for program outcomes related to social responsibility.

When the program outcomes are identified and validated as to their expected levels of internalization, they can serve as guidelines for selecting teaching and assessment methods that will facilitate their development in quarterlife students. We now examine six overlapping approaches: mentoring environments, cooperative learning, constructive controversy, design-implement projects, service learning, and global projects. We describe each approach, give examples, and point to sources of additional information. It is beyond the scope of this paper to provide details on the implementation of these approaches in the classroom.

Mentoring Environments

Mentoring, in a classic sense, is an intentional, mutually demanding, and meaningful relationship between two individuals, a young adult and an older, wiser person who assists the young adult in learning the ways of life. However, students often report that their most positive learning experiences were not only in one-to-one learning contexts, but also in environments where an instructor worked with a *small group* of students. [3] It is important to note that a network of belonging that serves quarterlifers as a mentoring environment may offer an effective context in the development of meaning, purpose, and social responsibility. Parks believes that good mentors know that knowledge and learning that matter are ultimately transforming and linked with the whole of life. [3] Mentors offer good company as quarterlifers cross the threshold of critical thought into new questions and possibilities. They respect the competence of the young adult, and at the same time, they are prepared to be present in ways that invite more learning and growth.

If an engineering student is to be initiated into the profession of engineering, a mentor alone is not sufficient. What is needed is a mentoring environment, that is, a network of belonging that constitutes a place for the potential and the vulnerability of imagination in practical, tangible terms. It offers a sociality that works physically, emotionally, intellectually, and spiritually as students become more fully at home in the universe. [4] A mentoring environment that prepares students for today's world can, and must, assist in creating norms of discourse and inclusion that 1) invite genuine dialogue, 2) strengthen critical thought, 3) encourage holistic awareness, and 4) develop a habit of reflection.

Cooperative Learning

Recognized for their many years of research and practice in cooperative learning, David and Roger Johnson describe cooperative learning as the instructional use of small groups so that students work together to maximize their own and each other's learning. It may be contrasted with competitive learning and individualistic learning. [14] A cooperative context tends to promote pro-social behavior and caring, supportive relationships, frequent and accurate communication, trust, and the promotion of each other's success. According to Johnson and Johnson, cooperative learning is unique for at least three reasons:

1. It has the power to affect student performance, development, socialization, and wellbeing.
2. It provides a constructive context for building and maintaining constructive relationships among students, between students and faculty, and socialization into the school, community, and society in general.
3. It reflects an organizational structure based on teamwork and the mutual commitment of all organizational members to achieve common goals. [14]

Educational researchers find three main outcomes of cooperative learning approaches in the classroom: 1) increased effort to achieve, 2) positive relationships, and 3) more mature decision making. First, research indicates that cooperation promotes greater effort to achieve than competitive or individualistic efforts. Secondly, the more positive the relationships among students and between students and faculty, the lower the absenteeism and dropout rates and the greater the commitment to group goals, feelings of personal responsibility to the group, willingness to take on difficult tasks, motivation and persistence in working toward goal achievement, satisfaction and morale, willingness to endure pain and frustration on behalf of the group, willingness to defend the group against external criticism or attack, willingness to listen to and be influenced by colleagues, commitment to each other's professional growth and success, and productivity. [14] Thirdly, the more cooperative the learning experiences students are involved in, the more mature their cognitive and moral decision making, and the more they will tend to take other people's perspectives into account when making decisions.

Constructive Controversy

Related to cooperative learning is a strategy called constructive controversy. Constructive controversy exists when one person's ideas, information, conclusions, theories, and opinions are incompatible with those of another, and the two seek to reach an agreement. [15] Johnson and Johnson believe that conflict is an inherent part of cooperation. Intellectual conflict among group members, if not essential for cooperation's success, has the potential for enhancing the effectiveness of cooperation. The more cooperative learning is used, the more group members need to understand how to

disagree with each other's ideas, conclusions, and opinions, and challenge each other's reasoning and information in constructive ways.

Constructive controversy may be used with almost any topic being studied. In doing so, the instructor organizes students into cooperative learning groups of four, divides each group into two pairs, assigns the pro position on an issue to one pair and the con position to the other pair, and then guides students through the following steps:

1. Research and prepare a position
2. Present and advocate their position
3. Engage in an open discussion in which they refute the opposing position and rebut attacks on their own position
4. Reverse perspectives
5. Synthesize and integrate the best evidence and reasoning into a joint position.

Many topics related to social responsibility could be debated in this manner. This approach gives students an opportunity to reflect on their own attitudes, articulate their positions, and begin to see the issues from the perspectives of others. Moreover, it helps students to develop skills in constructive disagreement.

Case studies from YouTube and other Internet sites can provide the stimuli for constructive controversy. Two examples are given here.

