Innovation Week (i-Week), a Way to Link Students, Industry, Government and Universities; the case of *Emergency First Response* at the Tecnológico de Monterrey

Graciano Dieck-Assad, Bertha Laura García-De-La-Paz, María Elena Dieck-Assad, Antonio Mejorado-Cavazos, Jakeline Marcos-Abed, Alfonso Avila-Ortega, Jaime Martínez-Garza, Juan Carlos Lavariega-Jarquin, Alejandra González-Avila, Martha Sordia-Salinas, María Marcela Dieck-Assad, Javier Rodríguez-Bailey, Alejandro Cervantes-Villarreal, Juan Raul Esparza-Martínez, Sergio O. Martínez-Chapa
Tecnológico de Monterrey, Monterrey Campus
Monterrey, México

Abstract

The Innovation Week or i-Week at the Tecnológico de Monterrey (TEC) provided a fertile challenge to link students of many undergraduate programs with practical real world activities in which they could make proposals to enhance social, health care and industrial productivity in their communities. The i-Week integrates academic departments, faculty and institutions that do not have anything in common, but could work together in multidisciplinary projects, providing a very relevant project administration case. The *Emergency First Response* (EFR) project at TEC during the i-Week, included 3 different schools: Engineering and Information Technologies (EITI), Engineering and Science National Posgraduate School (ENPCI) and Graduate School of Business Administration (EGADE). The EITI included 14 professors from Computer Science (CS), Electrical and Computer Engineering (ECE) and Information Systems (IS). From Government participated: the Social Development group from San Pedro County and the Public Health Department at the Nuevo León State in México. A total of 12 individuals from the Nuevo León Government participated in the project during the i-Week. From Industry, 2 Chief Maintenance Engineers provided an overview to the Industrial Contingency Security at Ternium Enterprise in Monterrey. The EFR project generated 30 different projects in several categories. Also, all the participating individuals received –after passing a qualification exam- a First Respondent certification from CENAPRA (National Center for Accident Prevention, México). The EFR project developed at the i-Week presented the students to real world challenges. The students and faculty interacted with Government and Industry to propose and apply innovative solutions to multidisciplinary problems.

Keywords
Higher education, multidisciplinary learning, student learning experience, university-industry-government interaction, first respondent certification

Introduction

The Tecnológico de Monterrey (TEC or ITESM by its official name: Monterrey Institute of Technology and Higher Education) is one of the largest private multi-campus universities in Latin America, with over 90,000 students at the high school, undergraduate

and graduate levels. Since its foundation in 1943, Tecnológico de Monterrey has lived a continuous innovation process to respond to the education demands that emerge from social, economic, scientific, labor and technological changes and to challenges that our country development faces. TEC is also familiarly known as Tec de Monterrey (or Monterrey Tech).

The TEC has taken an important step toward the development of an innovation learning strategy that creates an even stronger ties from students and their communities, both nationally and internationally. The seventh week of the fall semester of 2015, all undergraduate students from the 3rd thru the 9th semester of study selected a capstone project activity which allows them to develop high-value activities that encourage students in the analysis, implementation and the creation of concepts that would be very difficult to do in the classroom. In addition the project foster student's interactions with real world organizations and institutions. Figure 1 shows briefly the fall 2015 timeline at TEC. In this real world scenario students interacted with industry professionals, government officials, health care specialists, humanists, culture developers, social workers and others, in order to propose procedures and become active in the process of transforming ideas to solutions in their communities. In Monterrey campus, a total of more than 13,000 students participated in this i-Week (in Spanish: *Semana-i*) (Tecnológico de Monterrey, 2015) that took place from September 21 to 25 at different places in Mexico and abroad. This paper discussed the experience of the capstone project called Emergency First Response (EFR) (Dieck-Assad, 2015) that was developed in collaboration with six main groups from the State of Nuevo León in México: 1. EITI (School of Engineering and Information Technologies at TEC), 2. EGADE (Graduate School of Management and Business Administration at TEC), 3. Social Development Coordination group at San Pedro County (SEDESOL), 4. Public Health Department at the State of Nuevo León (SSNL), 5. National Center for Accident Prevention in México (CENAPRA) (Secretaría de Salud, México, 2014), and 6. Ternium Maintenance Department in Monterrey (TERNIUM).

