Draft Program OHIO PKAL 2018

Promoting Effective Learning in a Diverse STEM Environment

Note: This is a first draft of the program for the conference. It is subject to change. A final version will be posted closer to the conference. If you notice any errors in the program please bring them to the attention of t conference chair Mark McNaught at OH-PKAL@aacu.org.

Plenary Session

Promoting Effective Learning in a Diverse STEM Environment: Hidden Factors That Undermine Your Success

Melvin Hall (Northern Arizona University)

Broadening participation programs and services are typically organized around a theory of change and logic model that benefit from being "**evidence-based**." Today funded projects also typically have an **evaluation** component mandated; some even requiring use of a design from the ***What Works Clearinghouse***. In addition, the literature urges us to develop interventions that are **culturally relevant** and **responsive**, and deploy them in academic settings that are **inclusive**. **Formative** and **summative** evaluation efforts are put in place to inform us about **outcomes** and ultimate **impacts**. Could there be important factors we miss even with these progressive practices?

This presentation will focus on thinking evaluatively, guided by important considerations that can help uncovers hidden assumptions that have the potential for undermining project impact, and may even foreclose opportunities to recognize important impacts. Through illustrations from the literature and actual project narratives, a heuristic strategy will be provided that can be employed by everyone involved, encouraging broad-based evaluative thinking during all phases of the project. The end result will be tighter program designs, more integrated and empowered evaluations, and greater understanding of the "whys" of the outcomes…not just the "whats."

Morning Oral Presentation Sessions

SESSION I: Fully Realizing Talents: Supporting Talented STEM Students from Diverse Backgrounds I

Fostering Transfer Student Success Through Cross Campus Collaboration

Maia Randle (Columbus State Community College), Nikki Johnson (The Ohio State University)

Approximately 1 in 4 community college students will transfer to a 4-year institution. For underrepresented minority (URM) students, that number drops to about 1 in 6. In The Ohio LSAMP (Louis Stokes Alliances for Minority Participation) Alliance, community colleges partner with neighboring 4-year institutions to create a seamless transition for URM transfer students in STEM. Specifically, Columbus State Community College partners with The Ohio State University, Cincinnati State Technical and Community College with the University of Cincinnati, Sinclair Community College with Wright State University, and Cuyahoga Community College with Cleveland State University. Through an alliance wide peer mentoring program, faculty mentoring, undergraduate research experiences, academic support, and a collaborative programming model, The Ohio LSAMP Alliance places a significant focus on increasing the transfer rate of URM community college students to 4-year institutions. This session will explore the barriers that URM STEM transfer students face and discuss how The Ohio LSAMP Alliance minimizes those barriers and supports successful transition.

How does "Girls in Science Day [GIS]" affect rural adolescent girls' attitudes about science now, and in the future?

Carmen S. Dixon (Capital University)

Many females in rural middle schools often do not have the same opportunities to attend STEM-based events as urban students. Individuals in rural populations are more likely to face poverty and lack educational opportunities than those in urban areas. The researcher developed a one-day science camp in a rural county for girls (GIS) to stimulate their interest in science classes and careers. Ninety-five girls completed pre/post- surveys about their beliefs in science, and eight were interviewed before and after attending GIS. Years later, a total of eight girls were interviewed to determine if attending GIS in middle school impacted their post-secondary and career choices. The research will examine what changes the GIS attendance might have triggered in these adolescents. Hopefully, this program serves as a bridge for young ladies in rural schools to connect to science and to participants about developing a similar partnership with their institution for comparable programs.

Promoting Diversity in STEM: Lessons from the STEMcoding project's Youtube Channel

Chris Orban (The Ohio State University), Richelle M. Teeling-Smith (University of Mount Union), Erin White (University of Mount Union), Joshua Leiter (University of Mount Union)

Youtube videos have become an important part of STEM education. They are used by students as a primary source of information and they are used as teaching tool in the classroom. But many of the STEM-relevant videos, if not most, still overwhelmingly feature caucasian men. This is especially true in the field of physics, which can reinforce stereotypes about who is successful and welcome in that field. In the fall of 2017, the STEMcoding project released an Hour of Code activity and started a YouTube channel on the physics of video games. In the interest of boosting the visibility and agency of underrepresented minorities and women in physics, a high percentage of the people featured in these videos come from these underrepresented groups. Our team tries to ensure it is mostly undergraduate students on screen and leading the project, rather than professors or post-docs. We will discuss our experiences in developing the Youtube channel and comment on the impact of Computer Science Education Week in introducing a variety of users worldwide to the project.

Session II: Metacognition in a Diverse Environment

Developing Expert Learners in Introductory STEM Courses

Kathleen Koenig (University of Cincinnati), Dan Waddell (University of Cincinnati), Paul Nodzak (University of Cincinnati)

Several thousand students enroll in introductory STEM courses at UC each year. Although more faculty have incorporated evidence-based pedagogies into their teaching, students continue to struggle with knowing how to learn effectively. In order to better support students, a dozen faculty teaching introductory courses in biology, chemistry, math, and physics, joined together to incorporate metacognitive learning strategies into their courses based on the work of Saundra McGuire. Efforts included the integration of learning strategies into daily teaching, such as promoting a five-step study cycle (preview, attend, review, study, assess), as well as a session on metacognitive learning strategies to encourage students to devise and commit to individual action plans. This presentation will describe how the faculty worked together given that their students were concurrently enrolled in multiple introductory STEM courses. Details about data collected to determine the impact of the intervention, as well as lessons learned, will also be presented.

Promoting Metacognition in Anatomy & Physiology and Introductory Chemistry

Paul Nodzak (University of Cincinnati), Dan Waddell (University of Cincinnati), Kathleen Koenig (University of Cincinnati)

Over a thousand students enroll in Anatomy & Physiology and Introductory Chemistry courses at UC each term. Although both large enrollment courses include many elements of active learning, students continue to struggle and often apply study strategies that were successful for high school, but do not work in the college setting. This joint presentation will include the stories of two instructors who incorporated specific metacognitive learning strategies into their teaching. They will provide an overview of the strategies implemented, data outcomes, and lessons learned that will inform future course offerings.

