Rocky Mountain Section of the ASEE 2019 Conference

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University of Wyoming

Report of Abstracts

Full Paper Session / 18

A New Approach For the Latin Honors Award Process

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A process control methodology for awarding university Latin honors was implemented in 2004. It replaced the previous approach that awarded honors after the graduation ceremony when final grades for the last semester became available. This alleviated a situation where honors actually awarded would not conform to those singled out for honors prior to graduation. The new graduation with distinction process was designed to ensure that Latin honor allocations are conducted fairly and deviate as little as possible from the traditional one, three and six percent targets.
This paper addresses the development of a simulation model for the evaluation of the decision making approach for updating the catalogue Graduation with Distinction cutoff GPAs. The methodology utilizes statistical process control to track GPA cutoff values for Summa, Magna and Cum Laude honors designations in each of eight colleges and signals the need for updates to the catalogue published cutoffs for the next four-year cycle.
In order to determine the best decision making approach going forward, a simulation model of this process was created using the simulation software SIGMA. This model was initially validated and verified via this new graduation with distinction experience. After completing this phase of the research, additional process control rules and performance measures were integrated into the SIGMA model. The model is currently being modified to address various long running GPA scenarios. A trade-off between Type I and Type II errors will be performed using the L1, L2 and L-infinite distance norms as performance measures and various auxiliary process control rules. Replicates of the simulation will be run over variable and fixed horizons to generate statistics on these measures and make comparisons of the candidate decision approach rules.

Short Paper Session / 52

A Practice Oriented Final Design Project for an Instrumentation Course in Civil Engineering.

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As technology advances, field instrumentation and real-time data analyses are quickly becoming a part of many civil engineering (CE) projects. However, many CE graduates are not equipped with the necessary skills to select and deploy the plethora of field instruments available to them. This is likely due to unfamiliarity with tools that are more often designed and used by electrical and mechanical engineering students. Likewise, the analyses of the data can be confusing and difficult to perform. Regardless of students' apprehension, instrumentation use grows because these tools can be used to validate important design assumptions and monitor performance as the design is built. This is especially true in situations when unknown design parameters must be verified and workers safety may be compromised, such as a large earthwork and shoring projects. The experience CE students gain in instrumentation is non-existent or scant in many undergraduate and graduate programs throughout the U.S. An instrumentation course was designed to help students learn; instrumentation selection, data collection, data analyses, data interpretation and finally decision making. This course aims to develop the students higher-order level of thinking and decision making skills, and culminates with a comprehensive final project. The final project for the course was developed with the help of a practicing engineer and used real-world data collected at a site in Colorado. This paper will present how the instrumentation course was designed along with challenges realized. In particular, details concerning the final project, how it was developed and assessed, and what objectives where or where not met will be discusses.

Full Paper Session / 57

A SCALE-UP Instructional Environment for Multivariate Calculus in the Engineering Core

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The department of Applied Mathematics and Statistics at the Colorado School of Mines (Mines) is exploring a variety of pedagogical strategies to (i) encourage active learning in multi-section core mathematics courses and (ii) make the content of these courses more engaging and relevant to our students. With support from the Office of Naval Research, we have piloted a Student-Centered Active Learning Environment for Undergraduate Programs (SCALE-UP) version of our honors courses in Multivariate Calculus and Honors Differential Equations course sequence. This instructional model has been successfully implemented for the delivery of multivariate calculus at Mines since the Fall 2015 term. Based on the background of the students enrolled and the nature of the materials presented, this course has provided a rich environment in which to create group activities, with a focus on computation, application and reflection relative to the engineering curriculum. As students transition from single variable to multivariate mathematics, there is a significant opportunity to augment their learning experience with technology and reflective group work in order to develop meaningful connections between their existing mathematical background and the generalized versions of the calculus presented in this course. We have reinforced our instructional activities with undergraduate teaching assistants (UTAs) and Mathematica notebooks designed around the particulars of the weekly assignments for the SCALE-UP environment. With four-years of delivery, we take a moment to look back on the course and its accomplishments. In particular, we discuss our initial pilot, student feedback, lessons learned, content design (and re-design), growth mindset preparatory work, and the impacts of these efforts on the students, UTAs and faculty who have participated in this model.

Active Engagement Session / 34

A User-Centered Design Approach for Sharing Research Findings with Teaching Practitioners

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Adult and other nontraditional undergraduates (Horn, 1996) constitute a growing new undergraduate sub-population in science, technology, engineering, and mathematics (STEM) education. In today's STEM classrooms, undergraduates are no longer exclusively—or even majoritively—comprised of young high school graduates with few familial and/or work-related responsibilities. Today, increasing numbers of nontraditional students are entering STEM programs from diverse backgrounds, with varying levels of academic preparedness, and with substantial personal and work-related obligations. As policy makers emphasize the need for higher education to recruit and retain greater numbers of nontraditional undergraduates in STEM career pathways as means to strengthen and diversify the nation's engineering workforce, STEM educators are called upon to "acknowledge" and "work to accommodate" these student differences both in and out of the classroom—and most importantly in the context of gateway STEM courses (PCAST, 2012).

This engagement activity is designed to assist STEM faculty members, administrators, and graduate and undergraduate students, to (1) learn the varied characteristics of nontraditional undergraduates, (2) understand academic help-seeking behaviors and preferences of today's undergraduates engaged

in STEM programs of study, and (3) identify strategies for providing effective support for all undergraduates, both nontraditional and traditional, within their own courses. This activity draws upon findings from a recent NSF-sponsored research study entitled "Online Learning Forums for Improved Engineering Student Outcomes in Calculus" (Minichiello & Hailey, 2013). During that study, we examined synchronous and asynchronous help-seeking behaviors and preferences of nontraditional undergraduates enrolled in the first- year calculus sequence (i.e., Calculus I and II) using a mixed-methods approach. The overall goal of the study was to promote nontraditional student success in gateway STEM courses via changes to course-level instructional support strategies.

During this engagement activity, we will accomplish three goals. First, we will share findings and evidence-based recommendations for improving inclusivity and instructional support among contemporary undergraduates enrolled in gateway STEM courses. Second, we will introduce and generate discussion and feedback about a new, user-centered design (UCD) approach for sharing research findings with teaching practitioners in more accessible, memorable and empathic ways (Minichiello, Hood, & Harkness, 2017). Third, we will provide a collaborative opportunity for participants to use the UCD materials to ideate improvements to their current strategies for supporting help seeking among undergraduates in their own STEM courses. Participants' anonymous responses to the questions posed in this engagement activity will be gathered in accordance with an approved USU IRB protocol #10292 and used in our continuing research.

Active Engagement Session / 29

A bouquet of Bloom's: choosing active learning strategies to align with learning outcomes

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Research in STEM education has shown that engaging students in their learning process enhances their ability to recall information and apply concepts in new and varied contexts. To facilitate this student engagement, instructors can incorporate a variety of active learning strategies, such as minute papers and project-based learning assignments, into the learning environment. However, with the overwhelming number of active learning strategies available, how do instructors choose appropriate activities to help students achieve desired learning outcomes? In this collegiate interactive session, participants will practice effectively integrating active learning strategies into a learning experience by: 1) classifying strategies according to Bloom's taxonomy, 2) selecting and aligning strategies with a course learning outcome, and 3) planning the implementation of an active learning strategy in a specific learning experience. By the end of this session, participants will construct a resource of active learning strategies aligned with different levels of learning outcomes to incorporate into their course or learning environment.