"Poverty Tour: A Call to Conscience," Tavis Smiley and Cornel West, August 2011

<http://www.youtube.com/watch?v=dQJu7ldorbg>

DemocracyNow.org - Democracy Now! interviews two leading African-American voices who have hit the road to challenge President Obama's record on poverty. The veteran broadcaster, Tavis Smiley, and the author and Princeton University Professor Cornel West were in the midst of a 15-city, cross-country trek they dubbed, "The Poverty Tour: A Call to Conscience." The tour came on the heels of the previous week's deficit agreement, which had been widely criticized for excluding a tax hike on the wealthy as well as any measures to tackle high unemployment. On their tour, Tavis Smiley and Cornel West visited low-income communities and town hall meetings in what they call an attempt, "to highlight the plight of the poor people of all races, colors, and creeds so they will not be forgotten, ignored, or rendered invisible during this difficult and dangerous time of economic deprivation and political cowardice."

"Farmworker Justice," Immokalee, Florida, <http://video.pbs.org/video/2192680120>

Florida's tomato industry is a business that's long been accused of exploiting its workforce through overwork, underpay, and mistreatment. That's turned the fields of Immokalee into the frontlines of a high profile national campaign to improve the lives of farmworkers. Florida's tomato workers are usually paid by how much they pick, traditionally getting about 45 to 50 cents for every 32-pound bucket they fill. That means to make a day's minimum wage, each worker has to pick two-and-a-half-tons of tomatoes a day. Immokalee is a town full of young men from Mexico, Central America, and Haiti, many undocumented, who come there to scratch out a better life for themselves by harvesting Florida's tomato crops. The video encourages viewers to think about their connections with the people who toil in the fields day in and day out to put food their tables. For the men and women who pick Florida's tomatoes, their most important harvest has been some measure of justice and respect.

Design-Implement Projects

Most engineering programs have two or more design-implement projects. The focus is usually on *how* to engineer products, processes, and systems. A social justice and responsibility approach would ask questions not only about the *hows*, but also about the *whys*. Some engineering projects are directly related to social justice and responsibility issues in that they have community groups and service organizations for customers or users of their engineering solutions. However, any design-implement project can address the *whys* as well as the *hows*.

Caroline Baillie, Chair of Engineering Education at the University of Western Australia, suggests that students (and their instructors) consider the following questions: [16]

- What is the expected social impact of the work and on whom?
- Does it comply with the Engineering, Social Justice, and Peace (<http://esjp.org>) commitments for social justice?
- What will be the main outcomes – a paper? For whom? To do what? Direct technology transfer? To whom? For what?
- Who funds the work, and how does this affect the impact of the work?
- How are students involved? How should they be involved? What is their impact on the outcomes?
- How do we engage the public and the users of the engineering in a participatory way, considering whom we engineer for and why?
- How do we engineer? Are the organizational systems equitable, such as cooperatives that own the process of their own labor?
- What are the alternative market mechanisms?

To understand and value human rights and recognize the dignity of every human being, the engineer must engage in empathic design, where the customer, client, or user is valued, and the designer recognizes that the customer, client, or user has knowledge from which the designer can benefit, just as the designer has knowledge from which the customer, client, or user can benefit. The designer is not merely helping the user, but he or she is learning from and respects the user. [17] Engineering for social justice, however, is not uniformly valued across different education institutions. Their concerns about not adequately addressing “real engineering tasks” may be unfounded. Engineering for social justice, or human-centered design, or empathic design have been shown to:

- lead to innovation in engineering design
- help students develop skills in creativity, practical ingenuity, and communication necessary for the Engineer of 2020
- give engineers a competitive advantage in a global workplace, and
- help engineers address the Grand Challenges identified by the National Academy of Engineering in 2008. [17]

Service Learning

Design-implement projects focused on social responsibility are often referred to as service learning, a pedagogy that integrates academic learning with service that meets human needs. Often, these needs are for the underserved, thereby providing access to services for underserved people. When service learning is applied to design learning, it provides students with a direct user who has compelling needs and immediate interest in implementing the proposed solution or design. Service learning has been widely adopted in many disciplines and can be defined as an educational experience in which students participate in an organized service activity in such a way as to gain further understanding of the course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility. [17] Two traps need to be avoided in service learning:

1. Focusing on the student experience without balancing the needs of the community, and
2. Approaching people in a condescending manner, rather than working alongside people who have expertise and from whom we can learn.

A fundamental advantage of service learning as a pedagogical approach is the experiential nature of the course structure as well as the frequent interaction with a community partner who has specific needs that should be addressed by the project. When the community partners assist underserved people, it provides a direct contact for students to be exposed to these needs for themselves. Good designers understand the context in which they are designing, and for service-learning students, this means understanding the needs as well as the larger social context in which these needs exist. Service learning has the additional connection to social responsibility in that it leverages the assets of the university, college, or school to address compelling needs of local and global communities. [17] Service learning can provide young adults with multidisciplinary experiences that enable them to build both process and awareness skills. Service learning provides their instructors with opportunities to observe and assess student growth in these process and awareness skills.

