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Physical Science Day: Design, Implementation, and Assessment

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Physical Science Day at The University of Texas–Pan American (UTPA), in collaboration with the Edinburg Consolidated Independent School District, has been designed, developed and implemented to address an identified fundamental shortcoming in our educational process within this primarily (90+%) Hispanic serving border region. Physical Science Day overcomes the lack of knowledge about what physics is by raising youth awareness of physics as the foundation of science, engineering and technology disciplines, through activities including hands-on laboratory experiments, career orientation, and higher educational student and graduated student testimonials. Thus, Physical Science Day encourages, attracts, and enables more Hispanic youth towards science, technology and engineering disciplines in higher education. Pre- and post-survey results showed that Physical Science Day is effective at increasing student knowledge about physics, physical science, and chemistry programs, raising awareness of broad career opportunities, as well as for stimulating youth interest towards studying such disciplines at UTPA.

Keywords: University-Based Outreach, Physical Science, Hispanic-Serving Institution, Expectancy-Value Theory, Career Awareness

National Crisis

A position commonly held in the western world is that the fields of science, technology, engineering and mathematics (STEM) primarily make up the engines that drive a nation's economy and directly determine its standard of living. In order to secure a better national economic future, colleges and universities need to produce an adequate number of scientists and engineers. However, for the past few decades, the United States has experienced a shortage of engineers and scientists (National Science Board, 2004). This shortage is certainly reflected in the field of physics, the foundation of all science, technology and engineering disciplines.

Unfortunately, a compounding issue has been that across the nation, two thirds of the physics and chemistry classrooms in high schools are taught by teachers without a degree or teaching certificate in the subject (Committee on Prospering in the Global

Economy of the 21st Century, 2007). Without the proper guidance of qualified physical science teachers, students' potential interest in the physical sciences is left uncultivated. Owing to the academic requirements of the physical science disciplines at the University level, students who are not adequately prepared at the high-school level will face nearly insurmountable obstacles. Obtaining the prerequisite courses will inevitably delay graduation beyond the normal four-year span and, consequently, lead to an excessive financial burden on such students.

In terms of science and math achievements among high school students, it has been well documented that there has been great and consistent discrepancy among different ethnic groups nationwide (Hemphill & Vanneman, 2011; President's Council of Advisors on Science and Technology, 2010). Hispanic and African-American high school students perform much lower than their White and Asian-American counterparts. The first author's longitudinal research on the trends of gaps between Hispanics and Whites in students' course credit attainments and course taking patterns in STEM areas in Texas high schools echo the national findings (unpublished work by Zeng & Poelzer, 2015).

Texas Issues and Local Problem

Furthermore, in Texas, Hispanic students accounted for 51.3% of the enrollment in public schools in 2012-2013, much higher than the White students, 30.0% (Texas Education Agency, 2010). The Texas Department of State Health Services has predicted that the total Hispanic population in the state will exceed the White population by 2020 (Texas Department of State Health Services, 2014). This increasing Hispanic population will pose an even greater challenge for the economic future of Texas if efforts are not made to uplift their education.

In the meantime, all the school districts in the State of Texas are facing the great challenges of increasing physics curriculum requirements: First, physics became a mandated subject for all entering 9th graders in 2012 (Texas Education Agency, 2007); second, all high school students need to pass a set of end-of-course assessment exams on various secondary level courses, one of which is physics (Shapiro, Janek, Seliger, & West, 2007).

However, school districts in South Texas have encountered an enormous problem in effectively addressing these two requirements. According to the data from the Region One Education Service Center which covers seven counties in the region, there is a lack of 308 physics teachers, after physics became a mandated subject in high schools in 2012 (personal communication with Region I Education Service Center, 2007). Superintendents and curriculum/science specialists in many school districts have strong concerns about the situation, leading a local school district to take the drastic measure of recruiting teachers from overseas to teach these subjects.

Since 2011, the science coordinators from local school districts in the proximity of the University of Texas-Pan American (UTPA) have reported to the first author that high school students are unaware of what physics entails or the wide range of professions for which physicists can qualify; therefore, they lack interest in studying physics. One school district in particular, the Edinburg Consolidated Independent School District (ECISD), had requested collaboration with the Department of Physics and Geology at UTPA to help bolster student interest and to expose students to potential careers involving physics. From the perspective of UTPA, recruiting students into the physics program would help to strengthen and support the program, so this collaboration was viewed as beneficial to both UTPA and the ECISD. Furthermore, both parties agreed that establishing a university-based outreach program in the physical sciences would serve the best interests of the high school students in the school district.