Evaluating Student Use of Metacognitive Learning Strategies in General Chemistry

Ted M. Clark (The Ohio State University)

Many students struggle with introductory STEM courses because their approaches for learning, which led to success in high school, are ill suited for college. Therefore, an increasingly important objective has been to structure introductory STEM courses to promote student metacognition. In this investigation, students' use and perspectives of learning strategies has been evaluated for a large enrollment general chemistry course that strongly featured student metacognition. Evaluation included quantitative measures, like test scores and use of the online homework system, joined with a phenomenographic qualitative research methodology to investigate the different ways students experienced, thought about, and utilized strategies in different domains, including before class, in class, after class, and exam preparation. Significantly different perspectives and practices are correlated with success in the class. However, a strong awareness of the metacognitive best-practices is noted for students at all levels of achievement.

Session III: Trailblazing Technology to Enhance STEM Learning I

Teachers as Authors of Computer Based Tutoring Systems

Vasudeva Rao Aravind (Clarion University)

Attrition rates are high in the first few years of STEM classes, due to unprepared or under prepared incoming freshmen. To get these students up to speed and build their confidence, it is crucial to train them in fundamental concepts of mathematics and sciences. Typically, mastery and confidence is achieved by repetition (repeated practice) and reinforcement (timely feedback). Teachers and instructors, however, are not able to spend inordinate amounts of time training students. In this talk, I share my experience using a web based platform called 'Cognitive Tutor Authoring Tools' (CTAT) to act on behalf of teachers in providing repeated practice and feedback based learning in first year university students. Without the need for programming or coding expertise, I was able to design and deploy web based tutor in the classroom. In this talk, I will discuss the process of creating the tutor and how well the students learned concepts as a result of this tutor.

A Controlled Study of Stereoscopic Virtual Reality in Freshman Electrostatics

Christopher Douglas Porter (The Ohio State University), Chris Orban (The Ohio State University, Marion Campus)

Virtual reality (VR) has long promised to revolutionize education, but with little follow-through. Part of the reason for this is the prohibitive cost of immersive VR headsets or caves. This has changed with the advent of smartphone-based VR (along the lines of Google cardboard) which allows students to use smartphones and cheap plastic or cardboard viewers to enjoy stereoscopic VR simulations. We have completed the largest-ever such study on 1,189 students enrolled in calculus-based freshman physics at The Ohio State University. This initial study focused on student understanding of electric/magnetic fields and Gauss's Law. Students were split into three treatments groups: VR, video, and static 2-D images. Students were asked questions before, during, and after treatment. Here we present preliminary analysis including overall post-pre improvement among the groups, dependence of improvement on gender, training, and previous gaming experience. Results on select questions are discussed.

Online Solutions for Deaf and Hard of Hearing STEM Learners

Lisa B Elliot (Rochester Institute of Technology), Austin U Gehret (Rochester Institute of Technology)

Postsecondary students who are deaf or hard of hearing (DHH) face substantial challenges to mastering STEM coursework. Similar to other underrepresented minorities, these students are often less prepared to succeed in STEM, compared to hearing peers. DHH students typically receive in-person tutoring, but this approach depends upon qualified tutors and mutually available schedules. Standard online resources are plentiful for hearing peers, but DHH students' communication needs preclude effective use of those resources. Generic synchronous or asynchronous online resources, usually do not provide accessible features for DHH students. Online tutoring, an activity of the Deaf STEM Community Alliance, funded by NSF, has been implemented to address accessible tutoring challenges with students at community college, a medium-sized private university, and at an Ivy League institution. The proposed presentation will describe feedback and student outcomes of synchronous tutoring and asynchronous supplemental materials, and themes from a qualitative analysis of videos of synchronous sessions.

Session IV: Promoting Effective Learning Across Teaching Environments I

Improving Student/Faculty Engagement: Impact of End of Lecture Classroom Surveys on Student Evaluations and Motivation

Keith R Miller (University of Mount Union)

Student success is directly tied to effective feedback criteria where the focus is on what is being learnt and how students should go about it. To provide this learning environment, it is best if the student initiates the feedback conversations. From Fall 2015-2017, end of lecture surveys were included as part of each class session for an introduction to biochemistry class for junior and senior undergraduates. In this teaching strategy, students were anonymously asked to describe aspects of the day's lecture that were (a) surprising, (b) interesting or useful, and (c) confusing on a form turned in at the end of class. While submissions could remain anonymous, students were encouraged to place their name on the form for direct email feedback after class to answer any questions they had. These comments would then be used as a springboard for subsequent lectures, resulting in an immediate impact on student engagement and the clarity of the lectures. At the end of the semester, students were surveyed anonymously regarding whether this teaching strategy assisted in their learning for the course, if they chose to receive email feedback, and if they would like other courses to use these surveys. In the Fall 2014 semester, before these classroom surveys were initiated in the introduction to biochemistry class, most of the students did not feel the subject matter was understandable, half did not feel motivated to learn, and half did not feel the professor had created an atmosphere of mutual respect. After implementation, in Fall 2015, student evaluations reflected that the subject matter was overwhelming understandable, that an atmosphere of mutual respect was established, and that the professor cared about their learning. Students truly appreciated being able to ask questions if they could not make office hours. This presentation will discuss the implementation of the classroom surveys in large versus small classroom sizes in addition to its impact on student learning/evaluations.

How My Students Determined the Fate of the Universe - One Way to Overcome the Math Barrier with Non-STEM Majors

Steven Eugene Cederbloom (University of Mount Union)

Teaching science courses to non-STEM majors can be frustrating, especially to students who struggle with math. It is difficult to find problems in mathematically involved topics that such students can actually investigate themselves. Yet having the students take an active role is important in developing scientific literacy - "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (National Academy of Sciences, 1996). In my case, the challenge is to get these students to DO cosmology.