Full Paper Session / 36

An Introductory Nanotechnology Experiment Using polydimethylsiloxane (PDMS)

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We are developing a laboratory experiment for an introductory nanotechnology curriculum. This experiment will guide students in the use of Polydimethylsiloxane, or PDMS. This goal of this experiment will be to introduce students to several techniques that are useful in nanotechnology industry and give students hands-on experience and a new skill set at the completion of this experiment.

First, the student is introduced to simple soft lithography techniques in which they copy the surface structure of different sub-micron sized patterns. They then verify the surface was accurately copied through direct measurement using laser light diffraction. Further development of the laboratory experiment may include more advanced uses of PDMS. All the experiments will be suitable for associate degree and undergraduate students and are designed to be conducted outside a cleanroom.

This laboratory experiment is one part of a larger curriculum that is designed to teach students skills that are relevant and up to date in the nanotechnology industry, and is constructed in a sequence that is challenging, rewarding, and interesting for students.

Short Paper Session / 60

Approximately Constant Group Delay FIR Filter Designs

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Abstract for ASEE RMS Conference, May 2019
Author: John Pierre, ECE Department, University of Wyoming
Title: Approximately Constant Group Delay FIR Filter Designs

Digital filtering is a well established topic in any undergraduate DSP (digital signal processing) course. DSP is frequently a popular elective course in electrical and computer engineering. In the area of FIR (Finite duration Impulse Response) filter design, many design techniques are frequently discussed including windowing, frequency sampling, and Parks/McClellan methods. Usually, only symmetric and antisymmetric designs are discussed since they result in filters with constant group delay. Students frequently assume all FIR filters have constant group delay, but this is only true when the impulse response has symmetry characteristics. This paper reformulates the frequency sampling technique for a more intuitive design methodology which includes the ability to design filters that do not possess symmetry but have approximately constant group delay over the frequency range of the passband. While these filters do not have constant group delay, they can have lower average group delay than their symmetric filter counterparts and thus faster response times which may be important in some applications. In this paper, the design technique is presented and examples provided. Being a fairly straightforward design method, this is a good way to introduce the topic before going to more advanced techniques such as the Parks/McClellan method which includes an option to also design FIR filters that do not possess symmetry characteristics.

Short Paper Session / 26

Assessing Change in Students' Value-Based Decision Making, through Case Study Analysis

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This project was intended for the Integrative Design Studios (IDS), the mandatory design spine course for students in the Bachelor of Science in Engineering (BSE). An active research agenda was to answer the question: "How do students' ability to engage in ethical behavior in design and problem solving change throughout the Integrative Design Studio (IDS) courses; before and after ethics lessons/activities (E/LA)?" Assessment from this iteration will be used to work on other E/LA in IDS and beyond. The E L/A was to fulfill the learning objective: to appraise the ethical implications of the products of the design process and employ social justice and ethical considerations in proposed solutions. Students reviewed a hypothetical case study in the beginning of the semester and were asked to evaluate ethical dimensions of the case. During the semester there were short learning modules related to value-based decision making. At the end of the semester students reviewed the hypothetical case study again and were asked to answer the same questions plus an additional question to further describe their approach. Hence the authors will report change in students' perspective, through their responses to the case study, which were presented before and after the learning modules. As a team, students were also asked to apply what they had learned in value-based decision making in the final report on their respective engineering design projects. The Daniels Fund supports integration of ethics in our Mines engineering education curriculum. This project was a Daniels Fund initiative, since a couple of the authors have earned fellowships to participate in this endeavor.

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Banquet Keynote

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Keynote Address By Dr. Anant Kukreti, Professor Emeritus at University of Cincinnati

Combined Poster Session / 56

Bitumen Storage System Automation and Control

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ABSTRACT
Granite Construction proposed a project to improve the offloading system at their regional asphalt plants. The current system for asphalt oil offloading at most of the plants consists of manual operated inlet valves and rudimentary level indication for the storage tanks. There is a large amount of risk involved with filling a storage tank with hot oil by manual operation. Overfilling the tanks could result in expensive inventory loss, property damage, and operator injury. Granite Construction has requested our team to design and implement a system that automatically controls the flow and level of liquid asphalt within the storage vessels.
The primary scope of this project consists of implementing horizontal tank level measurement devices and a valve actuator system to fit the needs of the project administrator. Radar level indication will be used to monitor liquid asphalt volumes in each tank. The radar data will be continually relayed to the control room by integrating into the existing SCADA system. The system will determine the appropriate actions to take, and actuated valves will be operated automatically. The system will be designed to react accordingly to emergency situations, actuator failures, and operator overrides. The economic viability of the project will be considered to justify construction of the system. Granite

Construction plans to install the completed system in many of their current asphalt plants. A rate of five systems per year is desired by the project administrator. Project cost analysis and internal rate of return will decide actual rate of future system implementation.

Active Engagement Session / 63

CS:Unplugged

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Computer Science (CS) is not programming, yet when we introduce CS to our broader community we talk about engaging our K-12 (and even collegiate) students in hour-long coding activities and other plugged in activities. This is akin to introducing engineering as playing with blocks without ever talking about the engineering design process. We highlight several unplugged activities for K-12 teachers.

Full Paper Session / 48

Capstone Projects in a Computer Engineering Program

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Abstract

As with many computer science and engineering programs, students of the computer engineering program at XXXXXXXX (XXX) conclude their degree programs with a semester capstone design experience. The intent is for students to utilize competencies developed in the first three years of the curriculum in the solution of an embedded design problem.

This paper discusses recent senior design projects in the area of embedded system design and wireless sensor networks in our undergraduate senior design course. Our senior design course is structured as a collection of independent student projects. This course is offered every semester. The students in the Computer Engineering program take this course during their last semester. Students either can come up with an embedded project independently or work on a project that is given to them by their advisors. Students write a proposal to define problems and identify solution approaches for their project and the hardware and software that is needed for their project. After several iterations, the advisor approves their project. The faculty adviser will meet with each student individually on a weekly basis at a regularly scheduled, mutually agreeable time. Students find this course both challenging and rewarding as they are required to design, build and troubleshoot a fully functional embedded project. These projects give the students the chance to use their technical expertise and knowledge gained during years of study. Students work very hard to have a working project by the end of the semester. These projects provide students many opportunities to engage in self-directed learning. They develop the ability to debug, seek and find information they need, and the ability to understand and reverse-engineer poorly written documentation. The students' feedback and their final project presentation indicate that they have pride in their project accomplishments and have gained confidence in their engineering abilities.