This research was conducted at UTPA, where 91% of the student population of ~20,000 is of Hispanic origin (UTPA Office of Institutional Research and Effectiveness, 2014). Located in the south-most region of Texas bordering with Mexico and surrounded by several of the poorest counties, it is also one of only two doctoral degree-granting institutions servicing a population of approximately 1.3 million (Rio Internet Marketing, LLC., 2012). Over 80% of UTPA students report that their parents do not have Bachelor's degrees (UTPA Office of Institutional Research and Effectiveness, 2013), making the overwhelming majority first-generation college students. The local school districts are typically considered highly financially needy districts; public school students typically come from low-income Hispanic families, receive free meals based on government welfare criteria, and are labeled as high dropout risk students.

Our research questions for this study included: Does student awareness of potential careers in physics increase after participating in the program? Does student knowledge of degree programs in physical science increase after participating in the program? Does student interest in studying chemistry, physical science, and physics at UTPA increase after participating in the program, respectively?

Literature Review

Influence of High School Physics Teachers on Students' Future Physics Enrollment Choices

Several reports have appeared in literature concerning the impact high school physics teachers have on their students' future choices related to physics coursework and careers. Among the various factors that impact student interest toward science, Hasan (1975) from Jordan identified that secondary school teachers directly impact students on their interest, and students can be in a disadvantageous position without the influence of qualified science teachers. As an example, Dobbin (2011) reported that only about half of the enrolled university physics majors in four Midwestern states in the United States of America decided to major in physics while in high school. Further, the students expressed that their high school physics teachers were the most influential towards their decisions. Therefore, one can infer that the high school level is an important stage for physics educators to guide students to discover their interest in the studies of physics or physical science.

A particular problem concerning female high school students' interest in physics was revealed in the research by Buabeng, Ampiah, and Quarcoo-Nelson (2012) from Ghana. The researchers found that female high school students shied away from majoring in physics because they considered physics a dry and abstract topic, which only utilizes intense mathematics. Moreover, they believed that physics would not produce abundant opportunities in career choices other than being physics educators. The researchers further called for physics educators to help reverse the situation by bringing awareness of the physics career paths to the students. For example, most of the female students aspired to pursue careers in medicine but had no knowledge of medical physics options.

Examples of University-Based Outreach Programs

Among the various university-based outreach programs documented in literature that promote students' interest in studying science and engineering, only one focused on physics. Other university-based outreach programs focused on other fields including agriculture, biomedicine, natural resources, electrical engineering, and genetics. The duration of these programs varied from five hours to sixty hours, and the schedules were as diverse as after school, weekends, and school breaks. Descriptions of the programs are summarized below:

Under the Italian government's initiative to address the national problem of decreasing interest of students taking science courses in chemistry, mathematics, and physics, experimental physicists at the University of Palermo recruited about 130 high school and secondary school students to conduct experiments in physics research laboratories on topics such as superconductivity, optical spectroscopy, and x-ray astronomy calibration during the 2009 PalermoScienza week (Gallitto, 2010; Gallitto, Agnello, & Cannas, 2011). These students then explained the research to their peers at the end of the event. High school teachers collaborated with the university physicists in student selection and curriculum planning so that the topics were synchronized with the content that students were scheduled to learn in their regular classrooms.

To advance students' science literacy, a U. S. Department of Agriculture geneticist, Dr. Pinson from the Agricultural Experimental Station at the Texas A&M University, collaborated with Port Neches-Grove High School in Texas to arrange a total of 14 top biology students to conduct genetics research studies on rice farming from 1991 to 1996 (Moore & Holmes, 2003). They worked after school and on Saturdays for a consecutive period of eight weeks each year, collecting data from the fields. In turn, they presented the research to the other 130 students in their class, where together they analyzed the gathered data. A follow-up questionnaire showed that they better understood the research methodologies and techniques in genetics research as well as the resilience necessary in conducting research. Furthermore, some students commented that the research experience had impacted their career plans and fundamentally changed their outdated views on agriculture, such as gardening.

