AC 2012-4862: SUMMER MERIT CAMP AND ENVIRONMENTAL COM-MUNICATION WEEK: TARGETED APPROACHES TO ENVIRONMEN-TAL ENGINEERING EDUCATION

Dr. Sudarshan T. Kurwadkar, Tarleton State University

Sudarshan Kurwadkar is an Assistant Professor and a board-certified Environmental Engineer. He teaches environmental engineering and general engineering courses at the freshman, junior, and senior level. His research areas include fate and transport of micro-pollutants such as pharmaceuticals and neonicotinoid insecticides in soil and aquatic environment. He is a Co-faculty Advisor for the engineering club and French club at Tarleton State University. Kurwadkar is also a licensed Professional Engineer in the states of Texas, Ohio, and Missouri.

Dr. Daniel K. Marble, Tarleton State University

Daniel Marble earned a B.S. in electrical engineering from the University of Houston, with an M.S. and Ph.D. in accelerator-based nuclear physics from the University of North Texas. Marble began his academic career as an Assistant Professor of physics at the U.S. Military Academy in West Point in 1994. In 1998, he was hired to develop the first engineering program at Tarleton State University (engineering physics), where he presently serves as Head of the Department of Engineering and Physics. In addition to interests in ion solid interaction, physics of sports, accelerator technology, and materials characterization, Marble is actively involved in K-16 science and engineering education and teacher training. He has served as a physics content consultant for the Texas Center for Inquiry at the Fort Worth Museum of Science and History, President of the Texas Section of the American Association of Physics Teachers, and on the Texas High School Physics TEKS Committee.

Dr. Jennifer T. Edwards, Tarleton State University

Jennifer T. Edwards serves as an Assistant Professor of communication studies at Tarleton State University, and has functioned as a faculty member and student affairs practitioner for more than eight years. Her doctorate is from Sam Houston State University, and her research focus is on organizational communication, environmental communication, and communication technology (i.e. social media). She has published articles in the International Journal of Instructional Technology and Distance Learning, Academic Exchange Quarterly, Merlot's Journal of Online Teaching and Learning, and the American Communication Journal and others. She has studied, published, and presented research on the millennial student population, web 2.0 collaboration applications in higher education, and students' perceptions and preferences of computer-mediated communication with faculty. Edwards can be reached at jtedwards@tarleton.edu.

Summer Merit Camp and Environmental Communication Week: Targeted Approaches to Environmental Engineering Education

Abstract:

This paper discusses the effectiveness of two targeted approaches, a three-week paid summer camp for high school junior and senior students selected based upon proficiency in high school math and science classes and teacher recommendations and an environmental communication week targeted toward general university students, in promoting environmental education is presented. The environmental communication week was a cross-collaborative environmental education project involving lectures from experts in related fields and interactive activities highlighting the importance of green initiatives on college and university campuses. While the student selection for the summer camp was merit based and as such was restricted to selected fewer meritorious students, the participation in environmental communication week was open to all university students and as such nearly 580 students, faculty, staff, and community members participated in it. Summer camp students participated in various activities including classroom and laboratory work, talks on career and technical aspects from experts in industry and academia, and mentoring by undergraduates while participating in an undergraduate research group. At the conclusion of the camp, students demonstrated their understanding of environmental engineering education through poster presentations to parents and members of the university community. These targeted approaches to environmental education were productive in promoting environmental awareness among high school and university students, as well as an overall appreciation of the career opportunities available with environmental engineering degree. In addition, it sparked the interest in some of the summer campers who then chose to do environmental based school projects and to pursue technical majors in college.