My solution to this challenge was to take a problem and teach my students how to solve it numerically. The Friedmann equation is a differential equation that, along with several other coupled equations, governs the expansion of the universe. My students used Excel to solve this system of equations to find the history of a model universe.

Measuring the Efficacy of a Flipped Classroom Intervention in Calculus

Trefor William Bazett (University of Cincinnati)

Motivated by stubbornly high DFW rates and low long-term retention, an active learning model in introductory Calculus 1 was developed. 12 sections used a flipped classroom model based on creating

engaging online modules pre-class paired with collaborative problem solving in class. A further 11 sections used a traditional lecture approach. To study the efficacy of this intervention, the following data was collected and analyzed: class observations using COPUS, student attitude surveys, student and faculty engagement surveys, pre- and post-Calculus Knowledge Assessment performance, and course exam performance. We present the results of this study, describe some of the principles for the online modules and in class problem solving, and offer suggestions for future reforms.

POSTER SESSION

Theme: Bridging the Gap: Ensuring Successful STEM Transitions

Impact of undergraduate research on the transition to post-graduate and professional programs

Maria Diakonova (University of Toledo, OH)

University of Toledo is a doctoral/research extensive university with a strong focus on undergraduate research. The Department of Biological Sciences has an excellent record of successful STEM transitions from undergraduate into post-graduate research programs or health related professional programs. This Department offers many opportunities and programs to prepare and support undergraduates into this transition including the chance to conduct undergraduate research during the school year, several undergraduate summer research programs and student research symposiums, participate in the Honor Program, and study abroad at the University of Salford, England. UT also offers attractive scholarship initiatives (Founders and Trustees Scholarships, and many pre-medical scholarships). As a result, Biological Sciences undergraduates earned an average 3.33 GPA upon graduation and approximately 54% were accepted into graduate or professional programs in 2010-2015 demonstrating the impact of undergraduate research on STEM transition.

The Benefits of Collaboration between Colleges and High Schools

Luciana Aronne (Penn State Behrend)

For the past ten years there has been a pedagogical collaboration between the chemistry department at Penn State Behrend and Collegiate Academy, an urban college preparatory school in Erie, PA. For the first nine years, the goal of this collaboration was to have students work with a faculty member on developing new laboratory experiments for the first year general chemistry laboratory curriculum sequence at Penn State Behrend. The collaboration has now changed in the opposite direction. Students at Collegiate Academy want to develop new laboratory experiments to be implemented in the laboratory component of their AP chemistry course. This talk will demonstrate how a college fostering collaboration with high school students can be rewarding and beneficial for both communities.

Promoting STEM Synergies through Engineering Project Activities for pK-12 STEM Students and Educators

Ramakrishnan Sundaram (Gannon University)

This paper discusses the use of engineering laboratory and project activities for pK-12 STEM students and pK-12 STEM educators as part of the outreach program which recognizes and exploits the links between the pK-12 STEM curriculum and the undergraduate engineering degree programs. Hands-on laboratory and project-based experiences are among the most effective means to introduce and reinforce concepts in most engineering disciplines. Through the various forms of outreach, as outlined in this paper, pK-12 students and pK-12 STEM educators gain an understanding of aspects of engineering design, assembly, test, and validation. The faculty from undergraduate engineering programs interact with pK-12 students either by organizing visits by the pK-12 students to the engineering laboratories and/or travel to the STEM schools to demonstrate engineering project activities as well as engage the pK-12 students in engineering laboratory activities. The pK-12 STEM educators are engaged in structured project activities through workshops.

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The Academic Advisor/Professor: Role in Student Success

Diane Stroup (Kent State University)

Academic Advisors play an important role in providing guidance to students as they navigate the difficult journey through college to eventual career success. The nature of interactions with mentors shape students' perception of their college experience and outcomes. Transitions are particularly difficult. Active mentoring as part of the instruction and advising process was implemented to improve academic outcomes.

Goals of Advising Style:
Create a welcoming environment and provide timely information that increase the attractiveness of STEM programs and increase completion rates for all students as measured by increased enrollments and retention of female STEM students.

Methods:
Student success is the result of a large combination of factors. This method, in short, provides students with ready access to timely information and support through experienced instructors advising students following a mentoring model.

Results:
Exponential growth of enrollment and gender equity achieved during study period. When discontinued, gender ratio reverted, 2 males/1 female.

Aligned Learning Communities and Student Thriving: A First in the World Project

Michael P. Martin (John Carroll University), Graciela Lacueva (John Carroll University), Terry Mills (John Carroll University), Peter Manos (John Carroll University), Pamela Vanderzalm (John Carroll University)

Prior to freshman orientation, students were administered the College Student Inventory (CSI). The CSI data identified students as having "predicted academic difficulty" (Gold Group) and those who do not (Blue Group). Groups were matched for characteristics, such as first-generation, Pell Grant recipient, and gender. Seventeen STEM Gold Group students were co-enrolled in an introductory Biology course for majors and a foundational Communications (Speech) course; other aligned courses included Biology with either English or Theology and Religious Studies. Biology and Communications instructors aligned syllabi in order to have students give two informational speeches on biological topics and genetic disorders in the Communications course. The Biology instructor attended the speeches and assessed informational accuracy, whereas the Communications instructor judged the merits of the speech itself. This model has been continued for a second cohort of 33 students in Fall 2017.

Benefits of Evidence-Based Research: Investigation of STEM Retention in Chemistry.

Bridget Lee (Consultant, The Ohio State University), Ted Clark (The Ohio State University)

Enthusiasm for learning about and then implementing "evidence-based" practices is high among PKAL participants. Often, instructors are motivated to research their classroom innovations, share findings with colleagues, and this in turn leads to continued change. A significant shortcoming in this otherwise virtuous cycle is that frequently the research projects are not themselves evidence-based. Lacking training as educational researchers, it is not surprising these projects fail to reach the norms of educational research. This results in lost opportunities, in terms of time, lack of transferable results, redundant investigations, etc. Possible solutions include training STEM educators to be researchers, or partnering with professional educational researchers to properly design and conduct evidence-based research. Both of these options have been undertaken in an effort to evaluate and then improve retention of STEM majors enrolled in introductory courses in a sustained manner. The process of conducting evidence-based research will be discussed, along with preliminary findings.