In order to improve underrepresented minority students' interest in science and college enrollment, the National Resources Management Department at New Mexico Highlands University engaged a total of 76 high school students to participate in an intensive two-week Science Agricultural Summer Experience program from 2007 to 2010 (Martinez, Lindline, Petronis, & Pilotti, 2012). Students selected into the program varied from 10th graders to high school graduates, who had met certain criteria in the following areas: interest in science, academic goals, GPA, and Grades in Math and Science. It is noted that 86% of them were Hispanic, 9% Caucasian, and the remaining 5%, Native American and African American. Furthermore, 86% of the high school graduates enrolled in college, of which 24 enrolled at New Mexico Highlands University. Research has found that this summer experience increased students' interest in pursuing science careers.

A shortage of engineers exists in New Zealand; less of the public school students of New Zealand choose to take math and physics courses, and yet the country needs to produce twice as many engineers as in other Organization for Economic Co-operation and Development countries (Smaill, 2010). Since 2004, the Department of Electrical and Computer Engineering at the University of Auckland (UoA) has invited an average of 31 senior year physics students from a co-educational high school annually to participate in its outreach program. The program consists of four 90-minute sessions of electrical engineering lab experiments over the four-week break between the fall and spring semesters at the university. Lab activities include the use of oscilloscopes, signal generators, operational amplifiers, and interactions with lab teaching assistants. At the end of each lab session, the hosts give tours to the students in the research laboratories to demonstrate robotics, intelligent rooms, and power electronics. In the surveys administered after the event, students reported that these activities increased their knowledge as well as motivated them to learn more. Furthermore, in 2007, 66% of the students expressed that they were more interested in studying Electrical and Computer Engineering, and 42% went on to study in the Bachelor of Engineering program at UoA.

With the rapid advancements of the genomics and bioinformatics fields brought by computer science and information technology, the faculty in the Michael Smith Laboratories at the University of British Columbia felt it was appropriate to introduce these fields to secondary school students through the venue of a five-hour Genomics Field Trip Program (McQueen, Wright, & Fox, 2012). Since 2009, the program has invited 1300 9^{th} graders and their teachers to try out a short lab on DNA extraction, participate in hands-on activities on genes and proteins, watch videos on the Human Genome Project, visit the research facilities, have a question and answer session with graduate students, and participate in a wrap-up fun yet knowledge-oriented Jeopardy game. A different class of 24 to 32 students participated in the event on a weekly basis from October 2009 to May 2012, and four to five graduate students from the laboratories rotated to host the event. Students and teachers filled out rating forms after the event, which showed their consensus that this was a very successful field trip with a board range of interesting activities. Students could then truly understand the usefulness of science and thought favorably of scientists in the labs. The lessons gained by the hosts include the following: (a) align the objectives of the activities with the secondary school curricula, (b) choose projects that are interesting to the host, (c) link real-world applications to the concepts, (d) regard fun as a valuable component in science learning, (e) encourage students to ask questions, (f) invite enthusiastic senior and graduate students to organize and host the event, and (g) utilize surveys to evaluate and improve the event.

To summarize, the outreach programs, whether as short as five hours in one day, four sessions of 90 minutes during a university break, or as long as a 60-hour summer research program, are all successful due to the following characteristics: (1) directly immersing students in a university learning environment where advanced equipment is readily available; (2) involving them in stimulating hands-on activities with the equipment; (3) interacting with professors or senior students with enthusiasm and expertise in the field; and (4) gaining valuable field knowledge and career information. They have all increased student interest in the subject, and consequently an increased quantity of students chose a career path in STEM fields in colleges and universities.

Theoretical Framework

Modern expectancy-value theory (Eccles & Wigfield, 2002; Robnett & Leaper, 2012) provides the theoretical framework for this outreach study. The theory links an individual's choice, such as majoring in physics, with their beliefs related to their success in that choice, and the value they place on that choice, referred to as task-value (Eccles & Wigfield, 2002; Robnett & Leaper, 2012). Two components of the task-value, intrinsic and utility, are associated with this work, where intrinsic value refers to the satisfaction that an individual obtains from engaging in a chosen task, and utility value refers to the relationship between the chosen task and the individual's goals. For example, in physics, individuals' career goals might include: (a) to meet social needs (e.g. to study physics because society needs more qualified high school physics teachers); and (b) to pursue desirable occupations (e.g. one wants to become a medical doctor in the future and chooses medical physics as the field of study to prepare for it).