Introduction

History of environmental education indicates an evolving process both in terms of concern about the environment and its associated problems and the regulatory aspect to manage these problems at a level that will be protective of human health and the environment. Environmental education is the necessity of the current generation, primarily because of the enormous demand exerted on the natural environmental resources as a consequence of rapid population growth, pace of urbanization and industrialization across the world. The first official attempt at defining what environmental education ought to be was made by William B. Stapp in 1969. According to Stapp et al., "Environmental education is aimed at producing citizenry that is knowledgeable concerning the biophysical environment and its associated problems and motivated to work towards their solution"¹. The emphasis in this definition is on making environmental education a tool to create a self-sustaining human population that is aware of its environmental obligation. This post-hoc emphasis on environmental education is fraught with danger, simply because the goal of such education is to control or manage the effects of environmental pollution. At present the new emphasis on environmental education is better awareness and a pro-active approach aimed at reducing or eliminating detrimental environmental impacts before the ill-effects of environmental pollution becomes apparent. Currently the environmental protection approach is moving away from regulation-driven, adversarial 'government-push' approach to a more voluntary self-regulating environmental performance.² According to the U.S. Environmental

Protection Agency (USEPA)³ "Environmental education enhances critical thinking, problemsolving, and effective decision-making skills, and teaches individuals to weigh various sides of an environmental issue to make informed and responsible decisions. Environmental education does not advocate a particular viewpoint or course of action". This approach towards environmental education is much more holistic and devoid of any political or personal prejudices. According to the USEPA, the essential components of environmental education are awareness, sensitivity, knowledge and understanding of environmental challenges with commensurating skills and attitude of concern and participation in activities that are protective of environment or activities that essentially lead to the resolution of the environmental challenges.³

A greater push towards environmental education is primarily due to the perceived or known ill effects of environmental degradation. Since 1990, USEPA has established over 31 voluntary programs aimed at educating the public on environmental issues. Various Federal, State and Community level programs are geared towards spreading environmental education. Notable work has also been done by non-governmental, non-profit voluntary organizations. Academic institutes have also chosen to introduce environmentally conscious programs such as the green initiative to control the pollution problems due to anthropogenic activities.

This paper documents two such programs that were targeted towards spreading environmental education to two different audiences. While the first program is a summer camp program funded by the Texas Work Force Commission (TWC) to introduce high school students to STEM fields important to economic future of Texas including environmental engineering so as to increase the future number of graduates in these key areas, the second program is Environmental Communication Week (ECW) – an annual event organized by Department of Communication Studies at Tarleton State University is a voluntary initiative to educate the students, faculty and general population at large.

Targeted Approaches to Environmental Education

a) Summer Merit Camp

During the summer 2010 and summer 2011 the TWC funded the Real World Science, Technology, Engineering and Mathematics residential summer camp for high school students interested in STEM fields. The camps were organized into instruction on electronics and lasers, nuclear and medical physics, computer science, and environmental engineering which supported the aerospace, nuclear energy, and biotechnology industry clusters, the State of Texas had previously determined as being essential to the future economy of Texas. To be eligible to apply for the camp, a student had to be between the ages of 14-21 and have just completed the 9th, 10th or 11th grade from either a Texas high school or be home schooled with a curriculum found to be equivalent by the University Admission Office, be a U.S. Citizens or non-resident eligible to work in the U.S. and be in compliance with the U.S. Selective Service Regulation. Campers were selected based upon merit using past performance on high school math and science course work, teacher recommendations, and participation and success in extracurricular math and science activities including academic competitions. During summer 2010, the camp consisted of a single 3 week session with 24 students. In order to expand the number of students who could attend the camp without scheduling problems due to family vacations, driver's education, athletics camps, etc., it was decided to shorten the camp to two weeks and offer two sessions in summer 2011. A total of 56 students from across the State of Texas were selected. All costs including housing, food, instruction materials and field trips were covered by the TWC with participants only responsible for transportation between their home and Tarleton State University.