Full Paper Session / 58

Context Rich Differential Equations in the Engineering Core and SCALE-UP without Studios

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Student-Centered Active Learning Environments for Undergraduate Programs (SCALE-UP) are instructional models utilizing studio environments to support active and collaborative learning. While reasons for engaging student cohorts in this way are well documented, impediments may exist that keep an instructor from implementing this educational modality, e.g., classroom space, emphasis on lecturing, lack of appropriate activities. That said, if the average student learns best by defining meaning through experiential learning, then one possible way of mitigating SCALE-UP overhead is to leverage student learning groups outside of the classroom environment. To support the adoption of behaviors typical to students participating in a functioning studio environment, some instruction must be dedicated to educating students on those soft-skills supporting group function. In Honors Differential Equations at the Colorado School of Mines, students are asked to participate in group work, outside of scheduled classroom time, on context-rich problems emphasizing discussion, technical writing, and exploration of their own attitudes and values. In fact, contextualization of the mathematical content provides an excellent scaffold for these skill-building exercises. To support group function, students were asked to complete tasks based on curated instructional content focused on problem-solving strategies, meeting structure and design, and decision making. Additionally, to motivate individual reflection, students completed free-write exercises after reviewing material discussing meta-cognition, learning preferences and their relationship with learning, aspects of neuroscience relating to cognitive function, and mindsets. In this paper, we review the structure of Honors Differential Equations at Mines, some initial analyses of student work, and discuss whether the practice is useful and/or well-tolerated. Assuming both are true, the resources and workflows defined by this work may provide a good first-step for educators interested in SCALE-UP but lacking the resources necessary for its implementation.

Active Engagement Session / 16

Creating a “STEAM Team” for a First-Year Engineering Program Pilot Course

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Dr. Alina Handorean of the Engineering, Design, & Society Division and Dr. Olivia Burgess of the Humanities, Arts, & Social Sciences Division of the Colorado School of Mines will share their experiences and insights related to co-teaching a first-year course linking engineering design with writing, ethics, and the humanities. The presenters developed a highly effective teaching partnership that led to three years of intensive collaborative teaching and future plans to develop and co-teach other courses merging engineering with perspectives from the humanities. The presenters were originally paired by administrators, creating what Mary-Jane Eisen refers to in “The Many Faces of Team Teaching and Learning” as a “blind date” system that has the potential to lead to a “committed marriage” or “one-night stand.” Fortunately, the presenters developed a “committed marriage” partnership characterized by compromise, flexibility, and a shared pedagogical approach, along with a deep appreciation for what it takes to make a co-teaching partnership effective both in and out of the classroom. The presenters will offer their perspectives on the potential rewards of the co-teaching experience, as well as potential pitfalls to avoid along the way.

Short Paper Session / 24

Curriculum Needs for the Testing of Small Satellites

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The scope of activities in this area includes vehicles for space exploration, communication, tourism and national security. This trend is expected increase as nationwide there is a strategic focus on space. This focus has materialized recently by a call by the US authorities in favor of the creation of a separate branch of the military called Space Force in addition to the traditional branches of the Navy, the Marines, the Air Force, the Army and the National Guard. With this trend, demand for research, construction, testing and launch of space vehicles is expected to increase. More and better expertise will be needed for manufacturing and testing of the space vehicles in general and specifically for small satellites. Small satellites are defined as space vehicles in the range of 50-500lb (23-230 kg). While our university is well positioned in the manufacturing side of these small satellites, there is an opportunity for students and faculty to engage in the multidisciplinary testing aspects of these vehicles. Stakeholders from such collaboration include the university, the industry, the faculty and the students as well as the community.
The following paper describes the collaborative frame being put in place to address these needs. The specific needs are in the design, the advanced manufacturing and the testing of these small satellite aerospace systems and the anticipated impact on the curriculum.

Combined Poster Session / **47**

Decision-based Learning to Improve Research Skills in Engineering Students

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Knowledge has been categorized as conceptual, procedural and conditional. Simply put, conceptual knowledge emphasizes “the what” and “the why”; procedural knowledge, “the how”; and conditional knowledge, “the when” or “under what conditions”. A significant difference between experts and novices is the breadth and depth of experts’ conditional knowledge. However, most instruction emphasizes conceptual and procedural knowledge with little attention given to conditional knowledge. An instructional framework, called “decision-based learning,” has been developed wherein conditional knowledge and schema building are addressed explicitly and as first-order learning activities. A key method used in connection with the decision-based learning framework is “just in time, just enough” training, where subject matter is segmented into small, digestible pieces, and presented to the student at the time of need.
This framework is currently being implemented and tested in a variety of subject areas at the author’s institution and in other locations domestically and internationally. While application of the framework has included a diverse selection of subject matter, use of these methods within the engineering and technology disciplines has been limited. A pilot study involving engineering and technology students in an advanced writing course has been conducted to determine the potential benefits of using the framework during a one-hour information literacy workshop. A more formal study has commenced and will continue over the course of the next year.

This poster presents decision-based learning within the context of its application to information literacy for engineering and technology students, and shares results regarding the effectiveness of the approach. It considers the role of decision-based learning in increasing engagement in online learning and in helping students make decisions throughout the research process. Finally, it suggests other coursework within engineering and technology programs that may particularly benefit from this framework, based on study findings.

Short Paper Session / 49

Dimensions of a problems of that elicit requests for one-on-one help from students in a laboratory setting

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Each week, students in our Embedded Systems class work through a set of laboratory exercises. The goal of these questions is to prepare the students to complete the weekly programming assignment. As students work through these problems, they are welcome to solicit help from the lab instructor or teaching assistants. While we want our students to engage class by discussing ideas with their instructors, phrasing questions in such a way that they create questions that unnecessarily confuse students, creating the need for clarification from the lab instructor.

This paper seeks to investigate and identify dimensions of a problem that elicit questions from students in a laboratory setting. To do this, each lab question is classified according to its length, cognitive level, number of steps required to answer the question. The lab instructor has recorded the number of times the lab instructor is required to answer. We will provide the correlation between these dimensions and the number of times students requested one-on-one help for that question. The goal is to write laboratory questions which reduce the number of times that the lab instructors and TAs are required to answer one-on-one questions.

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Engineering & Education Keynote

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Keynote from Dean Pishko (College of Engineering and Applied Science) and Dean Reutzel (College of Education)

Short Paper Session / 33

Evaluation of an Early Exam on Student Performance in Engineering Mechanics: Statics

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Engineering Mechanics: Statics is the gateway course between freshman level physics/calculus courses and the Engineering Mechanics series and thus serves a pre-requisite for many upper division courses in most engineering majors. Helping students find success in Statics is a paramount to encourage them to build academic confidence that will carry them through their upper division courses and beyond. To help them obtain this success in Statics, we have added an early exam during the fourth week (of a 16 week semester). This early exam is a quarter the length and value of the midterms and final, but is rigorous with a parallel structure to the three other exams. The main goals for the early exam are to help students: (1) identify and establish their learning structure for

the future study and exams, (2) better understand the course rigor, (3) get familiar with exam policies and format, and (4) identify where they stand in the class. This paper examines the effect of the early exam on the subsequent mid-term exams and overall course grade. Additionally, it discusses additional assessment of the effects of the early exam.

