2006-22: ENGINEERING, SOCIAL JUSTICE AND PEACE: A REVOLUTION OF THE HEART

George Catalano, State University of New York-Binghamton

George Catalano is a Professor of Mechanical Engineering.He researches and teaches in the areas of engineering design, the fluid dynamics of the natural world and applied mathematics and is included in the Philosophers' Index for his work in environmental ethics

Caroline Baillie, Queens University-Kingston

Caroline Baillie was appointed in 2003 as the Dupont Canada Chair in Engineering Education Research and Development, the first position of its kind in the world. Caroline previously worked for the UK Centre for Materials Education, which was a national programme to support teaching and learning within engineering.

Engineering, Social Justice and Peace: A Revolution of the Heart

Abstract

The Engineering, Social Justice and Peace effort, begun at Queens University by a group of concerned academics from across Canada and the United States in the fall 2004, focuses upon the connections that exist among engineering and the pursuit of social justice and peace. Several conferences of interested faculty and practitioners have been held subsequently. The present work offers a new paradigm for engineering education based on the Integral Model of Education for Peace, Democracy and Sustainable Development and suggests modifications to the ABET criteria; proposes an engineering code of ethics based upon the notion of community in a morally deep world; and describes an engineering design algorithm consistent with the new code.

Key words: Integral model, morally deep world, ethics, design

Introduction

The phrase, "a revolution of the heart," is taken from the Catholic Workers movement, founded in the 1933 by Dorothy Day and Peter Maurin, a movement grounded in the recognition of the dignity of every human being and dedicated to promoting social justice and peace.[1] The present work seeks to bring the concepts of social justice and peace into reform discussions ongoing in both engineering and engineering education. The term "social justice" was first used in 1840 by a Sicilian priest, Luigi Taparelli d'Azeglio, and given prominence by Antonio Rosmini–Serbati in La Costitutione Civile Secondo la Giustizia Sociale in 1848.[2] Thirteen years later, John Stuart Mill in his development of Utilitarianism gave this approach to social questions a philosophical foundation.[3-4] For us, social justice is the belief in an equitable, compassionate world where difference and diversity is understood and valued, and wherein human dignity, and the dignity of the Earth are honored and respected.

What then is peace? Definitions of peace range from the most pragmatic to the most abstract. Borrowing from the schema first proposed by Dante Alighieri, there are at least four levels for the meaning of peace.[5] At the most fundamental or literal level, note the definition used by Ancient Romans who defined peace, pax, as absentia belli, or the absence of war. At the next highest level of meaning, the analogical, many believe that peace is more than the absence of war but also requires the presence of justice. In this conception, a society in which one group oppresses another lacks peace even in the absence of violence, because the oppression itself constitutes evil. At the third or moral level, peace refers to a harmonious balance between human beings, the rest of the natural world, and the cosmos. Peace does not necessarily have to be something the humans might achieve "some day" but rather can be created and expanded in small ways every day. At the highest or anagogical level, peace is perceived as a state of perpetual love. It comes from the understanding that any and all violence stems from an attachment, whether it is an attachment to a certain kind of truth or an attachment to survival. What is

borne out of the attachment is then a need for imposition of an idea upon the world, that is, if something is true for oneself, then, it must be true for everyone else.

The last level merits more discussion as to its implications for our present work. We too can easily become attached to our views on engineering, social justice and peace. If we do so then that attachment will result inevitably in movement away from our stated goals. Rather, we hope to offer an alternative to the present conceptualization of engineering and engineering education and ask that each of us choose freely from the alternatives consistent with our values.

It is the ultimate irony of our times that the scores of technological advances that serve us well and enrich us can equally impoverish, diminish, and destroy our lives. Many of the creations of modern engineering which instead of serving people, enslave them; instead of helping them develop their identities, take them away. As we have seen in the attacks on the Twin Towers in New York City, and on the mass transit systems in London and Madrid, potential terrorists have much more destructive potential than ever now at their command. In turn, we have also seen how much easier it is for nation states to seek revenge and unleash a torrent of weapons with accuracy and explosiveness unseen ever in the history of humankind. Equally as troubling is the ever-escalating power of the mass media, a direct result of advancing technology. Would anyone argue today that Joseph Goebbels would be less effective than he was during the halcyon days of the Third Reich? Perhaps each of us could identify a modern day Goebbels that has effectively hoodwinked a nation into supporting war, aggression and destruction in the name of some god, economic or political ideology. In addition and concurrently, when have people had such capacity to alter the world's climate or deplete so many of the Earth's resources in such a short period of time?

