Integral Formation for the Engineering for Peace from a Systemic and Interdisciplinary Perspective

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Abstract-

Purpose: the Electrical Engineering Department at the University of South Florida (USF), the Ibero-American Science & Technology Education Consortium (ISTEC) and the Complex Systems and Education (SCED), under the R&D ISTEC initiative, have developed a comprehensive electrical engineer formation model based on the Adaptive Complex Systems approach that responds to the challenges of the contemporary society (presented at WEEF 2012). The purpose of this paper is to show an application reference of the model in the development of ethical competences in the formation of the engineer for peace from a systemic and trans-disciplinary approach, integrating academia, industry and the community.

Method: a sequence of three progressive levels of one credit-hour courses for the Professional Formation of the Engineer (PRF) that integrate ethical competences focused on the being, the knowledge and the know-how. It includes individual and team work, resolution of case studies, simulations, ethics presentations, ethical practices, proposals writing, visits to industry and networking with successful industry professionals.

Results: graduates linked to the newly created True-Partner Network demonstrate their behavior integrity, responsibility, ability to interact respectfully with others and accepting differences in favor of general interests.

Conclusion: the ethical values of peace engineer must be formed through a systematic inter/multi/trans-disciplinary pedagogical approach connected to the labor sector throughout the Bachelor's program.

Keywords: employability, engineering, ethical, integral, peace, interdisciplinary

1. INTRODUCTION

The human being has to live in an ethically regulated society. To accomplish this, he/she must adapt and learn to live in peace and in harmony with others [1]. Therefore, ethics attempts to objectively measure the behavior of people and their effect on society [2]. In this sense, the importance of ethics in engineering is increasingly highlighted as a series of common criteria that clearly stipulate the obligations and responsibilities of engineers to face the working world in the contemporary society. The absence of an ethical culture in the engineer not only hinders their professional development, but also affects the closest people around them [3].

In order to optimize the ethical behavior, the different engineering societies such as the National Society of Professional Engineers (NSPE), the American Institute of Chemical Engineers (AIChE), the Institute of Electrical and Electronics Engineers (IEEE), the American Society of Civil Engineers (ASCE), the American Society of Mechanical Engineers (ASME) and the Accreditation Board for Engineering and Technology (ABET) have created codes of ethics that identify obligations, responsibilities, common criteria and standards of the engineer's professional conduct for the purpose to guide their behavior with integrity, honor and dignity in society [4].

However, in reality, codes of ethics remain theoretical and vague without practical application [4] since engineering ethics implies conviction [2], individual and collective commitment [5] and the development of complex cognitive processes within different contexts; therefore, it transcends the follow-up of a list of professional behaviors [5]. Although ethics deals with reasoning of why something seems right or wrong, why should I (or should not) do what I should (or not) do [6], "what is good for one person is not good for another" [7],[8],[9],[10].

In order to try to solve the basic problem from the formation of engineers perspective, ethics has being integrated, in a multidisciplinary approach, into engineering curriculums through humanistic and ethical content. However, the traditional teaching of engineering ethics does not fit the engineer's way of thinking and acting. Consequently,

students consider ethics and humanities courses as subjects that are distant from their technological and scientific training [11] Engineering is a practical discipline that systematically applies solid technical and scientific principles to solve problems. Therefore, engineering ethics must be practical, applied and oriented towards individual behavior, technical professional (micro-ethics), and to the collective relations or social (macro-ethics) in order to preserve the common good and serve society [12], [13],[14].

Ethics is not in the manuals ... Ethics is learned in practice, in life and in relationships [15]. Ethics is not a moral state that can be conditioned a priori. It is not a virtue that can be taught or transmitted. It is a system or a complex behavior that emerges in the practical interaction of the student or the professional within an environment and with others, in a non-linear way, in a particular moment and determined by a social-historical context, in constant adaptation and reconstruction. Therefore, to think of ethical formation as a series of ideal conditions, pre-determined, inherent to the human being, isolated from its context and from the other subjects, is to ignore the dynamics of reality [16]. From this perspective, the USF's Electrical Engineering Department and the SCED-ISTEC have developed a comprehensive engineer training model based on the Adaptive Complex Systems approach that responds to the challenges of contemporary society presented at WEEF 2012 [17]. The purpose of this paper is to show a reference of application of the model in the development of ethical competences in the formation of the engineer for peace from a systemic, interdisciplinary approach, integrating academia and industry.

2. METHOD

Implementation of a Professional Formation for Engineers (PFE) program with active educational experiences that integrate university, industry and society in a practical and systematical way. It takes place in sessions of one hour and fifty minutes per week for 16 weeks. Ethical training is carried out through collaborative learning that integrates the development of personal, technical and professional skills, stakeholder need analysis, society interests/trends, global thinking, exploration of job opportunities, research activities, and innovation & entrepreneurial thinking. The objective of the course series is to develop the ethical training of students in a practical way in three progressive levels that integrate ethical competences in the being, the knowledge and the know-how in an adaptive way. The learning scenarios revolve around group discussions conducted mainly by the students and facilitated by the instructor. Pedagogical mediations include individual and team work, resolution of case studies, simulation practices, group discussions, ethics hearings, defense and criticism of ethical practices, development of practical proposals, visits to the external sector, contact with successful professionals of the industry, and interaction with industry labor networks. The scenarios and the strategies proposed allow for active learning with a permanent ethical reflection applied in different contexts.

3. RESULTS

Graduates linked to the True-Partner Network demonstrating in their behavior integrity, responsibility, ability to interact respectfully with other people, accepting differences in favor of general interests.

The courses Professional Formation of Engineers (PFE) 1, 2, and 3 have connected the freshman engineering experience to the senior capstone design course by weaving professional skills and competencies (see Career Readiness at National Association of Colleges and Employers – http://www.naceweb.org/career- adiness/competencies/career-readiness-defined/) through the students' sophomore and junior years. A key characteristic of the PFE is that it has allowed for an active and a collaborative engagement of students with industry professionals and experiential learning activities beyond the university environment (service projects, community engagement, internships etc.) The course activities have included among others career planning, development and completion of a personalized qualification plan based on each student's professional goals, innovative design, project management, professional ethics, and entrepreneurship. Students in the inaugural class (PFE 1) identified a high impact project - a sustainable "Container Farm" and several teams (equivalent to a real company) were created for the development and prototyping of the farm. At the senior level, the BSEE program curriculum continues to strengthen community ties through the TRUE Partner Network. This is a network of local and regional companies that team with the department in the senior capstone design effort. A meeting of network companies held in July 2017 included Manitowoc/Welbilt, Florida Power & Light, RCA Solutions, DeliverLogic, NREC, GE Instrument Transformers, and Withlacoochee River Electric Cooperative, Inc. In the first year, nearly 20 BSEE graduates have participated in projects that initiated from the TRUE Partner Network.

4. CONCLUSIONS

The ethical training of an engineer for peace must be carried out through a systemic, complex and adaptive inter-disciplinary pedagogical approach.
The ethical training of the peaceful engineer must be connected to the labor world, industry and society from the early stages and through the Bachelor's program.
Ethical education for peace is not taught through the transmission of humanistic or ethical content. It requires the design of practical and contextualized teaching-learning scenarios.
Ethical training for peace requires trained professors and well-mediated pedagogical processes.

4. REFERENCES

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