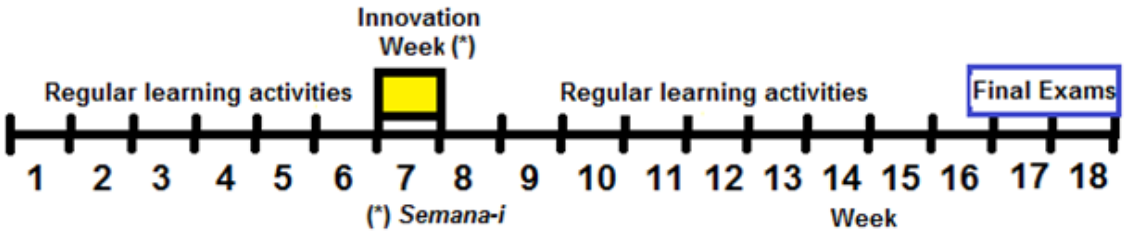

Figure 1. Fall Semester 2015 timeline at Tecnológico de Monterrey.

The Emergency First Response (EFR) Project

The percentage of death as a consequence of quick treatment of heart attacks surpasses 50%, and it is independent upon age (Secretaría de Salud, México, 2014 and Secretaría de Salud, Nuevo León, 2015). The main surviving factor is the immediate attention that the victim could receive by applying artificial ventilation and cardio-pulmonary reanimation (CPR) in the scene. The main objective of the EFR project is to provide undergraduate students and faculty a liaison with health care administration groups both in government and industry to develop projects for training and certifying First Respondents among the student population.

There are several training courses as first responders around the world. However most of these courses are offered to people pursuing a professional life as law enforcement officers, paramedics, emergency responders or fire fighters. Such first responder courses are provided by community colleges and/or on-line education institutions such as Kaplan University, ITT Technical Institute, or Azusa Pacific University. These programs are also promoted to people who "most likely" be the first on the scene of a medical emergency or works far from medical assistance such as search and rescue volunteers in rural areas, park ranges, lifeguards, teachers and security guards. Upon completion of a first responder course, individuals earn a certification that is valid for two years. In order to maintain certification, first responders must take biennial refresher courses. The certification is granted by the National Registry of Emergency Medical Technicians (NREMT).

However, there are very few documented initiatives for creating a community conscience of first responders (Buscell, 2015), even though the evidence has shown that when an emergency or disaster strikes, victims and volunteers act as the truly first responders. Take for example the following major disasters: the earthquake that struck Mexico City in 1995 or the tornados in central Florida in 1988. In both cases ad-hoc citizens groups self-organized to rescue other people from rumble, and created disaster relief centers among other emergency response activities.

The EFR project fosters the student and faculty participation [Nair, 2008; Khan, 2007; Hefferman, 2011; Oppenheimer, 2014] with the Government Health Care Administration in serving as a First Respondents and even more, to promote training and collaboration using Information Technologies and Apps to disseminate Health Care in emergency contingencies. The training consists of a First Respondent workshop that provides competences in first aid response, basic medical attention and evaluation of emergency contingencies to provide assistance to individuals who have suffered accidents or sudden illness while the paramedics or medical specialists arrives to the scene. The participating students were sophomores, juniors and seniors from most of the undergraduate programs in engineering (Computer Science, Information Technologies, Electrical, Civil, Industrial, Chemical, Mechanical, Biomedical, Nanotechnology and Chemical Sciences, Mechatronics, Biotechnology, and Musical Production) and business, humanities and social sciences (Business Management, Psychology, Architect, Digital Art, Nutrition, Law, Marketing, Economics, International Business, Journalism, and Communications). Faculty form Computer Science (CS), Electrical and Computer Engineering (ECE) and from Information Systems (IS) participated in the project as coaches and instructors during the i-Week. The participation of engineering majors from all disciplines, business administration majors, social science majors, other students from other disciplines, faculty from CS, ECE, IS and Graduate Schools generates a managerial challenge in providing a good project administration environment at all levels.

Conceptual Contents

The basic conceptual contents of the first respondent workshop are:

1. Accident scene´s evaluation
2. Victims evaluation
3. Choking maneuver
4. Cardio-Pulmonary Reanimation (CPR).
5. Wounds, burns, fractures and convulsions.

6. Bandages and victim dragging.
7. Main illness characteristics, risk symptoms and preventing measures.

The workshop includes practical exercises with mannequins and other materials provided by the Health care administration. Particularly the CPR training is exercised and verified in great detail to have the trainees developing skills and competences for CENAPRA certification. Moreover, the participating candidates must approve a theoretical exam in order to be certified by CENAPRA.