As we move forward into the 21st century, and as we tick off the gadgets of technological wizardry, which pervades our world, it seems obvious that the development of the rational, analytical or logical part of the human brain has far outpaced the portion of the brain that would ensure that these countless new discoveries would serve us, not destroy us. That portion of the human brain has lagged behind catastrophically. Our call here though must not be misinterpreted as a call to abandon rationality but rather a hope that within the context of a new engineering paradigm, reason and compassion can work together to integrate mind, body, and heart. We know that society cannot go back and only a naïve dreamer can believe that the solution lies in curtailing technological progress in some way or another. It will not happen.

Some argue that this points to the need for a new sense of responsibility, a call for our conscience to catch up to our reason, a divestiture of our egotistical anthropocentrism, our seeing the universe as a machine with our role as master mechanics, free to fix and fiddle to attain any result within our grasp. It would seem that this new responsibility must be based on a respect for all that transcends us: for the universe, the Earth, nature, life and for reality. With this new sense of responsibility, we as engineers would conduct ourselves as though we would live on this Earth forever and one day be held accountable for what we have done and the conditions that exist. However, is it truly a new sense of

responsibility for which we are aiming? What actually is meant by the term "social responsibility?" Does it go far enough?

A group of concerned citizens of the world have come together to offer a new view of future society in which technological advancement and engineering promote social justice and peace. We have chosen to use the term "social justice" rather than "social responsibility" as we feel that simply having a responsibility does not adequately address the issues we wish to raise. Too often, in our view, "social responsibility" can be used as a means to maintain the status quo. As organizers of that effort, we have written our ideas on this connection in the present work. The chief duty of this document is to offer hope, not despair, for it is such hope that will make our "revolution of the heart" possible. We do not seek to offer an annal replete with complaints about existing conditions. The greatest challenge of this then is: "How to bring about a 'revolution of the heart,' a revolution which has to start with each one of us?"[6]

As with other efforts for educational and social reform, there exists a paradox at the very core of the engineering for social justice and peace movement. We must first abandon the logic of engineering organizations and institutions so that we may gather the momentum necessary to alter their logic. Then with the power of the gathering momentum, we hope to put in place a new logic. The dynamics can be described as following: [7]

- Stage 1. Isolated individuals make an inward decision to live "divided no more," finding a center for their lives outside of institutions. The notion of "divided" here refers to an individual who makes valued contributions in her/his profession yet feels an uneasiness with the ultimate end use of the work.
- Stage 2. These individuals begin to discover one another and form communities of congruence that offer mutual support and opportunities to develop a shared vision.
- Stage 3. These communities of congruence start going public, learning to convert their private concerns into the public issues they are receiving vital critiques in the process.
- Stage 4. A system of alternative rewards emerges to sustain the movement's vision and to put pressure for change on the standard institutional reward system.

Literature Review

In November 2003, a conference was held at Bucknell University that brought together faculty, students and engineering practitioners to address several questions with the central issues stated as follows: (1) Do engineers have a central role in the promotion of peace? (2) How can engineering educators respond to the challenges of preparing engineers to proactively encourage peace? Vesilund outlined he evolution of what he termed "peace engineering" over the course of the last several decades.[8] Textor, an anthropologist and futurist, suggested that engineers need to take a proactive stance in the defining of the future of engineering.[9] The morality of weapons research was explored by Forge who argued that while engineers do have a duty not to provide the means to harm,

this does not lead to an absolute prohibition on weapons research.[10] "Just engineering" which links engineering, peace and sustainability was developed by Vallero who noted that often the least advantaged in society are forced to bear the greatest environmental cost.[11] Concurrently, Clewlow suggested that there not only is an opportunity but also a responsibility for engineers to be part of the effort to alleviate poverty and hunger around the world.[12] Engineers who work for peace in international emergencies have broadened the definition of the "public" in the engineering code of ethics to include all people according to Warner.[13]

