

ISEC 2019

9th IEEE Integrated STEM Education
Conference

McDonnell and Jadwin Halls
Princeton University
Saturday, March 16, 2019

Program Book



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Many thanks to Emily A. Carter, Ph.D., Gerhard R. Andlinger Professor in Energy and the Environment and Dean of SEAS, Princeton University; Andrea Mameniskis, Assistant to the Dean; and Michelle Horgan, Senior Conference and Event Manager, for your kind hospitality in hosting ISEC '19!

We also appreciate very much the contributions of the volunteer reviewers, session chairs, conference staff, and “friends of the conference.” The conference benefits greatly from the gifts of your time, skills, and knowledge. We would like to acknowledge the following IEEE officers for their support of the 2019 IEEE Integrated STEM Education Conference

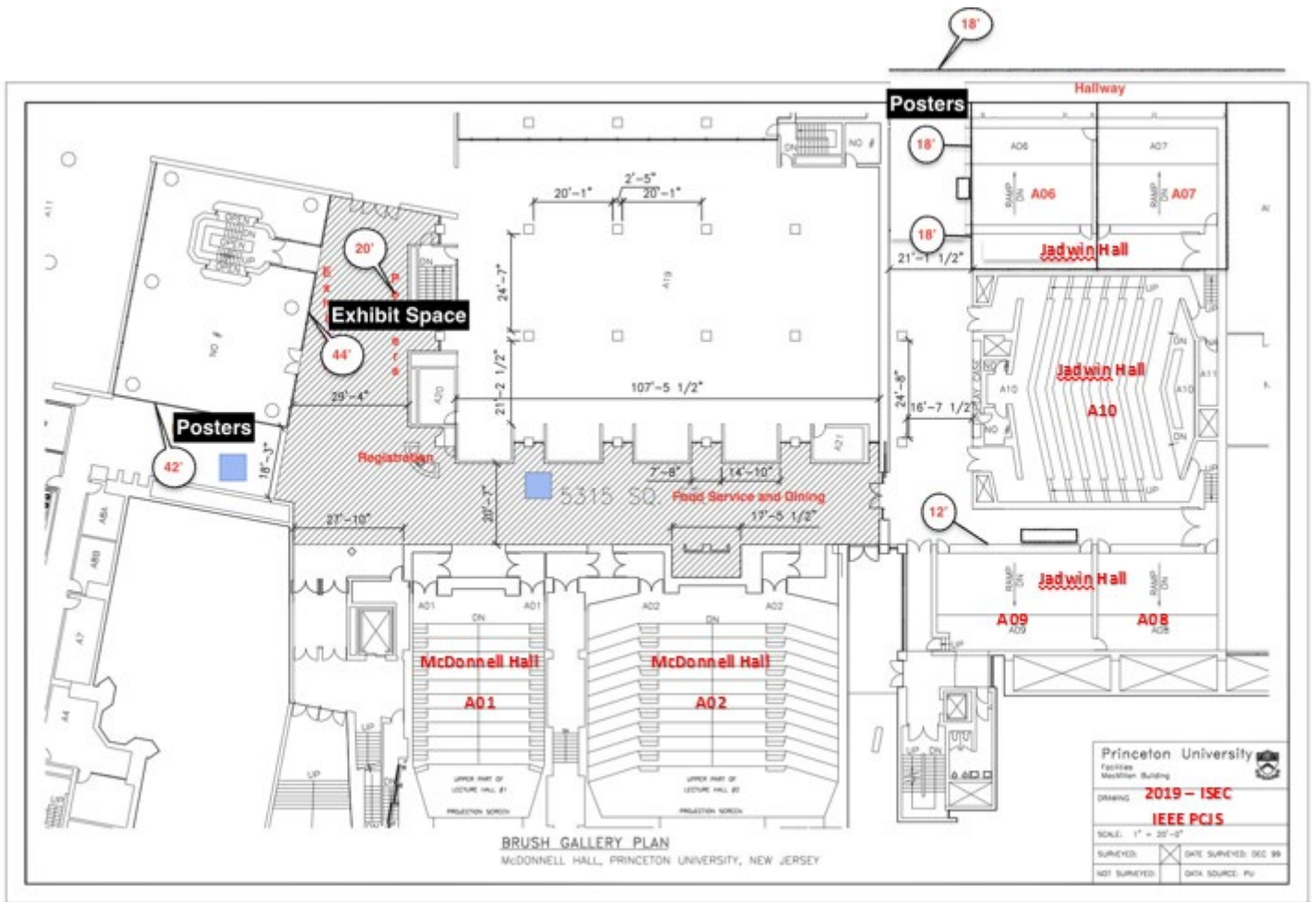
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Lastly we thank Dr. Susan K. Donohue, who recently stepped down from the committee, for the many years of support growing this event.

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CALENDAR of EVENTS

8:00am – 3:00pm	-	Registration	McDonnell Hall
8:00am – 11:00am	-	Breakfast	Brush Galley
8:45am – 9:00 am	-	Welcome	Brush Gallery
9:00am – 11:50am	-	K-12 Poster Presentation	Brush Gallery
9:35am-11:50am	-	Workshops Workshops I Workshops II	McDonnell Hall A01 McDonnell Hall A02
10:20am-11:50am	-	Paper Presentations – Morning Sessions Integrated K-12 and Outreach Programs – I Community-based Outreach and Pre-College Initiatives – I Inclusive STEM Outreach Programs Integration in Higher Ed. -I Computing in STEM Education - I	Jadwin A06 Jadwin A07 Jadwin A08 Jadwin A09 Jadwin A10
11:50am-1:00pm	-	Lunch and Networking	Brush Gallery
1:00pm-1:30pm	-	Special Focus on Posters and Exhibits	McDonnell Hall
1:30pm-2:30pm	-	Keynote Address Hydrogen and Fuel Cells Overview Dr. Sunita Satyapal Director for the U.S. Department of Energy's (DOE) Fuel Cell Technologies Office within the Office of Energy Efficiency and Renewable Energy	McDonnell Hall A01
2:30pm-3:15pm	-	Workshops STEAMWORKS MATHWORKS	McDonnell Hall A01 McDonnell Hall A02
2:30pm-4:45pm	-	Paper Presentations – Afternoon Sessions Community-based Outreach and Pre-College Initiatives - II Integration in Higher Ed. -II Computing in STEM Education - II Computing in STEM Education - III Integrated K-12 and Outreach Programs - II	Jadwin A06 Jadwin A07 Jadwin A08 Jadwin A09 Jadwin A10
3:15pm-4:45pm	-	Workshops Workshops III Code.org	McDonnell Hall A01 McDonnell Hall A02



KEYNOTE SPEAKER

DR. SUNITA SATYAPAL



Dr. Sunita Satyapal is Director for the U.S. Department of Energy's (DOE) Fuel Cell Technologies Office within the Office of Energy Efficiency and Renewable Energy. She has been responsible for roughly \$100 million per year in hydrogen and fuel cell research and development activities and has over two and a half decades of experience across academia, industry and government, including at United Technologies and as a visiting professor at Vassar College. She joined DOE in 2003 serving first as hydrogen storage lead and then chief engineer, and has been the Director since 2010. She has numerous publications, including in Scientific American, 10 patents, and a number of recognitions including a Presidential Rank Award. She received her Ph.D. in Physical Chemistry from Columbia University and did her postdoctoral work in Applied and Engineering Physics at Cornell University. Her keynote presentation is titled, "Hydrogen and Fuel Cells Overview".

ABSTRACT

This is an exciting time for hydrogen and fuel cells with several thousand commercial fuel cell cars now sold or leased, hundreds of hydrogen fueling stations worldwide, and more than a quarter of a million stationary fuel cells providing clean, reliable power. Fuel cells generate electricity from hydrogen and oxygen without combustion, which enables high efficiencies and near-zero life cycle emissions for a range of applications including cars, buses, residential and backup power, forklifts, aircraft, rail and ships. Despite the progress, there are still challenges to overcome so that hydrogen and fuel cell technologies are used widely across multiple sectors. Some of these challenges include cost, durability and efficiency. Dr. Sunita Satyapal will cover the potential benefits hydrogen and fuel cells have in enabling a sustainable energy and transportation system. She will also discuss research and development activities needed to overcome challenges facing the widespread adoption of the technology. The presentation will conclude with examples of opportunities for students to get involved in this field and specific areas in science, technology, engineering, mathematics (STEM) that are relevant to start a career in hydrogen and fuel cells.

AWARDS CEREMONY

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H. ROBERT (BOB) SCHROEDER BEST PAPER AWARD

Bob Schroeder, a life-long resident of the Trenton, NJ area, was a founding member of the Princeton / Central Jersey Chapter of the IEEE Education Society, serving as its inaugural chair. He retired as the communications and warning officer for the New Jersey Office of Emergency Management, New Jersey State Police, and led a technology consulting company, Adro!t. The Best Paper Award is given in his memory to honor his devotion to and expertise in technical writing and engineering education as well as his service to the conference.

NOMINEES

A Paradigm for Teaching Math and Computer Science Concepts in K-12 Learning Environment By Integrating Coding, Animation, Dance, Music and Art

Mirit Shamir, Mark Kocherovsky and CJ ChanJin Chung (Lawrence Technological University, USA)

Code Refactoring and its Impact on Internal and External Software Quality: An Experimental Study

Mohammed Alawairdhi (SEU, Saudi Arabia)

School-Age Children Program Social Robots - World Robot Summit Pilot Study 2018

Amy Eguchi (Bloomfield College, USA)

Data science education through education data: an end-to-end perspective

Ravi Rao (Fairleigh Dickinson University)

Applying Computer Science in Biology: A Model for Incorporating Interdisciplinary Pedagogical Approaches through ePortfolio in the First Year Experience at LaGuardia Community College

Na Xu and Charles Keller (LaGuardia Community College, USA); Yun Ye (City University of New York, USA)

Application of Text Data Mining To STEM Curriculum Selection and Development

Andres Fortino (NYU & Autonomous Professional Development, USA); Roy E Lowrance (Autonomous Profesional Dvelopment, USA); Qitong Zhong (NYU School of Profesional Studies, USA); WeiChieh Huang (Self-employed, USA)

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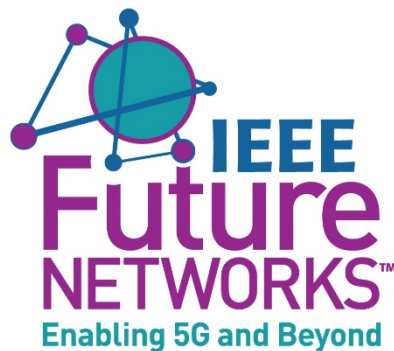
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Saturday, March 16 7:30 - 11:30

Registration and Breakfast in McDonnell Hall

Room: Brush Gallery

Saturday, March 16 9:00 - 10:15

K-12 Poster Session

Room: Atrium

Advanced considerations for defensive cyber products with regards to network security and enterprise integration capabilities

Jeremy Kiggundu (Johns Hopkins University Applied Physics Lab & Duval High School, USA)

The developing complexity of cyberspace has provoked the need for increased security methods in order to protect users and their information. Information available online including a user's banking information, social media, and etc., makes individual users more susceptible to potential attacks. The risk is exponentially larger when you look at an enterprise or larger scale networks, as; a network's security is only as strong as its weakest link and incidents small scale incidents such as an undetected virus on your computer can compromise you and your information. It takes more than a firewall to protect a computer from malicious actors; a full end to end cybersecurity system should be used instead. Many organizations have already acknowledged this risk and have established practical Enterprise Security systems that consist of multi-part security measures. These measures include complex scanners and orchestrators that can fully protect a user and their information, as well as detect and prevent any threats that it may encounter, this includes; Endpoint Management Systems, Network Scanners, and SIEMs (Security Information and Event Managers). These components are responsible for quickly detecting and denying entry into a computer, or into a network from an unknown user. However, they must work in conjunction with all security measures and hardware in an enterprise system, as alone they cannot reach their full potential. Therefore, a layered security approach of multiple components is recommended to combat potential threats, rather than a simple firewall. Network Scanner's for instance, are tasked with conducting vulnerability scans, and network port scans on a computer network which aids in conducting security assessments and system maintenance. Endpoint Management Systems, like firewalls, are tasked with conducting a three-step process that verifies the integrity of IP devices before allowing them to connect to a network. This greatly reduces any potential threat of being hacked or having information stolen by an exterior actor, due to unfamiliar and suspicious users being denied access. Finally, SIEM systems act as the administrator for the entire network by consolidating logs for actions taken inside the network either by end users or by the defensive cybersecurity tools. This situational awareness gives SIEM the capability to alert other components of a network in order to conjoin and suspend network access or to suspend a computer's current action. In comparison to only a firewall, which only provides a single point of security, these components work in conjunction in order to secure all information and assets inside and outside of a network, while firewalls simply attempt to block any potential threats from gaining access, and do not when an adversary has already penetrated into a network. All in all, it is important to consider the multiple layers of security needed to fully protect a user and their sensitive information, seeing as firewalls lack the capabilities that a full-fledged enterprise system has to protect users. In the poster, we will carefully look at how exactly each component in a security enterprise plays a role in defending users.

Innervation of the Human Esophagus - PGP9.5 Study

Ruth Martin (Baltimore Polytechnic Institute, USA)

Esophageal afferent nerves, also known as sensory nerves, regulate esophageal function and mediate painful sensations. Therapies targeting esophageal afferent nerves would alleviate symptoms and pain in many patients with esophageal diseases. However, insufficient knowledge of esophageal afferent nerves hampers the development of such therapies. The information of esophageal afferent nerves is obtained in animal models using mice and guinea pigs. However, it is unknown how the information from animal models translates to human nerves. We hypothesized that the esophageal tissue obtained from human organ donors is suitable for the analysis of the structure of esophageal nerves. We found that all tissue layers in human donor esophageal tissue were preserved and discernible. The nerves can be clearly visualized by immunostaining for pan-neuronal marker PGP9.5 and putative C-fiber marker CGRP. We concluded that the immunostaining of human donor esophageal tissue is a promising approach to validate the translatability of the knowledge of esophageal nerves obtained in animal models.

Utility of Commercial Satellite Shortwave Infrared Multispectral Imagery for Precise Geo-location of Active Wildfires Through Heavy Smoke Clouds over the California Camp Fire

Katie Kolodner (Richard Montgomery High School, USA)

The California Camp Fire, which began on November 8, 2018, is California's deadliest fire to date. Largely a result of extremely dry fuel and weather conditions, extensive drought, and directional winds, the fire killed 85 people in Butte County and the town of Paradise. As I aimed to apply remote sensing to the enhancement and expedition of wildfire detection, this research specifically investigates the implementation of commercial satellite shortwave infrared (SWIR) multispectral imagery (MSI) for precise geo-location of active wildfires through heavy smoke clouds over these areas of California. Utilizing Environment for Visualizing Images (ENVI) analysis software and data collected by DigitalGlobe's WorldView-3 satellite, which has an 8-band SWIR MSI sensor with a peak spatial resolution of 3.7 meters, I was able to identify the exact locations of the wildfires and track their movement through the dense smoke from November 15 to November 20. Particularly, I derived class images based on areas termed regions of interest (ROIs) where the detected radiance of Band 8, the longest wavelength band, was over $500 \text{ mW/cm}^2\text{-sr-nm}$, a minimum threshold determined by analysis of a SWIR Band 8 radiance histogram. I further employed ArcMap of ArcGIS to provide geospatial registering of the data, displaying both the WorldView-3 SWIR MSI false-color with RGB from Band 8, Band 2, and Band 1, respectively, and the accompanying class images of wildfire regions. Additionally, I affirmed that Band 8 is the optimal SWIR MSI band for detection due to its greatest sensitivity, or the ratio of intensity of the fire and non-fire pixels, in comparison to the other bands. Ultimately, this research illuminated the significance of SWIR MSI for high-accuracy detection of wildfires through smoke in the context of the California Camp Fire. Such results may have global implications, enabling officials and emergency response teams to rapidly determine the extent of a wildfire. As such, future work could involve implementing a plan in fire-prone regions to incorporate satellite SWIR MSI through communicating with local departments, thus contributing to the improvement of safety worldwide.

The Behavior of Iterations of Compositions of Inversions Preserving a Circle

Yizhen Chen (Princeton International School of Mathematics and Science, USA)

Let CC be a circle, and A_1, A_2, \dots, A_m be several points on the plane. From one point XX on the circle, we first draw a line through A_1 intersecting the circle at a point $f_{A_1}(X)$; then we repeat the process for A_2 to get $(f_{A_2} \circ f_{A_1})(X)$, and so on. We get $f(X) = (f_{A_m} \circ \dots \circ f_{A_1})(X)$ after repeating the process for all m points. We study the behavior of iterations of f from some starting point XX . As f is a Möbius transformation, we found that when f has fixed points, there usually are two, and one fixed point T is "typical"---it has the property that $\lim_{n \rightarrow \infty} f^n(X) = T$ for all starting point XX on the circle except the other fixed point. For $m=2$, using projective transformations, we give a simple criterion for determining which of the two fixed points is typical, and a criterion for when f has a fixed point, which is equivalent to when f is the identity, in the case that f has no fixed points. When $m=3$ the behavior is similar to when $m=2$. We found the region $E(A_1, A_2)$ of possible "third points" A_3 such that f has fixed points, and some properties of it. When fixed points exist, we provide a new way to construct the fixed points based on a known result on the composition of inversions; and we give a simple and symmetric criterion of the typical fixed point based only on the locations of the three points A_1, A_2 , and A_3 when they are all inside the circle. For general m , if the points A_1, A_2, \dots, A_m are constructed from the two fixed points of $f = f_{A_m} \circ f_{A_{m-1}} \circ \dots \circ f_{A_1}$, we give a simple criterion of the typical fixed point based on a generalized cross ratio formula. Our problem can also be generalized from the circle CC to the whole plane, where we are able to reduce the problem into that in the domain CC , which we have already studied above. In the future, the problem may be generalized to higher dimensional spaces or other settings such as the p -adic numbers \mathbb{Q}_p .

Topological Data Analysis of Fire Prone Weather Conditions in California

Hannah Kim (Marriotts Ridge High School, USA); Christian Vogel (Applied Physics Laboratory, USA)

The recent drought trend in California poses multiple threats to the United States economy and security and also increases the risk of wildfires. Wildfires cause serious air quality issues during the dry seasons and increase the number of mudslides in the subsequent rainy seasons. Frequent and severe wildfires are often correlated with abnormally warm and dry climates. However, this relationship is not linear, which means that there are other factors potentially influencing these fires. The objective of this study is to use topological data analysis (TDA) to detect and classify nonlinear patterns in weather data. In order to examine the fire-prone summer weather in California, TDA is applied to various weather variables, including temperature, relative humidity, and precipitation. The five most and least intense fire seasons in California, both in the summer and winter, are chosen to compare the

frequency of fires and the burned area data, taken from the California Department of Forestry and Fire Protection. Various pairs of two weather variables, e.g. temperature and humidity, are analyzed. Using the TDA package in R the Kernel distance, persistence diagrams, and barcode graphs are compared between the active and inactive fire seasons. This study will discuss the similarities and differences between active and inactive fire seasons based on these TDA results.

Using Diatomite to Enhance the Thermal Storage of Lunchbox

Anthony Javier Santos and Aeron Estrada (La Salle Green Hills, Philippines)

Most parents make their children packed lunches when they go to school and these packed lunches are usually put in thermal insulated containers or thermal lunchboxes. The insulating material used in these containers are usually insulating foams. However, the commonly used insulating lunchboxes could not preserve the temperature of the food. If the temperature of the food is not maintained properly, bacteria may inhabit the food which could lead to children having foodborne illnesses. Therefore, testing various kinds of containers with different insulating materials is essential (Chu, 2013). To look for another alternative insulating material for lunchboxes, this research will focus on the use of diatomite, an insulating material used in road pavements, in lunchboxes to preserve the temperature of the food. In the experiment, there were two set-ups, one with the diatomite insulated lunchbox and the commercially available insulated lunchbox. The insulating material used by the commercially available lunchbox is foam. Measurements of the temperature were obtained every thirty-six minutes using a thermometer. The means and the standard deviation of each lunchboxes were compared. T-Test was used to determine if there was a significant difference between the mean temperatures of the commercially available lunchbox and the lunchbox with diatomite. At alpha 0.05, it could possibly be concluded that there is a significant difference between the means of both lunchboxes. The mean of the diatomite insulated lunchbox is greater than the mean of the commercially available lunchbox. This shows that the diatomite insulated lunchbox tend to be more efficient in preserving the temperature of the food than that of the commercially available lunchbox. The study suggests that diatomite appears to be a more efficient substitute. Furthermore, the researchers recommend to use an advanced technology of thermometer in order to yield more accurate results and to prevent heat loss. The researchers also suggest to use different kinds of lunchboxes with different insulating materials.