The camp was promoted using a number of complimentary activities including presentations by university recruiters and faculty at high schools and teacher conferences, emailing high school teachers and counselors, camp website, and mailings. Students were asked to either submit an online application developed in-house or by mailing in a completed application. Required letters of reference from teacher and counselors were also accepted either as e-mail attachments or by mail. The application included questions about the applicant's academic background and professional interests including class rank, high school math and science courses completed, career aspirations, and participation in and math and science enrichment activities including UIL competition, Science Olympiad, etc. The application also asked the students to rank the emphasis area that they wished to explore. Students came from a variety of high schools including large 5A suburban high schools with more than 2,000 students, smaller rural high schools of less than 100 students as well as home schooled students. Since the participation in the summer camp was based on merit, overall 60% participants in the camp were in top 10% of their high school. Nearly 85% of the summer camp participants were in top 20% in their high school. The application also had a section for reporting personal and family demographic information which was used only for reporting to the TWC and not in camper selection. Figures 1-3 shows the ethnic, gender, and parent's highest level of education of 80 students who attended the summer camp program over the past two years.

Completed applications were reviewed weekly by a four person committee composed of faculty who taught the camp emphasis areas. During the initial application review process in 2010 it was discovered that several 12th grade students had applied for the camp even though, it was announced that the camp wasn't open to graduating seniors since the TWC considered these student's to be college students and therefore ineligible. These students were notified and removed from the applicant pool. If an applicant was chosen for a TWC scholarship, they were notified and given ten days to accept the scholarship. Every student received either their first or second track choice. The Engineering Technology track was canceled due to a lack of applicants once the application deadline expired. Twenty students accepted scholarships in the other three tracks along with four local students who attended the camp as day campers at no additional cost. Six of the campers chose the Environmental Engineering track.

Student spent weekday mornings and half of the afternoons attending lectures, laboratory, and research activities in their emphasis area. All of these activities were overseen by a Ph.D. faculty member from the Department of Engineering and Physics supported by one or more undergraduate students majoring in the field. Following afternoon lab activities, all students attended a professional seminar covering career development, study skills, or technical topics. Some of the topics included the application of accelerator technology to industrial and medical problems, computer techniques applied to artificial intelligence and chess, college success and study skills as well as career opportunities in a variety of occupations including nuclear engineering, hydrology, environmental engineering, mechanical engineering, engineering technology, bioengineering, and petroleum engineering. Speakers included Dr. Dwain Mayfield

(former VP of Lockheed and a member of the Environmental Engineering Advisory Boards at Tarleton State University, Paul McKee (NOAA), James Beach (Hydrologist), Paul Strauss (Medtronic), Dr. Lee Peddicord and John Poston (Texas A&M Nuclear Engineering & Nuclear Power Institute), and Brent Stroebel and Zac Kokel (Senior Mechanical Engineers at FMC). Following dinner, students took part in a recreational activity followed by study hall where they worked problems with undergraduate physics and engineering students who served as camp counselors and prepared for the next day's class. Students also had a half day of academic classes on Saturday mornings with organized activities and trips in the afternoon. In addition to class room and laboratory activities, several other off-campus activities were also provided including a star party using small telescopes and Tarleton's 32" fully robotic telescope at the Tarleton State University Observatory, a field trip to the Paluxy River for swimming and tubing, and a trip to Luminant's Comanche Peak nuclear plant visitor center where students were able to see the plant's simulator as well as listen to a presentation on nuclear power by Jeff Lamarca, a Luminant electrical engineer and member of Tarleton's Engineering Advisory Board. Campers had no academic responsibilities on Sundays and could spend the day swimming, watching planetarium shows, movies, or they could spend the day with their parents.

Some of the major targeted environmental engineering activities students completed during their four week long summer camp includes (Figure 4.):

- 1. Field investigation of water quality of Bosque River by conducting on-site measurement of water quality parameters such as dissolved oxygen, turbidity, temperature and pH. Students actually visited the Bosque River and measured above stated water quality parameters. They also brought Bosque River water sample and measured the same water quality parameters and observed the difference between the laboratory measurements and field measurements.
- 2. Simulation of water treatment plant processes. In this activity, students actually built a water filtration system and were able to treat highly turbid Bosque River water to a comparable clarity of drinking water. The simulation of water treatment began with class room discussion on drinking water treatment protocol and public health drinking water standards. Students conducted jar test experiments to determine the efficacy of ferric and alum coagulants. They were able to understand the underfeeding and overfeeding of the coagulants and were able to determine the optimum dose of the coagulants. Students built a filtration system by cutting the bottom portion of discarded 1L coke bottle and filling it up with different filtration media. Students measured the turbidity of the filtered water and compared with the turbidity value of the untreated Bosque River Water. Students were pleasantly impressed to see clear Bosque River water after the filtration step. A lecture was provided on various disinfectants currently being used and potential human health consequences due to eh disinfection by-products.
- 3. Ground water flow simulation by conducting permeability and porosity experiments. In this activity students were asked to build a permeameter comprising of materials of varying permeability. Students were able to understand the difference between permeability and hydraulic conductivity. This experiment was followed by discussion on major aquifers in the United States.
- 4. Groundwater chemistry analysis and implication of speciation equilibria in environmental engineering. In this activity, students plotted the speciation diagrams for all carbonate