The present work seeks to continue discussions began at the conference at Bucknell with a particular emphasis upon fully integrating compassion into the practice of engineering and engineering education. It is the compassion of the heart that we feel is an important element of engineering that has been too often ignored. This effort began with an inaugural conference held in Kingston, Ontario in November 2004.[14] Subsequent to the Canadian conference, an interactive workshop was held in Indianapolis, Indiana in October 2005 at the joint ASEE and IEEE sponsored Frontiers in Education 2005.[15] Additionally, a second workshop will held at the State University of New York at Binghamton campus in April 2006.[16] As this effort has been underway now for only one year, our suggestions represent our thoughts at this particular time and should in no way be mistaken as the last word. Rather, we offer them now in hopes that new dialogues will arise as more and more engineers and engineering faculty struggle with the role of engineering in promoting social justice and peace.

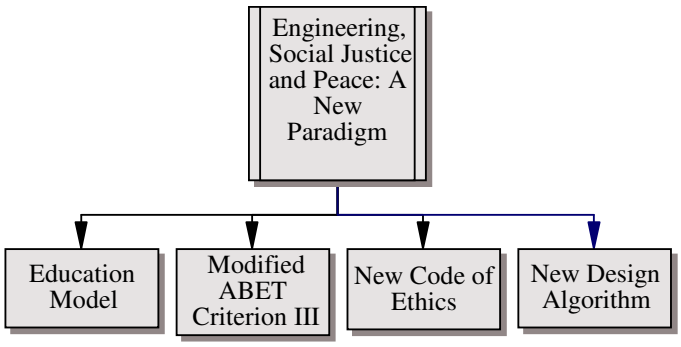

Figure 1: Brief Overview of Present Work

In the present work, the following elements are offered in an effort to change the nature of engineering and the way it is being taught to tomorrow's engineers. We offer a paradigm for engineering education based on the Integral Model of Education for Peace, Democracy and Sustainable Development [17] developed as part of the United Nations' Earth Charter[18] and offer suggestions for a revised ABET Criterion III.[19] We offer a code of ethics for engineers and engineering societies which includes the promotion of social justice and peace rank them as importantly as safety and more importantly than making a profit. As a result of the new ethics code, we offer an engineering design algorithm, which places the promotion of peace and social justice as key elements in every engineering design project.

A New Paradigm for Engineering Education

Background

In June 2000, an international conference entitled "Connecting Ethics, Ecological Integrity and Health in the Millennium" included one particular presentation, which focused upon what was termed by the authors a peace paradigm for education.[17] The model, the Integral Model of Education for Peace, Democracy and Sustainable Development, adopted from the Earth Charter[18] described three components needed in the shift. The three components describe the three fundamental interrelationships, which form the contexts of our lives: living with ourselves, living with others, and living with nature. Each of these three relationships can be characterized as being marked by violence or by peace. In turn, each of the three relationships can be further subdivided into different dimensions or levels of expression.

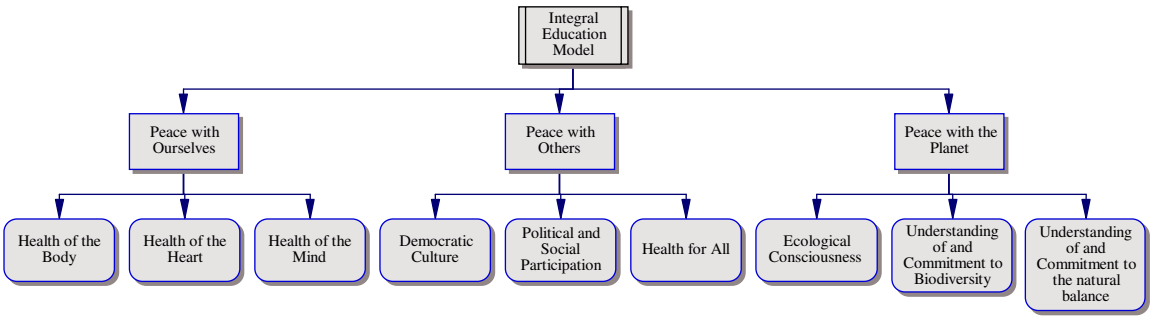

Figure 2. The Integral Model of Education for Peace, Democracy and Sustainable Development