Many different universities have incorporated service learning into the engineering curriculum to address contextual, motivational, and multidisciplinary needs. Two examples are provided here.

Engineering Projects in Community Service (EPICS), Purdue University, <http://engineering.purdue.edu/EPICS>

Founded at Purdue University in 1995, EPICS is a program in which teams of undergraduates are designing, building, and deploying real systems to solve engineering-based problems for local community service and education organizations. EPICS programs are now operating at more than 20 universities.

Humanitarian Engineering and Social Entrepreneurship (HESE), Pennsylvania State University, <http://www.sedtapp.psu.edu/humanitarian/about.php>

The emphasis of the program is on relationship building and not simply project-driven exercises. Long-term, sustainable, collaborative partnerships are formed with host universities and marginalized communities. This enables development of outreach programs at the universities reaching into local communities. There is also a strong emphasis on entrepreneurship in the program. Engineering design solutions are developed and students are encouraged to develop business plans and implement them in the host community.

There are also many examples of service learning projects in the United States that would be appropriate as joint projects of university students and high-school and middle-school students in the local community. Several examples are provided.

The Global Soap Project, <http://www.globalsoap.org/>

Headquartered in Atlanta and incorporated in Georgia, the Global Soap Project was founded by Derreck and Sarah Kayongo. Derreck is a humanitarian relief expert whose own family fled Uganda and the tyranny of Idi Amin in 1979. During this tragic and despotic era, close to one million people lost their lives. Many, like Derreck, were displaced in refugee camps. Today, millions of people around the world still live in compromised environments, with limited or no access to clean water and soap. Recycling soap is a simple concept that provides enormous benefits. The Global Soap Project raises awareness about the lack of sanitation and its consequences in many parts of the world. With 4.6-million hotel rooms in the United States, an estimated 2.6-million soap bars are discarded every day. By participating in this program, hoteliers are diverting tons of waste from the landfill and bolstering environmental sustainability programs. Hotel managers, housekeepers and guests become more environmentally conscious and more sensitive to the needs of vulnerable populations.

We Care Act, <http://www.wecareact.org/>

We Care Act is a 501(c)(3) non-profit organization that started out helping children who survived the deadly earthquake in Sichuan, China. Realizing that there are many needs that must be met after a natural disaster, for example, a 7.9-magnitude earthquake, We Care Act developed programs to meet some of these needs.

Their mission is to help school children recover from disasters and to engage young people around the world to help others in need.

Under the Acacia, Derry, NH, www.undertheacacia.org

Under the Acacia 501(c)(3) works in tandem with remote communities in Kenya to generate sustainable initiatives that further community development and growth. This group works in areas primarily untouched by the government and unchartered by NGOs. The organization believes that for a community to flourish, all basic human needs must be addressed including shelter, health, education, sanitation, food, water, safety, environment and employment. It invests in infrastructure and, together with communities, sets plans into action to achieve sustainable results so that days can be spent on growth rather than survival. In conjunction with community work, the group launches awareness campaigns and creative informational platforms that educate the international community on the incredible stories and incredible people coming out of these remote areas. In Kenya, everything happens Under the Acacia.

Greening Forward, www.greeningforward.org

Greening Forward began in the summer of 2008 when Charles OrgBon was only 12 years old and entering the 7th grade. In response to seeing litter found all over his school campus, Charles created an interactive website called Recycling Education that addressed many environmental issues. As Charles's knowledge of environmental issues was better established, the number of topics that were addressed on the website increased. As Charles's passion grew, he engaged himself in his school on environmental awareness projects. After seeing the mark that had been left on the Florence, South Carolina community, he felt that with help, Recycling Education could grow to empower different communities to join the green movement. Charles laid the foundation for building Recycling Education into a functioning charitable organization that sponsors the Earth Savers Club network. Later, Recycling Education's name was changed to Greening Forward in the summer of 2010 to reflect a more holistic view on environmental issues.

Drinking Water for India, www.drinkingwaterforindia.org

The inspiration for making a difference came when Rujul visited India with his family in January 2007. In Paras, he saw that villagers had to walk a few kilometers each way to reach their nearest water source – and that water wasn't even clean. When Rujul returned home to the U. S., he and a classmate realized that the best way to help was to build a tube-well in Paras. They raised funds for the project. Rujul returned to India and built a well there. Rujul and Kevin initially involved their fellow classmates at school in their cause. They have now involved an additional 30 schools in their mission to bring clean water to other Indian villages.