Broadening participation in STEM: Graduate Student Investigation into Participation Gaps

Jessica McQuigg (Miami University), Shan Shan (Miami University), J. D. Gantz (Miami University), Joyce Fernandes (Miami University)

In 2016, a special issue of CBE Life Science Education highlighted the need for broadening participation in STEM fields. In response to this, Miami University Biology Department faculty offered a graduate student seminar to discuss this issue and develop a plan to broaden STEM participation at the undergraduate level through a three-pronged approach. Graduate students 1) educated themselves on the current state of knowledge surrounding broadening participation, 2) examined the resources available for undergraduates at Miami University and realized a lack of graduate student led initiatives and collaboration with administrative and faculty effort, and 3) initiated programs aimed at filling the gaps in current resources with high quality graduate led programming. Here we offer the structure and outcomes of our graduate seminar and a pedagogical outline that other institutions can use to facilitate graduate student involvement in broadening undergraduate participation in STEM and beyond.

Wesleyan Math and Science Scholars Program (WesMaSS): A Bridge Program and Beyond

Ishita Mukerji (Wesleyan University), Teshia Levy Grant (Wesleyan University)

This poster will describe a pilot program designed to improve the retention of underrepresented students in STEM fields. The program uses several different strategies to promote student success including: an on-line bridge program, teaching students academic and metacognitive study skills, training advisors and mentors in fostering the growth mindset and providing students with early exposure to research experiences. The program has been effective in improving retention, creating a STEM community and generating corollary activities such as formation of a science and math student-faculty coalition to address issues of equity and diversity, and creation of a science teaching and learning center, STEM Zone 42. Participants will learn which activities have been most successful in promoting the retention and increasing the success of underrepresented students in science and math with a focus on bridge programming, academic skill building and faculty training and mentoring.

Theme: Fully Realizing Talents: Supporting Talented STEM Students from Diverse Backgrounds

Four-year student retention and success in the Chatham University (NSF S-STEM) scholarship program

Robert B. Lettan II (Chatham University)

Chatham University is a private institution with an undergraduate enrollment of around a thousand students, located in Pittsburgh, PA. With a two-year, overall retention rate around 75%, a cohort program to increase retention in chemistry, biochemistry, and biology was begun in 2015. Features of this program, funded by an NSF S-STEM scholarship grant (#1259577), included a session for first-year students prior to University orientation, a 3-week research experience in May of the first-year, and continued group activities and support throughout the four years. In addition, a 50-item survey on attitudes toward science was developed and administered to S-STEM and other science students in the first week of their first year and again when students were juniors. The first cohort from this program will graduate in the 17-18 academic year and preliminary data strongly support the advantages of both a cohort approach and early introduction to research in promoting student retention and student success in science. One possible confounding factor is Chatham's transition from a single-sex (women's) institution to becoming fully co-educational in the second year of the program. Aspects of this are also discussed.

Theme: Metacognition in a Diverse Environment

Developing a Comprehensive Supplemental Instructor Mentor (SIM) Program as Agency in Fostering Diversity, Retention and Completion in Liberal Arts Colleges

Joseph R. Lennox (Antioch College), Julia S. Dwight (Antioch College)

Antioch College has developed a 3-course curriculum for the development of practicing supplemental instructor mentors (SIMs). The first course, Learner-Centered Teaching (LCT: 4 credits), empowers willing participants to build the knowledge and skill in fundamental educational theory, including developmental metacognition and schema theory, and practice that would be expected of efficient beginning adjunct faculty. There is an emphasis on critical, democratic and feminist pedagogy, developmental metacognitive and college success skills, and on creating self-regulated learners. Satisfactory performance qualifies the student to then enroll concurrently in The Art & Science of Inclusive Mentoring (ASIM: 2 credits), based upon an inclusive professional engagement model, and Supplemental Instructor Practicum (SIP: 2 credits). Both the LCT and ASIM curriculum feature modules in diversity, equity and inclusion to prepare SIMs for teaching and mentoring in a diverse community with the goal of building learner self-awareness and metacognitive practices, thereby increasing retention and completion. SIMs are trained to understand high school to college transition dynamics of 1st year students with an emphasis on mentoring the first-generation student through understanding of their projected needs. SIMs are also trained to lead non-traditional discussion sections focusing on design and implementation of active learning exercises. As further application of SIM utility, we will be deploying our newly developed Antioch Educational STEM Outreach Program (AESOP) in early 2018. This program, having a SIM in a leadership role, seeks to provide experiential educational experiences to students of ages 5-15, and to assist in recruitment of high school juniors and seniors.

Early Prep Smart Modules, Do They Make a Difference in Student Outcomes

Kimberly Kay Loscko (Mount Carmel College of Nursing)

The significance of the relationship between final course grades in an introductory A&P course will be compared to taking the course after completing four cloud-based interactive modules two weeks before classes begin. Each module: Fundamentals of Science; Fundamentals of Math & Statistics for Life Sciences; Fundamental Skills for the Scientific Laboratory; and Fundamentals of Student Success is approximately two hours in length. Students complete these modules on their own while the built-in diagnostic tool gauges their strengths and weaknesses, and develops individualized learning plans and goals for them. Study participants include n = 106 first year nursing students. SPSS Statistical software (Version 22) will be utilized in this study.

Making connections outside the classroom: Using a case study approach to promote environmental justice and equity

Carolyn S. Reid (University of Mount Union)

A component focused on the role of chemistry in societal issues was added to an introductory-level green chemistry course. This component was geared towards preparing students for the 21st century and focused on the societal challenges that relates environmental justice and equity. Using short films, journal articles and peer-reviewed activities, students were guided by a series of questions as they used their knowledge of green chemistry to design strategies for solutions to the issues at hand. In doing so, students developed problem-solving skills through discussion-focused lecture and laboratory activities which culminated in each student giving a 5-minute oral presentation on a select topic. Students found these activities effective at promoting self-awareness, particularly the impact of improper disposal of chemicals on human health and the environment.