Living in Peace with Ourselves

The interrelationship, living at peace with oneself, is subdivided into levels of expression corresponding to living at peace in the body, in the heart, and in the mind. Having peace in our body entails the development of an awareness or consciousness of our physical needs for health and a wise optimization of any/all satisfiers of those needs. This may be seen as an indictment of the "all-nighter" work ethic that is far too common-place among engineering majors. (On a personal note, appealing to students' health and well-being has not been particularly effective for us in teaching time management skills. Perhaps it may be more effective to link the importance of such skills to the promotion of peace.) In addition, being at peace with ourselves certainly points to issues of proper nutrition and substance abuse among others. Peace in our heart requires the meeting of needs that generate a sense of basic security and trust. Here it is necessary to cultivate qualities such as love, compassion and tolerance. Peace in our mind refers to the possibility of self-realization based on an ethical consciousness of universal responsibility, that is, an appreciation of one's place in natural and human history, and understanding the interdependence of all beings in the universe, as well as the present day global challenges.

Living in Peace with Others

Living in peace with others has the main themes of a truly democratic culture, political and social participation, and health for all. Democratic culture encompasses the key elements of meaningful participation in societal affairs, a sense of responsibility and a sense of solidarity. Elements involved in political and social participation include a fully engaged and participating citizenship, an identification of the common good and an understanding of the principles of peaceful conflict resolution. What is not called for is an insistence upon a particular implementation of democracy; rather there is a recognition and respect that different societies and cultures may reach decisions in a fully democratic way. As an example, we offer the practice of reaching consensus and decisions practiced by our neighbors, the Haudenosaunee, who live on the Onondaga Nation territory in upstate New York. The Onondaga Nation government consists of the traditional Council of Chiefs and Clan Mothers. Additionally, the Onondaga Chiefs sit on the Haudenosaunee Grand Council. Chiefs from each of the Six Nations meet regularly at Onondaga. This governmental organization served as the actual model used by the founders of the American republic.[20] Lastly, the third level or component, health for all, requires an understanding and practice of generosity, an understanding of being itself as a guide for having and doing and a sense of economic security for all society with an absence of a fear of scarcity.

The translation of living in peace with others to the goals of democracy, political participation and health may be questioned in the following way: Are these truly universal values or simply the highest values embraced by Western civilization? How can we in the West be sure that we are not arbitrarily imposing these goals on non-Western cultures in order to remake their societies into versions of our own? We would suggest that though these are difficult questions to answer, perhaps the most important contribution we can make as educators is provide a forum within which students may wrestle with these issues.

Living in Peace with the Planet

Included in the concept of living at peace with the planet are an ecological consciousness, an understanding and commitment to biodiversity as well as an understanding and commitment to the maintenance of a natural balance. The use of the word “peace” to describe environmental care/stewardship is intentionally provocative. In my view the notion of care and stewardship presupposes a hierarchical relationship between humankind and the planet whereas peace summons forth a metaphor of sitting at a bargaining or “peace” table as equals. In turn, each of these three elements is further subdivided into three components. Ecological consciousness entails identity with the cosmos, an understanding and respect for evolutionary forces and ultimately a respect for life. Here the respect for evolutionary forces does not refer to the narrow view of “survival of the fittest.” Rather it calls on us to recognize that nature is ever changing, ever recasting itself, and not to seek to halt or reverse all such changes. This does not

preclude efforts to protect endangered species per se but it does call for a careful consideration prior to intervention. Perhaps, after reflection, society may wish to preserve gray wolves or Bengal tigers through government action while not permitting continued dredging of the Atchafalya River Basin near New Orleans, Louisiana. Biodiversity consists of an appreciation for the place in the web of life of the various plants and animals, a commitment to the protection of species, particularly endangered species and a commitment to conservation in concert with the dynamic nature of ecosystems. Natural balance encompasses an appreciation of the integrity of natural systems, an emphasis on sustainable resource use as well as on the importance of ecological security.