Capstone Activity

The capstone activity consisted upon the use of the acquired knowledge to design and implement a tool to support education and training about first respondent skills and participation in the community. Teams of 5 to 6 persons develop the procedure, specifications and necessary information to create the tool or app product. Some of the specifications released to reach a reasonable proposal for a practical tool are:

1. The tool must be proposed to an educational institution, service provider business, company or even the health care state administration.
2. The main idea is to advance in creativity and innovation for integrating the knowledge acquired to propose a very useful informative, servicing, campaigning, interactive tool or app that could educate, train or make more skillful a specified population sector pertaining the First Respondent in medical emergency situations.
3. The tool for emergency response should be selected to support users, workers in the prevention and servicing a medical emergency at their facilities.
4. A certification exam is applied to all participants.
5. The presentation could include a video or an application and all the team members must be available for the questions and answer plenary session.

The evaluation rubric for the product includes the following: The designed tool fulfills the goal of informing and educating about medical emergencies, the selected institution and organization exists and they are willing to use the application, and the selected project is practical, easy to use and innovative.

Outcomes, Rubrics and Evaluation

The competence development and desired outcomes for the students include:

a. Citizenship participation.
b. Communication abilities with Industrial and Government representatives.
c. Managerial competences in project administration and team work.
d. Use of information technology (IT) tools and basic programming skills to perform Apps for mobile devices.
e. Certification from CENAPRA.

In terms of citizenship the student demonstrate participation while attends, actively participates and accomplishes the assigned activities by the state public health assistants. Also the students need to attend the plenary sessions (by SSPNL) and proposal presentations (where the proposals will be evaluated) to have full credit. About the communication skills the excellent elaboration of documentation for the app and the presentation of the proposal would provide a full credit to the students.

Finally the certification from CENAPRA is obtained from:

a. An observation by instructors of a practice realization of the drills required: accident scene evaluation, shocking maneuver, CPR procedure and good development of bandages and dragging.
b. A successful passing of the certification exam (80% minimum grade) from CENAPRA.

The final evaluation consisted of: 50% student assistance, 20% CENAPRA certification, 20% capstone activity and project, and 10% oral presentation.

Student Interaction

The interactions between entities and students are: EITI, EGADE, ECE department, CS Department, IS Department, and TEC students from all majors. The external institutions are: SEDESOL, SSNL, and TERNIUM. The interaction among all the participating departments was very fluid and continuous meetings and feedback was performed, before, during and after the i-Week was developed (Tecnológico de Monterrey, 2015).

CENAPRA certified the 182 participating students and the 15 professors, once they presented and passed the comprehensive theoretical exam. As mentioned before students from all majors participated and they provided a very rich atmosphere for multi-disciplinary interactions among different disciplines. Moreover, they generated an extraordinary spectrum of viewpoints to achieve good project proposals.

Faculty-Student interaction was very good particularly at the consulting level where professor discussed the applications and the ideas with excellent maturity from the students. The interaction with external persons was extraordinary and the clerks and representatives from SEDESOL and SSNL were very surprised by the projects and ideas generated.

Table I illustrates a summary of the schedule of EFR at Tecnológico de Monterrey during the i-Week in the fall semester of 2015. The schedule included a one day plenary seminar where most of the theory was dictated. Days 2 and 3 included practice and drill exercises for the most important maneuvers (Choking and CPR), bandages and victim dragging. One day was also dedicated to a plenary session for an industry representative that gave a lecture about Industrial Security and medical assistance. Day 4 included a review of the theoretical concepts in preparation for the certification exam. Day 5 included project presentations and evaluation. Finally the same day, the certification exam was applied.

Representative Projects

The diversity in the student's disciplines resulted in innovation projects with a rich variety of both multidisciplinary innovation ideas and product prototypes. A total of 182 students, enrolled in the first respondent project, elaborated 30 innovative project proposals. Different media products were the outcomes of the innovation projects. The media products were: mobile applications, posters, workshops, banners at metro station, etc. An important characteristic of all the projects is their link with an institution or organization as client. The students contacted government dependencies, social groups, business and industrial associations. The interaction with these institutions was a key opportunity to justify the novelty of the proposed innovations. Two government organizations such as SEDESOL and SSPNL were very enthusiastic about the proposals

(Secretaría de Salud, México, 2014 and Secretaría de Salud, Nuevo León, 2015). TERNIUM, an industrial organization, was also very positive about promoting the proposals and GEOVISIBLE (a TEC alumni business) expressed their interest in participating in the project next year (Webb J., 2015).