How Climate Change Affects Coral Growth

Bailey McDougall (Bishop McDevitt High School, USA)

Global warming has recently become a topic of discussion amongst scientists, activists, and politicians. A problem many people wonder about is how climate change affects nature. Most people are currently focused on how warming temperatures are affecting the ocean, specifically coral. This research investigates how coral reacts to changing temperatures. It believes that if heat is applied to coral, then the coral will die. This initial conclusion is thought because coral is bleaching now more than ever with rising temperatures. Many scientists believe this is because of changes in the coral's habitat. This experiment focuses on water temperature and its direct impact on the coral. It attempts to minimize other environmental changes caused by changing water temperature like salinity, water depth, and light intensity. For this experiment, set up is simple. Three tanks are set up with the same parameters each having a coral sample, specifically zoanths, taken from the same colony. While zoanths aren't technically coral, many people who maintain reef tanks consider them to be coral. For the experiment, Tank A is maintained at a normal temperature of 25 degrees Celsius, Tank B temperature is increased up four degrees higher to 29 degrees Celsius, and Tank C is increased eight degrees higher to 33 degrees Celsius. The experiment progressed normally and data was collected from the experiment monitoring changing temperature of the tanks and health of the coral, however, no change was observed in the coral itself. Each tank did however have differing amounts of algae growth. Algae growth appeared to be proportionate to the increase in temperature. The failure to prove the hypothesis could be because of error, or secondary effects of climate change affecting the coral to include salinity, heat, current, light intensity, and other factors. Future testing will investigate more radical changes to temperature, longer exposure to heat, and corals sensitivity to other environmental factors affected by heat.

The Effectivity of using Makabuhay Plant (*Tinospora rumphii*) Stem Extracts As a Rodenticide

Gabriel Lambatin and Patrick Abrajano (La Salle Green Hills, Philippines)

The Effectivity of using Makabuhay Plant (*Tinospora rumphii*) Stem Extracts As a Rodenticide Gabriel P. Lambatin, Patrick S. Abrajano Science, Technology, Engineering and Mathematics, La Salle Green Hills, Philippines E-mail address: gabriel.lambatin140444@my.lsg.edu.ph Science, Technology, Engineering and Mathematics, La Salle Green Hills, Philippines E-mail address: patrick.abrajano070084@lsg.edu.ph Rodenticides have been long used as the leading approach in dealing with various mice and rodents. Rodents being referred to would be pest rodents that continue to post a threat to households and communities.

Most common rodenticides that are commercially available have been scientifically proven to negatively affect rats/mice whether it be through a process of interfering with the clotting of blood (anticoagulants) or poisoning them entirely with Bromethalin or vitamin-based substances ("Types of Rat Poison," 2009). The Makabuhay plant (*Tinospora rumphii*) has been widely used by many in rural areas to deal with surrounding pests. The study aims to validate its rodenticidal capacity by utilizing a less harmful extract without selecting a specific active ingredient. The researchers prepared a crude extract of ground stems of Makabuhay to test its effectivity as a rodenticide by measuring the mortality. Mortality in context can be measured through different factors. It was measured through 3 aspects including mice behavior, number of deaths through visual inspection and application of statistical treatment in significant differences in weight before and after experimentation. Experimentation was done inside a house wherein the researchers made a makeshift laboratory inside an available and secure room. It lasted for 7 days and mice condition were taken note of as the said organisms tend to thrive in normal household conditions. The results were interpreted, and researches concluded that Makabuhay extract affected the mice negatively leading to deteriorating conditions which correlate to a number of observations from a behavioral checklist presented indicating the scientific evaluation of mice health including welfare issues like immobility and ability to respond to sudden changes in its surroundings. 40 mice in total were marked deceased after receiving treatment of both commercial rodenticide and Makabuhay extract and at 0.01 significance using T-test for 2 sample means, it was noted that there was a significant difference in the mice's weights before and after. In view of the findings of this research, the researchers recommend that further study is required with regards to extraction of an active ingredient from the Makabuhay plant. This is to ensure that a substance from the plant's chemical properties can be used as a natural and commercially available rodenticide. It is also imperative that the extract be made palatable for it to be used as bait in an actual household or community without the need for forced oral administration. With more experimentation time and sample size, basis for the claims can be further reinforced. Keywords: rodents, anticoagulants, crude extract, mortality, behavioral checklist, Makabuhay Different Types of Rat Poison Explained. (2009, August). Retrieved from: <https://www.doityourself.com/stry/3-different-types-of-rat-poison-explained> Elliott, J. E., Hindmarch, S., Albert, C. A., Emery, J., Mineau, P., & Maisonneuve, F. (2014).

A Comparative Study of Different Methods of Presentation on Retention of Content

Zain Khan and Amine Bit (Philip O. Berry Academy of Technology, USA)

One of the biggest issues plaguing teachers today is "how to make students remember content?" With the advent of the internet, teachers are using a variety of online resources and methodologies to enhance content retention. Documentaries, online assignments, and PowerPoints are major parts of teaching in twenty-first-century classrooms. Even though we know more about memory now, we still do not have a concrete answer to this question. In our experiment, we will be using three common methods of content presentation. These include PowerPoint presentations, videos, and articles. Currently, the most common method of content presentation is through PowerPoint. PowerPoints are a good way to present a lot of information in a linear and comprehensive way. However, the downside of PowerPoints is that they can easily be boring which in turn leads to decreased student interest and ultimately, lower understanding. The second method of content delivery is to assign videos for students to watch. Some videos do a great job of being entertaining and intuitive while still presenting integral information. The downside of many videos, however, is that they sometimes fail to go over the topics thoroughly enough due to limited time. Videos may also end up being more entertaining, rather than informative, which may lead to a lack of understanding of the topic. The third way of presenting content is through assigning articles to the students for mandatory reading. Articles are a good way of providing highly specialized information from experts on the topic. However, certain informative articles may not have answers to questions of the students. Thorough understanding and retention through reading articles may also require some prior knowledge of the subject. In our experiment, we will test which of the above three methods is the most efficient in terms of either increasing or maintaining the content retention by the students. We will be replicating our experiment in two different subjects, math and science, and will observe how different presentation methods affect retention of content. We find it necessary to limit the prior knowledge of students about the topics to focus on the effectiveness of the method. Students will be presented with two new topics in the fields of science and math in a five to ten-minute session using one of the three methods. After the session, we will give students a test that will measure how well they understood the topic. This test will be designed based on the presented material and will not require any prior knowledge. We will administer the same test to the students three days after the first test. The results will be compared to see which method of content delivery had the most effect on students' retention. This study will highlight the most effective presentation method that can increase retention of information by the students without depending on their prior knowledge.

Utilizing Philippine Cupped Oyster (*Crassostrea iredalei*) Shell Powder and Waterborne Acrylic Resin as a Fire Retardant Coating for Marine Wood

Tim Joshua Cruz and Raffy Anjelo Atienza (La Salle Green Hills, Philippines)

In the Philippines, fire outbreaks are one of the preeminent types of disaster that are involved in multiple human casualties annually. Velasco (2013) reports that fires are the most costly preventable emergencies in the Philippines but are relatively unstudied. The study seeks to alleviate the occurrence of fire-related disasters by evaluating the capacity of the local aquatic species, *Crassostrea iredalei* (Philippine Cupped Oyster Shells) as composites in the fabrication of a fire retardant coating. The use of oyster shell was taken into consideration, because the material contains approximately 95-98% of calcium carbonate - a material that is recognized to be incombustible (Shah et al., 2014). The research was conducted through the UL 94 vertical flame testing procedure (UL Standards, 2013). The effectiveness of the synthesized coating was established in terms of their obtained time of burning. Prior the experimentation, the oyster shells were exposed to direct sunlight for 12 hours to remove moisture. They were then pulverized into particle size and calcined at 500-750 °C of heat. The fire retardant coating was fabricated by applying calcined oyster shell powder of different percent mass/volume composition (25% m/v, 50% m/v, 75% m/v) to the waterborne acrylic resin. The application of the fabricated mixtures was done using the brushing method of application. A commercially-available waterborne acrylic resin was utilized for the control group to compare whether these shells can potentially be used for fireproofing. The mean burning time of the experimental set-ups was 22.67 minutes (25% m/v), 25.00 (50% m/v) and 29.67 minutes (75% m/v); while the wood applied with the resin was recorded in 18.00 minutes. At an alpha level of 0.05, the obtained Pearson value of the experimental set-ups of different percent composition was 0.980306. Using the statistical tests: T-test for two sample means, ANOVA Single Factor, and Pearson Correlation, it was revealed that there may be a significant difference in the burning time of the oyster shell-based coating and the waterborne acrylic resin. Furthermore, it was discovered that there may have been a direct correlation between the percent composition of the oyster shell composite and the time of burning of the material. The findings of this study suggest that the material may be potentially used for fireproofing due to the improved thermal degradation of the samples. The researchers further recommend that other factors such as: air moisture, surface material and the angle of ignition that may affect the proliferation of fire be considered to obtain optimum efficiency.

Diving into STEM with Underwater Robotics

Sophie Zhang (High Technology High School, USA)

The poster details the development of Rogue Robotics, an underwater robotics organization founded by high school students in Monmouth County, New Jersey. The mission of the organization is to provide members of varying backgrounds and technical skill the opportunity to explore hands-on robotics through the design, construction, and testing of an underwater vehicle in preparation for the annual Marine Advanced Technology Education (MATE) ROV competition. The primary challenge discussed in the paper is the robot development process and methods for addressing the missions tasked. Establishing a company structure based on specialized divisions and focusing on design simplicity maximized efficiency and robot performance. Our approach to addressing the problems tasked by MATE was tested at the regional competition in Villanova, Pennsylvania, in which we qualified for the international level. Our success in competition and positive team reflections demonstrated our solution was effective and met the intended goals.

Developing an Offline Mobile Application with Health Condition Care and First Aid Instruction for Appropriateness of Medical Treatment

Alec Francisco Garces and Jose Paolo Lojo (La Salle Green Hills, Philippines)

Lower income families which comprise a majority of the population have limited access to proper healthcare (Bennett, Yoshizu & Hirai, 2017). However, first aid knowledge among the public is not common and incorrect treatments can be counterproductive (Anwar, Green, Norris & Bukhari, 2015). With these, the researchers developed an offline mobile application in the commonly preferred Filipino language to provide instructions for health concerns based around the needs of a poor community. The selected community, which was founded by Couples for Christ, is a partner community of La Salle Green Hills. The three-part study began with a community profiling wherein the researchers determined the community's common health concerns and socio-demographic profile. The second part involved dividing the respondents into two groups based on smartphone ownership - one group without (control) and another with (test). This stage established and compared the two groups' baseline first aid knowledge through a medical knowledge test, content of which was reviewed and checked by practitioners. The control and test groups' medical knowledge was also checked for association with their socio-demographic profile. Result of the t-test for medical knowledge test suggested that, at a 95% confidence level, medical knowledge between the two groups is statistically the same having a t-value of -1.64 within the non-rejection region. Additionally, the chi-square test of independence revealed that, in both groups, there is not enough evidence to conclude that their level of medical knowledge has an association to their socio-demographic profile at 0.05 level of significance. Development of the application then began with the content guided by the community's health concerns, sourced from the Red Cross First Aid app and Mayo Clinic website, and validated by medical practitioners. The app is programmed to operate offline and give users first aid instructions based on the symptom / injury that they select. It provides visuals of the

symptom / injury and Filipino instructions for easier understanding of the users in the community. Once the application was done, the researchers went into the final stage of the study wherein a medical appropriateness test was given to both the control and test groups. The said test was checked by medical practitioners and sought to determine whether the app will lead to significantly better scores for the test group who was given the application. Based on a t-test done on the scores of the groups, it was found that the program led to significantly higher scores for the test group. The results showed that the t-value of -2.19 is below the critical value for a left-tailed test which indicates that the app may be able to help increase the appropriateness of first aid interventions. Future studies may consider improving the content of the app, e.g., adding more visual aids and causes of injuries, to facilitate understanding. The app and the results of the study may also be presented to the Department of Health to possibly aid Geographically Isolated and Disadvantaged Areas (GIDA) in the country.

The Development of a Larvicidal Tablet Using Saba Banana (*Musa acuminata x balbisiana*) Peel Extract

Colin Albert B. Braganza (La Salle Green Hills, Philippines); Antoine Mel D Mendoza (La Salle Green Hills, Philippines)

Mosquitoes are insects that spread diseases that have resulted in millions of deaths every year (Kamaraj et al., 2011). Several studies have found larvicidal effects among plant or fruit extracts, which may help in controlling the increase of the population of mosquitoes. Fernandes et al. (2014) found that Sapotaceae manilkara extract has insecticidal properties. Kamaraj et al.'s (2011) also found that *Annona squamosa*, also known as the custard apple, exhibits larvicidal activity against mosquitoes. In this study, *Musa acuminata x balbisiana* peel extracts were hypothesized to have larvicidal activity, which may be possible through the secondary metabolites in the extracts which may affect the digestive system of the larvae, possibly eventually killing them. In this study, the extract was obtained by mixing the Saba banana peels with 70% isopropyl alcohol. The tablets were formulated by creating a mixture with the extract which creates effervescent tablets. The tablets had different concentrations of extract of Saba banana peels in 5% and 10% concentrations and the group with stronger larvicidal activity against mosquitoes was compared to a commercial larvicide. The experiment was done by placing the tablets and commercial larvicide in 100mL of water with 20 mosquito larvae in it. The prevalent statistical test was a t-test for two sample means (two-tailed). The mean dead mosquitoes in each group was observed and compared. It was found that in the first two days after application the Saba banana peel tablets were likely less effective than the commercial larvicide, however after three days the 10% tablets were able to kill as much as the commercial larvicide. The t-score between the 10% group and the commercial larvicide was -2.13809 which was within the alpha value of 0.05 proving that the 10% concentrated tablet was as effective as the commercial larvicide. The t-tests between the 5% and 10% extract tablets showed that the 5% group was not able to kill as much larvae. This led to the conclusion that the proposed treatments were possibly effective, especially the 10% tablets, although slower than commercial larvicide. Future studies may include a deeper analysis on the chemical composition of peel extract, studying other forms of extraction such as freeze-drying, and analyzing the growth factor rather than the mortality factor of the treatment. References: Kamaraj, C., Bagavan, A., Elango, G., Zahir, A. A., Rajakumar, G., Marimuthu, S., ... Rahuman, A. A. (2011). Larvicidal activity of medicinal plant extracts against *Anopheles subpictus* & *Culex tritaeniorhynchus*. *The Indian Journal of Medical Research*, 134(1), 101-106. Fernandes, C., Almeida, F. D., Silveira, A., Gonzalez, M., Mello, C., Feder, D., . . . Falcão, D. (2014). Development of an insecticidal nanoemulsion with *Manilkara subsericea* (Sapotaceae) extract. *Journal of Nanobiotechnology*, 12(1), 22. doi:10.1186/1477-3155-12-22

Production of Thermal Wall Insulation from Water Hyacinth (*Eichhornia crassipes*) and Cogon Grass (*Imperata cylindrica*)

Luigi Gabriel Mendoza and Willis Martin Co (La Salle Green Hills, Philippines)

Water hyacinth (*E. crassipes*), and Cogon Grass (*Imperata cylindrica*) fibers have long been used for different purposes such as paper, crafts, and insulation because of their abundances as pest plants and the fibers' characteristics (Bhuvaneshwari, 2016; Kassim et al., 2015). Previous studies have investigated and assessed water hyacinth regarding thermal insulation. However, cogon grass has not yet been studied regarding its insulating characteristics. Both plants may be used as eco-friendly materials in replacement of the synthetic fibers used in thermal insulation. In this study, the insulation panels were made in different compositions to test effectivity among the different samples in terms of insulating heat and compatibility among the fibers. Five compositions of panels were made: 100% hyacinth only, 75% hyacinth 25% cogon, 50% hyacinth 50% cogon, 25% hyacinth 75% cogon and 100% cogon. Fibers were obtained by boiling, trimming, and blending the stalks and leaf blades. The panel boards were formed and shaped according to the stipulated ratios in metal trays separated by sheets of aluminum foil. The heat test was conducted under the sun from 11:00 am to 2:00 pm to simulate the heat from the peak of the day's heat on thermal insulation. A heat test, density test, ANOVA, and T-test were conducted. Since the F_{comp} value was greater than the critical value, ANOVA results showed that panels with 25% cogon and 50% cogon compositions may have been effective in insulating the heat surrounding them and all were comparatively in line with standard thermal insulation may it be synthetic or hyacinth insulation from other studies. The comparison of hyacinth insulation and all the other panels utilized a two-way t-test, the 50:50 hyacinth-cogon composite was still the best performing panel in insulating

heat due to the balance of qualities possessed by cogon and hyacinth fibers. Although this paper shows the compatibility of these natural components as thermal insulation, there may still be many characteristics regarding insulation to be tackled and improved upon. Further studies should be done on different types of local pest plants for thermal insulation testing and prototype development.

Layering Silicon Dioxide (SiO₂) Spray Coatings to Increase Photovoltaic Module Efficiency

Jerik Adrian Bayon and Alistair V Enhaynes (La Salle Green Hills, Philippines)

Due to the negative effects of fossil fuels on the environment, people have been starting to look at renewable energy as an alternative source of power - specifically solar energy (Perkins-Kirkpatrick, & Gibson, 2017; Saboori, Rasoulinezhad, & Sung, 2017; Sturve et al., 2014). Photovoltaic modules are used to harvest energy from the sun by converting solar radiation into electricity. However, the glass on photovoltaic modules, that is used to protect itself from rain and dust, reflects potentially useful light away from the solar cells - thus lowering the amount of transmitted light; this causes the efficiency of photovoltaic modules to drop, making it difficult for people to switch to renewable energy (Ali, Khan, & Jafri, 2014). By layering SiO₂ anti-reflective spray coatings on the glass of a photovoltaic module, the researchers would be able to allow more light to transmit into the solar cells, thus increasing the efficiency of the photovoltaic modules. The researchers had six set-ups, one control and five experimental, with different amounts of layers each (single layer to five layers). The power produced by each set-up was measured using a digital multimeter at seventeen time intervals between 8:00 AM and 4:00 PM on December 6, 2018; the average temperature on that day was 30 degrees Celsius. It was discovered that the photovoltaic module with two layers of SiO₂ spray coatings performed the best by having a mean power of 4.34 W, while the photovoltaic module with four layers performed the worst by having a mean power of 2.15 W. Using a two-tailed independent samples t-Test, the researchers found out that the difference between the means of the control group and the experimental group with two layers of coating were not statistically different. Layering SiO₂ spray coatings probably improves the efficiency of the module, but the difference is not significant statistically. It is recommended to use an actual SiO₂ film to ensure the purity and thickness of the layers.

Starfall as a Basal Reading Program to teach Beginning Reading to Selected ALS Students

Jose Emmanuel Gayoso, Jose Miguel Jalandoni, Arvee J Veneracion and Shan Iverson Sumang (La Salle Green Hills, Philippines)

In the last century, educators have shifted their mode of instruction from pen and paper to computer generated educational programs (Hashim 2015). In the Philippines, the government implemented the Alternative Learning System (ALS) as a free education program implemented by the Department of Education under the Bureau of Alternative System to Filipinos who are not able to go through formal schooling. It has been observed that some ALS students are non-readers so they have a difficult time in school tasks. The researchers aim to enhance their reading skills by implementing Starfall, an English phonics basal reading program to improve the non-readers' basal reading skill, Starfall is a 15-leveled basal reading program that aims to enhance one's basal reading skills. There are studies that state Starfall is most effective when being used to teach students at the kinder level (Campbell. 2018) Numerous studies have also shown that the use of English Phonics online games has been an effective enhancer in enhancing a young reader's basal reading skills (Benson, Bredosky, Hester, Singleton. 2004). Five ALS students from different age groups classified as non-readers were taught Star fall as a basal reading program. The researchers went to the ALS classroom to teach the students for thirty minutes, three times a week for three months. Each lesson ended with a 7-item test taken from the Starfall comprehension test. A total of 15 tests were administered and the mean scores were tabulated. The Kruskal-Wallis Test or the H-Test has been used by the researchers to find the relation of the mean scores in a non-parametric manner. Furthermore, the critical value of 2.04 has been used by the researchers in reference to the ANOVA series. With the critical value at hand, the value of 21.35 has been derived which showed that there may be a significant difference in the basal reading skills of ALS non-readers when taught with Star fall. The researchers recommend further studies on the use of Starfall as an alternative way to teach basal reading to ALS students. In addition, the group size can be increased in order to see if it will yield the same results.