Accreditation Codes and Modifications

Considering the existing ABET criteria, Criterion 3 focuses upon program outcomes.[10] The modified Criterion 3 incorporating the integral model with the changes typed in bold, italics may be written as the following:

Engineering programs must demonstrate that their graduates have:

(a) An ability to apply knowledge of mathematics, science, and engineering
(b) An ability to design and conduct experiments, as well as to analyze and interpret data
(c) An ability to design a system, component, or process to meet desired needs
(d) An ability to function on multidisciplinary teams
(e) An ability to identify, formulate and solve engineering problems
(f) An understanding of professional and ethical responsibility
(g) An ability to communicate effectively
(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context
(i) A recognition of the need for, and an ability to engage in life-long learning
(j) A knowledge of contemporary issues
(k) An ability to use techniques, skills, and modern engineering tools necessary for engineering practice
(l) A fully integrative approach to engineering problems incorporating both reason and compassion in the development of solutions.

A New Code of Ethics for Engineering

In our effort to include the pursuit of justice and peace as important elements of engineering practice, a review of the presently existing engineering codes suggests that a different philosophical foundation for codes of ethics must be integrated. One such philosophy for ethical behavior is termed “a morally deep world” which will serve as the underpinning for a new code of ethics for engineering.[21] This philosophy has been developed in the context of responsibilities towards the natural world. We shall incorporate this expanded notion of responsibility to Nature into the practice of engineering as it impacts the physical environment. With this expansion of ethical responsibility in place, we argue that including the promotion of social justice and of peace is equally as compelling.

In A Sand County Almanac [22], Leopold declares: "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise." According to Leopold, acting ethically is a matter of concern both for us and for others with whom we are in some sort of community. The notion of a community deserves some discussion. We perhaps are most comfortable with community referring to a body of people having common rights, privileges, or interests, or living in the same place under the same laws and regulations; as, a community of Franciscan monks. In biology or ecology, community refers to an interacting group of various species in a common location. For example, a forest of trees and undergrowth plants, inhabited by animals and rooted in soil containing bacteria and fungi, constitutes an integral community. Extending the notion of community in this way is consistent with the pattern evidenced in human society over the centuries. We have progressively enlarged the boundaries of our understanding of community and recognized the membership of slaves, foreigners, etc., those for whom membership was not extended at earlier times in history. Leopold's land ethic then "simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land."[22]

Johnson discusses how non-sentient land can count morally and focuses upon the concept of a living being.[21] For Johnson, a living being is best thought of not as a thing of some sort but as a living system, an ongoing life-process. A life-process has a character significantly different from those of other processes such as thermodynamics processes for example. Our character, as living beings, is the fundamental determinant of our interests. Johnson [21] adds further that:

> "The interests of a being lie in whatever contributes to its coherent effective functioning as an on-going life-process. That which tends to the contrary is against its interests….moral consideration must be given to the interests of all living beings, in proportion to the interest. Some living systems other than individual organisms are living entities with morally considerable interests. …All interests must be taken into account."

A comparison of the proposed morally deep code of ethics versus other existing codes may be useful. Nearly all existing engineering codes are linked to various models of the natural world developed during the Middle Ages through the Age of Enlightenment, most commonly, the universe as a "mechanical clock" or "machine." Science today uses a new model for the natural world, that is, nature as a self-organizing system. A self-organizing system is characterized by synthesis rather than analysis and suggests a new code of ethical responsibility based upon community rather than individuality. Having established the importance of community of interests in questions involving engineering responsibilities towards the environment, the notion of a morally deep world is extended to include the interests of those often ignored or unheard: the working poor, the sick and enfeebled, children and the elderly, all those dispossessed or powerless in our society.

A criticism of a morally deep world perspective is that it prevents any action that will affect a community. On the contrary, though a morally deep perspective does assert actions that violate vital interests of the community or erosion of it self-identity should be avoided, it requires active participation in the protection of the essential functions and the

maintenance of the viability of life processes. Rather than calling for inaction, a morally deep world perspective suggests contemplation followed by a direct and specific response.