Table I. EFR Schedule during the i-Week at TEC.

	Monday	Tuesday	Wednesday	Thursday	Friday
AM	Inauguration. Plenary session	Practice: Scene Evaluation. Classroom session	Theory: bandages, and wounds, fractures, victim dragging, convulsions. Classroom session	Industrial Security. Plenary session	Proposal presentations by teams in Classrooms
AM	Theory: Scene Evaluation. Plenary Session	Practice: Chocking Maneuvers and RCP. Classroom session	Practice: RCP In Classrooms	Review and Plenary Practice session.	Wining Proposal Presentations Plenary Session
PM	Theory: Chocking Maneuvers. Plenary Session	Team Formation	Collaborative team work	Collaborative team work	Certification Exam.
PM	Theory: CPR. Plenary Session	Collaborative team work	Collaborative team work	Collaborative team work	Closure, Plenary Session

The innovation projects focused on three specific groups: assisting, training and raising awareness around first respondents. In the awareness group, the common goal was to promote consciousness about the importance and need to have first respondents among us. Examples of innovative ideas in awareness were: the elaboration of media and the proposals of guidelines to organize promotional campaigns at universities and high schools; the media and guidelines to organize run and walk events; the proposal of a law to call for restaurants with first-respondent certified employees and to display posters with chocking maneuvers at the workplace; and the elaboration of media that takes advantage of the curiosity-shame nature of people to realize the need for first responders.

In the second group, the common project goal was to assist the first respondent on how to react under an emergency and how to reduce response time. Examples of innovative ideas involved the development of mobile apps with features such as: guiding the first respondent in real time with specific step-by-step instructions; incorporating voice commands for faster response; incorporating an option for direct emergency calls; rapid access to key maneuvering data, tracking the location of an accident; incorporating a

database with the current location of first respondents; support for scene study to avoid risks; and tracking the path and arrival time of the ambulances.

The projects in the third group had the goal of educating/training first responders using different types of media. Several projects naturally combined the education and the awareness categories together. Educational projects covered common contingencies such as: cardiopulmonary resuscitation, burns, choking, convulsions, wounds, strokes, etc. The educational projects also considered instruction about maneuvers for different environments such as: home, social, club, gym, school, business and others. Examples of innovative ideas for first-respondent education were: the elaboration of first-respondent complementary materials with illustrations and concise instructions; elaboration first-respondent educational materials with specific emphasis on babies; a training program specific for rural areas and medically underserved communities; mobile phone content to reinforce the knowledge about the cardiopulmonary resuscitation procedures; an elective course about first respondents for high schools; tools for fast location of first-respondent training and educational materials; an instructional program that integrates books, videos, web sites and workshops; teaching awareness of ineffective traditional-medicine remedies and their medically accepted counterpart treatments; and interactive guides and video games to strengthen the knowledge about maneuvers like cardiopulmonary reanimation.

Other specific accessory development could have been assigned with more advanced students which could initiate the design of typical micro shield (clear mouth barriers for artificial ventilation systems) or rescue-mask devices for CPR procedures [Ambu ResCue Mask, 2009; Medical Devices International 2014) if the right student group profile was registered for the workshop. Also the interaction with students from the Electrical Engineering field (similar to Engineering Clinics) (Jansson et al., 2010), the development of technology driven applications (Tafa et al. 2011) and the participation of companies (Plaza et al, 2013) provided a very fertile environment to promote multidisciplinary innovation among the students.

Results, Certifications and Exit Surveys

The Table II illustrates the student´s opinion with respect to: workshop content, instruction by SEDESOL and SSPNL, Consulting and instruction by TEC faculty, time allocation to different topics and supporting materials such as audiovisuals and tools. With regard to the overall opinions and recommendations of the activity by the students, they suggested some precise actions that could improve, even more, the experience in terms of managerial, logistics, organization and structure. Some of the popular suggestions were:

1. Try to redistribute better the workshop theoretical content during the week. This is try to avoid having all the theory in one or two days only.
2. To have more practice sessions to do maneuvers and procedures.
3. To have a better logistics for the lunch time period.
4. To avoid some contradiction of the Medical Doctors and health care Administrators about concepts and manuals.
5. To give more time in developing the App or application. This will allow establishing an immediate alliance with interested parties.

The students also provided their opinion with respect to recommending the activity for future semesters at Tecnológico de Monterrey. Table III shows opinions from 182 students that attended the workshop.