The Feasibility of Biowastes Derived from Philippine Produce as Adsorbents for Heavy Metals and Oil in Water

Kyle Gabriel M. Reynoso and Marcelito S. Reyes, Jr. (La Salle Green Hills, Philippines)

Oil and heavy metals constitute majority of industrial discharges in aquatic sources around the world. The UNESCO World Water Assessment Programme (2018) reports that inadequate sanitary management of wastewater may contribute to the extent of water pollution, especially in developing countries, where only 8% of effluents are treated. In the Philippines, rising levels of these

contaminants in rivers due to urbanization are shown to negatively influence the sustainability of marine life and economic activities derived from these bodies of water (Gorme et al., 2010). In response, this paper seeks to evaluate the capacity of local, abundant and low-cost bio-wastes such as *Musa acuminata x balbisiana* (saba) banana peels, *Gallus gallus domesticus* (banaba chicken) eggshells and feathers as adsorbents for these pollutants in water. The research was conducted through two experiments: the first measured oil adsorption by mass uptake and the second, heavy metal removal by spectroscopy. The pH levels and qualitative data regarding the appearance of the resulting water were also noted. Saba banana peels and eggshells were rinsed with distilled water, dried at 250°C and powdered to a particle size of roughly 11 µm. For the chicken feather setup, barbs were detached from the rachis, rinsed with distilled water and exposed to direct sunlight for 8 hours to dry. An activated carbon powder was utilized for the control group to compare whether these bio-wastes can be used as substitutes to commercially-available options. In the first phase, four setups containing 150 mL of oil and distilled water mixture with 10% concentration of diesel were exposed to respective adsorbents for a duration of 1 hour and set to drip for another hour before data collection. For the second phase, the adsorbents were applied to heavy metal-polluted water obtained from Marikina River with a one-hour contact and drip time. Laboratory testing by Atomic Absorption Spectroscopy (AAS) was performed before application and on the resulting water. At an alpha level of 0.01, setups for each experiment were statistically tested through one-way analysis of variance (ANOVA) to determine whether there are significant differences between the groups and Tukey's honest significant difference (HSD) to locate between which groups the differences occurred. In terms of oil adsorption, statistically equivalent measures were obtained between the chicken feather and activated carbon setups, and the activated carbon and banana peel setups. However, greatest mean uptake capacity was observed from chicken feathers at 3.37mL/g followed by activated carbon and saba banana peels at 2.93mL/g and 2.40mL/g respectively, and eggshells at 0.43mL/g. Significant and analogous measures of heavy metal adsorption were also noted from the use of saba banana peels and eggshells, with the former exhibiting the greatest percentage of heavy metal removal. The results of this study suggest that these adsorbents may be applied to wastewater in removing the said pollutants, however the researchers recommend that their effectivity in different conditions such as pH level, temperature, dosage, salinity and reuse be tested as well to maximize adsorption and ensure generalizability.

Solving Complex Problems with Low-cost Swarm Robotics

Nia Maywar (Princeton International School of Mathematics and Science (PRISMS), USA)

Swarm robotics provide workforces for potentially dangerous jobs, or jobs that require covering a large area. The main applications of swarm robotics are controlling UAVs, post-disaster relief (searches for and maps out the location of survivors and dangers, transporting relief supplies, planning routes for rescuers and evacuees, and roadway repair.), geological surveillance, military operations, and cooperative transport (moving things). Although a swarm could be programmed for multiple applications, most applications imitate the foraging behaviors found in nature. Foraging behavior is useful in surveillance, search and rescue, and geological surveillance. The main focus of my project is to create a swarm that is proficient in obstacle avoidance, foraging, and communication. Swarms present many advantages over the use of human labor or specialized robots. Having more than one robots allows for the swarm to be scalable, able to cover a greater area, and able to perform multiple tasks at once. Additionally, they are cheaper. Mass producing a number of simple robots to complete certain tasks would be much cheaper than using the precise tools necessary for building certain specialized robots. This makes maintenance cheaper as well. Swarms are also typically decentralized, which eliminates the need to control them manually. The objectives of my project are to create a working durable swarm of inexpensive robots that are able to independently react to their environment and themselves. The robot consists of these parts: Vibration motors on opposite sides of each robot will be used for mobility. If both motors are rotating in one direction, the bots will go straight. If the bots are rotating in the other direction, they will go straight in the opposite direction. If the motors are moving in different directions, the robot will turn. The circuit board mill will be used to make each new robot more simple and elegant. The body of the robot will be constructed using SLA printed resin. I will use Arduino IDE to program my microcontroller, an ESP8266 (wifi module). A pixy camera will be used to track each robot according to color. This will be accomplished by putting different color LEDs on each robot.

Crowd Estimation via Thermal Images Analyzed by Convolutional Neural Network

Muhua Xu (Princeton International School of Mathematics and Science, USA)

This research focuses on improving the method of crowd estimation by using a single thermal picture as input. To be more specific, the purpose of this research is to combine state-of-the-art computer vision techniques and convolutional neural network on thermal image inputs to tackle the problem of estimating crowd density. Current crowd estimation methods are either too computationally expensive and privacy-invading like Switch Convolutional Neural Network or too complicated, needing multiple cameras or sensors. Different from preexisting methods, our approach focuses on developing different methods to estimate crowd density that utilized a

single thermal image and the knowledge of the environment setting as the only input. Dataset used to train are collected during school events and are accurately labeled. The result shows that our method of using a single thermal camera in a given space to estimate crowd density is a promising approach. This approach offers high accuracy, low computational cost, and privacy protection. Additionally, using thermal images as input can easily avoid errors like counting pictures of faces on clothes or posters. Future improvements for this research include extending the data collection and building an online public database. The neural network will also be fine-tuned, and other state-of-the-art methods will be implemented. Future applications can include a low-cost approach in event reporting and security services in public places like subways and airports.

Uncovering Genetic Relationships between Sleep and Alzheimer's Disease

Sihan Fei (Princeton International School of Mathematics and Science, USA)

Research has revealed numerous phenotypic relationships between Alzheimer's Disease and sleep; for example, sleep deprivation is a risk factor for Alzheimer's Disease and the onset of Alzheimer's Disease, in turn, often leads to disruptions of sleep patterns. Both phenotypes are known to have a significant genetic basis, but conserved genetic pathways have not yet been identified. In order to investigate the shared genetic basis of Alzheimer's Disease and sleep, we acquired lists of genes associated with both phenotypes from DisGeNET and Gene Ontology and performed network analysis with the STRING database. We identified genes that are highly connected in the combined Alzheimer's Disease and sleep gene network. We also highlighted genes that are strongly cross-connected between both phenotypes, as these genes may indicate important links between Alzheimer's Disease and sleep. Further analysis yields insights into the functions and biological significance of candidate genes. Our results hint at possible future directions for molecular level research aiming to cure Alzheimer's Disease.

Study of relationship between NMDA receptor aided memory and heat shock in C. Elegans

Ziqi Shi (Princeton International School of Mathematics and Science, USA)

In this research the plan is to study the effect heat shock applied on C.Elegans has on the animal's short term memory conducted by the channel proteins on the surface of central neural rings of the animal. The animals are fed on e. coli, and 3 different mutants are picked. First one is N2 wild type, while the other two are nmr-1 and nmr-2 mutants. The plan on the research was to train the animals with starvation and salt(NaCl). One group of the worms were trained to associate starvation with salt and the other group was trained to associate starvation with an environment rich of salt. This is achieved by placing them in agar plates treated differently in salt level and e. coli density. This training method was repeated for all three mutants, each of them are again separated into two groups. First group is directly released to a plate with different NaCl concentration on each side, while the other would be treated with heatshock to knock them inactive before transferring into the new plate. And then the number of worms on each end of the plate is recorded for each of the experiment after each specific time period, so that a comparison can be made between the different mutants of the worm.

Design and Implementation of a Panoramic Camera Apparatus

Rui Wang (Princeton International School of Mathematics and Science, USA)

As the virtual reality devices are creating a new experiences for people, the 360 degrees cameras that produces VR videos still lack of development. I present a novel approach of remotely controlling and precisely orienting multiple cameras in order. The videos produced by this approach are compatible with conventional video stitching software. Therefore producing videos with high resolution and covering all directions. In the apparatus, I will extensively use 3D printing materials, and use Arduino to control the apparatus remotely. The video produced will be processed by Autopano, and then create an immersive environment in commercial VR devices, such as Vive.

Creating an easy to produce seed planter made of polyethylene terephthalate bottles and scrap metal for Filipino Farmers

Hans Gabriel C. Nolasco and Kyle Sebastian Braga (La Salle Green Hills, Philippines)

The Philippines is some country rich in agriculture but very traditional in practice wherein farm mechanization hasn't been widely implemented. Upcycling junk materials such as PET bottles and scrap metals into a seed planter may create significant change in agriculture concerning a third-world country scenario (Ani, Uzoejinwa, & Anochili 2016). Using upcycled materials, production costs of the prototype will be significantly cheaper for third-world countries especially the Philippines. The planter was designed with a "push-cart" like design to make it easier to handle by the user. It was assembled in accordance to that design and was tested. The testing was done 5 times; the planter creating 6 samples per trial. The data gathered were then averaged into different columns and

averages were taken. The statistical analysis was done using a two-tailed t-test for one sample mean at alpha equals 1%. With the critical value being set at ± 4.60 , the tests resulted in t-values of 61.12, -64.63, and -2.77 for the seed spacing (cm), seed depth (cm), and in seed count per interval, respectively. Results showed that the seed planter can be created and produced but is not precise and accurate in terms of seed spacing and seed depth but can be consistent in terms of seed count. Studies in the future may improve this disquisition with a better proposed design and more efficient alternatives to the materials laid out in this paper.

Talahib (*Saccharum spontaneum* Linn.) as Alternative to Commercial Yarn

Marc David Torres and Ranns Meldrik Santos (La Salle Green Hills, Philippines)

A considerable contributor to the emissions of greenhouse gases is the textile industry's production of synthetic fibers due to their use of petroleum products (Laitala, Klepp, & Henry, 2018). With this, there is a need to discover more cellulosic fibers to probably lessen the environmental impact of those synthetic since cellulosic fibres is believed to be a carbon neutral resource that may give rise to a more eco-friendly globe (van Dam, 2008; Laitala, et al., 2018). However, there seems to be a lack of cellulosic fibers and natural yarns in the market, only Agave sisalana (Sisal) and the Ananas comosus (Pineapple) and commercially available (e.g. Cotton) to be able to replace synthetic fibers (Chadramothan & Marimuthu, 2011). Thus, this research aims to study said specimen, locally known in the Philippines as "Talahib" and internationally as "Wild Cane Grass" as an alternative to commercially available synthetic fiber. The researchers produced yarn blends that consist of 30% *Saccharum spontaneum* (300 g) with 70% pure cotton (700 g) by cutting, drying, blending, and spinning the fibers from the leaves and stalk onto bobbins. In spinning, the fibers passed through four machines - namely: blending machine, draw frame machine, speed frame machine, and ring frame machine. Pure (100%) Cotton Yarns were obtained from the Philippine Textile Research Institute. Tensile Strength Testing was used in order to determine the strength of the grass prototype yarn compared to pure cotton yarn. The mean breaking strength of the blended yarns were recorded at 3.99 N while the pure cotton yarns were recorded at 2.99 N. Furthermore, using statistical t-test for two sample means assuming unequal variances of the recorded breaking strength of the yarn, a t critical of -2.13 and a t stat of -12.13 were noted. Thus, the researchers concluded that there was a significant difference in strength of the *Saccharum spontaneum* - cotton blended yarn to the pure cotton yarn. The study tends to suggest that *Saccharum spontaneum* Linn. may be a viable substitute in terms of the strength of the yarn. The researchers recommend that further research should be done to study the feasibility of having a varied percentage blend of *Saccharum spontaneum* Linn. - Cotton yarns and testing its tensile strength.

A Study on the Use of Colored Wheels in Teaching Subject-Verb Agreement on Selected Alternative Learning System Students

Andre Angelo Enriquez, Luis Antonio Rafael Sumilong, Eduard James Salva Ramos and Deon R. Sih (La Salle Green Hills, Philippines)

Does color affect the way students absorb information? Dzulkifli, M., & Mustafar, M. (2013) noted that colors help in memory performance. Particular colors aid in cognitive attention and may contribute to academic success. The research aims to study the use of the Subject-Verb Color Wheel in teaching Subject-Verb Agreement to selected Alternative Learning System students. The Alternative Learning System is a government program which allows students who do not have the means to pay for formal schooling to attend informal schooling based around their available time. The researchers taught several concepts on Subject-Verb Agreement using the color wheel. The color wheel used is a learning device composed of two wheels attached to one another by a paper fastener, the wheel contains various examples of the different concepts in Subject-Verb Agreement. The larger wheel contains subjects that are in certain colors, while the smaller wheel contains the verbs also in matching colors. In order to be used, the student has to match the colors on both wheels by rotating the inner verb wheel. These color wheels had been made such that the various concepts of the lesson were printed on different colors and students may keep them a reviewer. The post-test was then conducted to determine whether or not the intervention and use of the modified Color Wheel reviewer on the student's test results in comparison with their pretest results. A Quasi-experimental study was conducted to explore the result of this study. An independent sample t-test was also used and revealed that though the hypothesized value of 0.50 wasn't attained, it showed a significant 0.23 increase in the grades of the participants after having undergone the intervention and implementation of the modified Color Wheels. The role and significance of modified teaching materials as a helping mechanism were also discussed. Further studies will be done through a satisfaction survey and focus group discussion among the selected Alternative Learning System students to determine if the use of the learning device may have a significant effect on their overall learning.

A Study on the Use of PowerPoint Presentation with Captions in Improving Deaf Learners' Reading Comprehension A

John Paul D. Gatdula, Lance Tan, Kenshin Umali and Jason Esteva (La Salle Green Hills, Philippines)

In the recent years, technology has become a medium to teach students (Trezek & Wang, 2006). Deaf Learners require visual input in order to process information. Deaf Learners have difficulties in learning the English language because they do not speak and hear how the words are pronounced. Interpreters or other visual input methods using the American Sign Language is one of the best methods for deaf learners in the classroom (Trezek & Wang, 2006). Many teachers believe that students using PowerPoint believe that its rigid format stifles not only students' creativity, but also their ability to understand and convey information (Tuftte, 2003; Keller, 2003). The researches aim to help selected deaf learners' reading comprehension by using PowerPoint presentations with captions to help them remember the lesson easier with the keywords presented in the PowerPoint. Power Point Presentation is a multi-media tool that is used to teach students easier because it can contain texts, videos and pictures at the same time. Utilizing PowerPoint can also help learners take notes (Cook, 1998). According to Harrison (1999), PowerPoint improves direction and persuades learners to comprehend. PowerPoint presentations fuse design, live picture, and shading (symbolism). Eleven Deaf Learners from the grade 12 of the Adult Night High School who belong to different age groups were taught to differentiate between trend and fad through PowerPoint Presentation with Captions. The Adult Night High School is a The Researchers scheduled a class in the Adult Night High School department to teach the students for thirty minutes in one night of the week. The Questionnaire called "Conversation Questions Fads and Trends: A Part of Conversation Questions for the ESL Classroom" consisted of 15 items were answered by the students. A Total of Eleven Questionnaires were collected and the scores showed a big improvement in the pre-test, post-test scores. The T-test for two sample means was used by the researchers to find the average scores. The mean scores are recorded at 6.545 the critical value of 1.81 has been used by the researchers in reference to the T-Test. With the critical value stated at 1.81, the value of 2.22 has been made after collecting the scores. Based on limited data, the researchers found that there may be a significant difference in test scores when the deaf learners are taught with the PowerPoint Presentations with Captions. The Researchers recommend that that the studies on PowerPoint with caption be replicated using more samples and include subjects like English, math and science. In addition, consideration as to the particular sizes of the caption and pictures be included in the study. Keywords: PowerPoint Presentation, American Sign Language, Visual Input Methods Reference Terzek, & Wang. (2006). The new Technology syllabus: preparing our students for an unknown future. Retrieved from <https://medium.com/groklearning/the-new-technology-syllabus-preparing-our-students-for-an-unknown-future-a52d7b5b4e36>

LiDAR Based Obstacle Avoidance

Zachary Brunet (Princeton International School of Mathematics and Science, USA)

The purpose of this research is to use LiDAR for autonomous driving of a small mobile robot. Two different mobile robots are used, for comparison, one being the AWS Deep Racer, and the other a four-wheeled Arduino robot. The Deep Racer already has an autonomous driving program, using reinforcement learning (RL), to travel the AWS Deep Racer Course. The Arduino robot has no autonomous driving program of its own. In the future, LiDAR will be used to develop autonomous programs for both the Deep Racer and the Arduino robot. Currently, the RPLiDAR A1 is the main option for the LiDAR sensor, although that may change as tests occur. The end goal of this autonomous program will be to travel around an obstacle-riddled course to get from point A to point B as quickly as possible, mapping it as it goes, and then going through the course again even faster. Comparisons between the two robots will be used, albeit the Deep Racer has a huge advantage from the start. A Roomba Red Generation Two was attempted to be used, but due to it having no Serial Command Interface (SCI) because it is an older generation model, there was no way to manually control it or add any new programs.

Biochar based seed shelling with organic fertilizer for tomatoes (Solanum lycopersicum)

Mark Gabriel C Bulaong and Carlos Leo P Mantilla (La Salle Green Hills, Philippines)

Waste management is a problem in the Philippines. Due to the production and exportation of products there would be an increase of organic and synthetic waste. This study focuses on bio/organic waste as it can be troublesome if not disposed of properly, when burying the bio waste underground it may become harmful to the soil as it can generate methane due to anaerobic decomposition. The researchers aim to lessen the bio waste by finding a way to reuse the waste. Biochar was one of the solutions to this as it can be made from burning dead plant matter using the process of pyrolysis. This study was performed in a vacant lot. The researchers developed 4 variables three being independent and 1 being the control. The first group was Biochar mixed with organic fertilizer (Apple Compost), second is Biochar, third is Biochar mixed with chemical fertilizer (Nitrogen Based), fourth is control. Each group was observed weekly to see if there was any significant difference. The experiment lasted a total of 26 days. After the researchers analyzed the data it was shown that the setup using biochar and organic fertilizer was the most promising out of the 4 groups as the total amount of seeds germinated was 16, then the soil was the healthiest being measured by acidity, also has the longest average

length being 7.27cm. With the data gathered there is an observable synergy between biochar and organic fertilizer (Apple based compost). The results of the experiment were processed using ANOVA test. The results of the soil acidity (Using ANOVA) showed that At $\alpha = 0.05$, there is not enough evidence to support the claim that there is no significant increase in the acidity of the tomato (*Solanum lycopersicum*) seedlings with the application of biochar, biochar with chemical fertilizer (Nitrate based), & biochar with organic fertilizer (apple peel compost).

Teaching Pecha Kucha to Improve the Oral Skills of the Adult Night High School Students

Aemoh Mario Santos Jordan, Sean Ethan L Pampolina, Kyle Angelo B Veloso and Jean Alfonse M Javellana (La Salle Green Hills, Philippines)

Teaching Pecha Kucha to Improve the Oral Skills of the Adult Night High School Students Traditional learning has been used for a long time for education, and many have been finding other methods to improve education -- thus, the rise of learner centered methods in the 21st Century (Freeman, 2016; Coskun, 2017). Methods such as media creation, small group discussion, and performing arts have already been incorporated into the modern curriculum. Pecha Kucha, a creative PowerPoint presentation, was one such method (Amy, 2011). Pecha Kucha is a 20 slides - 20 seconds per slide PowerPoint presentation that solely comprises of only one picture per slide. Since its creation in the early 2000's, Pecha Kucha has found itself into English classrooms focusing on oral skills and confidence building of students. Various researches have been conducted on its effectiveness in the classroom, and most results showed positive results (Nguyen et al., 2017; Carrol et al. 2016). Thusly, the researchers will use a Pecha Kucha presentation to help Adult Night High School (ANHS) students - a group of adult night high school students who are offered free education by La Salle Green Hills. The Public Speaking Anxiety Self-Assessment, a 20-item test that measures the perception of an individual with regards to public speaking, was used as the research instrument, and a pre-test post-test research model was used as the research design. A pre-test and post-test were conducted to see if the perception of the students improved. The pre-test of the Adult Night had a mean of 76.125 with the post-test having a mean of 88. From the t-statistic, $t = -7.827864378$, and $p = 0.000104702$, since $p < 0.05$, the null hypothesis that there is no difference between pre-test and post-test scores is rejected. There seems to be an improvement in the pretest and posttest of the perception of the Adult Night High School students as shown by the mean and t-statistics although the difference in marks is relatively small. The researchers recommend confidence building activities in conjunction with Pecha Kucha to maximize its effectiveness along with presentations being done in groups. Keywords: Pecha Kucha, Adult Night High School students, Oral Skills

Digital Storytelling vs Traditional Storytelling: Teaching English Language to ANHS Students

Alexander B. Alonzo, Isaac T. Cristobal, Michael C. Gutierrez and Rodrick M. Bustamante (La Salle Green Hills, Philippines)

English is the most common and utilized language in the world. Regarded as the lingua franca, it is seen in social media, academic texts, novels, television, and more. Due to its omnipresence, it is paramount that every citizen must at least have a decent grasp of the language. However, in the context of the Philippines, English proficiency has been on a steady decline. Instead of combating this using traditional teaching methods, this paper proposes that teachers instead use the storytelling approach. Storytelling has been proven multiple times by other researches to be an effective method of instruction. This paper will focus on determining which type of storytelling will be more effective in teaching English: Traditional Storytelling or Digital Storytelling. Traditional storytelling is the storyteller-listener approach, while digital storytelling is storytelling using computer-based tools. These two types of storytelling were used to test the English proficiency of 2 different sections from the Adult Night High School (ANHS) students of La Salle Green Hills. Using the pre-test/intervention/post-test approach, the researchers were able to compare the effectiveness of the two methods. Using T-Test: Two-Sample Assuming Unequal Variances with a 95% level of confidence, the researchers discovered that the $P(T \leq t)$ two-tail was 0.905. This meant that there was little to no statistical difference between the effectiveness of digital storytelling and traditional storytelling, as the $P(T \leq t)$ two-tail should ideally be lower than 0.05 for it to be considered. However, this could be attributed to the limitations of the study. Therefore, more research must be done in order to come to a more conclusive result.