Given a shift to a morally deep world paradigm, a new engineering code of conduct is outlined. The majority of existing codes within the various engineering professional societies and disciplines are structured in similar if not identical ways with fundamental principles supported by fundamental canons. That same structure will be incorporated into the present work.

For a morally deep world, the first fundamental canon and rule of practice is specified as:

> *"Engineers, in the fulfillment of their professional duties, shall hold paramount the safety, health and welfare of the identified integral community."*

The task at hand then becomes to explore a process whereby an integral community can be identified in the context of an engineering decision. Who and what are included in the integral community, the on-going life process, and the living system? Simply stated, who and what, in fact, matters? Such questions are treated in depth in second article and will not be treated here.[23] Rather a case study will be presented which will hopefully illustrate differences that may occur when making engineering decisions based upon a morally deep world.

Consider the following scenario. Harvesting machines are replacing migrant workers as grape pickers in northern California.[24] Today, such machines cost approximately $126,000. It takes five workers about eight hours to pick 10 tons of grapes. To harvest the 100 tons would require 90 workers if they wanted to be done before sun-up. The costs are relatively straightforward to calculate. It costs $120 a ton to harvest by hand, and $30 a ton by machine. A mid-size wine producer expects to harvest about 4,000 tons of grapes total. For 4000 tons, the cost to pick the grapes by hand is approximately $480000 while the costs using a harvester are $120,000 representing an increase in margin above cost equal to $340,000. Even with the cost of the harvester subtracted from this margin, the net increase in profits is equal to $204,000. Traditional engineering ethics discussions might stop here. But what if we go a bit farther and identify the workers as being part of the community? What else would we be forced to consider? If it takes 90 workers to harvest 100 tons then it would take the equivalent of 3600 workers to harvest 4000 tons. Certainly there are many more people involved than simply the workers themselves with the total involved growing far beyond the estimate of 3600. What will become of them? Should we as the engineers who designed, built, tested, evaluated and delivered the harvester care? If we use the code of ethics described by countless engineering societies today, the answer would be no. There is no consideration given to the workers whose livelihoods have been eliminated. Codes of engineering ethics based on the notion of a morally deep world would suggest a very different result as it forces us as engineers to consider the entire living system, in this case, including the men, women and children who toil as grape pickers and whose quality of life is intimately linked to the harvest.

This particular case will be revisited after a new design algorithm is suggested and described in the following section of the present work.

Engineering Design

Engineering design is a process that creates and transforms ideas and concepts into a product definition that satisfies customer requirements. The role of the design engineer is the creation, synthesis, iteration, and presentation of design solutions. The design engineer coordinates with engineering specialists and integrates their inputs to produce the form, fit and function documentation to completely define the product.

A new design algorithm, which can be partitioned in the following four steps, is offered:

- Via Positiva. The problem is identified, fully accepted and broken down into its various components using the vast array of creative and critical thinking techniques which engineers possess. What is to be solved? For whom is it to be solved?
- Via Negativa. Reflection on the possible implications and consequences for any proposed solution are explored. What are the ethical considerations involved? The societal implications? The global consequences? The effects on the natural environment?
- Via Creativa. The third step refers to the act of creation. The solution is chosen from a host of possibilities, implemented and then evaluated as to its effectiveness in meeting the desired goals and fulfilling the specified criteria.
- Via Transfomativa. The fourth and final step asks the following questions of the engineer: Has the suffering in the world been reduced? Have the social injustices that pervade our global village been even slightly ameliorated? Has the notion of a community of interests been expanded? Is the world a kinder, gentler place borrowing from the Greek poet Aeschylus?[25]

Consider the case of the replacement of workers by a harvester as outlined previously. In Via Positiva, an identification of the problem is made. Grapes have to be picked at a particular time and in a particularly rapid fashion. The harvesting of grapes by hand has in fact been done satisfactorily for thousands of year on farms of all sizes and now to a limited extent by machines. In Via Negativa, the possible implications or consequences of the change to a harvesting machine are considered. The effects upon the environment for the given case seem minimally affected by the mechanization of the process as stated here. The consequences for the workers, their families and their ways of life are however profound and disturbing. A large number of workers will be replaced and their jobs completely eliminated. In Via Creativa, engineers have in fact designed and delivered machines that will meet the criteria set forth by the grape farmers and have thus met their professional responsibilities as has been commonly understood. But a consideration of the net effects on the suffering in the world, Via Transformativa, might yield a different result. Engineers who design such devices without concern for the impact on the numbers of farm workers who are being replaced solely in order to increase the profits of the landowners have acted unethically.