Short Paper Session / 15

Evidence that Adaptive Online Textbook Utilization May Lead To Higher Grade Performance

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The new generation of online college textbooks (e-Texts) usually include several tools to help track student performance. However, at this early stage of the technology, it is still unclear what benefits (or detriments) e-Texts provide to students. Furthermore, it is unclear what the best implementation practices might be for faculty who may have e-Text options. This study investigated how the time students spent reading an e-Text impacted their overall grades in a freshman mechanical engineering course. The course in question, MECH105: Problem Solving, is required for all Colorado State University freshman. Data was collected on the amount of time students spent with assigned e-Text readings. The average amount of time students spent reading the textbook throughout the semester was 354.8 mintues. Students were split up into two populations, low time commitment (LTC) if they spent less than the mean time reading and high time commitment (HTC) if they spent more than the mean time reading. Results indicate that the average overall grade for HTC students was 86.3% which was statistically significantly higher than the average overall grade for the LTC students which was 83.4% ($p = 0.0404$). The author acknowledges several limitations with this study and welcomes discussion. The first limitation is that the time statistic may not accurately represent student effort towards reading. It is impossible to know if students were actively reading or simply had a web browser tab open. Secondly, it is the authors opinion that the median time of 343 minutes reading throughout the semester is dissapointingly low considering there were 15 chapters assigned. This equates to approximately 23 minutes per chapter. However, this short study does indicate that students who spend more time reading e-Texts are likely to score more points overall.

Combined Poster Session / 54

First Year Engineering Success Seminar for Multiple Campuses

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CLEN 001 (Engineering Student Success) is a course originated for first generation college students who received the university (Regents) scholarship, and are required to take a success seminar their first year at Texas A&M University. The class is also taught in Galveston and McAllen as there are Regents scholars on those campuses as well. As of 2018-2019 school year, the course was expanded to include helping students with low math scores. In addition, the course also expanded to remote campuses where we have a few hundred academy students taking their introductory courses. Fall 2018 had 37 sections with 1,356 students enrolled across all campuses. Once the course started to reach further than the College Station campus, there was a large need to create content that would be consistent throughout each classroom which is why the course started to work on an eCampus presence. Resources on the College Station campus are available for all these students to use since

many of the other campuses do not have them available, however; the accessibility of them is hard for the students located more than 30 minutes away from the campus which is over 600 students on just the Galveston and McAllen campuses alone.

Active Engagement Session / 25

Follow the Yellow Brick Road: Advising – A Roadmap to Student Retention

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The purpose of this active engagement session is to offer participants an opportunity to engage with advisors from the CEAS Advising Center to explore the opportunities professional advising creates for engineering students and faculty. Imagine being Dorothy from the Wizard of Oz, waking up in an unfamiliar place with no landmarks, no friends, no IDEA of where you are and how to get somewhere else. This is probably what it feels like for many first-time UW students—freshman, transfer, and non-traditional students alike.

UW previously utilized a faculty-based advising model. A review of advising best practices across universities indicated using professional advisors and faculty mentors provided the best advising experience for students. As a result, the Centers for Advising in each academic college were instituted in the Summer of 2018. These Centers are linked by a common cause: providing comprehensive advising for every student on the University of Wyoming campus.

Professional academic advisors were hired and placed in the Centers to assist students in navigating their educational experience. These advisors compliment the faculty by consistently completing the paperwork tasks, providing more access to the student body, and a more holistic approach to advising.

Across university campuses, advising is recognized as a unique role in higher education (Cook, 2009). There are as many definitions of advising as there are munchkins in the Oz. For this presentation, we will say "advising is a tool that contributes to the institutional mission for student success (NACADA Journal, Volume 38(2), 2018).

Many students enter college totally unprepared for the college experience. Lenning, Beal, and Sauer (1980) indicate that approximately 50 percent of an entering freshman class at a four-year college will remain by the end of the fourth year. Professional advising will lead to better student retention and graduation rates as well as offering opportunities for more in-depth faculty mentoring.

Full Paper Session / 45

Formula SAE as a Capstone Design Course at the U.S. Air Force Academy

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The U.S. Air Force Academy (USAFA) uses the intercollegiate Formula SAE (FSAE) competition as a year-long capstone mechanical engineering course project choice for students. This student design competition has become the preeminent international test of engineering prowess for engineering students. The authors are currently FSAE capstone team advisors and have been previously involved with FSAE as students at both military and civilian institutions. The capstone program in the Department of Engineering Mechanics at USAFA is briefly described with an overview of the department's FSAE project choice. The FSAE student design competition is described. Historical performance

comparisons are made between the FSAE teams from the only two U.S. military academies that participate (Air Force and Navy) in the competition. Anecdotal "lessons learned" and challenges are addressed from the perspective of the USAFA team advisor. Topics such as funding, evaluation, mentoring, schedule, designing, building, testing, recruiting, the actual competition event, morale, and team continuity are individually addressed. The historical pedagogical advising approach is summarized for the
USAFA team. Newly proposed pedagogical approaches for structuring the FSAE team advisory and faculty support methodology within a larger capstone curriculum are discussed, with two specific goals: (a) to better align and integrate into the department's capstone curriculum and
military environment, and (b) to improve the team rankings and the overall student project experience. The perspective is from authors in established FSAE team advisory roles with
ongoing institutional support, although many of the topics apply to newly formed teams and new faculty advisors as well. The specific recommendations and discussions that are presented here are advisory program management centric and thus automotive vehicle design agnostic (i.e.non-technical).

Combined Poster Session / 51

Fueling Cybersecurity Interest through Authentic Experience, Competition, and Teamwork

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Students rely largely on class lectures and assignments to refine their skills and prepare themselves for their future careers. However, success in the workplace depends on each individual's ability to transfer their academic knowledge to professional occupations. The opportunity for authentic experiences, specifically modeling real world jobs, enables students to learn important skills through hands-on practice. These experiences allow students to learn common pitfalls and complications before they start working for a company. In cybersecurity, this could mean the difference between defending a company's system against intruders and a security breach. With security threats becoming more prevalent and increasingly complex, professional success hinges on the ability to refine student's skills in a controlled environment before they enter the workforce. Cybersecurity competitions provide these controlled environments and facilitate learning. Crucial to students preparing for their future careers, cybersecurity competitions garner student interest, get students involved in extra research opportunities, and bring enjoyment to tasks that would be difficult to learn on the job. Additionally, competitions empower students to balance education and experience and empower companies to hire applicants with a mastery of complex subject matter as well as real world experience. Competitions help students see who they will be competing against for jobs in the future and show students where they have room for improvement. Our research lab has found that students involved in competitions are more interested and more involved in cybersecurity and better equipped for the workplace

Active Engagement Session / 39

Hands-on microcontroller workshop for grades 6-12

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We are frequently asked to give hands-on STEM workshops to visiting K-12 students. This paper describes a one-hour workshop aimed at grades 6-12 that gives participants a taste of basic electronics and computer engineering. The challenge was to come up with meaningful and interesting activities that could be completed in 40-60 minutes. The result is a two-part workshop in which participants start with simple experiments in electricity and go on to build a game-playing computer.
Part one introduces concepts of current and voltage and introduces a few simple components such as coin cell battery, resistors, LED, pushbutton switch, and photoresistor. The operation of each component is discussed while students experiment with them using simple breadboard circuits.
Part two of the workshop introduces the idea of a microcontroller and discusses how it expands what can be done with simple components. The pushbutton switch and photoresistor take on new roles as sensor inputs. Computer software makes decisions based on sensor inputs and then acts on the world by controlling outputs such as LEDs. The software is preprogrammed on provided microcontroller chips.
The completed circuit runs one of two selectable games: Whack-a-Mole and Simon Says. A simple modification transforms the circuit into a light meter that indicates ambient light conditions. The cost of the parts is minimal (about $3-4), allowing us to send a working kit home with each participant.
This ASEE workshop will be of interest to anyone interested in learning some basic electronics but is also geared toward educators wanting to offer their own similar workshop. Information is provided about where to source parts, how the software works, and how to upload the software onto microcontroller chips.