Theme: Promoting Effective Learning Across Teaching Environments

Integrating laboratory research projects into an upper-level undergraduate Developmental Neurobiology course.

Aswati Subramanian (Miami University, Oxford, Ohio), Joyce Fernandes (Miami University, Oxford, Ohio)

Understanding and analysis of scientific research is crucial to progress in STEM disciplines. Thus, it is important to structure a course that allows side-by-side comprehension of research methodology along with study of current highlights in the field. BIO472 was a Developmental Neurobiology course developed to facilitate teaching through lecture-lab integration. Course material relied on familiarizing students with literature from journals, analysis of research trends and familiarity with techniques in neurobiology. Concurrently, students also conducted a semester-long research project that provided hands-on experience with experimental techniques. Outcomes: 1) Data obtained from the project will be integrated into a manuscript intended for publication. 2) Students engaged high school teachers and students in a civic learning project related to neurobiological problems affecting adolescents. 3) Students developed competency in science communication in the classroom. 4) Research data and concepts from the class were presented at an undergraduate research forum to other students and faculty.

Utilization of class observational activity for behavioral study

Lita Yu (Ursuline College)

Clinical microbiology is a course often completed by first year students in the nursing program at Ursuline College. The course has an associated laboratory, however the concepts of epidemiology are difficult to gather hands on experience. To address this students are instructed to make observational studies in bathrooms accessible to the public and record hand washing behavior. The purpose of the exercise is multiple-fold including to have students become engaged in the process of science and to understand the impact of handwashing. Students gather raw data and analyze results. The effectiveness of the exercise is gathered through Likert scale analysis. Furthermore, students gather data about handwashing behavior that will be used for further research analysis.

Does active learning lead to 'long-term' conceptual change? A case study.

Rodney Austin (Geneva College), Tracey Murray (Capital University)

College STEM instructors are increasingly adopting active learning strategies in the classroom. This approach promotes critical thinking, problem solving, and conceptual change. Frequently, conceptual change is measured from beginning to end of a single course using a pre/post-test assessment protocol. In this study, we examined conceptual change post-course (more than 1 month) of students who completed the first biochemistry course in an active learning environment. The conceptual inventory was given pre/post-test during this first biochemistry course, which was taught in the fall semester. Then, students were given the conceptual inventory, again, during the following spring semester (either

1 or 4 months post-course) or during the next academic year (10 or 13 months post-course). Initial results indicate students, largely, maintain conceptual understanding in post-course measurements. Further analysis will be presented.

Engaging Environmental Science students through project-based service learning in the community

Christine Anderson (Capital University)

Connecting community-based service with academic course material has been shown to enhance the development of personal and cognitive skills, and fits with the mission of Capital University to inspire individuals to be civically engaged. Students in ENVS 250 Environmental Science (taken by both science and non-science majors) conducted a data-driven environmental research project focused on sustainability and waste issues on campus and in the local community. Survey results showed that out of 17 students, 82% and 76% agreed or strongly agreed that they made substantial progress in gaining a broader understanding and appreciation of science, and developing a sense of community responsibility, respectively. Additional feedback and personal reflections were summarized to inform ways to improve this experiential course-based research experience. In addition to focusing on effective student learning and community engagement, this work also provides baseline data for the recently adopted City of Bexley Zero Waste Plan.

How (and why) does one measure faculty instructional practice?

Moira van Staaden (Bowling Green State University), Anne Bullerjahn

Efforts to improve undergraduate STEM teaching and learning by introducing high-impact evidence-based practices (a.k.a. Research-Based Instructional Strategies) depend on an accurate assessment of the current situation, the design of appropriate pedagogies, and the ability to track the implementation of innovation. High-quality measures of faculty instructional practice are, however, seldom readily available. Here we combine self-report surveys, semi-structured interviews, and direct classroom observation using the Generalized Observation and Reflection Platform (GORP), a mobile-friendly and fully customizable interface for classroom observations to (i) evaluate the utility of self-report surveys for characterizing the university classroom, (ii) measure the fidelity of implementation of various evidence-based practices in a college STEM context, and (iii) provide robust baseline measures for application in communities of practice in both teaching and research.

Liberative Pedagogies in Engineering Education

Shehla Arif (University of Mount Union)

Inspired by Paulo Freire's work on achieving liberation through the practice of teaching and learning, I re-structured two Engineering courses. I shall present various strategies employed (inside and outside the classroom) for centering the learner while decentering myself, giving the learner a stronger voice while acting as a guide, contextualizing technical knowledge in larger societal backdrop, and highlighting

ethical dilemmas in technical decision-making. This work seeks to alleviate a student-centered approach in Engineering education to student-empowerment through critical thinking and reflective action.

Theme: Trailblazing Technology to Enhance STEM Learning

Blended and Online Learning Strategies for Chemistry Courses - A Conversation

Christa Currie (Mount St Joseph University)

This present will discuss a variety of strategies that have been successful in blended or online learning for basic chemistry, nursing chemistry, and major's level chemistry courses. The session will begin with an overview of the various courses that were transitioned to either a blended or online format or what factors led to these choices. In the area of online course development, the session will review the importance of the development of measurable course objectives and how to select appropriate assessment measures to evaluate student success in online learning. In the area of learner engagement, strategies on how to improve and sustain learner engagement during the course and beyond. Specific examples in each of these areas will be presented. Examples from several blended chemistry courses (for allied health students, majors and and non-majors) will be showcased by a Chemistry faculty member. Students in these courses include both traditional and adult students. Audience participation will be used throughout this session.