Using Songs on the YouTube Platform in Improving Vocabulary Competence Among Adult Night High School Students

Kenneth M. Amores and Rafael Javier Punzalan Rivera (La Salle Green Hills, Philippines); Matthew Benjamin L. Nava (La Salle Greenhills, Philippines); Sean Kyle B. Santos (La Salle Green Hills, Philippines)

There is a lack of vocabulary competence among the Adult Night High School (ANHS) students which is affecting their overall English proficiency and acquisition of the language. One possible way of dealing with this issue is the integration of Multimedia Learning in their classrooms. Multimedia is the incorporation of two or more mediums of presentation to deliver information, particularly visual

and audio aspects. One such platform that provides multimedia content is YouTube. YouTube is a resource where users can upload and share videos online, also providing users a chance to view other videos. Music has been proven to provide positive results to exposed students in a classroom setting with multiple other studies supporting music's role in improving multiple cognitive aspects. It is through songs in YouTube that the researchers plan to improve students' vocabulary competence by showcasing lyrics and providing lessons. The students are provided with a pretest and posttest through VKS or also known as the Vocabulary Knowledge Scale. The group is from the Adult Night High School Grade 8 level and consists of at most thirty (30) students in one class. The Adult Night High School community is an extended group in La Salle Green Hills that provides education to students who can not attend regular high school classes. The group is then handled with the YouTube songs and lyrics taught to them through the videos. A T-test was used to compute for the results of the difference between the Pre-test and Post-test scores revealing a computed t value of -0.21. It revealed that there is a slight positive change within the scores of the group, where they improved on their vocabulary competence more. However, it is not a significant improvement. Multimedia, specifically YouTube, proved itself to be a potential tool for education. Therefore, more study is required to see to the effects of multimedia in effective learning within a classroom setting. This is in regards to the type of songs used, its quality, format, and the sample size.

Methodology for Analysis of Crop Health Using Aerial Photogrammetry

Zhamilya Bilyalova (Princeton International School of Mathematics and Science, USA)

The purpose of this research is to develop an application/program using Wolfram Language image processing capabilities that can work with RGB and Infrared images taken by a micro UAV, calculate Normal Difference Vegetation Index, make 3D reconstruction of an experimental field of a crop, estimate the canopy size and number of fruits using convolutional neural networks and analyze crop health. The micro UAV used is a DJI Phantom 3 Advanced, the camera of which was modified to take visible light, infrared images and images with color filters at the same time. The final result will be a web application used by farmers, researchers, and students to which images, taken by a drone, can be uploaded and results about NDVI, canopy size, potential diseases, number of fruits can be displayed. The use of modified commercial drones and a free web application will be an affordable solution to current precision farming methods. The advantages of using remote sensing include the elimination of observer bias, a personal availability problem, speed, repeatability, large area coverage, and greater cost-effectiveness. Drones can be used from the start of the crop cycle. Finally, the analysis in early in the growing period would allow farmers to take important management decisions about irrigation, fertilization, nitrogen-level etc.

Data Mining and Sentiment Analysis of Real-Time Twitter Messages for Monitoring and Predicting Events

Maya Albayrak (Johns Hopkins Applied Physics Laboratory & Chesapeake Science Point High School, USA); William Gray-Roncal (Johns Hopkins University Applied Physics Laboratory & Preparation Meets Opportunity Foundation, USA)

Real-time geographical data can be used to map the occurrence of natural and social hazards, helping create early warning systems, monitor recovery efforts, and forecast future events. Technological advances that allow fast processing of large amounts of data have motivated researchers to look for alternative sources of information. Challenges for data collection are cost, public access, and accuracy. An innovative way to address these challenges is through social media data such as Twitter. Twitter is an online social networking service that lets its users communicate through short messages consisting of text, location (latitude and longitude), and time. Twitter created an Application Programming Interface (API), that allows public access to tweets in real-time. Exciting progress has been made in using social media analytics and developing research algorithms; however real-world adoption has been limited. In this work, we explored methods to extract tweets and use data science to track three use cases: rain, earthquakes, and flu spread. Tweets were collected using the API and filtered based on keywords. Data mining techniques were then applied to filter and cluster messages and identify trends based on key phrases in addition to key words. Sentiment analysis was performed using machine learning software to eliminate tweets containing keywords used in a different context. We created a tool to visually represent the results and to aid in quick decision-making. We leveraged Plotly, a Python graphing library, to provide maps of rain precipitation and earthquakes, and a dashboard consisting of flu symptoms, flu spread, and graphs of related hashtags. To determine the efficiency of the dashboard, human factors were considered. For example, a custom-made mouse tracker and a commercial eye tracker were used to create heat maps identifying areas where the user's eyes focused. In addition, test participants were surveyed to verify that the graphs contained information necessary to support accurate interpretation of affected areas. The results we obtained using these methods were compared to ground truth. For example, weather.com and the U.S Geological Survey use expensive satellites and seismometer data. The U.S. Center for Disease Control provides flu maps, but with a week delay. Google Trends collects data in real-time, but results are based on raw data and mapped by state, creating imprecise reporting. Our work showed that we were able to effectively produce predictions consistent with these data sources, offering an inexpensive method that uses real-time data with precise geolocation and includes human factors methodology to aid the researcher in interpreting results. Our real-time weather

data has been used to validate NASA satellite data through a citizen science project. In future work, we plan to extend this research beyond the initial dashboard reports to allow users to input their desired keywords and make calls directly to the Twitter API. This will provide the public with an easy interface to explore trends and predictions of real-time information, facilitating the decision-making process in a variety of areas.

The Case for the Z-Pinch Plasma Approach for Nuclear Fusion Propulsion

Julia K Williams (Reservoir High School & Johns Hopkins Applied Physics Laboratory, USA)

My project illustrates the differences in the computational design of Nuclear Fusion Propulsion (NFP) systems, and, as a result, argues the Z-Pinch plasma approach as potentially the most expeditious, economical, and safest design concepts. By comparing and contrasting other methods of fusion propulsion in my analysis, I concluded that the Z-Pinch approach has the potential to provide a solution to the arduous instability of fusion breakeven using a guiding set of parameters fitting for in-space propulsion, such as power-to-weight ratios, specific impulse, mass, etc. over similar fusion concept designs. The Z-Pinch system itself exists on the premise of running mega-amperes of current through the plasma in the "J" direction over approximately 10^{-6} seconds, in which a magnetic field forms in the θ direction, causing the plasma to radially implode into fusion conditions. Accordingly, for fusion propulsion, the annular nozzles for the Z-Pinch, in which a conical arrangement of the nozzles behaves as a cathode, allow its fuel mixture to serve as a current return path for the circuit. Moreover, each additional concept design introduced in this project is examined using in-space fusion parameters, taking into account differences in computational methods. Thus, the paper illustrates the case for the Z-Pinch system as a necessary power source for interplanetary travel, beginning with the assumption of current technology, and moving into the necessary advancements in order to reach technical readiness level 9. As a consequence, using conclusions drawn about interplanetary travel throughout the solar system using the Z-Pinch plasma approach, expansions and further investigations would provide feasible evidence and reasoning for interstellar space travel in the near future.

Measuring sugar content of a liquid with a laser pointer

Roshan S Natarajan (Georgetown Day School, USA)

Background: Did you know that you can figure out how much sugar is in a liquid without ever tasting it? For my project, I will examine how to measure the concentration of sugar dissolved in a liquid by using a laser pointer, a hollow prism, and some physics. I will discover how refraction, or the bending of light, is the key to measuring the sugar content of a liquid with a laser pointer. The index of refraction is the speed at which light waves travel through the medium. Waves travel at various speeds through different mediums so if each substance in the prism is varied then the refraction of light will be different for them too. This project is representing science and mathematics because the project involves physics which combines the studies of math and science. This project is important because it shows people how light does not always go straight, it refracts, depending on the density of the liquid it goes through. An example is when a straw is put into a cup of water. The straw does not look like a whole, it might appear broken or even bigger. Experiment: I will be testing the sugar concentration in a clear substance by measuring the index of refraction on other substances with sugar in them to estimate the sugar concentration of a substance that I do not know the sugar concentration of. The way I am going to set this up is by putting the laser pointer on a small piece of cardboard and the prism next to it. The experiment must be set up next to a wall so I can see how the light refracts. The objective of this project is to determine the sugar concentration of a liquid (water or fruit juice) that is clear by measuring the solution's index of refraction. I will test the amount of sugar in each substance in the prism by seeing how the light refracts. Future Applications: A practical application of the concepts in this experiment can be used to measure global warming. Changes in the refraction of light on the ocean surface can demonstrate changes in salinity in the water. Sources https://www.sciencebuddies.org/science-fair-projects/project-ideas/Phys_p028/physics/measuring-sugar-content-of-a-liquid-with-a-laser-pointer#procedure

Simple Image Processing in Excel

Muhammad Ali Yousuf (Johns Hopkins University, USA); Akbar Ali (George Washington Carver Center for Arts and Technology, USA); Haider Ali (University of Maryland, USA)

Image Processing is a subject of wide interest in STEM-related fields and its applications range from cell biology to astrophysics. Learning the concept and mathematics behind Image Processing is difficult and requires training not readily available to high school students. Various ready-made free tools (like ImageJ) are available, but younger students still find it difficult to understand what is really going on behind the scenes. Pre-built functions in languages like Octave provide a better approach, but the real image processing is still buried under layers of sophisticated functions. As such, we experimented with various Image Processing techniques in Microsoft Excel to make the process simple and understandable to younger students. The applications required to

teach this (Excel, Google Sheets, etc.) are easily available to school students and many of the aspects can be taught with minimal to no programming. This method will help in three key areas needed in various fields of research: 1. Developing skills in analyzing and manipulating Excel files with a deeper level of understanding. 2. Converting mathematical equations and ideas into algorithms which can be implemented into Excel. 3. Laying the groundwork for more advanced image processing techniques and applications in the future. We present some of our experiments and results in this area involving a high school student (first author) and an undergraduate student (second author). Image Processing techniques presented include binary operations (addition/subtraction), thresholding (converting gray images to binary), edge detection, image recognition, etc. Sample Excel/Google Sheets will be available for download from our website.

Ned Erickson Poster Contest Abstract

Ned D Erickson (Princeton High School, USA)

For my poster, I will be outlining how I built a soprano ukulele. My goal was to create the ukulele almost entirely from parts that can be easily and cheaply purchased from any home improvement store or found around the house. Specifically, I used oak for the sides and back of the ukulele. This oak wood was cut very thin then bent using hot water to achieve the curves of the side. The soundboard/top of the instrument was made with spruce from a common 1 by 6 board. Everything in the body was held together by wood glue. The neck of the instrument was made with a wooden stake for fences. To make my tuning pegs, I used simple bolts with nylon lock nuts. In addition, the bridge was made with an oak scrap and a piece made by melting milk jugs. The two parts not made from parts from a home improvement store were the strings and fretboard. As for the strings I simply purchased the most inexpensive pair I could find. The fretboard was 3d printed using PLA plastic. This ukulele was meant to be an exercise in my creativity and ingenuity while working in specific limits. I also learned lots about acoustics and music theory from the instrument. My favorite part was the fusion of the traditional woodworking, the math and physics, and the modern 3d printing technology.

Simple table-top experiments to demonstrate fiber optic communication

Saniya Nagali (Allentown High School, USA); Vanisha Nagali (Northern Burlington Middle School, USA)

Fiber-optic communication is a method of transmitting information by sending pulses of light through an optical fiber made of glass or plastic. Fiber optics has revolutionized the communication industry by making transmission of large amounts of data over long distances cheap. For example, the popular Verizon FIOS service uses 100% fiber-optic network to support voice, television and internet services simultaneously. In other words, fiber-optic communications form the backbone of the information age we live in. Fiber optics works on the principle of total internal reflection of light. When light passes from a medium with one index of refraction (m_1) to another medium with a lower index of refraction (m_2), it bends or refracts away from an imaginary line perpendicular to the surface (normal line). At one particular angle (critical angle), the refracted light will not go into m_2 , but instead will travel along the surface between the two media. If the beam through m_1 is greater than the critical angle, then the refracted beam will be reflected entirely back into m_1 -- total internal reflection -- even though m_2 may be transparent. In fiber optics, the light carrying the information is transmitted in a glass or plastic cable 'core' covered on the outside by another material 'cladding' which has a lower index of refraction than the core. When light is sent through the core of fiber, it reflects off the cladding due to total internal reflection. Since the fiber does not absorb any light, it can bounce the light frequencies over long distances. As a part of our poster, we will demonstrate fiber-optic communications using a range of simple experiments made using commonly available materials. First, we will demonstrate total internal reflection by sending a laser beam through a prism. By changing the angle of incidence at which the beam traveling in the prism strikes the air, we will demonstrate how light striking at an angle greater than the critical angle is reflected back into the prism. In the second experiment, we will demonstrate fiber-optic communication by sending a laser through one end of a curved tube filled with water and observing the transmitted light emerging at the other end of the tube. An observer will clearly see the light being total internally reflected inside the water-filled curved tube, similar to what happens in fiber-optic cables used in communication. By turning the laser traveling through the water tube on and off, we will demonstrate how information is carried as pulses of light 'digital communication'. By allowing different light channels, each with a unique wavelength, to be sent simultaneously over an optical fiber using an approach called 'wavelength division multiplexing' the amount of information 'bandwidth' carried over the fiber can be increased. We will demonstrate this by sending light from two different lasers through one end of the curved water tube and separating the light at the other end of the tube using a prism. In addition to the experiments, our poster will illustrate optical principles and components that enable fiber-optic communications.

Testing Slime for Its Properties - The Quest to make the perfect slime!

Sowmya Natarajan (Georgetown Day School, USA)

I first started playing with slime in 5th grade. I love making slime. I am now in 6th grade. You can make a basic slime with glue and borax. If you want to get more complicated you can add shaving cream and substitute the borax with laundry detergent or contact solution. You can also add foaming soap, colors and scents. When you add lotion it makes the slime more stretchy. When you add water it makes the slime more jiggly. Did you know that there are a lot of different kinds of slime? There is cloud slime, clear slime, foam slime, micro foam slime, fluffy slime, and glossy slime to name but a few. But I have always wondered whether "old" borax makes the same kind of slime as "new" borax. I have also wondered why clear glue is easier to activate than white glue when making slime. My project will be to explore these questions and to quantitatively measure what happens to slime when you add different amounts of ingredients to the slime. I will be measuring and testing different slimes for their elasticity (stretchiness), jiggliness, crackleiness, and softness. You may not have heard of the terms jiggliness or crackle-ness. Jiggliness is the jiggle of slime when you poke it. Crackle-ness is the sound slime makes when you roll it into a ball and squish it and hear air bubbles pop. This project is based on science and chemistry. Getting the perfect slime is important because it is really fun to play with. Slime is also great as a fidget toy and it can help with your creativity.

Using plastic waste and metal bottle caps in concrete for fortifying and sound resistance

Ian Jerome Baria Patrimonio and Manuel Lacsamana (La Salle Green Hills, Philippines)

Garbage Waste Disposal is a huge problem in our world today. Wastes which commonly occupy majority of space in dumpsites are Polyethylene Plastics and Metal Bottle Caps. The researchers wanted to find a way to reuse these garbage wastes for a better viable product. The proposed concrete wall is able to provide two things. First, the strengthening of concrete structure with the addition of plastic waste and metal bottle caps, reduce crack propagation and make the concrete more durable. Second, the sound resistance ability that would be able to block nearby sound and to repel noise disturbances. a 4x6x16 inches "blocks " with the proportion of 1:2:5; 1kg for concrete, 2 kg for sand, 5 kilos for plastic waste and metal bottle caps for concrete with mixture of plastic waste and metal bottle caps, and proportion of 1:7:1 kg for concrete, 7 kg for sand and gravel for concrete with pure mixture and gave them 7 day curing period. Four types of concrete blocks are produced; a block of pure concrete, concrete block mixed with plastic waste, concrete block mixed with metal bottle caps and concrete block mixed with both plastic waste and metal bottle caps. Strength qualities of the concrete blocks are tested with the help of Engr. Fulgencio Damaso who recommended the size of the block to be subjected to the hydraulic press which is 4x6x16 inches, the blocks are then put in the press and the data showed that the concrete block containing the mixture of metal bottle caps shows a result of 12.70 Mpa(Megapascal). To test the soundproofing factors of a concrete wall, the researchers assembled a 2x3x2 feet concrete wall, the researchers tested it in two ways by attaching the mic outside/inside the concrete then using the Decibel Meter App to measure the frequency sound and by using the Hertz App for producing the different level of hertz. The data shows that a concrete wall with pure mixture sound frequency gain a t stat of 2.34 with a t critical value of 1.68 , so there are significantly different between the amount of frequency sound from outside and inside of the concrete wall. And also the data shows that the concrete wall with mixture of plastic waste and metal bottle caps amount of frequency sound are have gain a t stat value of 3.41 and a t critical one tail 1.69, so there is a significantly higher difference between the measurement from the outside and inside the concrete wall. It is concluded that using plastic waste and metal bottle caps had increase the compressive strength of concrete and also the data of the frequency had shown that the frequency had lessened with the additional of plastic waste and metal bottle caps. The researchers recommended that it is possible to increase the strength if the proportion of the given variables are manipulated and the amount soundproofing factor can be improved by increasing the frequency onto the wall.

Open Software and Hardware Blood Glucose Analysis

Aditya Vidyadharan (Middlesex County Academy for Science, Mathematics and Engineering Technologies, USA); Saamia Khan (Williams College, USA); Yashwee Kothari (NJIT, USA); Max Ramer (Tufts University, USA)

The Open Hardware and Software Blood Glucose project was performed as part of the NJ Governor's STEM Scholars research competition. It involved reverse engineering of a blood glucose meter, along with augmentation of features implemented in custom software. An app was created in order to access carbohydrate intake based on dietary consumption, which enables comparison to a diabetic's daily glucose level readings. Projections of biometric trends, along with identification of foods that are helpful or to avoid, can provide important feedback to the user about their personal choices. Pharmaceutical companies are increasingly limiting access to this data, so the open model is encouraged as it provides more customization and greater understanding to the user. This project was implemented over the course of about 6 months by a team of 6 high school students, an undergraduate college student, and a faculty mentor. The cost of parts was under \$50.00, plus a programmable microcontroller. Skills learned included: circuit reading, circuit design, parts ordering, breadboarding, soldering, database construction and management, programming language learning, microcontroller integration, and software and application design and programming. The high school students divided themselves

into hardware and software focused teams. The hardware team researched how commercial blood glucose meters are designed, and then replicated a circuit found on Hackaday. This was interfaced to an Arduino prepared with firmware that prompts the user to apply blood to a strip that is analyzed by the circuit. The blood glucose reading is then displayed. The software team created a front-end mobile iOS app that allows a user to log and access meal history, blood glucose readings, and other health symptoms. The user can view a calendar that displays their stored blood glucose readings, view these as a graph over time, and also correlate the foods they consumed during each day. To integrate the front-end of the app with the open source hardware, a back-end system was developed in Java/MySQL. This back-end database provided user experience functionality. The program accomplished 3 tasks: inputting data, retrieving data, and analyzing data. Input from the user was entered chronologically by date. The user can then retrieve their data and access a food dictionary. The food dictionary was populated with nutritional information from the US Department of Agriculture. A sample list of foods and their respective nutritional values are stored in the database. Using the blood glucose reading for each date and meal type, the program generates 3 different line graphs (breakfast, lunch, dinner). This helps the user analyze on which days and which meals they had the biggest "spike" in their blood glucose readings. The project received 1st place in the NJ Governor's STEM Scholars competition, held on May 12, 2018, at Kean University. Since the competition, the team was able to assess and continue expanding aspects of the proposed work, including: hardware calibration, circuit rewiring, food database augmentation, a real-time interface between the BGM circuit and software applications, open medical technology advocacy and awareness, and uses of this project in STEM education.

Saturday, March 16 9:35 - 11:50

Workshops I

Room A01 McDonnell Hall

9:35 Carnegie Mellon University Computer Science Academy

Erin Cawley (Carnegie Mellon University, USA)

Carnegie Mellon University has launched a free, online curriculum for high school students that helps instructors teach programming skills using engaging graphics and animations. The curriculum fills a gap between introductory computer science educational materials available for grades K-8 and the rigorous Advanced Placement courses that the most advanced students might take later in high school. The CS Academy was established and its CS1 curriculum developed in response to requests from secondary school teachers and principals, who face growing demands from parents for computer science education but must cope with a lack of educational standards for computer science, a paucity of trained teachers and limited teaching materials. One of CS1's distinctive features is graphics and animation exercises for each unit that were developed by dozens of Carnegie Mellon computer science students. CS1 was initially piloted in 14 high schools with 400 students in 2017-2018. The pilot program was expanded by 26 schools and another 1,300 students during the current school year. Most of the schools are in western Pennsylvania, but others are in such states as Texas, New Jersey, and Washington. Now being piloted in 40 schools, CS1 will be available for general use this fall, free of charge. It is designed for use by classroom teachers, not as a self-guided online course.