Full Paper Session / 40

Implementing a Unified Science Course

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Abstract

H.E.M. Jr/Sr High school has developed a course entitled “Unified Science” to its upperclassmen. The course integrates concepts from agriculture and science curricula and is co-taught by the school’s high school agriculture and science teachers. The course has taken a place-based approach in which students consider the economic and environmental impact of industries invested in their community and engage in progressive problem-solving tasks related to said industries. These tasks often include the engineering process and employ technology such as computer science, 3-D modeling and printing, prototype construction, and consolation with industry partners in the community. This proposed paper will focus on the experiences of students and teachers who have participated in this course over that last three years. The accounts will include the noticed benefits of integrating the two content areas, some trial-proven elements for success in initiating such a course, and some insight into implementation strategies. The benefits to teaching and learning in a cooperative environment include: enriched relevance and rigor, enhanced connection among diverse content, inquiry-based instructional style, enriched teacher and learner creativity, amplified teacher enthusiasm and accountability, and diversity of teacher and student perspectives. Some essential elements for success to explore before unifying courses in your school and integrating progressive approaches to engineering concepts include the following. Schedules should provide a common planning time within the school day. Teacher buy-in, patience, creativity, and commitment to the development of the course is ideal. Funding & community resources will be crucial to the progress of the course. Teachers will need to commit to various professional development opportunities and garner the support of administration. Finally, for an elective course to sustain itself, it must maintain minimum levels of student enrollment which can be achieved through recruitment and retention efforts. Finally, a road map for implementation will be provided including course design models, suggested course content, instructional methods, and potential teaching recourses.

Full Paper Session / 14

Incorporating Research Data Management into an Existing Graduate Course on Theory and Methods of Research

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Training and practical knowledge in Research Data Management (RDM) is a mandatory need for today's researchers. Thus, graduate school, when students are focused on research is the time to obtain this education. To address the RDM need of graduate students, several approaches have been taken from workshops to stand-alone courses. The content of these approaches varies from the high-level RDM coverage of a short workshop to the practical experience of developing a full Data Management Plan (DMP) during a course. However, the literature indicates that a one-size fits all approach isn't required as students balance their RDM needs with the time required to obtain the training and knowledge.

As a middle approach between workshops and full courses, RDM was incorporated into an existing required graduate course on the Theory and Methods of Research. Thus, all students in the program would be exposed to some preliminary concepts and practices in RDM. Depending on the student's needs, they can then obtain additional RDM exposure through subsequent stand-alone workshops or full courses. Material from a recently developed semester-long RDM course was used to deliver three lectures on: 1) RDM and Sharing Mandates, 2) What is Data? and the Data Lifecycle, and 3) Planning for Your Research Project and DMPtool. This provides the students with the big picture requirements along with practical education on data, the data lifecycle, data in your research project, and using DMPtool to develop a DMP. Motivation for and details on these three lectures will be provided. Lessons learned and proposed modifications to these lectures will be discussed.

Full Paper Session / 21

Innovative Hands-on Teaching Tools Inspiring Upcoming Petroleum Engineers and K-12 Students

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Petroleum is a challenging engineering discipline since things happened millions of years ago and located miles away into the earth. Teaching petroleum engineering to college students require using innovative teaching tools. Teaching high school students and non-technical audience calls for more creative educational tools. These tools include 3D-printed oil and gas filed equipment. This also includes hands-on experiments that tell the story of oil and gas all the way from generation to production. In addition, this includes a state-of-the-art drilling simulator that can be used to re-drill wells in Wyoming. This simulator is coupled with a virtual reality snapshot for an actual drilling rig located in the 3D visualization center (CAVE).
Students education improved significantly when these tools were utilized starting in August 2017 at UW. Evaluation showed that more college students were able to develop deeper understanding and to advance their knowledge. Furthermore, the outcome of these tools was outstanding in summer 2018 during the Wyoming Energy for You course to high school students from around Wyoming. One student described his experience as "My learning experience has definitely becoming better, and I have already learned more than I expected. I learned how to use a simulator, and the basics that go along with that. As well as learning in depth things surround the career of petroleum engineering, by having many useful hands on activities". Also, in one of the elementary schools visit, a student in fourth grade descried his experience as an epic.

In conclusion, utilizing these innovative hands-on teaching tools proved to inspire the upcoming petroleum engineers and K-12 students. It is highly recommended that petroleum engineering instructors utilize these tools in their challenging courses and in K-12 outreach events.

Active Engagement Session / 19

Integrating Ethics and Societal Impacts into Engineering Courses: Opportunity to Develop Actionable Ideas

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This active engagement session in the collegiate track will focus on the integration of ethics and societal impacts (ESI) in engineering education. Ethical reasoning and an understanding of the social and environmental implications of engineering and technology are important skills for future professionals. The acceleration of technology and interconnectivity of globalization necessitate engineers having these technical and professional competencies. Despite this motivation, engineering faculty face challenges in infusing ESI into their courses such as a lack of training and expertise and limited time in a dense curriculum. This session will help educators address these challenges and realize the potential of teaching ESI in their own courses. The facilitators will introduce participants to results from an ongoing National Science Foundation (NSF) project on ESI education that is synthesizing perspectives from faculty, students, and alumni and conducting in-depth explorations of integration practices in engineering courses across the Unites States. ESI is inclusive of a broad range of topics that are relevant to all engineering disciplines and subjects and can be taught and assessed with a variety of methods. The active engagement session will provide the opportunity for participants to think of topics, teaching approaches, and assessment techniques that they can include in their courses. In the introductory part of the session, participants will be asked about the courses they teach in which they are considering integrating ESI. The facilitators will then leverage those interests and address those needs. The interactive session aims to provide actionable ways for participants to integrate ESI while collaborating with each other and the facilitators to generate ideas and strategies.