Furthermore, students' intrinsic value in science can be improved by engaging them in studying interesting topics, real-world contexts, and hands-on activities (Hoffmann, 2002; Gardner & Tamir, 1989; Häussler, 1987; Lind, 1982). These three dimensions that construct student interest can also give indications on whether a student enjoys studying science. For example, interest in topics refers to the enjoyment of the content such as diffraction, electromagnets, sound waves, collisions, etc. in physics. Interest in real-world contexts means how one could apply these topics to solve real life problems. For instance, the topic of electromagnets is widely used in modern technologies such as MRI, transformers, and magnetically-levitated trains. Activities refer to student interest in participating in hands-on experiments, evaluating the results, and applying the topics learned in various contexts.

Fundamentally, all of the outreach programs introduced earlier have increased students' intrinsic value toward studying a subject. However, very few programs, other than the Genomics Field Trip program at the University of British Columbia, included a solid component focusing on improving students' utility value by shedding light on career choices. Post-survey results showed that students enjoyed learning about the various jobs related to the field of genomics.

Methods

Since 2011, the full-day UTPA "Physical Science Day" outreach program, founded through collaborations between the university and ECISD, has been anchored on modern expectancy-value theory and has aimed at bolstering student interest in physical science fields and exposing students to potential careers. The Department of Physics and Geology and Department of Chemistry designed the event to serve the following purposes: First, to raise student awareness of the physical science disciplines, because few students have had any exposure to these subjects in the local school districts; second, to identify potential career paths, which is an important concern for this student population; and third, to attract students to the degree programs including Bachelors of Science in Chemistry, Physical Science, and Physics.

Selection of Students

Annually, each school district has selected 150 to 200 students with an average of 50 per high school to the program, mostly 11th graders, who are enrolled in Advanced Placement and Pre-Advanced Placement programs in math and science. Beginning as a pilot program with 66 students from ECISD in 2011, the program has grown to 350 student participants in 2013, from both ECISD and Weslaco Independent School District (WISD). The event is scheduled on a day(s) at the end of each spring semester, when the school schedules were least conflicting.

Seeking to provide role models for the high school students, the authors relied exclusively on senior physical science majors and graduate students in the Master of Physics Education program to host the laboratory activities. These hosts were recruited from local chapters of the Society of Physics Students (SPS), Elliott Chemical Society (ECS), Geology Club, Astronomy Club, and the UTeach STEM programs. Most have served as Teaching Assistants within the departments and were well versed in running the laboratory and planetarium activities. This has served to emphasize to potential students that, upon arrival, they will rapidly become part of the departments, responsible not only for their own education but also serving as mentors for those that follow.

Activities

Activities were designed to include topics interesting to students, and to provide contexts and hands-on activities during the program. The emphasis in the program is that the students be actively engaged throughout the day, not passively listening to faculty members presenting their research. Furthermore, the activities included opportunities for students to interact with student hosts and departmental faculty as well as effectively disseminate career information.

Because a primary goal of the event is to attract students to the physical science disciplines, the researchers chose to structure the event in a set of 40-minute blocks. The block duration was chosen, in part, due to the length of the full-dome planetarium visual presentation in the Astronomy block. Laboratories at UTPA are sized to accommodate 12 independent experimental stations. Attendees were divided into groups of no more than 25 students (nominally two students per station) to ensure that each student is afforded the opportunity to actively participate. Each group followed a different pathway through the list of activities, including physics, astronomy, chemistry, host testimonials, geophysics, and finale. As this strategy entailed moving between campus buildings, a host is assigned to each group to serve as a guide to expedite room changes. These guides served as ambassadors for the program, utilizing the transit times to answer questions about the university and the science programs.