species and were able to understand the issues regarding hardness of water and its importance in drinking water

5. Several other entertaining events such as, environmental jeopardy, environmental quizzes and a seminar on 'Crude Awakening: Environmental Implications of Deep Water Horizon Oil Spill' were also organized to make participants at ease at the same time help them to critically evaluate the environmental challenges of the day

b) Environmental Communication Week

Every spring semester, Tarleton State University sponsors Environmental Communication Week (ECW) which provides environmental education and awareness opportunities for students, faculty and staff, and the surrounding community. The ECW is facilitated through the generous sponsorship of the Communication Studies Department, Library, Environmental Advisory Council, and the Staff Council at Tarleton State University.

Daily three to four virtual workshops of 45-50 minutes duration each and 16 face-to-face workshops were provided. The ECW planning board and interns worked together to offer daily activities through social media tools (i.e. - Twitter and Facebook) and several exciting environmental education themed workshops such as "Green Printing at Tarleton State University", "Water Trivia and Watersheds," "Gardening 101," "Water Gardening," "Conserving Water," and an interactive workshop aimed at educating general audience on fun ways to reuse commonly used household materials called "Minute to Win It" (Figure 5.). A booth was also set up to facilitate information regarding recycling. This booth provided answers to basic questions such as: Where do I recycle? What can I recycle? Similar approaches were also included to emphasize the importance of green living so as to minimize the carbon footprint. One of the innovative events that targeted this message was the "Green Works House Party" in which each participant was encouraged to bring an appliance to swap with others. Furthermore, importance of green living and possible sustainable human existence was communicated through the screening of 'No Impact Man' movie. As expected, this particular event received tremendous audience response.

Besides interactive workshops, expert presentation on environmental topics were also delivered, some of the notable presentations that espoused the cause of environmental education, environmental sustainability and pro-active approaches to environmental conservation includes:

- a) Texas: The STATE of Water (How Water Affected Our Past, Affects Our Present and Will Affect Our Future). This was an interactive lecture on the global water crisis and how it affects the population.
- b) Green Printing @ Tarleton State University: Can You Accept the Challenge? The emphasis of this presentation was on reducing waste and deliberate approaches to optimize the printing resources at the university.
- c) Political Perceptions of Environmental Problems in Europe. This was an interactive lecture deliberating on how do individuals from various political parties view the environmental problems? The role of politics in addressing environment problems in America.

- d) Human Health and Ecological Consequences of Occurrence of Pharmaceuticals in the Environment. This presentation was on emerging micro-pollutants in the environment and how prudent usages of pharmaceuticals can reduce the risk of growth of superbugs.
- e) Earth Day: The Impact of the Gulf Oil Spill One Year Later. This program featured a national webinar focused on the Gulf Oil Spill and its impact on the animals of the Gulf region.
- f) Panel Discussion Ordinary People Who Are Doing Extraordinary Things to Go Green. This program focused on several people who adopted a "green lifestyle" and consequent lifestyle changes due to eating organic food, driving a hybrid car, and installing solar panels etc.
- g) The Southwest Regional Dairy Center and Environmental Sustainability of Animal Agriculture. This program focused on the new dairy center at Tarleton State University and how the dairy center has adopted several methods to improve sustainability in the local agricultural industry.