10:20 Everyone can invent: A S.M.A.R.T. methodology approach

Fang Lu (IBM, USA)

1. Topic: a. Importance of inventing b. How to come up with invention ideas c. Introduce S.M.A.R.T. methodology d. Review sample patents e. Conduct prior art search f. Conduct market comparative research g. Develop invention project h. Create meaningful use case 2. Focus: This workshop intends to encourage faculty and students to be involved in fun invention activities and develop their technical, collaboration, presentation, and critical thinking skills in STEM fields. 3. Proposed activities: a. The attendees can be divided into groups of 4-5 people. The attendees will be given a box of paper clips and asked to design innovative solutions to present to the other attendees. An example could be folding them together into a cell phone holder or a cup holder. The attendees need to discuss the challenges they want to solve and why their solution is better than existing solutions. b. The attendees will think through the challenges around them and the possible solutions they can come up with to solve this challenge. c. The attendee will conduct a prior art search and review the search results as a group to determine whether the solution is novel, useful, and implementable. d. Each team will select one person to present their solution to the group. e. The workshop host and attendees will provide feedback about the presented solutions.

11:05 Rapid Assessment of an Individual's Knowledge and Skills (RAIKS™) Workshop

Behzad P Tabaei (Autonomous Professional Development, USA); Joseph S Nadan (Autonomous Professional Development & New York University, USA); Roy E Lowrance (Autonomous Professional Development); Andres Fortino (NYU & Autonomous Professional Development, USA)

Topic: Professional development via autonomous risk-free learning Summative (i.e., evaluative) assessments are by their very nature lagging indicators. Properly constructed formative assessments, especially when they are quantitative and done at the right time and frequency, supply valuable information to enable learners, instructors and supervisors to receive real-time feedback and guidance to reduce the time and effort to improve outcomes. Moreover, the assessments can provide valuable and confidential real-time information and diagnostics to all stakeholders as a measure of their progress in acquiring skills and knowledge during learning, help learners gain confidence in what they know and don't know and their eventual mastery of the material, and enhance their self-confidence and satisfaction. This workshop presents efficient strategies for rapidly assessing knowledge and skills based on short, easily created assessment instruments. RAIKS™ is our implementation of such a diagnostic tool that enables individuals to learn what they know and don't know in a risk-free, supportive, mutually beneficial and user-friendly environment. Immediately after completing a RAIKS™ participants receive the confidential results of their assessment. Individuals are able to focus on what they want to improve, anonymously see where they stand in the group and privately compare themselves to their fellow group mates. RAIKS™ sponsors receive a report on the strengths and weaknesses of the group as a whole but do not receive any information about any one individual. This feature provides a risk-free environment to learners that motivates them, improves their learning, and consequently increases the success of the group. Focus: Introduction to and hands-on experience in designing, developing, using and managing a new and innovative knowledge and skills assessment method and tool. Workshop activities: Participants in this 90-minute workshop will: • Be introduced to new and advanced assessment methodologies • Learn why summative assessments are lagging indicators • Learn how to use formative assessments to help autonomous learners • Learn how to use formative assessments to help instructors and sponsors • Learn the advantages of using real-time results to improve autonomous learning • Use autonomous support to learn from their detailed responses to improve their knowledge and skills • Understand how to implement all of the above ideas and create a RAIKS™ • Experience taking a RAIKS™ and immediately upon completion receiving a private and confidential individual report • Learn about the experiences of RAIKS™ education, training, and industrial users
Presenter: Joseph S. Nadan, Ph.D. Dr. Nadan is a well-known "Innovation Sherpa" and innovation scientist who invented, innovated and/or worked on many products and services including eZPass, CD-ROM, Reuters Triarch™, and 16: 9 HDTV for which he received a 2002 Emmy Award for Scientific and Technological Advancement. Currently, he is President and CEO of APD, IAOP Chief Innovation Scientist, Associate Editor of the International Journal of Innovation Science, and an Adjunct Professor in NYU SPS where he teaches graduate courses in Business Research Process and Methods, Strategic Management of Technological Innovation, and the Innovation and Entrepreneurship Capstone. From 2009 to 2016, he was Professor - Management of Business and Technology Innovation in NYU SOE where he was director of its MS Management of Technology Program. Prior to joining NYU in 2009, he was President & CEO of the U. S. division of TORI Global, a financial services London-based consulting company focused on creating and improving innovation programs, IT strategic planning, and leaderships development serving clients including Barclays, Credit Suisse, GE, HSBC, Société Générale, UBS and other leading companies. He was also CTO of AIG Technologies, Executive Vice President of the Market Data Division of Cantor-Fitzgerald, and Group Director and Scientific Consultant to the President of U.S. Philips Research Laboratory.

Workshops II

Room A02 McDonnell Hall

9:35 online real time Assimilation and concept clearing for K12 students by online methodology

Daljit Singh (NIT Jalandhar, India); Amit Dixit (Kad Tutorial, India)

Education always opens new vistas of opportunities. Hence we believe that education will spread out all over the world. It is very important to note that without good and experience teacher, education is about to impossible. Good faculty people are always less in society but their requirement is always high. A good teacher cannot teach 1000 students per day for particular course. If we want to deliver and conserve the knowledge and education of that particular faculty we have to use to with technical support of current era. Whole education is waste of time, money and energy until we cannot realize students about concerning topic and relate with it to real world. To educate people by breaking technological barrier. Our team want to present workshop in the conference on the topic online real time Assimilation and concept clearing for K12 students by online methodology. One line of expert is equivalent to thousands word of others. Let's suppose we are planning for a lecture by a faculty and if a small byte of expert is also incorporated with lecture. It became more effective. Every lecture consist of two part (Faculty outcome & Expert input).

10:20 Integrated STEM Makes Drone Education Fly Workshop

Veronica Farr (600 Eagleview Blvd & Achievement House Cyber Charter School, USA); Gerri Light (University of Pennsylvania, USA); Kathleen E Mastauskas (Achievement House Cyber Charter School & Project Lead The Way, USA)

Explore drones and its technology as an innovative education and career pathway to help broaden participation in science and engineering and the pursuit of STEM careers. The drone industry offers engaging opportunities to present a myriad of content and standards in science, technology, and math with cross-curricular applications. We are developing a STEM centered drone education program, the Drone Innovators Program. The curriculum features project-based content that immerses students in real-world, complex mission simulations to capitalize on students' imagination varied interests. The simulations embed career and technology standards to link student aspirations to real STEM careers in the burgeoning drone ecosystem. In this workshop, attendees will complete a fictional drone search and rescue (SAR) mission from our Drone Innovators curriculum. We will walk participants through the Engineering Design Process as they work in groups to execute a successful mission. Presenter Expertise: • Katie Mastauskas is a STEM & Computer Science teacher at Achievement House Cyber Charter School, PTLW teacher and coach. She trains STEM teachers as a Core Training Instructor for the Project Lead The Way organization. Katie has a BS in Meteorology from Rutgers University and a Master of Secondary Education with a concentration in physics from Wilmington University. Email: kmastauskas@achievementcharter.com • Veronica Farr is an administrator at Achievement House Cyber School and Program Director of Innovation Academy - a program featuring coursework in Entrepreneurship, Computer Science, and STEM. Veronica has a Masters of Education and is a licensed commercial drone pilot. Email: vfarr@achievementcharter.com • Gerri Light is a professor of Information Technology and Computer Science. Gerri has a Masters in Instructional Design and Technology, a Masters of Informational Technology, and a Doctor of Information Technology. lightg@seas.upenn.edu

11:05 A Novel Approach to Teaching Basic Math Skills Through Balkan Folk Dance

Michelle P. Vassilev (Princeton High School, USA)

Socrates is known to have said that one is not truly educated until one has learned to dance. It has been shown that there is a positive correlation between people who participate in Balkan dance and people who thrive in the fields of maths and sciences. The question is, why is this trend seen? The goal of this poster is to show how this trend can be used to teach kids simple mathematical principles that they struggle with when taught the traditional way. It is possible that Balkan folk dance activates the same parts of the brain that certain math problems activate. For example, the cortex is responsible for spatial ability - a skill required both in folk dancing and in math. Similarly, just as the frontal lobe is used in math for problem solving, it may be also activated by the proportional reasoning required in Balkan dancing. The occipital lobe is responsible for recognizing patterns such as those in music, and likely also patterns in number sequences. It is likely that people who do folk dance activate these sections of the brain, and when they must perform math, they use the same sections of the brain that they have already trained during their dance experience. Based on this theory, the poster will present a novel approach of teaching basic math skills through Balkan dance. The poster will consist of pictures and diagrams showing an aerial view of dancers on a stage. By thinking of the stage as a coordinate plane and the dancer or a group of dancers as a point or line respectively, the movement of the dancers will clearly model how certain dance formations actually constitute basic math transformations, such as translations, reflections, rotations, and dilations. Many of these movements involve the splitting of a group of dancers into smaller groups. This will show more engaging methods of calculating the distance between two dancers (points) and the slope between them. The poster will also contain images and explanations of different dance steps. This will demonstrate how patterns within the steps and their order can help teach insightful ideas about arithmetic and geometric sequences in math. Finally, if allowed by the conference, music samples along with calculations on the poster can be used to teach polyrhythms such as those present in the unique time signatures of 5/8, 7/8, 9/8, 11/16, 13/16, 15/16, and 18/16. For example, by examining how beats of two can be played against beats of three, students can be taught how and when these two meters can combine. This can be explained through studying the patterns, ratios, and fractions that exist among the rhythms. Using these unique characteristics of Balkan folk dance, the poster will present a specific combination of dance steps, geometrical figures, and patterns that can be used to enhance the teaching of basic math.

Saturday, March 16 10:20 - 11:50

Integrated K-12 and Outreach Programs - I

Room: Jadwin A06

Chair: Olga Lopez (Instituto Tecnológico y de Estudios Superiores de Monterrey, Mexico)

10:20 Analyzing the Impact of Computer Science Workshops on Middle School Teachers

Isabel Morais (Kean University, USA); Mayra S Bachrach (1000 Morris Ave, USA)

Computational thinking and computer science are instrumental in learning how to creatively solve problems and develop thought out solutions. Over the years, workshops have been held to provide high school teachers the ability to teach high school students computer science, however not much has been done for middle school teachers. Funded by Google, the three day CS Educator Professional Development Workshop for Middle School Teachers at Kean University brought together teachers to learn about key computer science concepts and work with tools that were previously not known to them, such as Scratch, the Makey Makey tool kit, and the Cue robot. The results of this research find that middle school teachers need access to curriculum materials and digital tools in order to successfully teach computer science to their students. Furthermore, more work should be done to get middle school teachers access to materials and lesson plans aimed at teaching middle school students.

10:35 A Paradigm for Teaching Math and Computer Science Concepts in K-12 Learning Environment By Integrating Coding, Animation, Dance, Music and Art

Mirit Shamir, Mark Kocherovsky and CJ ChanJin Chung (Lawrence Technological University, USA)

A paradigm for teaching math and computer science concepts in K-12 education integrating coding, animation, dance, music and art is presented. This teaching paradigm introduces an effective learning tool to teach math and computer science concepts to K-12 students as well as increase the interest of K-12 students in STEM classes and their interest to pursue a career in STEM fields. We taught a "MathDance&Music" program to seventh grade students using the Scratch 2.0 creative learning environment. Students were given assessments before and after the MathDance&Music program. The assessment results show that the MathDance&Music program improved students' ability in math and computer science significantly as well as increased students' interest in STEM classes and interest in pursuing a career in STEM. Students who repeated the MathDance motions and coded the music for the dance did better on the math and computer science test in the assessment with statistically significant p-value than those students who did not repeat the MathDance motions and did not code the music for the MathDance.

10:50 Bringing Geosciences to K-12 Classrooms: A Teacher Training Program Developed by Sterling Hill Mining Museum

Ralph Tillinghast (US Army & CCDC Armaments Center, Picatinny Arsenal, NJ, USA); Edward Petersen (Picatinny Arsenal, USA); William Kroth (Sterling Hill Mining Museum, USA); Gordon Powers (Sterling Hill Mining Museum, USA); Missy Holzer and Jeff Osowski (Sterling Hill Mining Museum, USA); Mo Mansouri (Stevens Institute of Technology, USA)

Science, Technology, Engineering and Math (STEM) outreach can be provided to many different stakeholders in the education ecosystem. This includes providing STEM training and experiences to teachers that can make a positive impact in the classroom. As STEM covers a broad range of technologies and sciences one area that can use further support is the geological sciences. This paper discusses a program to aid in bringing the geosciences into the classroom through a teacher training program conducted at the Sterling Hill Mining Museum. A review of geoscience based outreach programs is presented along with a description of the Sterling Hill Mine program. Key learning objectives are outlined to aid other teachers interested in bringing these materials into the classroom. Survey findings are also presented from the teacher participants that were collected pre, post and approximately one year after the program was conducted. With this data examples provided by participants on how the materials were integrated into the classroom are presented. Overall it is hoped that these findings will bring more geoscience into the classroom.

11:05 An Integrated Secondary School STEM Research Program: Results, Challenges, and Opportunities

Xiang Gong and Erik Mohlhenrich (Princeton International School of Mathematics and Science, USA)

Numerous models exist for secondary school research programs, from summer extra-curricular programs lasting one or two weeks to more extended programs based in a student's school. The degree to which a research program is integrated into the culture and curriculum of a school may have a significant effect on the learning outcomes of the program. In this paper, we present survey results from a cohort of 44 students in a school-based, integrated STEM research program in which students complete a two-year, on-campus research project in a discipline of their choosing. Paired sample t-tests were used to test for differences between student responses following the 2017 and 2018 academic years. The results indicate statistically significant gains in dimensions such as understanding the nature of science, research skills, feeling part of a scientific community, and their likelihood of pursuing advanced degrees in STEM fields. In addition, we test for differences between juniors (one year in the research program) and seniors (two years) to determine there are significant gains associated with the second year of the program. The results of this comparison were non-significant and may suggest diminishing returns in the second year of the research experience. However, small sample sizes may

have limited the power of this comparison; seniors do report higher gains than juniors in all variables measured across both years. The unique advantages, challenges, and opportunities associated with this integrated model of a secondary school research program are discussed, with particular attention to the role of internal mentors, the length of the research experience, and the relationship of the research program to school culture.

11:20 Integration of Virtual Reality in Secondary STEM Education

Eric Nersesian, Adam Spryszynski and Michael J Lee (New Jersey Institute of Technology, USA)

While the next generation of educational technologies (ET), such as virtual reality (VR) and monitor-based (MB) applications, are still in their infancy, they do show promise for improving education. In this study, we compared MB and VR educational technologies as alternative supplemental learning environments to traditional classroom instruction using lectures, textbooks, and physical labs. We tested this in four high school chemistry classes, as chemistry education is well-suited for visually enhanced explanations for learning abstract concepts, and provides a solid testing situation for current and extended reality ET. Ultimately, this research project serves as a foundation to determine whether ETs have the potential to engage high school students in their STEM classes. Successful integration of ET into the public school system curricula may be a viable solution to engage students in STEM education.

11:35 Open Software and Hardware Blood Glucose Analysis as a STEM Project

Rebecca Mercuri (Notable Software, Inc, USA); Max Ramer (Tufts University, USA); Yashwee Kothari (NJIT, USA); Saamia Khan (Williams College, USA); Aditya Vidyadharan (Middlesex County Academy for Science, Mathematics and Engineering Technologies, USA)

The use of open software and hardware in STEM education is advantageous due to cost effectiveness and ready availability of design and implementation information. This project, performed as part of the NJ Governor's STEM research competition, involved reverse engineering of a blood glucose analysis meter along with augmentation of features implemented in custom software. An app was created in order to access carbohydrate intake based on dietary consumption, which would then be compared to a diabetic's daily glucose level readings. Projections of biometric trends, along with identification of foods that are helpful or to avoid, can provide important feedback to the user about their personal choices. Pharmaceutical companies are increasingly limiting access to this data, so the open model is encouraged as it provides more customization and greater understanding to the user. This project can be implemented over the course of a school semester, with one or more teams of 4-6 high school or early college students working in an engineering laboratory setting. The cost of parts is under \$50.00, plus a programmable microcontroller. Skills learned include: circuit reading, circuit design, parts ordering, breadboarding, soldering, database construction and management, programming language learning, microcontroller integration, and software and application design and programming. The set of tasks can be divided up among the students, but results should be shared during final implementation in order that all can benefit from what was accomplished.

Community-based Outreach and Pre-College Initiatives - I

Room: Jadwin A07

Chair: Adetola A Salau (Carisma4U Educational Foundation, USA)

10:20 Comprehensive Amateur Radio Education including Public Outreach

Thomas Fuhrmann, Michael Niemetz and Michael Farmbauer (OTH Regensburg, Germany)

An amateur radio lecture was developed and is conducted within the general education program of the Ostbayerische Technische Hochschule Regensburg. This course enables the students to a variety of activities within the university. In combination with an amateur radio station of the university, different learning formats for communication engineering are carried out. Additionally, some of the projects serve as anchor points for increased visibility of the university in local society. It is seen that this course together with the amateur radio station have several positive effects for technical education and university visibility.

10:35 Ethics and Transversal Citizenship in the Teaching of Science and Engineering

Francisco Iracheta and Adriana Martinez-Cantón (Tecnologico de Monterrey, Mexico)

One of the most accentuated characteristics in the current educational models has to do with integral and multidisciplinary training of people. The barriers and limits that we once took for granted in and among the various academic disciplines have been blurring to such a degree that it is difficult to speak today of a single discipline that does not collaborate with another one for the achievement of significant learning and meaning, by both goals and competency. In this contribution, we are interested in presenting a reflection on the interdisciplinary work among some subjects of basic sciences, engineering and humanities (specifically, ethics and citizenship) in the Tecnológico de Monterrey University in the professional area. Our objective is to disseminate the importance of interdisciplinary work among the human sciences, mathematics and basic sciences and, above all, to highlight the importance of transversal competency in the formation of critical thinking in the student.

10:50 Do PISA Scores Relate to Happiness?

Swapna S. Gokhale (University of Connecticut, USA)

The Program for International Student Assessment (PISA) tests the skills and knowledge of 15-year old students across the world in the key subjects of reading, writing, and math. Student achievement on PISA tests is believed to be a solid indicator of a nation's economic health. Recently, however, it is believed that economic prosperity is not the sole measure of the happiness and well-being of a nation. Therefore, since 2012, the UN Sustainable Development Solutions Network measures the well-being of the people using six key indicators and also composes an overall happiness score from these indicators. The objective of this paper is to investigate how PISA scores relate to these indicators of happiness. To examine this relationship, countries which administered PISA tests are first clustered into two groups, namely, High-Achieving and Under-Performing based on their average PISA scores. Subsequently, the average happiness indicators are compared across these two clusters for statistical significance using the t-test. It was found that indicators such as GDP and health differ significantly across the two clusters. However, human-centric, progressive indicators, especially freedom and generosity do not differ significantly across the two clusters. Therefore, although PISA scores do translate into economic prosperity and better health, they do not necessarily lead to more equitable and kinder societies.

11:05 Cuning: From play to wit, a STEM science club for technological and social entrepreneurship

Neil Guerrero Gonzalez (Universidad Nacional, Colombia); Juan Franco Rubio (ATD-Industry S.A.S, Colombia)

The lack of -Science, Technology, Engineering and Math- STEM skills in the Colombian students, has stopped the development of abilities required in the twenty one century. The kids and young people do not consider STEM careers as a successful and viable life project, because of the economy background. That is the reason why scientist, technology entrepreneurs and non-profit organizations seek a social transformation by expanding the access to high quality STEM education, through programs that include projects in order to find problem-based solutions, develop technical and cognitive skills and real experiences with scientific and technological material, incorporating 80% practical and 20% theoretical classes and the interaction between high quality scientist and a rural community, in order to share knowledge. This investigation shows the work made by a Scientist team and a group of kids and young people of the municipality of Túrreques, Nariño, supported by the German technology Fischertechnik, the Technical Academy of SENA and "Clubes de Ciencia Colombia", that allowed these kids to increase their self-confidence by using this technology and their logical reasoning as an intention of contributing to the realization of a better future in Colombia. This work is opened to future research in the field of education and science.

11:20 Radiolytic Denaturation of Bovine Milk Proteins with Fast Neutron Bombardment

William Nolan (Johns Hopkins Applied Physics Laboratory, USA)

This experiment was conducted to analyze the feasibility of neutron irradiation as a method for reducing milk allergens. In a temperature-controlled environment, whole milk was irradiated with 4 MeV fast neutron irradiation from a 5 Ci Pu-Be source. After irradiation, the samples were treated with Bradford reagent as an assay. The final concentrations from the Bradford Assay indicated protein degradation rather than denaturation leading to further testing with discontinuous polyacrylamide gel electrophoresis. The gel electrophoresis results determined that most proteins had been degraded into unidentifiable proteins components. The remaining main allergenic proteins, alpha-casein and beta-lactoglobulin, decreased by a factor of 3 and 13 respectively after 30 hours of irradiation in an inverse exponential manner. The results strongly indicate that the allergenicity and composition of milk allergens can be reduced by fast neutron irradiation.