The figure 2 shows the results from the exam required to receive the certification from CENAPRA. From the figure 2 the minimum-approving grade was 15/20 (or 75/100) and therefore all the 182 students were certified as first respondents with an amazing 93% of the 182 students obtaining a percentage grade of 90% or more.

Table II. How did students like the fundamental elements of the EFR.

How did students like?	**% of students saying: EXCELLENT**	**% of students saying: VERY GOOD**
Workshop content	59	33
Instruction by SEDESOL/SSPNL	61	28
Consulting/instruction by TEC faculty	73	22
Time allocation	39	33
Supporting materials	62	37

Table III. Student Expectations and Recommendation to others.

Were your expectations fulfilled?	**Would you recommend the workshop?**
YES	YES
88%	92%
Opinions of 182 students using an exit survey at the end of the workshop	

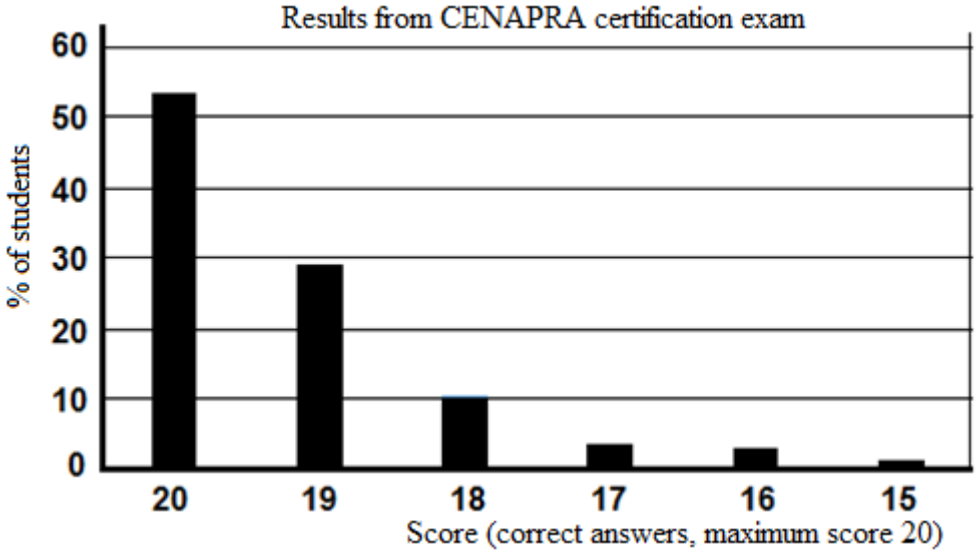

Figure 2. Results from the certification exam for 182 students.

When the students delivered their products, personnel from SSPNL and CENAPRA were part of the jury in the final oral presentations. The figure 3 illustrates the categories of the different product prototypes developed by the students during the EFR I-Week (September

21st through September 25th of 2015). SSNL and CENAPRA were very optimistic about the use of the generated products and applications. The multidisciplinary and collaborative [Oppenheimer, 2014; Florida, 2015; Benyus, 2002; Casado, 2015; Govindrajan, 2012) approach to the EFR project was so successful that a continuing project is being developed for the CS faculty to provide a follow up to the best applications and proposals.

Finally, the TEC performed an institutional survey to a sample set of students participating in the i-Week (Tecnológico de Monterrey, 2015). From a sample of 3,966 students from Monterrey campus (C.MTY), and 1,365 from EITI, 64 students were interviewed about the EFR Experience.

Figures 4 and 5 illustrate a summary of opinions from the interviewed students with respect to: their living experience and their Satisfaction, respectively. Figure 5 shows that more than 50% of the students participating in the Emergency First Response (EFR) activity had a Good to Excellent opinion about the "Living Experience" during the i-Week at the Tecnológico de Monterrey. Figure 5 shows that about 75% of the students participating in the EFR activity had a Satisfied to Very Satisfied opinion about the i-Week Workshop. Finally, considering the overall opinion of the students participating in the EFR experience, figures 4 and 5 illustrate that the number of students with positive opinions are much higher than the percentage of students from the EITI and C.MTY (Tecnológico de Monterrey, Monterrey campus). Also the figures show that the number of negative opinions of EFR students are much lower than the number of negative opinions from the EITI and C.MTY.