To encourage and reward participation in the ECW weeklong activities, each participant was given an ECW passport on an 8.5x11 sheet of card stock paper that featured the titles and times of each of the face-to-face workshops (Figure 6.). After each participant attended a workshop, they were instructed to receive an ECW stamp on their passport for the session attended. At the participants' last session, they were asked to submit their completed ECW passport to an intern and within a week, they received an e-mail highlighting the sessions attended. If participants attended five or more sessions, they received an Environmental Communication Awareness Certificate.

Qualitative Assessment of Targeted Approaches to Environmental Education

a) Summer Merit Camp

Informal assessment of student learning was performed during the camp by faculty and through student poster and oral presentations to parents, faculty, and other individuals from the university community. Students demonstrated their understanding of environmental issues and showed a genuine interest in learning about the environmental issues, particularly when such issues were taught through hands on real life problems such as field investigation of water quality, simulation of water treatment plant and ground water flow and quality of groundwater. Faculty members were impressed with the quality and diligence of the campers and their performance working with the faculty. Not only have the participating faculty agreed to participate in any future camp, but faculty in other departments including chemistry and math have indicated that they would also like to participate in future camps.

Student perceptions of the camp were obtained through informal interviews in small groups near the end of the camp and a group out briefing of students and parents was held at the conclusion of the camp. Several campers indicated that the camp either changed camper's future career choice or had increased their likelihood of pursuing at least Science, Technology, Engineering and Mathematics (STEM) major. All of the campers indicated that they would like to attend if the camp was offered again. One of the campers sent an email that they learned more during the camp than during a Governor's school they attended in July following the camp. Environmental engineering student participants indicated that participation in the summer camp enhanced their

understanding of the environmental problems arising due to anthropogenic activities. Students also indicated that they enjoyed doing environmental engineering related field investigations as well as laboratory experiments. The only "negative aspect" of the camp indicated by any respondents was the three week length of the camp which made it difficult for them to arrange their summer schedules around the camp and which caused some of their friends not to participate.

The Department of Engineering and Physics at Tarleton State University used these informal assessments to make modifications in the summer camp program. The 2011 Summer Camp was modified to a two week camp with two offerings and expanded to also include students who had completed their freshman year of high school in order to try and increase the number of participants. The number of qualified applicants in 2011 exceeded capacity for both of the camp sessions with a total of fifty-six participants attending in 2011. The Department of Engineering and Physics has attempted to stay in touch with camp participants electronically in order to track the number of participants who enter a STEM field and to recruit students for our programs. Twenty seven students who participated in either the 2010 or 2011 Summer Camp have either graduated or will be graduating high school in spring 2012. Fourteen of these students are either attending or have been admitted to a STEM program at Tarleton State University. Of the fourteen students, seven students have chosen Engineering (at Tarleton State University, students are categorized as 'Engineering major' until they finish first semester of sophomore engineering coursework. After that they can choose their major and will be classified according to their chosen majors), four students Physics, two students Computer Science, and one student Nursing. Four other students are known to have applied to STEM programs at other institutions. Of those students who are still in high school, several have chosen environmental engineering related work for their school projects.

b) Environmental Communication Week

The ECW was a grand success in creating awareness about the environmental issues of the day. Over 580 people attended 16 workshops and interactive sessions during the ECW. Almost 25 university and community businesses/organizations presented workshops. On average 35 people attended each of the sessions. At the end of the ECW, the participants who attended five or more sessions were awarded the Environmental Communication Awareness Certificate. In order to fathom the participant's appreciation of the ECW, participants were requested to evaluate the weeklong ECW activities. Most participants indicated that they like the variety of speakers presenting different aspect of environmental issues of the present day. Participants also expressed their appreciation for the 'No Impact Man' movie which highlights a New York family's journey to becoming a sustainable and green household. Several students also indicated that, although they have attended the ECW for extra credit they were able to learn a lot about the environmental issues and how pro-active behavior can lead to sustainable existence. Traditional favorites such as gardening, and importance of wind and solar power were also very well received by the participants. Survey administered to the ECW participants shows that they benefitted from the weeklong environmental related activities. Survey feedback received from the participants is as follows:

"I liked that professors from different departments contributed topics about environmental awareness."