Engaging Students in Computational Thinking and Problem Solving through Low-cost and Sustainable Robotics Sessions

Liqiang Zhang (Indiana University South Bend), Raman Adaikkalavan (Indiana University South Bend)

Robotics have been used effectively in teaching students various skills and keeping them engaged. However, running a successful camp with minimal resources and budget within time constrains can be challenging. In this presentation, we will share our experience in successfully running both a week-long Robotics summer camp for middle school students and a 2-week-long Robotics session in our introductory computer science course. Our goal was to teach design, development, problem solving, and teamwork to students having little or no computer programming experience. We created a low-cost and sustainable solution using Arduino-based Robotics cars. We used a race and Robo-pong game where teams competed with each other. These activities ignited their interests in learning programming and increased their confidence in solving problems, interacting with the real world, writing programs, and working in teams, as evidenced by survey results. Overall, students reflected it was a practical, productive, enjoyable, and rewarding experience.

Developing a STEMcoding Project Youtube Channel

Richelle Teeling-Smith (University of Mount Union), Chris Orban (The Ohio State University), Erin White (University of Mount Union), Joshua Leiter (University of Mount Union)

Youtube videos have become a vital part of STEM education. They are used by students as a primary source of information and they are used as teaching tools in the classroom and in the lab. The

STEMcoding project has developed a set of fun, user-friendly, video game-like coding activities that can be easily integrated into introductory physics courses. As part of the Hour of Code, the STEMcoding project has developed a set of undergraduate-led, instructional videos intended to help guide students through the basics of computer coding and through the computational activities. We will describe the development and function of the videos as well as the sudden jump in project visibility (as measured via online views) as a result of participation in the Hour of Code and Computer Science Education Week.

Google Forms and Slides for Collaboration and Assessment

Bradley Allen Wood (Owens Community College)

Google forms provides and easy and inexpensive way to incorporate both active learning and assessment in the lecture and lab activities. This session will provide 3 examples of how Google Forms and Slides can improve student retention along with teaching collaboration in the classroom.

LUNCH TABLE DISCUSSIONS

Best Practices for the Integration of Advising into Curriculum for Student Retention

Diane Stroup, (Kent State University)

Academic Advisors are important for student success but can be more effective if they are integrated into the student experience. The Professor/Advisor is in a better position to understand the issues that students encounter on their path to degree completion and beyond college as they interact with students in and out of the classroom. Participants in this Discussion would include both professors and professional advisors, who would bring their experiences and best practices to the group. Conversation starters could include: Helping a student find direction; dealing with academic integrity issues; internships and other experiential activities; professional development.

Bridging the Gap: Ensuring Successful STEM Transitions

Joseph R. Lennox (Antioch College), Julia S. Dwight (Antioch College)

Intercollegiate collaboration in Liberal Arts Colleges to promote an exceptional model of supplemental instructor mentor scholarship and deployment for optimal high school to college transition in STEM education.

Diffusing evidence-based instructional methods at 2-year and 4-year institutions

Moira J. van Staaden (Bowling Green State University), Anne Bullerjahn (Owens Community College)

Innovative teaching strategies and evidence for high impact practices abound, and yet implementation of evidence-based instructional methods is frequently limited. To encourage sensemaking, diffusion and adoption of such strategies, Project SEA Change (NSF DUE 1525623) utilizes low-stakes lunch meetings, internal grant competitions and opportunities for leadership development. We are keen to elicit feedback and the opinions of our colleagues about what strategies might work, or are working, on their particular campus.

Google and Phone applications

Bradley Allen Wood (Owens Community College)

Using Google Forms and phone applications in the classroom for formative assessment of students and to hep students learn course concepts.

Integrating Computational Science into STEM Courses

Steven Eugene Cederbloom (University of Mount Union), Richelle M. Teeling-Smith (University of Mount Union), Chris Orban (The Ohio State University)

Are you interested in integrating computational exercises into your courses, or have you already done so? Computers have become indispensable in STEM fields, but it is difficult to introduce computation into courses, especially introductory courses, that are already expected to cover too much content. How do you start? What difficulty level is appropriate for introductory courses? How do you scaffold in advanced courses? What learning gains should we expect in terms of conceptual learning of the topic as well as the technical skill of computer programming? What resources and opportunities already exist, such as integrative textbooks or groups such as PICUP (Partnership for Integration of Computation in Undergraduate Physics)?

Technology and Techniques for Hands-on Network Security Education

Ken Smith (University of Mount Union)

Recent graduates in the field of information security are being greeted with a wide-open job market but positions that often require more hands-on experience than undergraduate programs are providing. This discussion will serve as a means for network security and computer science educators to discuss techniques, technology, and tools that they have used to propel their former students into successful information security careers.

Afternoon Concurrent Oral Presentation Sessions

Session V: Fully Realizing Talents: Supporting Talented STEM Students from Diverse Backgrounds II

Effectiveness of a low-cost, graduate student-led intervention on performance and study habits in introductory biology

Tyler D. Hoskins (Miami University), Josiah D. Gantz (Miami University), Joyce J. Fernandes (Miami University)

We developed a metacognition-based sprint course caught in conjunction with the introductory biology series at Miami University and evaluated its impact on study habits and performance in the lecture. We taught enrollees the Study Cycle (Cook et al. 2013) and emphasized the use of outlines and concept maps as tools with which students could review, re-organize, and study their lecture notes. We found

that focal students (i.e., those who voluntarily enrolled in our course) improved more on lecture grades than peers who did not enroll, that students improved at constructing outlines and concept maps, and that study habits (e.g., weekly study hours) improved in our focal cohort. However, none of these improvements were associated with the degree of improvement on lecture exams. We will discuss our approach, our findings, next steps, and how we feel our approach could be adapted to work at other institutions.

Teaching and Faculty Development Strategies for Promoting Student Engagement and Inclusive Excellence

Jennifer Speed (University of Dayton), Donald Pair (University of Dayton), Travis Doom (Wright State University), John Gallagher (Wright State University)

The University of Dayton and Wright State University will present their experiences with a successful three-year project (funded by AAC&U, 2014-2017) to broaden participation among underrepresented students in computer science. They will share with session participants an overview of their projects' designs and the context in which they were developed, details of the projects' implementation, and a summary of the project evaluations and their findings. In addition, presenters will offer a summary of the key project elements that may be relevant for adoption by other institutions seeking to change the learning landscape for a single STEM discipline.