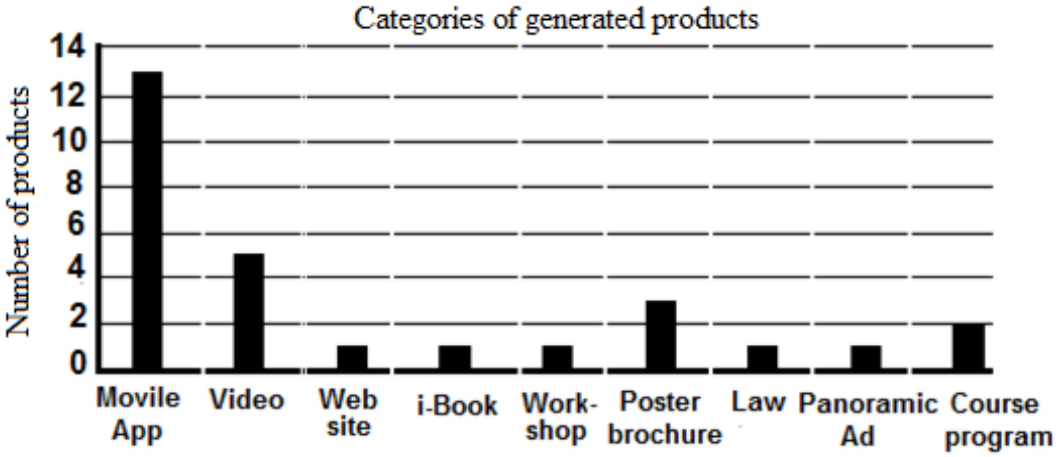

Figure 3. Categories of the product prototype generated during the EFR i-Week.

Conclusion

The EFR project developed for the i-Week at TEC delivered 182 more first respondent students in our community to be prepared for providing medical attention to individuals having accidents or sudden health contingencies. In addition 14 professors from areas such as Computer Science, Electrical Engineering and Information Systems are also certified to provide this kind of service not only in the Monterrey campus but abroad. This project was the initial seed that will exploit in higher and more profound benefits in the academic community because the student has the opportunity to interact not only with government officials servicing the population in health care issues, but also with industry personnel

dedicated to provide health care and security in working environments. The project focused in the following outcomes to strengthen in the students: citizenship participation, communication abilities using Information Technologies, and application development using different Software and IT techniques.

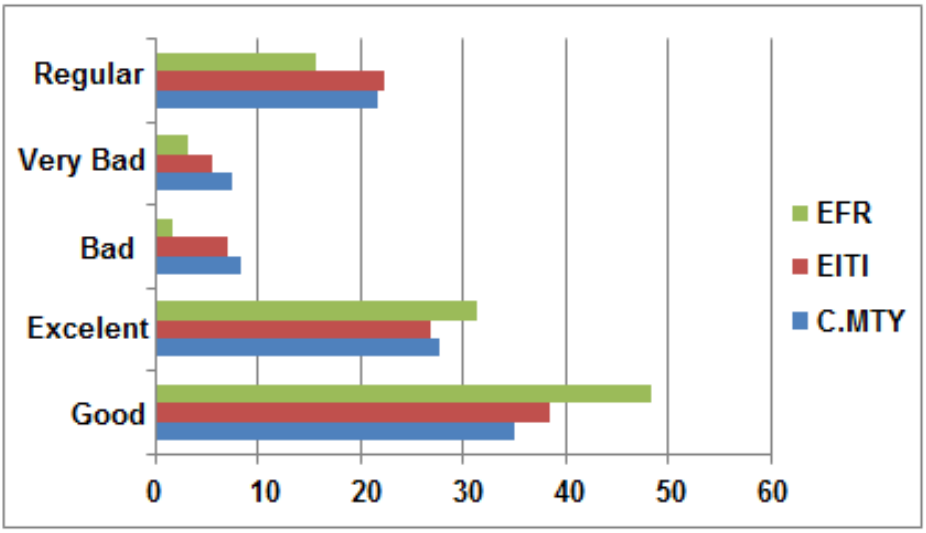

Figure 4. Institutional survey to students (Tecnológico de Monterrey, 2015). Question: "How was the living experience at the i-Week?"

The health care administrators were included in the evaluation procedure and presentation of applications developed by students. They were very satisfied with all the different opportunities generated during the workshop i-Week. Also, using the evidence collected by the state health administrators and CENAPRA personnel, all the 182 participating students approved the certification exam and the practice exercises to become first respondents in Mexico. CENAPRA recommends a review workshop every year.