11:35 Developing a Model for Increasing Leadership & Diversity in STEM through Mobile STEM Workshops, Collaboration, & Community Involvement

Lori Sheetz (United States Military Academy and Center for Leadership and Diversity in STEM); Samuel Ivy (United States Military Academy and Center for Leadership and Diversity in STEM, USA); Debbie Conn (United States Army Research Laboratory, USA); Jasmine Motupalli (United States Army, USA)

The United States Military Academy (USMA) and the United States Army Research Laboratory (ARL) have worked collaboratively to develop a model to provide educationally enriching STEM workshops held at various locations across the nation. The workshops provide hands-on STEM experiences, such as robotics, bridge design, wind energy, and circuit design, to underserved and underrepresented middle and high school students, led by West Point faculty and cadets. Concurrently, ARL leads workshops for parents, educators, government and industry partners, and other key stakeholders to explore ways to connect school curriculum to real-life experiences and viable resources to encourage students to participate in multi-level STEM programs. We discuss the model that has evolved from our outreach and the impact we have seen.

Inclusive STEM Outreach Programs

Room: Jadwin A08

Chairs: William Gray-Roncal (Johns Hopkins University Applied Physics Laboratory & Preparation Meets Opportunity Foundation, USA), Michael Lawrence (Queensborough Community College, USA)

10:20 The Wisdom of our Native American Tribes: The Iku/Arhuaco People. Their Science, Culture and Math as a tribute to an exiting Civilization

Ernesto Vega Janica (IEEE Standards Association, USA); Hugues Vega Murgas (Retired. Santa Marta Board of Education, USA); Simón Esmeral Ariza (Santa Marta Board of Education, Colombia)

This paper discusses our most recent studies and documented learning experiences related to this Pre-Hispanic indigenous community in the northern region of Colombia, South America. This paper is a simple attempt to raise awareness of the magnificent STEM skills of the Iku (a.k.a. Arhuaco) people, and how they have preserved their knowledge, and applied science in harmony with nature and other civilizations.

10:35 An Accessible, Distributed, Technology-Based Approach for Student and Mentor Engagement

Liem Huynh, Karla Gray-Roncal, Maria Roncal and William Gray-Roncal (Johns Hopkins University Applied Physics Laboratory & Preparation Meets Opportunity Foundation, USA)

Communication is a key capability of successful organizations, ranging from small, individual teams to large corporations. STEM outreach efforts similarly rely on an effective interchange of ideas and messages across many different stakeholders, ranging from the students that are being served, staff, and volunteers. Fortunately, solutions exist in the corporate space, especially in the science, technology, and education fields. However, translating those ideas and tools to the outreach and non-profit spaces is often challenging. Many of the tools that are available require trained technologists to design, customize, implement, and execute an effective solution. Furthermore, the needs, use cases, and requirements of these organizations are frequently different than those of the corporate world, making direct translation a challenge. Identifying and leveraging relevant tools can be daunting when considering the plethora of available options. We have developed an extensible ecosystem to facilitate effective outreach activities, and applied this in our college prep outreach program to create a low-cost, accessible way to impact underserved students. This manuscript shares both our design paradigm and our experiences working through these challenges to develop a solution that integrates existing technology and extends it to our specific use case. We have been using and improving these tools over our past ten program cycles to effectively reach students and support our mentors and leadership team. We believe that our approach, as well as our specific technology solution, provide a good starting point for similar organizations. We document our results in the context of our outreach efforts, and contextualize these metrics in terms of student satisfaction and our ability to achieve program goals.

10:50 miniGEMS 2018 Summer Camp Evaluation: Empowering Middle School Girls in STEAM

Chaoyi Wang and Michael Frye (University of the Incarnate Word, USA)

STEM and STEAM enrichment programs (e.g. summer camps; after-school programs) have been widely implemented for girls and students of colors in the middle school level. miniGEMS, a free two-week summer STEAM and programming camp, has been launched at the University of the Incarnate Word (UIW), San Antonio, Texas with the goal of introducing more females into the fields

of STEM and engineering since 2015. In summer 2018, the program recruited 108 middle school girls from Title I schools and school districts in San Antonio, Texas. This study provides an overview of the miniGEMS summer camp and demonstrates descriptive data through analyzing the evaluation survey, interview, and students' posters. The findings of this study indicated that (1) the camper's most favorite subject was Science (40%), while 45% of students identified math as their least favorite STEM subject; (2) the interview data collected the information about students' backgrounds and attitudes to STEM subjects; and (3) the camp was fun and engaging. Campers revealed three layers of learning outcomes, including information, skills, and attitude changes.

11:05 Engineering Exposure for Pre-College Women: A University-Based Workshop Model

Zahraa N Krayem, Angela Kelly, Jennifer R. McCauley and Monica F. Bugallo (Stony Brook University, USA)

Equity and diversity in science, technology, engineering, and mathematics majors and careers in the U.S. has been consistently problematic. Many policy initiatives and outreach programs have attempted to remediate these inequities. A one-day university-based workshop for high-school female students was designed and sponsored by the Science Training & Research to Inform Decisions and the Institute for Advanced Computational Science at Stony Brook University to inform them about science and engineering opportunities, to connect them with female role models, and to engage them in a hands-on engineering task that applies science concepts. The workshop was hosted by 11 female faculty, staff, and university students from various departments ranging from Electrical and Computer Engineering, Ecology, Marine Science, to Chemistry. Quantitative data (N=32) were collected through pre- and post- surveys, which compared their attitudes toward science and engineering before and after the workshop experience, and explored whether the exposure to engineering activities and role models improved their interest in science and engineering. Results indicated an improved attitude toward STEM majors and careers as a result of the workshop, specifically in terms of confidence to do engineering and knowledge of engineering academic and career pathways ($p < .001$). This intervention shows tremendous promise in engaging high school women in science and engineering in an informal context to increase their self-efficacy and awareness of different career choices.

11:20 Workshop to Increase Women's Enrollment in Technology Discipline at the Community College

Dugwon Seo and Michael Lawrence (Queensborough Community College, USA)

The enrollment of women in our Engineering Technology program at Queensborough Community College (QCC) is as low as 3 %. The challenge is that while technological change is rapidly expanding opportunities in every discipline today, the number of women entering technical studies remains low. The gender gap in academic technology could be due to the lack of opportunities for female students to be exposed to technology. Accordingly, female students rarely chose technology disciplines as their first choice in academic fields. The opportunity we are suggesting is that we can evoke and boost the women's interest in technology disciplines thru exposure to cutting-edge technologies including 3D printing and cloud computing. A workshop can be offered where students design a variety of products, including jewelry, in CAD software and 3D print them. The workshop also includes exposure to cloud computing and machine learning. Students develop and host a website to chronicle their workshop experiences using HTML, CSS & JavaScript. The workshop exposes students to Design Thinking and leading-edge technologies while building their interest, involvement and personal confidence in technical domains. During the summer of 2018, we offered this practical, technical, project driven workshop and successfully provided technology-learning opportunities to 35 female QCC students.

11:35 Measuring the Influences of a STEM Enrichment Program on Middle School Girls' Self-efficacy and Career Development

Chaoyi Wang and Michael Frye (University of the Incarnate Word, USA)

The research is an ongoing qualitative study and focus on exploring the long-term influences of a STEAM enrichment program on middle school girls' self-efficacy and early stage of career development through multiple qualitative methods, such as art-based activities and interviews. In this study, the researcher utilizes miniGEMS (Girls in Engineering, Mathematics, and Science) program as a single case. miniGEMS program consists of a summer STEAM camp and a full year program. The summer camp is a free two-week single-sex STEAM and programming camp for middle school girls launched in 2015 at San Antonio, Texas. miniGEMS full-year program is an extension of miniGEMS summer camp. It is an all-girls robotics club sponsored by the UIW and held for middle schoolgirls at Tafolla Middle School. The goal of this STEM enrichment program is to introduce more female students into STEM field through hands-on project-based learning experiences.

Integration in Higher Ed. -I

Room: Jadwin A09

Chair: Ronald DeMara (University of Central Florida, USA)

10:20 An experiential learning cybersecurity project for multiple STEM undergraduates

Aunshul Rege, Katorah N. Williams and Alyssa Mendlein (Temple University, USA)

The human element is often regarded as the weakest link in cybersecurity, yet education efforts focus primarily on the technical aspects of cybersecurity and downplay the relevance of the human factor. One way to exploit this human vulnerability is through social engineering, in which cybercriminals utilize persuasion and manipulation to get targets to reveal private information. This paper shares an educator's efforts to engage undergraduate students from multiple STEM disciplines in a hands-on social engineering project across the Fall 2017 and Spring 2018 semesters. This activity was designed using the experiential learning framework that promotes "learning by doing." The authors share the experiences and challenges of both the students and the educator in conducting this learning exercise. In addition, this paper details aspects of designing multidisciplinary hands-on projects that consider meeting university ethics standards; generating relevant project instructions and rubrics; engaging in, and promoting cross-disciplinary STEM dialog; and evaluating student engagement and learning.

10:35 Interdisciplinary Internship Projects Utilizing Legacy Robotic Equipment under Budget Constraints at a Small-sized Institution

Haklin Kimm (East Stroudsburg University, USA)

- In this paper we would like to share with other small universities who intend or hold an interest in participating interdisciplinary STEM mission projects with their students. The interdisciplinary science and engineering projects attract the students from different disciplines and backgrounds: computer science, electrical engineering, physics, mathematics, and others. When initiating the robotic vision project at East Stroudsburg University, we began to have open discussions with the students on what we might be able to do. The students of the project were always open to challenge diverse problems, which were hardly seen in their class course works, and to encounter technical difficulties in the project. In doing so, the students were encouraged to work on their interests and specialties mainly such as hardware, software, and programming languages. The students presented their understanding of possible problems and solutions to other team members because the projects require sharing the knowledge and helping each other to achieve a shared goal to see the project succeed. All the team members including faculty adviser were in discussions on finding and solving the problems, in self-motivated learning and helping each other, playing their roles for the project development, management, and technological entrepreneurship of rebuilding the old robot arms within university budget constraints. The interdisciplinary projects using robot arms outperformed in the students' learning outcomes, motivated the students to enhance their career interests into research fields, and prepared them to an advanced science and technology level in solving practical problems.

10:50 Quality Improvement of Engineering Mathematics: A Case Study at Shaqra University

Mohammad T Haweel, Abdulaziz S. Alsayyari and Adel Khalid Alblawi (Shaqra University, Saudi Arabia)

In this work, a performance enhancement case study that targets engineering mathematics courses at College of Engineering (COE) at Shaqra University (SU) is designed, analyzed and evaluated. A new academic plan for the targeted mathematics courses is proposed and compared with the old one. Three different methodologies are designed to evaluate the case study namely as: 1) methodology to design a student questionnaire to evaluate the new academic plan, 2) methodology to measure (i.e. through a second Questionnaire) the degree of utilization of information technology in learning mathematics and 3) A final questionnaire is carried by faculty members. Analyzing and evaluating the three questionnaire outcomes indicated a high rate of satisfaction among students. , the questionnaire constructed by faculty members has showed 87% satisfaction about the proposed methodologies compared to 70% in the old plan. An improvement of 13.35% using MATHEMATICA software and 7.95% using MATLAB software program was addressed as an indication of improvement in learning mathematics using software programs.

11:05 Developing hands-on laboratory exercises for teaching STEM students the internet-of-things, cloud computing and blockchain applications

Ravi Rao (Fairleigh Dickinson University); Riddhi Dave (Fairleigh Dickinson University, USA)

The fields of computer science and engineering are undergoing rapid change, with significant advances in areas such as the internet-of-things, cloud computing and blockchain technologies. Consequently, the gap between traditional course material taught to students in B.S./M.S. programs at universities and the cutting edge of technology used in industry is widening at an unprecedented

rate. Students may get overwhelmed and discouraged by the amount of material they need to learn, contributing to high dropout rates in STEM fields, particularly in computer science and engineering. We propose a hands-on laboratory based approach to teach the students the basics of these emerging areas. The objective is to motivate and engage students by encouraging them to tinker with physical systems, so that they can develop an intuitive understanding of the new technologies. We present an approach using the Raspberry Pi, a small and inexpensive platform that allows students to build interesting applications in the area of the internet-of-things. We provide the preferred sequencing of necessary material, and the required combination of different software modules necessary to teach the students. We discuss our experience of teaching this course to both graduate and undergraduate students. Our results should be beneficial to instructors interested in exposing their students to these emerging technologies. Our main finding is that students prefer hands-on laboratory exercises to theoretical instruction. They are able to grasp concepts better when there is a short theoretical lecture followed immediately by related hands-on laboratory exercises. We present specific laboratory exercises to teach students about the end-to-end processing involved in acquiring images, creating immutable records using a cryptographic hash function, and transmitting and storing them on the cloud. These lab exercises provided students with an understanding of camera-based security applications, basic blockchain technology and cloud computing.

11:20 Difference in Student Performance When Changing Course Duration

Tamer Breakah (Ball State University, USA)

The change in the students' life requirements and responsibilities requires alteration of the way courses are offered in the university level. One of the things that can be changed is the duration of a course. The author was the instructor of a statics course that was offered in three different course durations, while maintaining the same contact hours. The course durations were three, five and 15 weeks, with some restrictions applied on students choosing the shorter alternatives. The main purpose of the research is to evaluate the difference in student performance in these three settings and evaluate their suitability. The overall student performance was evaluated using two different techniques; class GPA and student evaluation of their achievement of the course outcomes. It can be seen from the results that the student performance was different from one setting to the other. It can also be seen that the performance was best when the students took the course in an accelerated setting and were not allowed to take any other courses concurrently. The class performance was inversely proportional to the course duration. The results also showed that there was no significant change in the student evaluation of their grasp of the material. It is recommended to evaluate the performance of these students in dependent courses.

11:35 Scalable Delivery and Remediation of Engineering Assessments using Computer-Based Assessment

Ronald DeMara, Tian Tian and Soheil Salehi (University of Central Florida, USA); Navid Khoshavi (Florida Polytechnic University, USA); Steven D. Pyle (University of Central Florida, USA)

Inspired by the success of Computer-Based Assessment (CBA) prevalent in disciplines outside of Engineering, a large-scale multiple-year project has been undertaken at the University of Central Florida (UCF) to develop authentic CBA assessments. To-date 29 faculty at UCF have been converting their assessments for delivery in a vacated computer lab which has been repurposed to create an Evaluation and Proficiency Center (EPC), which realizes proctored testing, autograding, and scanning of scrap sheets for formative and summative assessments. The scrap sheets are utilized to self-motivate learners to revisit the EPC to remediate their missed problems with the assistance of the Graduate Teaching Assistant tutors who were freed up via reduction in their grading loads. Meanwhile, the learners build their soft-skills, as well as their confidence, to convey and explain solutions to engineering problems. Using this EPC model, the scalability of the assessment infrastructure is measured and evaluated across five Engineering degree programs, indicating a breakeven point around 2,000 Student Credit Hours, while harvesting over \$400,000 of instructional value annually.

Computing in STEM Education - I

Room: Jadwin A10

Chair: Samuel Antonio Rosas-Melendez (Tecnologico de Monterrey, Mexico)

10:20 Code Refactoring and its Impact on Internal and External Software Quality: An Experimental Study

Mohammed Alawairdhi (SEU, Saudi Arabia)

Over a significant period of time, code refactoring has been considered as an effective means to improve effectiveness of legacy systems. Using refactoring, we can improve the internal structure of application without having to necessarily modify external behavior. This helps in improving quality of systems in terms of its reusability, scalability, understandability and flexibility etc. In this paper, the code of three components of an existing application under operation Saudi Electronic University has been refactored using seven refactoring techniques. The refactored components have been evaluated for selected internal and external quality measures. The results show a profound improvement in the internal quality of refactored components whereas the improvement in external quality measures has been found to be modest. An analysis of results has been made at the conclusion of the study.

10:35 Project-based learning in the Chemistry Laboratory: a case of Mexico

Samuel Antonio Rosas-Melendez (Tecnologico de Monterrey, Mexico); Jesus Beltran-Sanchez (Tecnologico de Monterrey & Escuela de Medicina y Ciencias de la Salud, Mexico)

The study of Chemistry is unpopular to students because their lack of connection to their daily life. Project-based learning in a laboratory environment have shown to change the students' perception. In this work in progress, a methodology is presented where the students relate their Chemistry laboratory course with the project of brewing beer. The objective is to observe how the implementation of the project influences the perception of the students taking the course. A pre-experimental research was designed and implemented with a sample of 29 students of the First-Undergraduate Year for different bachelor degrees in Engineering. The students related some concepts shown during the class with some steps of the process of brewing beer. They also got the experience of speaking with experts that work in the field. Three stages of the project are presented and described. The results, measured by the Institutional Opinion Survey of the Student and the comments the students, show that the teaching methodology satisfies the expectations of the students. As a future work, it is proposed to implement a control group in order to compare the experience of the students in the same course. We also propose to include other variables of analysis and to use a broader instrument of measurement in order to perform parametric statistical tests.

10:50 STEM for Public Safety in Cyber: Training for Local Law Enforcement and Cyber Security

Michael Losavio, Adrian Lauf, Jarrod Hinton, Adel S Elmaghraby, Andrew Wright, Ghiyoung Im, Jeff Hieb, Kyra Fritz, Jeffrey C. Sun, Deborah Keeling and Mathew Bergman (University of Louisville, USA)

We consider public safety and cybersecurity as an integrated endeavor, for pervasive computing puts interconnected devices everywhere. This benefits everyone by placing cyber security within the traditional public safety framework, both of criminological study and practical implementation. We examine cybersecurity training for law enforcement from this traditional perspective. Our findings suggest great potential within this group for expanding effective cyber security protections for communities. They further suggest a commensurate need for training and support to realize this potential.

11:05 Education-Robotics Symbiosis: An Evaluation of Challenges and Proposed Recommendations

Habib Ahmed (Advanced Robotics and Automation Lab, University of Nevada, Reno, USA); Hung M La (University of Nevada, USA)

In the wake of technological innovation, integration between Robotics and Education is essential to promote the education and skill acquisition, which will lead to the training and development of the workforce of the future. This paper explores the two primary aspects related to Education and Robotics discussed in the relevant literature; one dealing with utilizing education of Robotics, primarily for Science, Technology, Engineering and Mathematics (STEM)-related courses and the other discussing the usage of different robots in the broader context with the purpose of facilitating education and learning for students of all ages. At the same time, a model of Education-Robotics Symbiosis has also been highlighted, which discusses some of the critical components that can ensure that the vision of successful and sustainable Education-Robotics Symbiosis can be practically materialized at the various levels of the educational system. The proposed recommendations have implications for national-level policy-making in relation to STEM education, professional-level skill development as well as institutional-level Robotics education.

11:20 Evaluating the Effectiveness of a STEaM Training Project

Neville Jacobs (IEEE Baltimore Section); Heather Tomasello (IEEE WIE Southern NJ Affinity Group, USA)

Begun in 1996, the Robot Challenge extrapolates a science experiment to become a finished STEaM project, with all the requirements and details that this entails. The product selected is a specially designed walking robot with a creative and artistic functional body, which High School students develop and build from scratch as they learn to cope with the challenges of a competitive marketplace. Boys and girls learn and have fun preparing for these activities, and earn points for performance,

workmanship, team-work, creativity, report-writing and oral presentations, all skills an engineer (and many other professionals) must develop to be successful in today's job market. We had anecdotal reports from teachers that the project had been a very significant factor in encouraging a number of their students to become engineers, but decided it would require a Survey of the students themselves to substantiate this. The results were generally quite positive, but to our surprise we found there were significant differences between the responses of boys compared to girls, and between younger and older students. This not only has led to a better appreciation of the factors that influence the students, but has caused us to make changes in how the program is run, and to include Middle School students. A second Survey is planned this year to evaluate their effect.

11:35 School-Age Children Program Social Robots - World Robot Summit Pilot Study 2018

Amy Eguchi (Bloomfield College, USA); Hiroyuki Okada (Tamagawa University, Japan)

The World Robot Summit (WRS) Junior Robot Category's School Robot Challenge provides an opportunity for school-age children to learn to program the Pepper robot, a sociable humanoid robot by SoftBank Robotics, Inc. to realize their ideas for living with a social robot in school. This paper presents a pilot study examining the programming performance of the participating teams in the School Robot Challenge. The data for the study was collected from the WRS 2018 Junior Category, School Robot Challenge held in Tokyo, Japan in October 2018. Analysis of the data shows that having Pepper at a team's school does not necessarily contribute to the success of students at the competition. The teams without access to the Pepper robot could also be successful at the competition. It is clear that prior programming experience is a factor that makes teams better able to program the humanoid robot. Further investigation is necessary to determine what contributes to the success of the teams without access to the humanoid Pepper robot prior to the competition.