Topics of activities were selected in collaboration with the science coordinators and aligned with Texas College and Career Readiness Standards (Texas Higher Education Coordinating Board, 2009) and their high school physics curricula. The following four disciplinary areas were covered for the students:

Physics. The activities included in the physics section emphasized how physicists use tools to extend our senses, measuring properties of systems with a precision beyond human capacity. The experiments utilized standard laboratory equipment but the activities were modified for the short times and equipment assembly was done prior to attendee arrival. The activities showcased the computer-aided data acquisition and analysis software utilized in the introductory physics laboratories. The activities have included the following:

- Using ultrasonic motion sensors to demonstrate the conservation of energy in the 1-D motion of a cart on a track,
- Using small cloud chambers to visualize the tracks of cosmic rays,
- Using diffraction gratings to measure the spectra of different, elemental light sources,
- Using a solenoid and direct current to generate a magnetic field,
- Using Helmholtz coils and a magnet suspended on a spring to demonstrate the existence of a force on the magnet when current flows through the coils.

The activities selected were among the more visually interesting of the standard laboratory experiments and were chosen because the essential steps could be accomplished during the allocated time. For example, the spectrum lab was incorporated in the sequence because spectroscopy is common to all disciplines. When introducing the spectra lab, student hosts discussed about distant stars emitting light and analyzed the chemical elements of the stars by examining the characteristic emission lines. All activities required attendee participation, as illustrated in Figure 1. In addition, attendees have also toured the X-ray material characterization facility, housed in the Physics and Geology building.

Astronomy. Attendees viewed a full-dome video from the UTPA planetarium collection, such as *Oasis*, which describes the details of each planet in the solar system. Attendees were also introduced to the *Stellarium* software package that projects the night sky onto the planetarium dome. Hosts can manipulate the images to demonstrate the time dependence of the night sky, focusing on the changes over a single night or jumping back in time to historical dates. Astronomy faculty presented their research involving Hubble Space telescope images and explained the process of digital data analysis.

Chemistry. In the chemistry lab, activities included "elephant's toothpaste", acetaminophen synthesis, oxidation reaction of gummy bears with sodium chlorate solution, and precipitation and titration reactions. The purposes of these activities were to show students how everyday items were involved with chemistry, and to have students experience and understand reactions involving color changes and enthalpy changes at the introductory chemistry level. In addition, the students received a guided tour to the Nuclear Magnetic Resonance facility and faculty research labs.

Geophysics. In addition to examining a collection of minerals used in the introductory Geology laboratories, the hosts demonstrated use of the ground penetrating radar (GPR) system. The GPR equipment enables operators to visualize the shallow subsurface, using microwave radiation. Other hands-on activities included modeling of the Earth's magnetic field strength, field lines, and polarity utilizing Styrofoam Earth models, bar magnets, compasses, and magnetic field viewers. Hosts elaborated on the foundation of physics for geological studies.

Host Testimonials

During the lunch break for each group, students participated in question-and-answer sessions presented by outstanding majors in the three disciplines, Physics, Physical Science, and Chemistry. For example, a Chemistry major described her internship experience while attending a summer Research Experience for Undergraduates program sponsored by the Amgen Scholars Program hosted at the University of California at Berkeley. A Physical Science major, who was studying to become a physical science teacher, shared her passion for the career and how the UTPA B.S. in Physical Science degree program has granted her a full scholarship through the National Science Foundation's (NSF) Robert Noyce Scholarship program. Furthermore, a Physics graduating student shared his story of study at UTPA and the fellowship award

Figure 1. High school students conduct the spectroscopy lab with host (pictured at left).

Figure 2. Student hosts present the grand finale.

and Ph.D. graduate program acceptance news he received from the Texas A&M University Nuclear Physics Research group. In addition, physics and chemistry faculty presented diverse career paths, including medical physics, and information on scholarships available at the university including the Robert Noyce Scholarship for Pre-Service physical science teachers and S-STEM scholarship for needy students studying physics and chemistry, both funded by the National Science Foundation.

Finale. In order to end the day with a bang, so to speak, the attendees were reassembled in a large amphitheater where demonstrations were conducted by students from the SPS and ECS organizations. These activities have included the hands-on presentations of thermal properties of liquid nitrogen (see Fig. 2), various electrostatics phenomena with Van de Graff generators, and always end with the ECS students demonstrating the exothermic nature of hydrogen combustion through the use of balloons. With their ears ringing, attendees were dismissed.