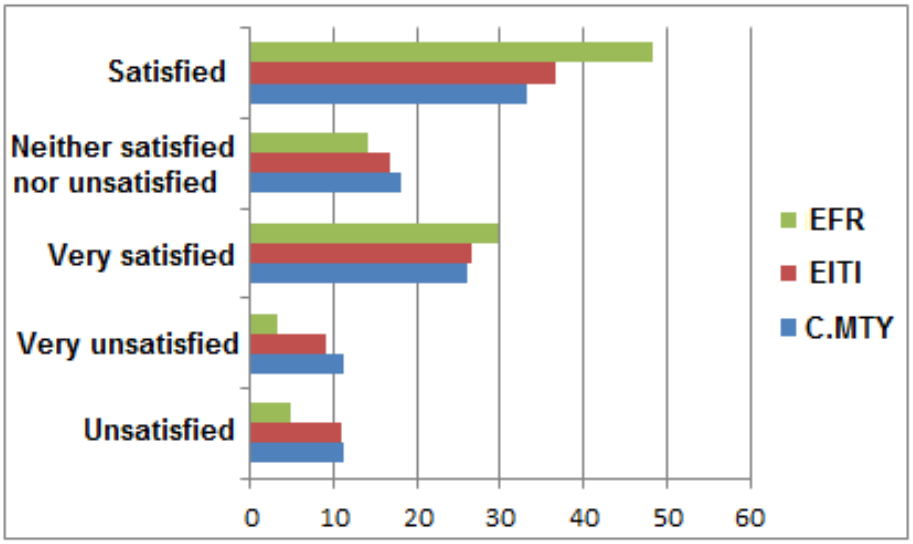

Figure 5. Institutional survey to students (Tecnológico de Monterrey, 2015). Question: "What was your satisfaction level at the i-Week?"

From the exit surveys, 88% of the students fulfill their expectations and 92% would recommend the workshop to future students at TEC. The replication of this project at TEC would help in the development of future technologies and mobile applications which can be developed by students working not only in areas of science and engineering, but in the vast majority of the undergraduate university programs.

This project generated some opportunities for improvement to provide an even higher and enriched environment for innovation and project development. Future work along those lines are:

- To incorporate the workshop at all educational levels and strengthen in particular the high school and college levels.
- To design and develop infrastructure to promote this sort of topics. Among different promotion media are: posters and videos at schools, enterprises, business and public places.
- To involve medical school students to participate in the workshop instruction at all educational levels.
- To involve engineering students to participate in the development of high performance tools that could facilitate the correct and opportune intervention of first respondents in emergency situations. This will enhance the learning of the fundamental aspects.

Finally, if initially some students entered the workshop without understanding the intricacies of the workshop; at the end they were very enthusiastic, motivated and proud due to: a) their learning of the subject of first respondent, and b) their products and proposals that will be available to the community. All those important issues reinforce the human sense, which constitutes one of the fundamental values promoted by TEC, considering that after the students passed through the workshop, they would acquire an insight touch as better citizens for a society which is lacking of fundamental human values.

Appendix

Figures 6, 7, 8 and 9 show some representative photographs of the theoretical training and practical activities performed both, in plenary sessions and in classrooms to develop the necessary skills to become a first respondent during the EFR i-Week at the Tecnológico de Monterrey, September 21 to 25 of 2015.

Figure 6. EFR plenary session, September 21st, 2015.

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Figure 7. Photos of practice with manikis in the plenary session

Figure 8. Photos of CPR practice in the classroom, for child and adult


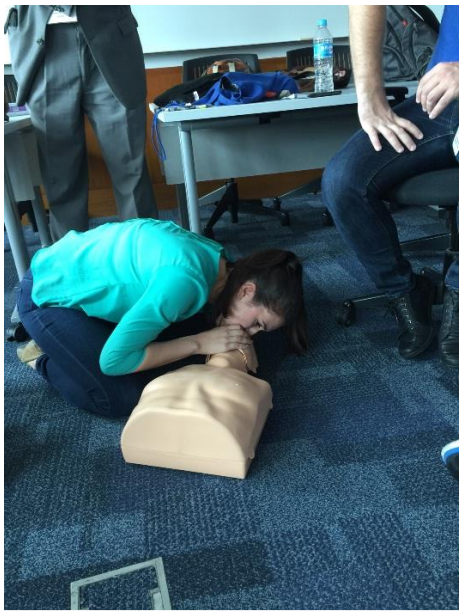

Figure 9. Photos of CPR and CPR ventilation practices in the classroom

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Authors Biographies

Graciano Dieck-Assad received the B.S. degree in Electronics and Communications Engineering at the Tecnológico de Monterrey in 1977. He received the M.S. and PhD degrees from the University of Texas at Austin in 1979 and 1984, respectively. He is a professor of Microelectronics and Bioinstrumentation at the Tecnológico de Monterrey since 1991.