Experiments in supporting Diverse Community of Learners

Tom Giblin (Kenyon College), Aaron Reinhard (Kenyon College)

Recruitment and retention. Like many physics departments, Kenyon Physics has faced the challenges of our field: the undergraduate physics population does not reflect the demographics of our world, or even of our institution. To combat this, the department has engaged in several experimental strategies that include: first-year research experiences, sending students and faculty to national diversity meetings, creating a Women in Physics advising group, developing co-curricular experiences illuminating stereotypes and rewarding active pedagogy in all of our courses. We will discuss this multi-pronged approach and present some hopeful data; however, our goal is to begin a multi-college conversation about common strategies.

Session VI: Metacognition in a Diverse Environment II

"Inside the Numbers": Motivating Students to Use Metacognition Skills and Track Their Learning Progress

Stacey Allyn Cederbloom (University of Mount Union)

One of the most frustrating aspects of teaching is grading a quiz and returning it in a timely fashion, only to see students make the very same mistakes on the following exam. I concluded that either the students were ignoring my warnings that the same concepts would appear on the exam, or they were attempting to use the quiz to study but were unsuccessful. In either case, I needed a teaching innovation.

When I became aware that “when students are required to think about their own learning and articulate what they understand and what they still need to learn, achievement improves” (Black & Wiliam, 1998a; Hattie, 2009), I created "Inside the Numbers" as a progress-tracking tool which helps me hold students accountable for correcting their mistakes on quizzes. It also helps me hold students accountable for assessing their confidence in understanding the concepts and executing the skills addressed by quizzes.

Metacognition in the General Chemistry Program; a just in time workshop model

Kimberly A. Trick (University of Dayton), Mark Masthay (University of Dayton), Garry Crosson (University of Dayton)

The development of metacognition in first year STEM students can have a significant impact on retention and persistence. Some obstacles to the development of these skills in the first year include lack of student receptiveness and limitations on available classroom time in content rich first year STEM courses. A model in which just in time out of class workshops were offered to students across a relatively large general chemistry program found some success. The workshops delivered metacognition skills to students as applied to specific general chemistry topics at times throughout the semester at which students were most motivated. The timing and coupling of skills with specific content motivation student participation and the out of class format did not require use of class time. The success of the workshops was supported by a faculty cohort culture within the general chemistry program that supported common learning objectives and consistent timing.

Using Timed Practice Exams to Improve Student Learning

Daniel Andrew Turner (The Ohio State University)

“I knew the material much better than my exam score indicates.” This comment is often expressed by students who do not have a great understanding of the material they know, and more importantly, the material that they do not know. As a metacognitive tool, instructors typically post practice exams online and encourage students to complete them, but most students treat the practice exams like additional homework problems. During the Fall 2017 semester, I taught a first-semester general chemistry course that had common exams throughout all sections. Instead of posting the practice exams online, I delivered timed practice exams in class about 5 days before each exam, following up with a review session 3 days out. Relative to other sections, the student performance on each common exam was above the average for my section. I believe these timed practice exams were an important factor in the exam performance.

Session VII: Trailblazing Technology…/ Promoting Effective Learning…..

"Plickers" as a Formative Assessment Tool

Yong S. Colen (Indiana University of Pennsylvania), Bailey L. Marasti (Indiana University of Pennsylvania)

"Plickers" is a powerfully simple tool to collect real-time, formative assessment data. With this technology, there is no need for student devices. All from the palm of the teacher's hand, with her smartphone, she gathers meaningful feedback and fosters student engagement. We will demonstrate the necessary steps to making the Plicker-cards and utilizing the application and will reflect upon the actual classroom use.

Coding integration in introductory STEM courses

Richelle M Teeling-Smith (University of Mount Union), Chris Orban (The Ohio State University)

Despite the success of code.org and the hour of code(TM), very little content currently exists to integrate coding into introductory STEM courses even though computer science is now designated as a "core subject". This presentation will describe computational exercises developed by the STEMcoding project which in some ways resemble web interactives like PhET (phet.colorado.edu) but include a coding component. We will discuss the process and challenges of integrating these coding exercises into existing introductory physics courses and some preliminary data on both student attitudes and impressions as well as the potential impact on student learning gains.

A Framework for Mentoring Students Attending Their First Professional Conference

Darren Wood (West Virginia University), Elizabeth Flaherty (Purdue University), Rachael Urbanek (University of North Carolina Wilmington)

Scientific conferences provide opportunities for developing professional social skills, a sense of belonging to their field, and an understanding of potential career options. However, undergraduate student attendance at professional conferences is low. When undergraduate students do attend, they often express anxiety associated with speaking with professionals, networking, or with the conference environment. To address these concerns, instructors from several institutions developed an undergraduate course with the objective of training students to attend their first professional conference. The course framework involved meetings with students and course assignments before, during, and after the conference. Assessment results indicated a greater sense of belonging to their profession, gains in confidence, and an improved understanding of career pathways. Our results suggest that formal preparation for conference attendance maximizes the potential for students to benefit from

their experience and reduces the anxiety many students express about attending a professional conference.

Session VIII: Bridging the Gap: Ensuring Successful STEM Transitions

Effects of the Operation STEM Program on Underrepresented Minority Students

John Holcomb (Cleveland State University), Jenna Van Sickle (Cleveland State University), Susan Carver (Cleveland State University), Elaine Barnes (Cleveland State University)

Operation STEM (OpSTEM) is a NSF grant-funded program that seeks to improve retention and graduation among high-risk students seeking STEM degrees by supporting them through the precalculus-calculus sequence. OpSTEM focuses its attention on students from underrepresented minority (URM) groups, first-generation college students, and women. The OpSTEM program has two levels of treatment—one group receives supplemental instruction while another group receives a comprehensive program. This study considers URM students as compared with their non-URM counterparts and considers how well these groups fare in their precalculus courses. Both of the OpSTEM treatments show all groups making significant gains, with URM students making relatively greater gains. For non-URM students, the majority of the gains in pass rates are seen with supplemental instruction alone. For URM students, however, the comprehensive program increases the pass rates so much that URM students become difficult to distinguish from their non-URM counterparts. We conclude that for URM students in particular, a comprehensive program is necessary in order to narrow the achievement gap between these students and their peers.