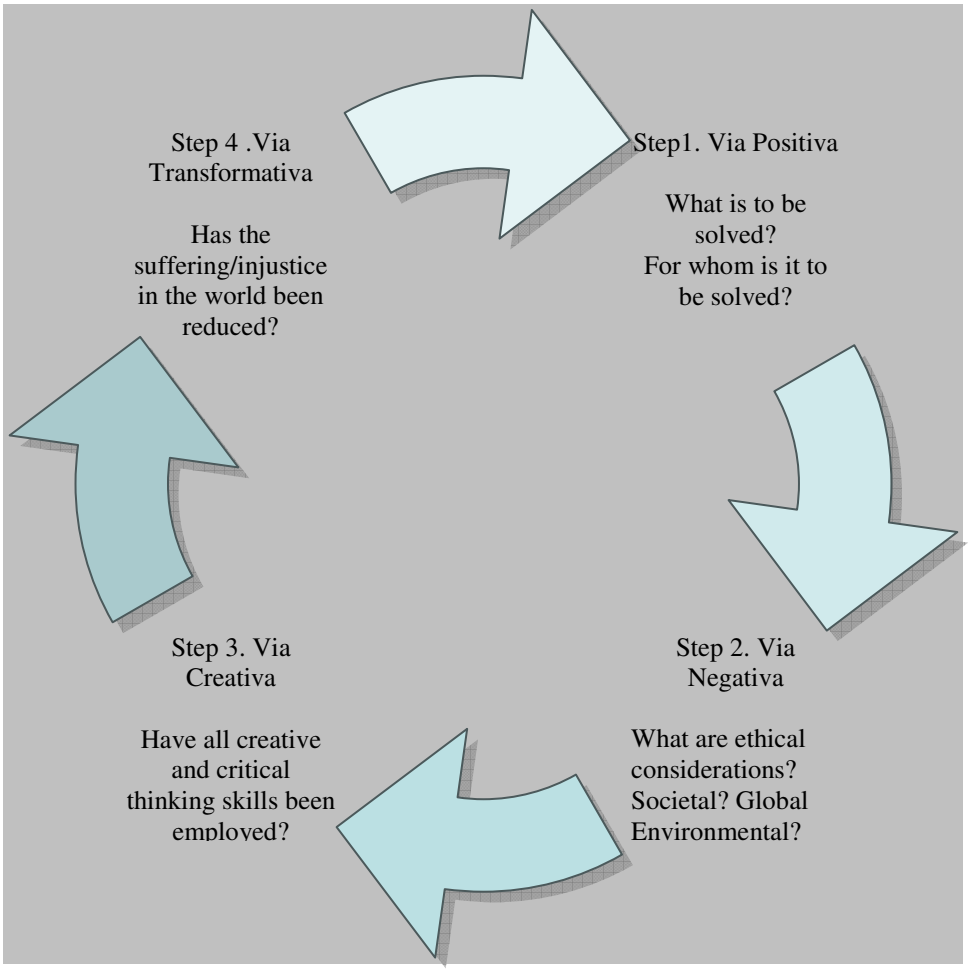

Figure 3. Visual Representation of an Engineering Design Algorithm based upon a Morally Deep World

In the context of the farm workers discussed here, a logical question to ask would be the following: Is it possible to arrive at an end result which was a creative design that met everyone's needs and established justice for workers and their families and furthered the interests of the vineyard? While we cannot offer a device, we can suggest that those whom the new machine would make irrelevant might be included in discussions concerning the consequences of implementing the new design. The landowner may ultimately decide to mechanize this task but at the very least the criteria for making ethical choices would also include a careful consideration of the impact of the engineering design on the lives of the workers. It would seem such an inclusion is as important as any other.