Bertha Laura García-De-La Paz received the B.S. degree in Computer Systems Management at the Tecnológico de Monterrey in 1979. She received MS and MBA degrees from the Tecnológico de Monterrey in 1994 and 2000, respectively. She is a professor of Information Systems and Business Intelligence at Tecnológico de Monterrey since 1989.

María Elena Dieck-Assad received the B.S. degree in Computer Systems Management at the Tecnológico de Monterrey in 1981. She received MBA and MS degrees from

Tecnológico de Monterrey in 1984 and 1992 respectively. She is a professor of Information Systems and Business Intelligence at Tecnológico de Monterrey since 1982.

Antonio Mejorado-Cavazos received the B.S. degree in Computer Systems Engineering, MBA and MIS degrees at the Tecnológico de Monterrey in 1982, 1991, and 1995 respectively. He is a full time professor at the Tecnológico de Monterrey since 1990.

Jakeline Marcos-Abed received the B.S. degree in Computer Science at the Tecnológico de Monterrey in 1981. She received MS degree in Management Information Systems from Tecnológico de Monterrey in 1998. She is a professor of Computer Science at Tecnológico de Monterrey since 1998.

Alfonso Avila-Ortega received the B.S. degree in Electronics and Communications Engineering at the Tecnológico de Monterrey in 1989. He received the M.S. and PhD degrees from the University of Arkansas in 1994 and 1998, respectively.. He is a professor of Electronics Engineering at The Tecnológico de Monterrey since 1990.

Jaime Martínez-Garza received the B.S. degree in Electronic Systems Engineering, MBA and M.S. degrees at the Tecnológico de Monterrey in 1980, 1983 and 1987, respectively. He is a full professor at the Tecnológico de Monterrey since 1981.

Juan Carlos Lavariega-Jarquin received the B.S. and M.S. degrees in Computer Systems Engineering at the Tecnológico de Monterrey in 1987 and 1990, respectively. He received the PhD degree from the Arizona State University in 1999. He is a professor of Computer Science at The Tecnológico de Monterrey since 1990.

Alejandra González-Avila received the B.S. degree in Computer Systems Engineering and MS degree in Computer Science at the Tecnológico de Monterrey in 2000. She has been a professor at Computer Science Department at Tecnológico de Monterrey since 2000.

Martha Sordia-Salinas received the B.S. degree in Computer Systems Engineering and MS degree in Computer Science at the Tecnológico de Monterrey. She has been a professor at Computer Science Department at Tecnológico de Monterrey since 1985.

María Marcela Dieck-Assad received the B.A. degree in Communications Sciences at the Tecnológico de Monterrey, M.A. degree in Social Psychology at the Universidad de Nuevo León, and an M.A. degree in Brief Systemic Psychotherapy, at the Milton H. Erickson Institute of Monterrey, in 1984, 2002 and 2014, respectively. She is a Professor of Humanities and Social Sciences at the Tecnológico de Monterrey since 1984.

Alejandro Cervantes-Villarreal received the B.S.. degree in Electronics and Communications Engineering at the Tecnológico de Monterrey in 1977. He received the M.S. degree at Stanford University in 1979. He is a professor of Electronics Engineering at the Tecnológico de Monterrey since 1991.

Juan Raúl Esparza-Martínez received the B.S.. degree in Electronics and Communication Engineering at the Tecnológico de Monterrey in 1979. He received the MS degree in Informatics and Computer Science from Tecnológico de Monterrey in 1985. He is a professor of Computer Science at Tecnológico de Monterrey since 1979

Sergio Omar Martínez-Chapa received the B.S. degree in Electronics and Communications Engineering and the M.S. degree in Control Engineering both from Tecnológico de Monterrey, in 1983 and 1985, respectively. He received the M.S. degree in Electronics from Philips International Institute, Eindhoven, Netherlands in 1990; and the Ph.D. degree in Microelectronics from National Polytechnic Institute of Grenoble, France in 2002. He is a professor of the Electrical and Computer Engineering Department at Tecnológico de Monterrey since 1986.