"I was only able to attend one session due to my school & work schedule but I think it is awesome that the communication department took the time to put on a full week of activities. I hope to attend more sessions next year."

"The only suggestion I have is to make sure that the presenters realize that they are not talking to THEIR students, because some of the topics went over my head. What I can understand from a scientific perspective I can't understand when presented to me in the form of statistics, etc..."

Participants offered the following suggestions for ECW2012:

"More movies and interactive seminars."

"More sessions relating to us as college students. I was only able to attend one session, for class, which was the solar panel session and I personally couldn't relate to the session because I live in the city. However, the information was interesting!"

"I think more sessions about things we do as students, such as not recycling our paper, overprinting, and things such as that would get more students' attention."

"Something where we actually get to take something home; for example, when we went to the horticulture center we actually got to plant something. I don't think would be too big of a problem to charge around \$5 to attend that session if you get to keep something."

"Have the events more spread out through the week."

"More warning! I was not aware of this until the week before it occurred."

In summary, the ECW was a grand success. It offered a unique opportunity to the participants to engage in interactive activities related to environment as well as to listen from the diverse group of environmental experts about the past, present and future environmental issues. Participants recommended that more interactive sessions and information about student roles and responsibilities in recycling initiatives at university level should be included.

Conclusion

Both the summer merit camp and the ECW programs were successful in spreading environmental awareness to students, faculty and general population. These targeted approaches were chosen to encourage students and responsible citizenry to be pro-active with regard to environmental protection. The summer camp was structured and targeted towards high school seniors and juniors and later expanded to all high school students to make them aware about the environmental issues as well as making them aware about the distinct environmental engineering discipline. Based upon the responses from students, parents, faculty, and outside speakers, Tarleton's Summer Camp was very successful. The camp's initial three week length was chosen so that students could receive a much deeper and intense learning experience than traditional camps and enable the students to work on a small research project with Tarleton's faculty and students. The summer camp was a great success in providing students with hand-on-experience in conducting basic environmental engineering related laboratory experiments. The summer camp has also been shown to be an excellent tool for recruiting high performing students to our Department.

The ECW was a weeklong, fun filled, hands-on approach to disseminate the information on emerging environmental issues, public policy and perception about environmental issues and targeted to the audience which would otherwise have not learned about these issues. The ECW provided an excellent environmental awareness opportunity to general audience by facilitating informative presentations by environmental experts, interactive workshops and panel discussions. In summary, the student acquired a comprehensive skill set including, team work, public speaking, career options and an overall appreciation of the environmental engineering discipline.

Acknowledgements

The authors would like to thank the Department of Communication at Tarleton State University for sponsoring the ECW, the Texas Work Force Commission for funding under grant #0410WSW002 SMP and #00411WSW000, and the students, faculty and the general public who assisted or participated in these activities.

Bibliography

- 1. William B. Stapp (1969), "The concept of Environmental Education". The Journal of environmental Education, 1, 30-31
- Khanna, M. (2001), "Non-mandatory Approaches to Environmental Protection". Journal of Economic Surveys, Vol. 15, number 3, 291-324
- 3. U.S. Environmental Protection Agency (USEPA) accessed through http://www.epa.gov/education/basic.html on January 04, 2012



Figure 1: Ethnic distribution of 80 Campers in 2010 and 2011 Summer Camps



Figure 2: Gender distribution of 80 Campers in 2010 and 2011 Summer Camps



Figure 3: Distribution of parent's education of 80 Campers in 2010 and 2011 Summer Camps



Figure 4: Activities of the environmental engineering summer campers: a) On-site field investigation of Bosque River water quality, b) Water treatment simulation c) Understanding of groundwater flow



Figure 5: Some of the environmentally themed activities such as watershed demonstration and displays set-up during the weeklong ECW activities



Figure 6: The passport showing the weeklong activities that were organized as part of the ECW