Saturday, March 16 2:30 - 4:35

Community-based Outreach and Pre-College Initiatives - II

Room: Jadwin A06

Chair: Frank Washko (Saint Martin's University, USA)

2:30 Examining the Social Aspect of Climate Change through Mathematics

Debasmita Basu, Nicole Panorkou and Michelle M. Zhu (Montclair State University, USA)

We designed an instructional module that seamlessly integrates mathematics, environmental science, and technology to help students to critically think about the climate change. The results from a design experiment in a sixth-grade classroom show that our tasks not only enhanced students' covariational reasoning in mathematics but also helped students identify the different traits of climate change they encounter every day in the news media.

2:45 Developing Partnerships for Unique Science Technology Engineering and Mathematics (STEM) Education Facilities

Albert Kerecman (InfoAge Science History/Learning Center, USA); Raymond Ross (3536 State Route 66 & RLRLaw, USA); Thomas Lanagan (Inge, USA)

The InfoAge Science/History Learning Center, a 501.c3 non-profit organization, located at 2201 Marconi Road, Wall, NJ, 07719, is seeking to engage industry, academia, and grant providers in forming a STEM Education partnership. The Center's mission is to preserve, develop, and manage unique scientific facilities that are applicable to STEM Education. The approach is one of motivating youth to become STEM students by sharing our unique existing facilities with their school systems and instructors, which through the utilization of hands-on experiments, ignites learning and instills the desire for scientific careers. Authors: Thomas Lanagan, Raymond L. Ross, Esq., & Albert J Kerecman

3:00 Ketchup: A STEM Project in Gashora, Rwanda, Rooted in Philadelphia

Jorge Santiago-Aviles and Gerri Light (University of Pennsylvania, USA)

Learning by doing is a bit of a mantra at the Gashora Girls Academy of Science and Technology (GGAST), an all-girls High School located in the village of Gashora in Rwanda. No doubt theory and formal education are of vital importance in learning science and technology, but building, fabricating, assembling, writing or coding, integrate the best of theoretical and experiential learning. Doing so provides students with the type of satisfaction that rewards them with something of solid value at the completion of their scholarly effort. Through experience, we have found that this is perhaps one of the most optimum ways to relate to our students. For this exercise in the form of a collaborative effort, formally a service learning course at University of Pennsylvania (Penn), the two co-authors have been engaged with the GGAST and Penn students during the last five years. Spending a few weeks each summer in residence in Gashora and maintaining year-round collaboration via online meetings and shared resources, we used as a guide and foundation the ideas expressed in a previous publication [1], with our audience was Penn students.

3:15 Visually Representing the Landscape of Mathematical Structures

Katherine Gravel (Massachusetts Institute of Technology, USA); Hayden Jananathan (Vanderbilt University, USA); Jeremy Kepner (Massachusetts Institute of Technology, USA)

The information technology explosion has dramatically increased the application of areas of mathematics traditionally labeled "pure" or "theoretical" to wide ranges of fields, which has created a critical need to make abstract mathematics readily accessible to a broader community. This paper presents a method for categorizing and diagramming mathematical structures that enable students and professionals to rapidly understand relationships among and between mathematical structures. This paper also presents 11 maps diagramming 187 mathematical structures through the method described in the paper.

3:30 Transforming learning through relevant STEM education for Nigerian students

Adetola A Salau (Carisma4U Educational Foundation, USA)

It's no surprise to state that little has changed in how STEM is taught in Nigeria in the last three decades. As a result, it seems, Nigerian students have been left behind, falling further behind in science and math literacy. There have been futile national reform efforts to improve things. The issue with them has been a lot of inconsistency and lack of a cohesive effort as changes in teaching practices have been minimal. In our reform efforts in working with schools, our social innovation enterprise Carisma4U has aided some teachers to implement modifications - with some success. The crux of the matter is more often than not; the changes aren't as substantive as they should be. They don't get at the heart of the matter: What does it truly mean to teach and learn STEM?

3:45 Integrating Entrepreneurship Education into Project Based Design Education

Frank Washko (Saint Martin's University, USA); William Edwards (Kettering University, USA); Leslie Washko (Saint Martin's University, USA)

The effort to transform innovation into economic goods and new organizations is addressed in this paper by way of combining entrepreneurial engineering education and project-based design for optimal results. Traditional engineering education, which focuses on technical activities or issues associated with product, service and design, must be reevaluated to include innovation and entrepreneurship activities. A seven-step project-based design learning model is presented that has shown to be effective, and it is proposed that this model can be successfully integrated with principles of entrepreneurship that better prepare students for the establishing new businesses or being strong contributors to innovative startups.

4:00 Fomenting STEM Careers through Robotics Competitions: A Work in Progress

Rodrigo A Canek, Yeisson R Chicas and Oscar Rodas (Universidad Galileo, Guatemala)

The world needs more engineers that can help solve the problems the future brings. Universities are not preparing a sufficient number of students that choose areas of science, technology, engineering, and mathematics (STEM) as their professional career. Creating outreach programs from the universities that can make high school students have an engineer experience while having fun in a STEM competition can reaffirm their decision to continue a pathway through a STEM career. Our outreach program has shown that the participation of students in international and national robotics competitions can assure up to 75% of those students to decide for their professional career a STEM career.

Integration in Higher Ed. -II

Room: Jadwin A07

Chair: Yashvi Desai (Fairleigh Dickinson University, USA)

2:30 The SeaPerch Evolution: From Grassroots to a Global Community

Lindsey Groark (RoboNation, USA); Kelly Cooper (Office of Naval Research, USA); Daryl Davidson (RoboNation, USA)

The implementation of STEM education programs at any level can be challenging for a variety of reasons. As programs aim to scale to a regional, national, or international level, additional considerations must be made to promote successful adoption of the program while still supporting the needs and interests of the engaged local communities. Through an application of integrated STEM education approaches focused on formal and informal learning environments, the collection of STEM disciplines, and robust communities oriented around the program, programs aim to engage students in ways that are applicable to the real world. One such program taking this integrated approach to STEM education is SeaPerch. The SeaPerch program, part of the RoboNation family of hands-on educational robotics programs, is an innovative underwater robotics program that equips teachers and students with the resources they need to build an underwater remotely operated vehicle (ROV). Over the period of more than a decade, the SeaPerch program has experienced significant growth from a relatively small grassroots program to a global community represented by participants in all 50 United States and over 35 countries globally. As the SeaPerch program has evolved, particular focus has been paid to fostering a local focus and supporting the sharing of best practices and lessons learned across participating communities. This paper explores the growth of the SeaPerch program and the key factors that contributed to the program's expansion. Starting with an overview of the SeaPerch program, the paper delves into the four primary components of the program and how these components and other factors evolved with the growth of the program. Following a discussion of the approach to intentional growth and continued support of localized programs, the paper concludes with lessons learned through this evolution and the road ahead for the program.

2:45 Impact of Project-based Learning on Self-Efficacy of Students in Engineering Modeling and Design Courses

Muhammad Safer Khan and Mohamed Ibrahim (Arkansas Tech University, USA)

This paper reports results of a longitudinal study to investigate the impact of project-based learning on self-efficacy of students in engineering modeling and design courses. Engineering modeling and design curriculum is based on hands-on and project-based learning activities to provide students an experience of going through the engineering design process. An important measure of effectiveness of engineering modeling and design curriculum is the determination of self-efficacy of students. Self-efficacy refers to the degree of confidence in their ability to utilize the skills learned during these courses. The data for the study was collected through a specially-designed self-efficacy instrument during three iterations of the Engineering Modeling and Design Course at Arkansas Tech University. A within-subjects approach is used to assess self-efficacy and perception based on learning style preferences of the students. This approach helped us statistically analyze the variability in students' course grades based on their preferred learning styles. We also examined the data to identify factors that could predict students' course scores based on their self-efficacy. The results indicate that there is strong correlation between the self-efficacy scores and the overall course grades of the students in engineering modeling and design courses.

3:00 Early Lessons in Changing Engineering Culture for the Success of URM Doctoral Students in Engineering: PITT STRIVE

Sylvanus Wosu (The University of Pittsburgh, USA); Steven Abramowitch and David Gau (University of Pittsburgh, USA)

Research universities face the increasing challenge of diversifying its STEM faculty. The National Science Foundation (NSF) Alliance for Graduate Education and the Professoriate-Knowledge Adoption and Translation (AGEP-KAT) is trying to address this challenge by supporting sustainable programs that improve the transition of a diverse population of PhD students into the professorate. One such program is the Transition to the Doctorate by Adaptable Engagement program (aka: PITT STRIVE Program). The goal of the program is to Adopt Evidence-Based Strategies to Improve the Academic Climate and the Success of Underrepresented Doctoral Students in Engineering. We have developed a four-dimensional model that includes the key components that we believe contribute to the academic climate, including: Leadership Receptivity and Intentionality; Cultural Competency and Awareness, Shared Vision and Adaptation for Collective Impact, and Proficiency for Engaging Culture, Climate, and Community. The initial plan was to adapt/adopt strategies from other institutions, with an eye towards practices implemented through the University of Maryland Baltimore County (UMBC)'s PROMISE and Meyerhoff programs. Realizing a direct adoption of successful activities from one institution does not

guarantee their success at another, as success can be significantly influenced by various factors; it necessitated the PITT STRIVE program to initially assess its own climate/culture to determine a systematic approach for adoption/adaptation that addressed the specific needs of our school. Thus, the goal of this paper is to describe our initial assessments related to dimensions I and II of our model (Leadership Receptivity and Intentionality and Cultural Competency and Awareness). We provide data from surveys of our leadership (deans and department chairs), faculty, and graduate students. We conclude by discussing how these data influenced the decisions related to replicating UMBC strategies and practices at PITT.

3:15 An Analyze and Actions to Increase the Quality in STEM Higher Education

Radu A. Vasiu (Politehnica University of Timisoara, Romania); Diana Andone (Politehnica University Timisoara, Romania)

This paper presents and analyze the impact of some of initiatives performed in recent years by our university, Politehnica University of Timisoara as to increase the quality and academic retention in STEM Higher education. Based on a profound analyze of the existing situation, actions involving the ecosystem Professors - Companies - Students are included

3:30 Data science education through education data: an end-to-end perspective

Ravi Rao (Fairleigh Dickinson University); Yashvi Desai and Kavita Mishra (Fairleigh Dickinson University, USA)

The increasing importance of data science has created a pressing need for more professionals to be trained. Hence, it is necessary to design efficient education techniques to rapidly train the next generation of students. We describe a holistic approach that integrates multiple objectives within a single semester course taught at the freshman level. The objectives include basic data processing techniques, statistical analysis, teamwork and project management. We conducted a project that combined different public datasets related to the cost and quality of education in the US. Students demonstrated a high degree of involvement in this exercise as they were curious to explore data that related to their own college selection process. It is well known that it is difficult to perform a cost-quality analysis in the field of college education. We used college ranking data created by the Wall Street Journal, and combined it with data from the Integrated Postsecondary Education Data System (<https://nces.ed.gov/ipeds/>) database that provided college costs and graduation data. Students worked in teams to download sections of the data from multiple sources, performed cleaning and verification, and merged the data for analysis. This taught them the values of teamwork, goal-setting and process measurement for timely project completion. We determined that the Pearson correlation between the rank of a college and in-state tuition was -0.65 ($p < 0.005$) for private colleges, and -0.34 ($p < 0.005$) for public colleges. This indicates that higher ranked colleges charge higher tuition. The Pearson correlation between the rank of all colleges and their graduation rates is -0.75 ($p < 0.005$) and between rank and retention rates is -0.71 ($p < 0.005$). Private college tuition is typically \$40,000 annually, whereas public colleges cost \$20,000. These figures suggest that public colleges provide good value. This has policy implications for government funding of education.

3:45 Hip, Hip, Array: Teaching Programming for Data Science is the same as Computer Science--Just Different

Jan Buzydlowski (Holy Family University, USA)

Teaching an introductory programming class to a data science major needs to be done in a different manner than with a computer science major. This paper will focus on the major differences between the need for different topical coverage for the two majors.

4:00 Enhancement of Introductory Computer Science Recitations: from Passive to Active

James Heliotis and Sean Strout (Rochester Institute of Technology, USA)

Course recitations are a venue wherein students normally review recent concepts through additional discussion and/or exercises. Although the inclusion of a recitation in a course's schedule almost always yields some kind of positive impact for the students, they can degenerate into something in which the students are not very engaged. In in our introductory computer science courses we have begun to practice a new one-hour, multi-activity, active recitation format. First students take an ungraded "quiz". Second, a very brief slide presentation takes place, that summarizes the most important points of the most recent lecture. Third, students work on a small code development exercise in pairs. In the last time period, they are given another quiz administered on line using Kahoot to improve engagement and in-class participation. The scores on this quiz, along with recitation attendance, do count for a small part of the course grade. We are currently collecting data on this approach and are looking for feedback and other similar avenues to consider as we collect more data and refine our recitation structure. Anecdotal evidence so far directly from the students and performance in in-lab activities has been positive.

Computing in STEM Education - II

Room: Jadwin A08

Chair: Rahul Razdan (Florida Polytechnic University, USA)

2:30 Does Creating Shared Projects in Virtual Reality Capture Students' Interest in Technology? An International Project in STEM Education

Mark Frydenberg (Bentley University, USA); Diana Andone (Politehnica University Timisoara, Romania)

Virtual reality (VR) provides an immersive setting where it is possible to experience the perception of being present in a different place or environment. The TalkTech international project matches students at universities in the United States and Romania, to work as members of international teams as a virtual mobility. They research applications of VR, visit locations in their home countries related to their team's assigned cultural landmark, and create VR scenes to share with international partners. Team members demonstrate, share, compare, and discuss their work using online communication tools of their choice. This project-based learning provides new advances in STEM education by using digital media, as students experience how technology enables them to communicate and work in a collaborative global environment, create and share digital content, and gain insights into the culture of their partners' countries. Informal results suggest that the project sparks students' interest in possible future business applications of VR.

2:45 Applying Computer Science in Biology: A Model for Incorporating Interdisciplinary Pedagogical Approaches through ePortfolio in the First Year Experience at LaGuardia Community College

Na Xu and Charles Keller (LaGuardia Community College, USA); Yun Ye (City University of New York, USA)

This paper describes the use of ePortfolio as a platform for an interdisciplinary, collaborative course project for First Year Seminar (FYS) students in an Engineering and Computer Science FYS class (ECF090), and in a Liberal Arts: Math and Science FYS class (LMF101). This project was designed to enrich the integrative research experience of new-to-college students at LaGuardia Community College, whose student body is known for its diverse background, and to engage them in hands-on inquiry and problem solving practice, with a broader goal of increasing the retention rate in STEM majors. An additional goal of this work was to introduce students to the interdisciplinary nature of modern science and encourage them to think of their future career paths in the same context. The major task in the project was to compare RNA sequences using computer programs, in order to facilitate the study of blood cancer. Throughout the project, students in both ECF090 and LMF101 classes applied mathematical skills to perform algorithm analysis on a biological problem and were exposed to the application and basis of relevant technology in Computer Science. Collaborative work was conducted using ePortfolio as an online course platform which hosted all student work and allowed remote communication and collaboration to happen between two classes in different majors. Based on survey feedback, students were impressed by how they could contribute to the task using basic math and computer skills, and interest in continuing their STEM education was expressed unanimously.

3:00 A Smart Classroom of Wireless Sensor Networks for Students Time Attendance System

Fawaz Alassery (Stevens Institute of Technology, USA)

Today, Wireless Sensor Networks (WSNs) have been included in many researches to form smart environments. IoT is becoming increasingly integrated in our daily life at homes, streets, schools and everywhere. Using IoT based on WSNs in the educational field is an important resource for better preparing students for the future digital world. Digital students attendance system in schools or universities is an example for case that technology can facilitate the traditional ways for checking students attendance instead of using the manual paper sheets which consume time and resources with higher probability of failure. In literature, there are many time attendance systems that proposed to enhance the manual traditional methods for taking and calculating students attendance in smart ways. In this paper, we proposed a user friendly students time attendance system that can be applicable in different schools or universities in order to form a smart classroom based on WSNs and IoT technologies. We proposed intelligent chairs that can be identified as the sources of information, which integrated with four 50 kg load sensors and HX711 amplifier that measure the students weights and send the digital signals to a receiver in order to recognize the student presence during class schedule. This smart classroom is also installed with one ZKTeco ZK4500 fingerprint reader in order to increase the identification for students. The transmitted signals from the intelligent chairs will be connected by Android application which will be installed on the lecturers' smart

phones. So, teachers will get details and summary report of students attendance through the Android app. We implemented our proposed idea using java language, database and android system.

3:15 My Teacher is a Hologram: Measuring innovative STEM learning experiences

Sandra Gudino Paredes and Nohemí Rivera Vázquez (Tecnologico de Monterrey, Mexico)

There has been very little research regarding the use of holograms for educational purposes, and it seems there is not enough research on the use of holographic technology and its effects on students' learning outcomes. This study proposes a way to measure how learning outcomes, engagement, flow and social presence are impacted by a hologram teaching experience implemented with first-year engineering students, specifically, in a physics class. The University has been guided lately by a new educational model, the Tec21 model, that has four fundamental pillars: a) inspiring teachers, b) technology to improve learning, c) flexible learning experiences and d) challenge-based learning. Our objective was to evaluate an Engineering School initiative for first year students aimed to address two of the new educational-model pillars; namely inspiring teachers and flexible learning experiences. The research problem lies on the difficulty of measuring whether "Educational Innovations" really impact learning outcomes and, if they do, to what extent? This was our research question. A quantitative instrument was developed and applied in a pilot phase to six groups of students (N=160). The pilot study showed good instrument reliability. It seems to indicate that an isolated strategy does not impact learning outcomes or student engagement directly, but the combination of many factors does.

3:30 FRODO: An Open-Source Architecture for Instruction IP

Rahul Razdan (Florida Polytechnic University, USA); Rodger Polanco (Nextgenedu.net, USA); Damien Razdan (Next Gen Edu, USA); Zachary Weingarten (Motorola, USA)

The conventional education paradigm consists of a craftsman-like delivery model. This model suffers from variable quality, system level inefficiency, high costs, and lack of scalability. Online and blended solutions can significantly address these issues, but at the expense of significant R&D-like development expenses. Currently, these costs are product-like in nature, and do not fit into the fundamental financial structure of most institutions. This paper presents, FRODO, an open-source architecture for instruction IP which has the potential to reduce R&D-like development costs, crowd-sourced pedagogical innovation, and build an ongoing active maintenance structure. Though patterned on successful open-source software IP such as Linux or Canvas, Instruction IP has unique requirements, governance needs, and participating actors. This paper proposes a specific architecture for Open-Source Instruction IP which accounts for these differences, and further outlines a pilot for a critical STEM class to test these ideas.

3:45 Aspire High School Internship - Redesigning a Wide-Angle Camera Lens to Study the Aurora Borealis

Charlotte Alavi (Johns Hopkins Applied Physics Laboratory, USA)

Through the Aspire high school internship program at the Johns Hopkins Applied Physics Laboratory, I have been able to learn hands on skills that have helped me determine the path for my future. Gaining exposure and the opportunity to collaborate in a technical professional environment has provided me with the valuable knowledge, engineering skills, and new learning approaches that augment my traditional academia. My assignment in the Geospace and Earth Science Group has been to repackage a camera lens for a mission proposal to study the Aurora Borealis from orbiting satellites. The mission goal supports space weather science in determining Earth's interaction with surrounding space. To experiment with the engineering design process, I worked on the deconstruction of a practice lens. I determined the distances between the inner lenses to experiment designing and fabricating several lens holders. Through trial and error, I created the Version Three lens holder prototype that will be used in the design of the final wide-angle lens. After the final lens angle was calculated, two lenses with proper specifications were purchased. One of the lenses will be deconstructed and the other one will be used for a computerized tomography (CT) scan. This scan will provide the distances between the internal lenses that are necessary in the design of the final holders. This internship has allowed me to conduct research, consult experts, design and fabricate prototypes, learn time management skills, understanding the cost of off the shelf parts compared to the cost of labor, learning new technical skills, and networking.

4:00 When science meets the market: a multidisciplinary approach of entrepreneurship education

Elda Barron (Instituto Tecnológico y de Estudios Superiores de Monterrey, Mexico); José Amorós (Tecnológico de Monterrey, Mexico)

Entrepreneurship education has increased in scientific areas with the purpose of bringing research to the market and creating science-based firms. The boom of the entrepreneurship education boosts the proliferation of several entrepreneurial programs and

education formats. Despite the popularity of entrepreneurship education programs their effects and scope need more attention. This article analyzes the effect of an entrepreneurial program called NoBI in a scientific community to develop entrepreneurial skills. This public program was designed to help scientist to understand the importance of the market. During nine weeks participants receive training from experts of business, science, and technology to validate their ideas. We examine the effect of this education program on entrepreneurial self-efficacy (ESE), business model learning and Entrepreneurial intention. We set up a quasi-experimental cohort longitudinal study on a 179-individual sample. We performed a two-stage survey, at the start and end of the program. We used a Wilcoxon Matched-Pairs Signed-Rank non-parametric test. Our preliminary results suggest that after the NoBI program, participants increment their ESE and learning. Also, this entrepreneurial program has positively impacted entrepreneurial intention. This research provides valuable insights into how entrepreneurial programs could provide skills and modify intention to start a business in a scientific context.