Pre- and Post-Survey

A pre- and post-survey was created to probe attendees' knowledge of the physical science programs at UTPA, career awareness, and their interest in studying these subjects at UTPA, as well as general questions on their opinions about the event. Attendees were asked to complete the pre-survey prior to and the post-survey after the day's activities.

Questions in the surveys were analyzed using descriptive statistics except questions on student interest in studying at UTPA. A Related Samples Wilcoxon Signed Rank test was used to measure the increase in student interest as measured by the 5-point Likert scale in Question 4 in the pre- and post-survey. The scale read as follows: 1 = unsure, 2 = no interest, 3 = some interest, 4 = interested, and 5 = very interested. The Alpha level was set at 0.05, and IBM SPSS Statistics 20 software was utilized to conduct the data analysis. Compiling survey results has been critical in improving the program over the years.

Results

Student feedback has been improving from 2011 to 2013, and in particular, the researchers present the 2013 data due to them being the most recent results the authors have obtained and analyzed. Student Feedback from the 2013 UTPA Physical Science Day was based on 147 paired responses from pre- to post-surveys in both school districts.

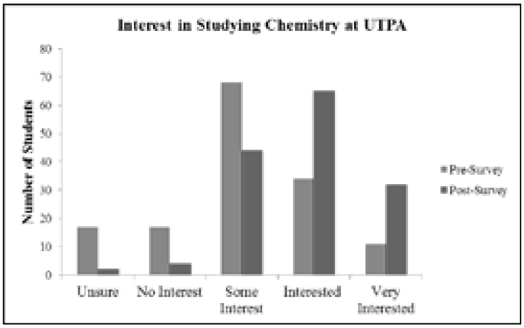
The survey results showed that prior to the event, most students (88.3%) had no knowledge about the Physics and Physical Science programs at UTPA. Further, it showed that only 33.9% of the students knew scholarships exist for those majors at UTPA. After the event, survey results showed that 97.2% of the students were knowledgeable about the scholarships and programs. Furthermore, pre-survey results showed that only 48.3% of the students could name at least three careers one could pursue with a Bachelor's Degree in Physics, whereas in the post-survey the corresponding percentage increased to 76.2%.

Figure 3 shows that the means of student interest as measured by the 5-point Likert Scales in studying chemistry, physical science, and physics all increased from pre-survey to post-survey (P-value=0.000), respectively. Specifically, the mean for chemistry in the pre-survey, 3.03, increased to 3.82 in the post-survey. Student interest in studying Physical Science increased from a mean of 2.96 to 3.36, and their interest for studying physics increased from 2.95 in the pre-survey to an average of 3.27 in the post-survey.

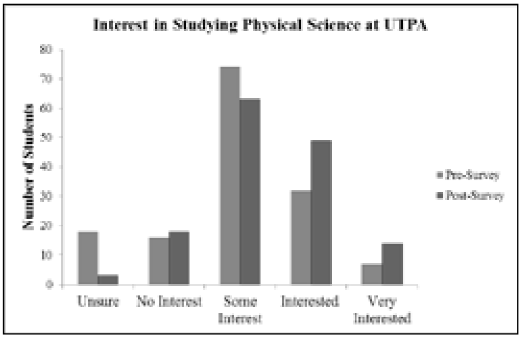
Furthermore, the number of students in the "Unsure" categories have been reduced: In the pre-survey, 17%, 18% and 18% of the students were unsure about whether they would like to study Chemistry, Physical Science and Physics at UTPA, respectively, whereas in

Figure 3. Student interest in studying (a) chemistry, (b) physical science, and (c) physics at UTPA in the pre- and post-survey.

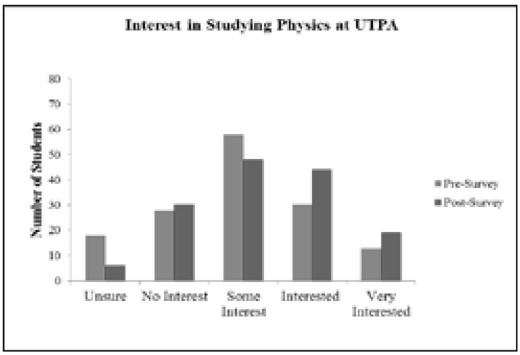
(a)



(b)



(c)



the post-survey only 1.4%, 2%, and 5% of them remained unsure about their interest.