Short Paper Session / 38

Introducing Physical Computing in STEM Professional Development Workshop for K-12 Teachers in the State of Wyoming

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In this paper, we describe a professional development workshop model for K-12 teachers on the use of physical computing for teaching STEM topics to K-12 students in the State of Wyoming. We aim to introduce elementary, middle and high-school teachers to computer programming with physical outcomes known in general as physical computing. The physical outcomes are focused on various topics of STEM. The workshop titled Engineering Summer Program for Teachers (ESP4T) consists

of two weeks of activities in the summer and year-long communication exchanges between K-12 teachers, undergraduate students, and faculty at the University of Wyoming. The focus of the ESP4T workshop is to train teachers on programming Arduino microcontroller and Raspberry Pi computer interfaced with sensors used in various topics of STEM. The first week of the workshop is offered online with a focus on introduction to basic programming concepts using different programming languages suited to elementary, middle and high school levels of teaching. The following week at the University of Wyoming campus, the participants of the workshop are exposed to physical computing with a focus on developing classroom modules on topics in the areas of STEM for use during the academic year. The feedback received from teacher participants over the past three years of workshops has provided insight to the use of computer programming in STEM topics by K-12 teachers and has given future direction for changes to be incorporated in the upcoming version of the workshop in summer 2019.

Combined Poster Session / 32

Introduction to Engineering for High School Students through an Engaging Program of Hands-on Exploration and Discovery

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This paper describes the University of Wyoming's Engineering Summer Program (ESP) for rising high school seniors. This program was established in 1988 and continues to inspire participants to pursue engineering education and engineering careers.
"ESP assured me that I really want to be an engineer, and it helped me decide what career I want to do, and how I want to approach it." - ESP Participant

The mission of the Engineering Summer Program is to provide an opportunity for top, regional high school juniors to explore the field of engineering, the College of Engineering and Applied Science (CEAS), and the University of Wyoming. ESP's goal is to recruit gifted students to the CEAS at the University of Wyoming. ESP provides an environment that encourages students to work directly alongside UW faculty members while simultaneously becoming acquainted with the university's campus. Students develop a personal connection to the University and are able to envision themselves attending
the University of Wyoming. Throughout the week-long residential program, students explore various fields of engineering. They participate in a series of courses offered by CEAS faculty from the Departments of Computer and Electrical Engineering, Civil and Architectural Engineering, Computer Science, Mechanical Engineering, and Atmospheric Science. Students also visit a variety of regional engineering sites and interact with professional engineers who are active in the workforce. Participant feedback has been very positive and continues to validate the mission and goals of the Engineering Summer Program.

Short Paper Session / 61

Making Multi-Cultural Experiences for Engineering Students a Reality

Jennifer Tanner Eisenhauer[1] ; Mary Katherine Scott[None] ; Shelley Jewel[None] ; Jorge Varela[None]

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As our world becomes more global, it is increasingly important to expose students to multicultural experiences; however, this is tough to manage when fitting a variety of technical classes within a degree program. Furthermore, engineering students like to optimize their studies to take as few classes as possible. Recent changes at the University of Wyoming (UW), have helped to make short-term study abroad experiences more common place. This paper presents the results of a vigorous effort to activate a study-abroad experience between two partner universities, Autonomous University of Yucatán (UADY) and UW. Funds from a "Partners in the Americas" grant were used to prepare a short class on masonry for six students, a professor, and the Dean of Engineering from UADY. A fundamental part of this visit was to discuss and collaborate on methods to remove barriers to studying abroad. Six months later a class was developed to bring eleven students from UW to Merida for a class titled "Culture and Engineering of Ancient Mexico". A few introductory lectures and meetings were used to help prepare students for the experience. The class was very well received and mobility has increased. Unfortunately, few students have the language skills necessary to spend a semester abroad studying primarily in Spanish. To resolve this issue, the Global Exchange Program is working to recruit students studying degrees in the humanities, specifically Spanish, to attend UADY.

Full Paper Session / 43

Motivating Engineering Students: Simulation versus Real-Time

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After many years of practicing, reading and writing about signal processing education, we have observed some common themes. This paper discusses the trade-off of simulation versus the use of real-time processing on real-world signals as a motivator for signal processing students. A real-time DSP demonstration accompanies the presentation of this paper.

The authors have been highly involved in signal processing education for over 20 years. Over that time, we have written many papers (at ICASSP, ASEE, and other venues) that have described our various lessons learned, projects that worked well, and described many tools that we made freely available to educators [1-26]. In all of those years, our fundamental goal of maximizing student engagement has not changed.

We believe that if students are truly interested in a topic, not only will they pursue course knowledge, but they will regularly exceed our educational expectations. This belief has been confirmed over and over with our students at multiple institutions.

Most professors agree that interactive learning, exercises, and demonstrations are invaluable for helping students understand a given concept [22, 27-32]. We've come to believe that even more effective than demonstrations where students sit passively are actual hands-on exercises and projects [2,3,9,10,15,17,23]. We even provide a book and a website that supports hands-on projects [33, 34].

In our opinion, the hook that metaphorically reels the students in is working with real-world signals, preferably on real-world hardware. This is what industry does, and a significant number of our students will go on to work for industry.

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Opening Keynote

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Keynote by ASEE Vice President of Member Affairs Gary Steffen - Director School of Polytechnic / Purdue University Fort Wayne

Full Paper Session / 46

Patterns in Middle School Snowfall and Rainfall Measurements

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This university outreach project started with an email from a colleague who was offering two automatic precipitation gauges. The gauges originated from a well-known vendor and were only a few years old. We accepted the offer, configured the gauges to communicate with a computer, developed analysis and display software, and inquired in the Laramie K-12 community to see if there was interest in collaboration. The Laramie Middle School (grades 6 to 8) accepted. Four years on, the collaboration has addressed the following topics: (1) the atmospheric side of the hydrological cycle (i.e., rainfall and snowfall), (2) the development of a meteorology curriculum at Laramie Middle School, (3) student involvement in the precipitation measurements, and (4) analysis of patterns in precipitation and temperature data recorded at the middle school. These activities address many of the Next Generation Science Standards for weather and climate curricula in US middle schools. One of the patterns is that larger temperature is associated with larger peak precipitation rates and vice versa. This result conforms with meteorological theory and is consistent with analyses conducted by professionals using state-of-the-art instrumentation deployed at numerous sites across the globe. The significance the temperature-peak precipitation relationship is threefold: it improves understanding of how the hydrologic system can potentially respond to global warming, how changes in the hydrologic cycle can feedback into global warming, and how engineers design infrastructure for changed precipitation in a warmed world.

Combined Poster Session / 20

Rubric Assessment of Ethics and Societal Impacts Content of Student Assignments

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It is important that engineering students graduate with the "ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which consider the impact of engineering solutions in… societal contexts" [ABET Criterion 3 Student Outcome (4)]. One way that programs can document achievement of this outcome is using a rubric to assess student work. In this work we evaluated the extent to which a standard rubric could be successfully applied to assess a range of assignments. The *Pittsburgh-Mines Engineering Assessment Rubric* (2003, Shuman et al.) includes five categories measuring student's abilities on a 1 to 5 scale: recognition of dilemma,

argumentation, depth of analysis, perspective / fairness, and resolution (judgment). We also developed three additional categories based on the motivation cycle of Vanasupa et al.'s *Four Domain Development Diagram*, exploring evidence of autonomy, value, and interest around ethical issues. These rubrics were applied to five different student assignments (ranging from a half to 10 pages in length) from four different courses. Depending on the prompt, some categories of the rubric could not be reliably applied. For example, one prompt proposed to students a scenario where genetic engineering technology was available to society, and asked them to discuss ethical/societal issues or disruptions to I) values and ways of living, II) subsistence, III) freedom and autonomy, and IV) existence. This prompt made it more difficult to gauge student's abilities to recognize a dilemma, but a wide range of ability to provide supporting information and analysis in their argument was evident. This poster will provide educators with ideas for assignments that allow students to demonstrate a range of abilities and motivation around ABET outcome 3(4).