Computing in STEM Education - III

Room: Jadwin A09

Chair: Leopoldo Julian Lechuga Lopez (Universidad Nacional Autónoma de México, Mexico)

2:30 Application of Text Data Mining To STEM Curriculum Selection and Development

Andres Fortino (NYU & Autonomous Professional Development, USA); Roy E Lowrance (Autonomous Profesional Dvelopment, USA); Qitong Zhong (NYU School of Profesional Studies, USA); WeiChieh Huang (Self-employed, USA)

We applied text data mining techniques from machine learning to position (job) descriptions posted on NYU's job search site, Bureau of Labor Statistics (BLS) standard U.S. job descriptions, course descriptions, and curricula descriptions. Our work compared Term Frequency-Inverse Document Frequency (TD-IDF) to Latent Semantic Indexing (LSI) and found that TD-IDF was preferred in this application. We used TD-IDF to measure the extent of coherence among the collections of our documents. We then leveraged those measurements to developed novel approaches to assist students and curricula designers in answering these questions: (1) for students, given an interest in specific jobs, which degrees and courses are most relevant; (2) for students, given courses that have been taken, which jobs are most likely to result in initial interviews; (3) for curricula designers, how aligned are degree programs with specific groups of jobs (for example, with STEM jobs); (4) for curricula designers, to what extent do current and proposed degrees address different job opportunities. Other similar applications are possible by composing our Python and JMP code. Our work could be extended by providing open source implementation of the algorithms.

2:45 Digital Signal Processing in Radio Astronomy: An Interdisciplinary Experience

Pranav Sanghavi and Kevin Bandura (West Virginia University & Center for Gravitaional Wave and Cosmology, West Virginia University, USA); John Makous (Providence Day School, USA); Howard Chun (Cranston High School East, USA)

The Digital Signal Processing in Radio Astronomy (DSPIRA) program is a National Science Foundation (NSF) Research Experiences for Teachers (RET) in Engineering and Computer Science Site at West Virginia University in the Lane Department of Computer Science and Electrical Engineering. The program combines radio astronomy and digital signal processing in a multidisciplinary way to provide educators with a framework to enhance their STEM class curricula. In this paper we discuss the details of the program conducted with 15 teachers over two summer sessions. Radio astronomy is taught through these distinct approaches Digital Signal Processing (DSP), Astronomy, Prototyping of the horn antenna and Curriculum Design with an emphasis on DSP. This program provides teachers with a working radio astronomy observatory and the requisite skills to build and operate it from scratch. We have also established an online repository of DSP and Radio Astronomy lessons.

3:00 Virtual Reality and Statistical Thinking Enhancement

Olga Lopez (Instituto Tecnológico y de Estudios Superiores de Monterrey, Mexico); Leopoldo Julian Lechuga Lopez (Universidad Nacional Autónoma de México, Mexico)

Author: Olga López Abstract - For decades, simulation has been a highly reliable tool for decision making. Even before its fundamental origin, the mathematical branch of system dynamics led to pioneering advances in research, technology and business. Today, virtual reality has become a mainstream technique for employee training. The combination of augmented and virtual reality technologies along with traditional methods of simulation has led to the development of a new powerful instrument of learning applied to complex systems. Our work is the first step of an ambitious project which aims to reinforce the Statistical Thinking of

undergraduate students at the Monterrey Institute of Technology and Higher Education. Using virtual reality and numerical simulation methods our project connects processes and statistics. The student faces the challenge to solve a process problem, which is presented in a first step as a 3D video. By using virtual reality, we expect to develop strong and soft skills in our students enhanced by what we call the five S linked by the five C: Scope-Strategy-Standard-Seamless and Success with Choice-Collaboration-Communication-Critical-Thinking and Creativity. We have measured the impact of using this strategy on student learning. For the last two semesters the outcome has been positive for our learning model, in both quantitative and qualitative variables. We have carried out a parametric hypotheses test, comparing the mean grades obtained in a similar final exam, by students having followed our new method with those having a traditional learning method. Finally, by means of a general survey, we obtained that the student's general opinion, concerning learning statistics by visualizing the 3D real process and challenges, is highly motivating and rewarding

3:15 Real-Time Visualization of Neural Network Training to Supplement Machine Learning Education

Michael You and Jessica Yin (Carnegie Mellon University, USA)

In machine learning, neural networks have excelled at performing tasks at a high level with a simple and flexible implementation. Neural networks are particularly well-suited for novice programmers due to the availability of open-source libraries like TensorFlow and Caffe. However, novice programmers often neglect to learn beyond the black-box behaviors that these libraries provide. Introductory college students often lack the understanding of neural network internals, such as hidden layers and activation functions, and their interactions during training, which are crucial to efficiently solving more complex problems. Here, we present Omega3, a device that opens up the black-box of neural networks by visually representing how hidden layers behave during training in real-time. In addition, Omega3 provides an engaging tactile and visual educational experience to students, and waives the requirement for a strong programming background in order to learn about neural networks. In this paper, we will discuss the fabrication and set-up of Omega3 as well as evaluate and compare Omega3 to traditional lecture-based learning.

3:30 WiFi Motion Detection: A Study into Efficacy and Classification

Sadhana S Lolla (Poolesville High School & Johns Hopkins Applied Physics Laboratory, USA); Amy X Zhao (Johns Hopkins University Applied Physics Laboratory, USA)

WiFi and security pose both an issue and act as a growing presence in everyday life. Today's motion detection implementations are severely lacking in the areas of secrecy, scope, and cost. To combat this problem, we aim to develop a motion detection system that utilizes WiFi Channel State Information (CSI), which describes how a wireless signal propagates from the transmitter to the receiver. The goal of this study is to develop a real-time motion detection and classification system that is discreet, cost-effective, and easily implementable. The system would only require an Ubuntu laptop with an Intel Ultimate N WiFi Link 5300 and a standard router. The system will be developed in two parts: (1) a robust system to track CSI variations in real-time, and (2) an algorithm to classify the motion. The system used to track CSI variance in real-time was completed in August 2018. Initial results show that introduction of motion to a previously motionless area is detected with high confidence. We present the development of (1) anomaly detection, utilizing the moving average filter implemented in the initial program and/or unsupervised machine learning, and (2) supervised machine learning algorithms to classify a set of simple motions using a proposed feature extraction methods. Lastly, classification methods such as Decision Tree, Naive Bayes, and Long Short-Term Memory can be used to classify basic actions regardless of speed, location, or orientation.

3:45 Developing STEM competences by building Low-Cost Technology Robots: A Work in Progress

Yeisson R Chicas, Rodrigo A Canek and Oscar Rodas (Universidad Galileo, Guatemala)

In the world, there is a concern about not preparing a sufficient number of students and teachers in the areas of science, technology, engineering, and mathematics (STEM). Developing countries, like Guatemala, have the need to organize this kind of competitions and be able to develop them locally. Outreach programs created by local universities, like Universidad Galileo, and other organizations can contribute in the development process of this STEM activities. After four iterations of a local robotics competition and founding the National Robotics Competition in Guatemala we can conclude in a preliminary state that our local students have the STEM competences needed to participate in this kind of competitions. Our proposal is to design and manufacture a local low-cost robot to engage more students nationwide for the next iteration of this robotics competition.

4:00 Autonomous Vehicles and Aerospace Engineering as a STEAM development platform

Rolando Bautista Montesano (Tec de Monterrey, Mexico); Edgar Lopez-Valdez, Diego Jiménez-Ríos and Víctor Gómez-Aladro (Tecnológico de Monterrey, Campus Ciudad de México, Mexico)

This paper presents the work in progress of using nanosatellites and autonomous vehicles as education platforms for pre-college preparation and career development at Tec de Monterrey in Mexico. Students are recruited in their junior high school year. They undergo a set of tests, until a selected set is recruited to participate in two MIT programming competitions. They are encouraged to continue their participation until the end of their senior year. When they begin their undergraduate studies, they work as mentors and conduct research on autonomous navigation. Participants develop not only high technical skills, but social and leadership skills as well. This program has been running since September 2016 in the Mexico City campus and due to its success, it is being implemented in other campuses. The alumni and current members of these projects have demonstrated a significant growth as compared to their class.

4:15 Detection and evaluation of brain and spinal cord conduction function based on functional electrical stimulation

Lei Ma (University of Nantong, P.R. China); Feng Ju (Nantong University, P.R. China); Kaixin Pan (Case Western Reserve University, USA); Xiaoyan Shen (Nantong University, P.R. China)

Objective: The purpose of this study is to detect and evaluate the brain and spinal cord conduction function in rats with functional electrical stimulation (FES) technique, and to provide a practical simple atlas for electrode implantation in the microelectronic neural bridge system. Methods: FES was performed on the brain and spinal cord of 16 SD rats and the normalized coordinate spinal signals of nerve and the types of evoked motion were recorded. Results: ①The FES technique could activate the core area of the spinal cord and induced the lower limb movement of the key muscle. ②The spinal cord conduction function of the rat primary motor cortex nerves in the brain and spinal cord could be assessed by Cerebus system. Conclusions: FES can activate multiple sets of spinal nerve fibers and to complete special action.

Integrated K-12 and Outreach Programs - II

Room: Jadwin A10

Chair: Ralph Tillinghast (US Army & CCDC Armaments Center, Picatinny Arsenal, NJ, USA)

2:30 High School Students' Perceptions about Biology, Related Influence of Factors and Players

Angeles Dominguez (Tecnologico de Monterrey & Universidad Andres Bello, Mexico); Itzel Hernandez (Tecnologico de Monterrey, Mexico); Jesus Beltran-Sanchez (Tecnologico de Monterrey & Escuela de Medicina y Ciencias de la Salud, Mexico)

Research about students' viewpoints regarding STEM fields mostly address two target groups: physics/mathematics/engineering areas and undergraduate students. The purpose of this paper is to explore 9th-grade students' perceptions about biology and some of the factors and players that influence them in pursuing an academic or professional career in these fields of knowledge. A 13-item survey graded on a 5-point Likert scale was administered to 350 Mexican students from two states, Chiapas and Nuevo Leon, as part of a broad research project that aims to determine which factors and players influence the perceptions of teenagers, from a gender perspective, about STEM fields. Results show statistically significant differences among group participants in the perceptions of the value of biology to their academic futures (T-Test, $p=0.035$) between genders in the state of Nuevo Leon (T-Test, $p=0.037$, 0.083). Results also show significant correlation between parents' levels of education and students' self-efficacy (Pearson correlations). Conclusions drawn from this paper discuss the relatedness of teenagers' STEM perceptions and their academic and professional futures with respect to gender, geographic residency, family and self-efficacy. The research also highlights the need for a profound comprehension of students' appreciation for science, technology, engineering and mathematics.

2:45 Integrated STEM Helps Drone Education Fly

Veronica Farr (600 Eagleview Blvd & Achievement House Cyber Charter School, USA); Gerri Light (University of Pennsylvania, USA)

The emerging drone industry presents an ecosystem rich with STEM careers. This paper discusses the development of an integrated STEM curriculum, the Drone Innovators Program, designed to immerse middle school and high school students in STEM careers through drone education. A work in progress curriculum presented in this paper is a series of creative problem-solving web-based micro-courses for both online schools and brick-and-mortar classrooms. The curriculum is being piloted in an online charter school that serves students throughout the state of Pennsylvania, reaching a vastly diverse demographic. The course design uses research-

based instructional models to capture a wide range of student interests, skills, and abilities. We will present the program framework and a lesson from our first unit.

3:00 STEM Education: How Best to "Illuminate the Lamp of Learning"

Dwight Bues (Engility Corp., USA)

Engineers often need to present design and implementation proposals, speaking in front of a group. STEM students may be reticent about publicly discussing their ideas and they could use good examples to follow, as this will definitely enhance their performance in College and the Business world. Largely, engineers have the Mathematics and Science background necessary to be Subject Matter Experts (SMEs), useful for being able to advise students within the particular STEM pursuit. Actually, my High School Calculus teacher was a Chemical Engineer by trade. Everybody hates homework, and Engineers are no exception, but no one can teach without preparation. My mother, who taught English in Baltimore for 38 years, always went to work with her lesson plans for Hamlet, even though she had taught it her entire career. Any engineer who wants to participate in a STEM endeavor will need to prepare. This paper is intended to help engineers "come out of their shells," giving pointers on methods and pitfalls of various types of instruction.

3:15 An Industry Perspective: Using Systems Engineering Characteristics to Address K-12 STEM Challenges

Gennaro Avvento (Gennaro J. Avvento Technical Services LLC & Lockheed Martin (Retired), USA); Eric Sudano (Eric V. Sudano System Solutions LLC, USA)

Both the US Industry and the Federal government have applied many of the principles of system engineering to many large-scale projects in the 20th and 21st Century; achieving a high level of success. It provides a foundation; providing a systematic and holistic perspective toward problem identification, solution, design, assembly and operation of systems. We believe these same characteristics can be used to address key challenges in the STEM program. Our strategy is to use the idea of a K-12 HOM Factory based on SE concepts. This idea may offer both a framework for HOM research and K-12 STEM and non-STEM programs a promising alternative emphasizing critical thinking skills within their respective environments. an integrated STEM environment.

3:30 Sample Vehicles for Integrating Education across STEM Disciplines

Janusz Zalewski (Florida Gulf Coast University, USA)

The paper presents a novel view of integrating education in STEM disciplines, which is based on an historical perspective of how discoveries and inventions are made. Coherent examples of projects that can be used across disciplines are given, and their relationship with the project-based approach is explained.

3:45 Simulation Design and Development for Learning Seasons and Lunar Phases using HTML5 and JavaScript

Michelle M. Zhu, Sneha Gulati and Nicole Panorkou (Montclair State University, USA)

This paper presents our recent work in progress aiming to design effective learning simulations of day/night and seasons and lunar phases using web technology for K-12 Earth and Environmental science curriculum. Two interactive simulations using HTML5, JavaScript and CSS are developed with steerable parameters for students to interact and manipulate. The design and development details are discussed in this paper. We are currently in the process of designing the lesson plans with various investigations to engage students with the seasons and lunar phases concepts as well as assessments to evaluate their learning outcomes.

4:00 Real-time assimilations and concept clearing for K12 students by online-offline methodology

Daljit Singh (NIT Jalandhar, India); Amit Dixit (Kad Tutorial, India)

Education always opens new vistas of opportunities. Hence we believe that education will spread out all over the world. It is very important to note that without good and experience teacher, education is about to impossible. A good teacher can not teach 1000 students per day for particular course. If we want to deliver and conserve the knowledge and education of that particular faculty we have to use technical support of current era. Whole education is waste of time, money and energy until we can not realise students about concerning topic and relate with it to real world. In this paper are presenting the novel way of concept clearing to the student with real time input of the expert in the faculty lecture.

Saturday, March 16 2:30 - 3:15

Workshop: STEAMWORKS

Sudendu Das

Room A01 McDonnell Hall

Workshops: Mathworks

Room A02 McDonnell Hall

Saturday, March 16 3:15 - 4:45

Workshops III

Room A01 McDonnell Hall

3:15 College Prep Program in a Box: A Model to Support Trailblazing Students in Pursuing STEM Careers

William Gray-Roncal, Karla Gray-Roncal, Liem Huynh and Maria Roncal (Johns Hopkins University Applied Physics Laboratory & Preparation Meets Opportunity Foundation, USA)

In this workshop, we will present an overview of our outreach model to help high school students prepare to succeed in the college application process and in their college experience. Our goal is to empower trailblazing students facing systemic obstacles with profound opportunities to become exceptional leaders in society. This group of students is critical in enhancing our national competitiveness in STEM, but is often overlooked or difficult to reach via conventional efforts. We recruit high-achieving students who face significant barriers in achieving their goals, such as first generation college students, English language learners, and individuals with limited financial resources. We will share how we select and support these students through an intensive, all-volunteer mentoring program, and how we help them to persist through the STEM pipeline. Critical to our success is our novel technology paradigm, which extends open source tools to provide a high-contact platform for student and mentor engagement. We provide these resources following a data-driven model, which allows for continuous, quantitative and qualitative outcome assessment and improvement. We will share lessons learned, a "day-in-the-life" view of a College Prep student and mentor, and how participants can leverage tools, materials, technology, metrics and ideas in their own programs. To learn more about our college prep program, please visit: www.trailblaze.org

3:45 Workshop on Scalable Low-Cost Solutions for implementing IoT

Yeisson R Chicas, Rodrigo A Canek and Oscar Rodas (Universidad Galileo, Guatemala)

For 10 years we have organized a technology event in Guatemala having the participation of international and national speakers. During this event we have promoted the use and understanding of IoT solutions that can help participants develop their own solutions. Prototyping during this years has made this track during this event a well-known and attractive one. For the past two years, we have been using a low-cost open-source platform for implementing IoT solutions called Node MCU. This platform is based on a WiFi SoC well known that makes a reliable solution. Our workshop will help participants get to know and program this low-cost open-source platform. It will also show participants how to integrate a couple of sensors and start building their own basic Low-Cost Environment Monitoring IoT Node and be able to send data to the cloud. At last, all the data send to the cloud will be display in the web on different dashboards with the help of the open-source platform called Node Red. A guide through all the implementation will be handed to all participants.

4:15 Introduction to Social Network Analysis using R

Khadija N Shah (Johns Hopkins University Applied Physics Laboratory & Gerstell Academy, USA)

TITLE: Introduction to Social Network Analysis using R **AUTHOR:** Khadija N. Shah (email: Khadija.Shah@jhuapl.edu) **AUTHOR BIO:** I have been in the ASPIRE Program at the Johns Hopkins Applied Physics Laboratory since October of 2018 diligently studying Social Network Analysis (SNA) utilizing a statistical computer programming called R. I have had the privilege of working under my mentors on a project that uses SNA to identify malware. My understanding of statistics from my AP Statistics class has been very useful and has demonstrated the power statistical analysis can have in any field. **ADVISERS:** Dr. Anthony Johnson, Ms. Sophia Oluic, Ms. Emily Spalding **DESCRIPTION:** Our goal is to educate high school students on the advantages of approaching the problem of persistent malware through the lens of SNA and R. We will primarily focus on three main sections: first, introduction to SNA and its applications, then, introduction to R and how it can enhance research within SNA, and, finally, how R and SNA can be used to enhance malware identifying technologies such as fuzzy hashing and similarity digests. **ABSTRACT:** Attendees: Our workshop will serve as a way for those unfamiliar with either SNA, R, or even malware identification to obtain a basic understanding of SNA. To fully participate in the planned activities, all attendees should bring a laptop computer. In the beginning of the workshop, students with both MACs and PCs will have time to download the program R if it already does not exist on their computers. R includes the datasets that will be used later in the workshop. The malware datasets will be provided. Our discussion will focus on the features of R that enrich our ability to interpret results when conducting research within the realm of SNA. We will begin with how to navigate the program itself and go over R's basic functions. Specifically, we will be exploring how to assign variables, how to use R for arithmetic, and how to create plots from data. Plots will be the main area of focus within this section of the workshop. After downloading all of the necessary packages in R to plot data properly, we will explore the different ways in which R can help interpret data. During this section, we will explore a wide variety of graphs, such as the traditional plot, bar graphs, scatterplots, and histograms. An understanding of how R takes data and converts them into readable graphs is critical for the student, as our analysis in malware identification will rely heavily on the interpretation of plots. We will also be giving students the time to create their own plots and experiment with plot size, shape, color, and other graphical characteristics. The goal of the experimentation is to allow students time to exercise their abilities in R and help them understand how changing the characteristics of nodes can change the visualization of the results. To supplement this experience, we will be introducing students to concepts of centrality and measures of centrality to contextualize the plots they will be graphing. After students feel comfortable with plotting, we will begin to speak about how R and SNA can be used to tackle to problem of malware. We will go over what malware is for any students unfamiliar, and also mechanisms that have been developed to protect computers and other software from malicious code. We will be talking about fuzzy hashing programs and similarity digests, such as ssdeep, LZJD, and tlsh. They can be used to identify most types of malware. Through R, we will be looking at different plots of malware data and how reading them can lead to investigating the most efficient method of malware identification, allowing us to explore the possibilities of improving upon existing technologies and, therefore, making cyberspace safer. Our discussion into how R aids in malware identification will open a dialogue of how R can be useful in the world outside of computer science. We hope to inspire students to further explore the applications of R on their own time by showing them how its versatility can be used in a multitude of fields. Human Rights Groups use R to analyze statistics for the impact of war. Weather services use R to predict where extreme weather is most likely to occur. Whether the students are passionate or not about data science is arbitrary. The significance of this workshop is to promote the importance of statistics, and how R analyzes those statistics in almost every academic discipline whose mission is to enact positive change.

Saturday, March 16 3:15 - 3:45

Workshops - Code.org

Room A02 McDonnell Hall

Save the Date!

10TH IEEE INTEGRATED STEM EDUCATION CONFERENCE

**PRINCETON UNIVERSITY
SATURDAY, MARCH 15, 2020**