GreenShields Project, <http://web.me.com/jonnymonster/GreenShields/Welcome.html>

Jonny Cohen, a student at Highland Park High School in Illinois, noticed the cumbersome build of school buses. He wondered whether it was possible to streamline them for aerodynamic efficiency. His idea was to attach a polycarbonate shield on the front of the school bus, redirecting the airflow and ultimately, saving gas and money for schools. Hence, the GreenShields Project. In 2008, Jonny, his sister Azza, and her friends applied for and won a \$1,000 grant from Youth Venture, an organization that helps young social activists bring their ideas to life. The first thing they did was to build a wind tunnel in the garage to test mini GreenShields models on toy school buses. They were invited to represent GreenShields at the 2009 Youth Venture International Conference in Boston. While in Boston, they met with a professor from MIT whom they had contacted with questions about their ideas and he showed them around the Wright Brothers' Wind Tunnels. The GreenShields Project became a reality.

Global Projects

Many of the service learning projects described above have global components to them, in that they reach beyond the local communities and countries in which the founding organization is based. Many global projects are initiated and organized by engineering faculty as part of their research programs. Caroline Baillie, cited earlier, while engaged in her research in materials, shifted her focus so that her work became more directed toward the aims of social justice. [16] As a result she founded an organization called *Waste for Life* (<http://wasterforlife.org>), a loosely joined network of people across the world, who work with waste collecting cooperatives to co-develop, apply, and

disseminate poverty-reducing technologies for repurposing scavenged waste. She was guided by a series of self-reflective questions:

- Is it possible for engineering to be co-developed and applied in a way to support cooperatives through initiatives such as Waste For Life?
- Can we shift our research focus so that it can be directed toward the aims of social justice?
- Can we as university researchers co-create sociotechnical solutions that support and develop new systems and structures, which promote equity, rather than reinforce existing power as well as economic and social imbalances?
- What would engineering be like if we looked at it through a lens of social justice?
- What is the social impact of one's research, that is, who would benefit from the results of one's research?
- Would one's work actually result in a net benefit to social justice or to maintaining or even worsening the disparities between social groups? [16, p. 91]

Other engineering organizations committed to social justice, equity, nonviolence, and an ethic of caring include Engineers Without Borders, Engineers for a Sustainable World, and Engineering World Health. We describe each briefly here.

Engineers Without Borders, <http://www.ewb-international.org> and <http://www.web-use.org>

Engineers Without Borders - International facilitates links and collaboration among its member groups toward improving the quality of life of disadvantaged communities worldwide through education and implementation of sustainable engineering projects, while promoting new dimensions of experience for engineers, engineering students, and similarly motivated non-engineers. The vision of Engineers Without Borders - International is to be recognized and respected as an international organization whose members deliver sustainable solutions to developing communities worldwide and make use of their diverse technical expertise to solve critical problems affecting the health of our planet. Engineers Without Borders -International sees a world where ALL people have access to the knowledge and resources with which to meet their basic human needs and rise out of poverty. Several universities, including the Massachusetts Institute of Technology, have campus chapters of EWB.

Engineers for a Sustainable World, <http://www.eswusa.org>

Engineers for a Sustainable World (ESW) is a nonprofit network committed to building a better world. Established in 2002, ESW is comprised of students, university faculty, and professionals who are dedicated to building a more sustainable world for current and future generations. Through collegiate chapters across the United States, ESW mobilizes students and faculty members through new educational programs, sustainability-oriented design projects, and volunteer activities that foster practical and innovative solutions to address the world's most critical challenges.

Engineering World Health, <http://www.ewh.org>

Engineering World Health is a nonprofit organization that mobilizes the biomedical engineering community to improve the quality of health care in hospitals that serve resource-poor communities of the developing world. With this professional expertise, EWH installs donated and newly designed medical equipment, carry out repairs and build local capacity to manage and maintain the equipment. They also harness the resources of collegiate engineering programs through a network of university-based chapters and contract with Duke University to manage a summer program that sends student biomedical engineers to developing country hospitals where they repair broken equipment.

SUMMARY

We believe that quarterlife students in our engineering classrooms want to live lives that matter. It is our position that they want to contribute to the betterment of society through the pursuit of their careers. In order to do so, they need engineering programs that will inspire a vision and facilitate the development of a commitment to social responsibility. In this paper, we examined the meaning of social responsibility and set it on a four-pillar foundation of compassion, an ethic of care, solidarity, and a preferential option for the poor. We addressed ways in which engineering programs can help students to develop social responsibility, suggesting six approaches: mentoring environments, cooperative learning, constructive controversy, design-implement projects, service learning, and global projects. It is our hope that we can continue to frame our engineering research and projects in contexts of social responsibility.

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Other Professional Resources

Engineering, Social Justice, and Peace, <http://esjp.org>

Engineering, Social Justice, and Peace Journal, <http://esjp.org/journal>

International Journal for Service Learning, <http://ijsl.org>

Biographical Information

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