Full Paper Session / **44**

Scaling Up: Challenges and Lessons Learned During Implementation of Phase Two of an Academic Makerspace

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In 2017, the University of Wyoming (UW) College of Engineering and Applied Science, together with the UW Libraries and the UW IT department, unveiled a temporary experiential learning makerspace in the largest campus library. This Coe Student Innovation Center (CSIC) makerspace —the first phase of a broader makerspace initiative at UW – was designed to explore student and community interest in a budding maker movement in southeast Wyoming, and to gauge whether such a center would be a useful and regularly utilized addition to campus. Almost two years on, and with more than 5,900 visitors to date, 218 events hosted, and a 185% rise in usage from year to year, the CSIC has proven very successful, enabling the University to not only green-light the planned transition of the makerspace from its temporary location to a permanent home in the new Engineering Education & Research Building , but also to maintain the current CSIC space as a K-14 outreach facility and introductory makerspace. This paper sets out to provide a useful guide to other makerspaces or experiential learning centers as they prepare to transition from phase I (inception and early development) to phase II (significant growth and development of established policies, protocols, usage, and instruction). The paper discusses the challenges and lessons learned during the planning and build-out of a campus-wide makerspace network, and lays out the steps necessary to enable both facilities to expand in scope, maintain active, engage userbases, share policy and ideas, and collaborate together effectively.

Full Paper Session / **37**

Six Sigma for All Engineering Students

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Whether employed in design or manufacturing, all engineers must consider issues related to quality: quality of design and quality of production process. At CSU-Pueblo, students majoring in mechatronics and in industrial engineering take a sequence of two courses in probability and statistics and Six Sigma. Upon successful completion of the two courses (with grades of B or better) students are awarded a Six Sigma Green Belt certificate.

This paper will describe the justification for requiring all engineering students to take these courses, detailed contents of each course, and the methods of teaching this course using in-class activities.

Even if primarily working as a design engineer, Design for Six Sigma gives important guidance; also design engineers must design for manufacturability. All engineers working in production must be familiar with concepts of continuous improvement, especially statistical methods for finding root causes, reducing variability, and improving process capability.

Based on knowledge of the binomial, Poisson, and Normal distributions and of the Central Limit theorem, engineering students learn how to determine if a process is in control and if it is capable of meeting specifications, how to design and analyze experiments to determine factors that affect variability, how to analyze a measurement system, and how to maintain control of the improved production system.

In class exercises on Six Sigma tools (brainstorming, FMEA, DMAIC, etc.) and on statistical techniques (using randomly generated data in Minitab) give students a good foundation to apply Six Sigma in many production settings.

Full Paper Session / 53

Summarizing the Use of Knowledge Surveys to Inform Effective Learning and Teaching Practices

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It is widely understood that students' ability to self-assess their own learning is a key component in their effectiveness as lifelong learners. When students are skilled in their ability to identify what they do or do not know, they are better able to learn independently. One method for both encouraging and quantifying a student's ability to self-assess is the use of knowledge surveys. Knowledge surveys are a series of questions that require a student to assess their ability to perform a task, but do not require them to actually complete the task. Knowledge survey results can then be compared to an instructor's assessment of the student's learning (e.g. an exam or design project) to evaluate a student's ability to self-assess. The literature suggests that knowledge surveys are effective at all levels of Bloom's Taxonomy. This paper focuses on results from knowledge surveys implemented across several 3rd and 4th year required and elective courses for civil engineering majors at the United States Air Force Academy. Results from these surveys are grouped by Bloom level and conclusions are drawn regarding the students' ability to self-assess at each level. Results indicate that while students are reasonably good self-assessors at all levels, there may be greater variability at higher Bloom levels within the cognitive learning domain. This study further underscores the importance of proper alignment between the lesson objectives, lesson material, and assessment method. Included in this study is a summary of how results from knowledge surveys have been used to adjust and evaluate effective teaching practices.

Active Engagement Session / 65

Talk, Listen, Discuss and Collaborate

Come together during the final session of the conference to talk about your key takeaways, listen to others, have conversations and build your collaborative networks! This is an open session with no primary author affiliation.

Active Engagement Session / 41

The LIFT Project: High-Altitude Ballooning Opportunities for K-12 Science Education (Team 1)

Author(s): Philip Bergmaier[1]

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For the last five years, the Wyoming NASA Space Grant Consortium (WSGC) has conducted a successful high-altitude ballooning program for K-12 teachers and students across the state. Through this program, students develop their own scientific payloads – taking into account space, size, and weight limitations – and launch them to near space with high-altitude balloons. Online software allows them to track the trajectory of the balloons and monitor atmospheric conditions (i.e., temperature, pressure, humidity, wind) in real time. Following the launch, many teachers and students also participate in payload recovery. These launches are typically single, one-off events designed mainly to generate interest in STEM. Thus, while they provide great hands-on experiences for the teachers and students, the science content tends to be rather limited.
To help address this, two teams of UW undergraduate student participants in the WSGC's LIFT Project (Learning to Integrate Fundamentals through Teaching) have been developing new citizen science scientific payloads and curriculum for high-altitude ballooning. These small-scale projects will eventually be made available for K-12 teachers to use for their own launches. During this activity session, undergraduate participants from one of the LIFT teams will showcase one of the ballooning projects currently in development. In particular, they will provide a hands-on demonstration of how the project is carried out in a K-12 setting, discussing the payload items, pre- and post-launch curriculum, and data analysis. Ultimately, they will show how their project seeks to further engage K-12 students in STEM learning and improve the science content of the WSGC ballooning program.

Active Engagement Session / 42

The LIFT Project: High-Altitude Ballooning Opportunities for K-12 Science Education (Team 2)

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For the last five years, the Wyoming NASA Space Grant Consortium (WSGC) has conducted a successful high-altitude ballooning program for K-12 teachers and students across the state. Through

this program, students develop their own scientific payloads – taking into account space, size, and weight limitations – and launch them to near space with high-altitude balloons. Online software allows them to track the trajectory of the balloons and monitor atmospheric conditions (i.e., temperature, pressure, humidity, wind) in real time. Following the launch, many teachers and students also participate in payload recovery. These launches are typically single, one-off events designed mainly to generate interest in STEM. Thus, while they provide great hands-on experiences for the teachers and students, the science content tends to be rather limited.
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Combined Poster Session / 64

The WGU Faculty Model

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Western Governors University (WGU) is an accredited online university with a 2017 total enrollment of 91,436 and the College of Information and Technology (COIT) enrollment is 13.272. Seventy-four percent of students are pursuing undergraduate degrees. The typical student is 37 years old and works full time, and 71% of students are part of an underserved population (first-generation college students, ethnic minorities, low income and rural area residents).
The 3,423 faculty at the WGU follow a disaggregate model with Program Mentors directing students through their degree, Course Instructors supporting the course as Subject Matter Experts, and Evaluators reviewing papers.
This poster will present details of the disaggregated model and results of student and employer surveys.