Final Thoughts

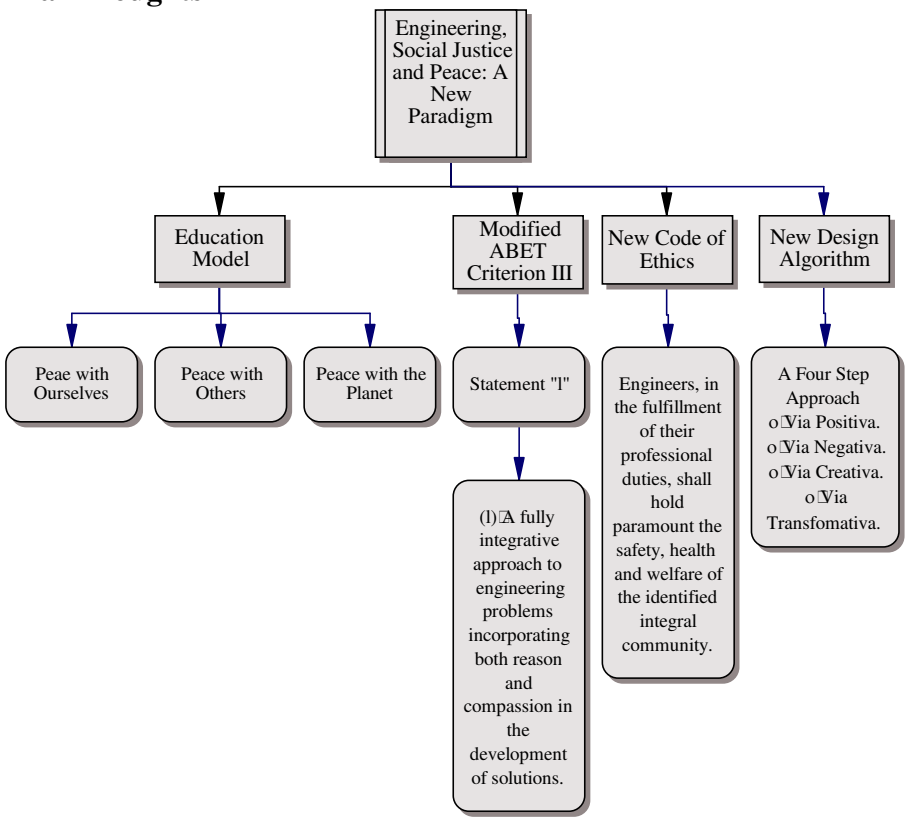

Figure 4: Final Schematic of Present Work

The present work has offered a new paradigm for engineering education based on the Integral Model of Education for Peace, Democracy and Sustainable Development; a proposed new engineering code of ethics based upon the notion of community in a morally deep world, a suggestion for a new engineering design algorithm and a review of resulting modifications to the existing ABET criterion that would be required. The totality of our ideas represents a very different way of viewing modern engineering and engineering education than is commonplace today.

The expressed hope contained implicitly within is that these ideas trigger a conversation concerning engineering and its connections to the promotion of social justice and peace. There is much that is good and noble within the engineering profession. The case study examined which dealt with the harvesting machines and the negative effects such a machine has had on so many lives is only one machine among countless machines, some of which have, for example, helped eliminate the commonly occurring mining disasters of the late 19th and early 20th centuries. The argument offered here is not that neither all machines nor all advances in technology are necessarily evil. Rather, our thought is that engineering must take a far broader sense of responsibility than it has in the past. We must extend the moral sphere or who counts morally to include not only our story, and our profession but to also include the entire integral community, the totality of living interests that will be affected by our choices as engineers.

In the beginning of this work, we attempted to define what we mean by social justice and peace. Ultimately the final questions remain: (1) can peace and social justice ever be truly achieved? (2) how would we know if we ever met such goals? In our discussion of peace, we borrowed from Dante Alighieri's schema for multiple levels of meaning.5 In that same work, Dante likened the personal journey that each us takes in life to a grand sea voyage about which we would look back at its end with gratitude for the journey. Such a metaphor seems fitting for the present effort. We believe that it is the process (i.e. our efforts to bring an awareness of issues of peace and social justice embedded within the engineering profession) that holds the greatest significance.

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