Finally, in the post-survey, 93% of the students expressed that they are interested in attending more STEM programs or events similar to this one. It is noted that 99% of the students believed it critical for students to attend STEM programs such as this one, and the themes of their written feedback are summarized as follows:

- Exposure to new careers: Students believed that the program properly exposed them to the careers and helped them with gaining a better perspective of these fields; further, some commented that high school teachers do not have time to expose them to these science fields.
- Great learning experience: Students thought that this was a great learning experience that they did not receive in their high schools.
- Gained knowledge of science programs: Students commented that they gained a clear understanding of science programs at UTPA through interacting with college students and experiencing college classes.
- Enabled them to discover their interest: Students felt that this experience helped them with discovering their interests and knowing what they would or would not like to major in, and thus they were able to make decisions earlier rather than having to switch majors in college.
- Helped them realize science is quite interesting: Students agreed that the program activities made them realize that science is “fun and cool”.

- Motivated students to pursue college: Students believed that the program has encouraged them to become more interested in going to college and majoring in science.
- Understood critical demand of STEM graduates: Students expressed that this program allowed them to understand the critical demand of STEM graduates and the need for science teachers locally and nationwide.

When students were asked about their favorite activity in the event, they cited various labs and activities they enjoyed, with the most frequently mentioned being the finale, which included hydrogen balloon explosions and liquid nitrogen demonstrations. In addition, students also suggested that the authors could improve the event by adding more time to each hands-on activity, offering a large variation of activities to choose from, and extending the event.

Conclusions

The Physical Science Day event has been successful as assessed by the participating high school students, teachers, departmental faculty, and student hosts. Lessons learned from the event were the following:

In order to boost students' intrinsic value towards choosing a subject to study, the selection of topics for the hands-on lab activities merits thorough consideration. The authors concur with the University of British Columbia paper (McQueen, Wright, and Fox, 2012) that the topics and activities should be interesting and applicable to the real world. Further, it is necessary to match the topics and difficulty levels of the activities with the students' normal curriculum, which agrees with the University of Palermo study (Gallitto, 2010). Furthermore, physical science demonstrations and the planetarium full dome video have facilitated visual learning and eased the abstract concepts. Through these efforts, students will not feel intimidated by the complex subjects, but rather gain enthusiasm towards exploring them.

The career orientations during the event through a diverse format, including student testimonials, question and answer sessions, and faculty presentations, have significantly increased the utility value of students choosing physical science subjects to study. As an example, the medical physics career path was introduced to the students, prompting a realization that medical career paths are available to Physics majors. This finding confirms the suggestion from Buabeng, et al.'s paper (2012) that more career information can encourage the youths' choices in pursuing physics studies. Particularly, the major benefit of early awareness is to allow students to understand whether or not they have an interest in attending college to study these science disciplines.

In comparing the results with the New Mexico Highlands University's outreach program (Martinez, et al., 2012), which closely mirrored our program, the authors found that both programs have helped significantly those students who were unsure or neutral about their interest towards earning a science degree to be decisive. Data from the New Mexico Highlands University paper indicate that around 72% of the students who were still neutral about their interest in earning a science degree became definitive about their interest after participation in the event. In our program, the authors have found that on the average, 79.6% of the students who were unsure about pursuing the physical science degree programs became assertive in their interest after the event.

The last lesson learned from the event lies in close collaborations between the university and the local school districts in the areas of curriculum planning, program scheduling, program evaluation, and program improvements from year to year. Through these collaborations, the capacity of the program has been expanding over the years, increasing from 66 students from one school district in 2011 to 350 students from two school districts in 2013.

Applying the above lessons has made the program stronger over the years. Therefore, the first author plans to expand the program to a Physical Science Week in the near future to serve four to five local school districts. It may require applications for external funding to expand the program and to include a summer research component to better serve the students and the community in the near future. Furthermore, we plan to track the record of enrollments of Physics and Physical Science majors as a result of this intervention. The continuation of this program not only will contribute significantly to the uplift of the public education for the Hispanic youth population on the border but also will create more career opportunities for the students.

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