Combined Poster Session / 31

The experiences of women in engineering

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Women remain disproportionally represented in leadership positions and in academic disciplines including science, technology, engineering and math (STEM). This gender disparity is a primary concern for researchers and administrators because it has a direct impact on student learning and the potential for advancement in research. In concert with this concern, this literature review explores the barriers faced by women in engineering that contribute to the persistence of gender inequity in the field. The organization of this review begins with an exploration of why this topic matters and how gender diversity has transformed over time. This cultural and historical context provides a foundation for exploring the internal and external challenges that women encounter today when

making academic and professional career advancements. Further research is required to explore the personal narratives of women in engineering as a method for better understanding the repercussions of the existing academic culture.
Over the course of the Spring 2019 semester, I plan to interview 3-5 women who are currently pursuing degrees in engineering. My goal in conducting these interviews is to gain insight to the experiences of undergraduate women in engineering at the University of Wyoming. I hope that the findings from my research will provide direction for developing meaningful programs and initiatives that help create a learning culture that is inclusive and inspiring.

Active Engagement Session / 27

Understanding the new hands-on learner

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Having students create and build an artifact during their educational journey is a powerful instructional method with many positive outcomes. This hands-on session aims to reintroduce participants to this experience and compare their reflections to those of students who participated in a similar experience.

During their first week in the Microcontrollers class at the Colorado School of Mines, students are required to solder together a complex development board. After completing the assignment, students reflect on this experience in an essay that includes listing their initial concerns, problems or insights while soldering, and things that they would have told themselves before starting.

This active engagement session will require participants to solder some components onto a simple circuit board. Afterwards participants will reflect on their experience using the same reflection instrument used in the Microcontrollers class. The session will close by comparing the participant's reflections of this experience to our students.

The session moderator will bring supplies (tools, safety equipment, and circuit elements) required to assemble 10 circuit boards at the same time. The conference venue would need provide 10 electrical outlets (100 Watts each), and hard stable surface (about 36" wide) for each participant to work on. Participants would keep their assembled circuit board.

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Welcome - Opening of Sessions - Keynote

Corresponding Author(s):

Welcoming Keynote Address by Dr. Laurie Nichols, President of the University of Wyoming

Active Engagement Session / 30

What is effective teaching? How do we define it and how do we measure it?

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Within higher education, assessing effective teaching is important to ensure that students are receiving a high quality education that prepares them for their future careers. Additionally, evaluations of effective teaching are an important component in the tenure process for faculty members. In many settings, student evaluations of teaching are the primary measure of teaching effectiveness. However, student evaluations 1) measure perceptions that may or may not align with the effectiveness of the instructor, 2) are often difficult to interpret, and 3) can be influenced by biases. In this interactive session, participants will explore additional measures of effective teaching beyond student evaluations that can provide a more holistic evaluation of teaching.

This session is intended to foster dialogue between faculty members, administrators, faculty developers, and other stakeholders in academia to gain a shared view of effective teaching in higher education and to identify opportunities to measure various aspects of effective teaching. During the session, participants will define effective teaching, examine how their institution currently measures effective teaching, and identify additional opportunities to collect evidence of effective teaching. By the end of this session, participants will synthesize a definition of teaching effectiveness and align measures of effective teaching with that co-created definition.

Full Paper Session / 13

Work in Progress: Developing an Undergraduate Theory and Methods of Research Class for Honors Students

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Our institution has focused on expanding the Honor's College experience in an effort to improve recruiting and retention. Within the Engineering College, the goal is to focus the Honors experience on undergraduate research with an aim of broadening research opportunities and competitiveness of student applications for summer research programs, NSF REUs, internal/external research funding applications, participation in undergraduate research conferences, and preparing the students for graduate school. Historically, many students have received credit for completing undergraduate research, but this is often a "stand-alone" course with no additional preparation and ill-defined outcomes. In an effort to improve the undergraduate research experience, we will be initiating a Theory and Methods of Research course for the undergraduate Honors students as pre-requisite for undergraduate research during the Fall 2019 semester.

The course will be broadly focused by providing a general approach to research and graduate school preparation. Course topics will include: finding a research mentor, literature search skills, using the scientific method for approaching a research problem, developing a research methodology, writing a funding proposal, delivering a research presentation, and selecting and applying for graduate school. This presentation will present the motivation for this work, course details, learning objectives, course schedule, and course assignments. In addition planned assessments and student outcome tracking for the course will be presented.

Short Paper Session / 35

Work in Progress: Examining the Formation and Effects of Student Interactions on Engineering Course Performance using So-

cial Network Analysis

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This work in progress paper describes a mixed-methods research study to develop and disseminate new understandings relating the effects of student interactions with peers and course materials to performance in engineering courses. Previous research has shown regular peer-to-peer interaction can positively influence engineering student performance. The current study is conducted with students enrolled in a large (100+), required second year engineering course. This study uses social network analysis (SNA) and qualitative content analysis (QCA) to examine student interactions. Results of this study will be used to develop practical recommendations for promoting and supporting effective student interactions with peers and course materials.
Researchers use SNA to quantitatively assess traditionally qualitative interaction traits. Specifically, the frequency, reciprocity, and quality of interactions between members of a group are described mathematically through quantities known as SNA measures. In this study, we will identify correlations between SNA measures, including degree centrality, group/sub-group density, PN centrality, and student/group course performance. QCA will be used to analyze textual data depicting actual student interactions in small groups that naturally form within the course.
In accordance with an approved IRB protocol, mixed methods data collection is currently being conducted via open and closed ended online student surveys and direct observations of student small (<10) groups. To date, the initial survey (survey 1) was used to identify student intended interactions in the course. Follow-on surveys will be distributed to identify student interaction quantity (survey 2), quality, and motivation (survey 3) longitudinally throughout the course. Transcribed video/audio recordings of student small groups will be used to triangulate survey data and to deepen understandings of small group formation and evolution. Preliminary results describing student barriers to forming peer groups, students' anticipated interaction levels with peers, and usage levels of curricular tools at the start of the course will be presented.

Active Engagement Session / 28

Wyoming Energy For You

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Do you know that the world we live in is dependent on energy from natural resources, mostly oil and natural gas? Do you know that Wyoming is ranked number two in the US for total energy production, number four in natural gas reserves, and number eight in crude oil reserves?
In this active engagement session, you will discover the story of Wyoming oil and natural gas, where did it start, and where it is going. You will also explore the story from oil and gas generation, exploration, drilling, production, to processing. You will participate in educational hands-on activities including investigating different energy resources. This also includes learning about reservoir rock and fluid properties. In addition to performing fun experiments on how to explore for oil and gas, drill vertical and horizontal wells, produce oil and gas naturally or with pumps, injecting CO2 to improve the oil and gas recovery while cleaning the environment, and finally participating in the peak oil game.
Join us for a hands-on adventure, exploring Wyoming energy potential!