STEM teaching modules in a pre-college summer experience as part of the ReBUILDetroit program

Jacob D. Kagey (University of Detroit Mercy)

The ReBUILDetroit program is a multi-institutional effort to increase diversity in the biomedical science supported by the NIH. This collaboration is between the University of Detroit Mercy and Wayne State University. One aspect of this program is that students participate in authentic classroom based research experiences (CUREs) in their first year. At the end of their first year, each student is paired with a research mentor and begins working as a full time undergraduate research scholar. The goal of the NIH ReBUILDetroit program is to prepare scholars to enter into graduate programs in the field of biomedical research. To help prepare incoming ReBUILDetroit scholars for college and the additional research requirements of the program, all students participate in a 7-week Summer Experience Program (SEP) prior to their first semester in college. One focus of the SEP is to provide students with a foundation in different STEM disciplines that will help them succeed in their first year courses. Pre-freshmen summer interventions like this have been demonstrated to help increase the retention of underrepresented minorities pursuing STEM careers. Knowing that these types of interventions have the capacity to help shape students' STEM career paths, we are working to improve the curriculum in this program both as it

pertains to students' attitudes towards pursuing post-graduate degrees and careers in STEM, and to student achievement towards identified STEM learning outcomes

Broadening participation in STEM: graduate student collaborations with university resources to promote undergraduate research

Adam F Parlin (Miami University), Miranda Strasburg (Miami University), Michael T. Stanley (Miami University), Joyce J. Fernandes (Miami University)

Promoting undergraduate research requires highlighting career pathways that may deviate from the standard STEM pipeline. We aimed to actively engage with student organizations and university resources (Office of Undergraduate Research) at Miami University to disseminate resources to undergraduates and share our personal journeys in such a way that we could humanize the STEM field. We collaborated with existing undergraduate programs that focus on student success and career development for underrepresented groups to develop graduate led programs that address gaps in the current programming by organizing two events addressing alternate pathways. With this approach, we successfully reached students from varying disciplines early in their academic careers. We provide recommendations at the university, department, and student organization level to help broaden participation and emphasize the role of graduate students for broadening undergraduate participation. This would also require department and university to provide resources and approaches that involve graduate students in broadening participation.

WORKHOPS

Investigating How Student Dispositions Affect STEM Retention at Your Institution

Ted M. Clark (Ohio State University), Bridget Kiger Lee

The STEM pipeline often begins "leaking" when first year students take introductory science courses and move out of STEM majors. In this workshop participants will learn how to investigate students dispositions, such as motivation, epistemological belief, and personal interest in a STEM field, and consider the ways in which these view affect retention. Such dispositions are especially important for students in which stereotype threat is a concern, e.g. based on gender or race. It is hoped that participants will gain insights that may improve STEM retention at their institution and perhaps contribute to research in this field.

The Nuts & Bolts of Integrating Metacognitive Learning Strategies into STEM Courses

Kathleen Koenig (University of Cincinnati), Paul Nodzak (University of Cincinnati), Dan Waddell (University of Cincinnati)

Students often struggle with knowing how to learn effectively. Many claim that strategies that were successful in high school are not nearly as effective in the college setting. This session will focus on how instructors can integrate specific metacognitive learning strategies, based on Saundra McGuire's book "Teach Students How to Learn", into the college classroom without taking too much time away from course content. The workshop will be interactive and participants will be asked to (1) play the role of a student and develop an action plan for effective learning in a specific course, and (2) play the role of an instructor, who must make choices on the type and amount of activities to devote to this important skill. Data regarding the impact of these strategies on student success in multiple introductory STEM courses will be presented as well as lessons learned.

Teaching and Faculty Development Strategies for Promoting Student Engagement and Inclusive Excellence

Jennifer Speed (University of Dayton), Donald Pair (University of Dayton), Travis Doom (Wright State University), John Gallagher (Wright State University)

The University of Dayton and Wright State University will present their experiences with a successful three-year project (funded by AAC&U, 2014-2017) to broaden participation among underrepresented students in computer science. They will share with session participants an overview of their projects' designs and the context in which they were developed, details of the projects' implementation, and a summary of the project evaluations and their findings. In addition, presenters will offer a summary of the key project elements that may be relevant for adoption by other institutions seeking to change the learning landscape for a single STEM discipline.

Applying what we know from cognitive science and discipline-based education research to inform teaching

Alexandru Maries (University of Cincinnati)

During this workshop, participants will learn about learning frameworks put forth by cognitive scientists and work together to understand what these frameworks entail in concrete instructional settings. Additionally, participants will learn about principles from cognitive science, such as knowledge organization, cognitive load, memory storing capacity and will also learn about studies carried out by discipline-based science education researchers and discuss their instructional implications.

Which Instrument Should We Use? Assessing Classroom Observation Protocols

Kathryn Plank (Otterbein University), James Joseph McCargar (Baldwin-Wallace University), Meredith Frey (Otterbein University), Paul Joseph Wendel (Otterbein Univeristy)

This interactive workshop is for those interested in using classroom observation protocols to improve understanding of current teaching practices for personal improvement of teaching, institutional change, or research on teaching & learning. After a brief overview of five different observation protocols (RTOP, TDOP, COPUS, PORTAAL, and DART), participants will be divided into groups, each assigned to TDOP, COPUS or PORTAAL (since these three can be quickly learned). Participants will use their assigned instrument to observe one or more short teaching videos. After the observations, groups will share and compare data from observations and from RTOP and DART reports that will be prepared by the presenters prior to the session. Participants will attempt to answer research questions about the observed class and will discuss how well each helps them answer the questions in different contexts. Based on this experience, the group will develop a framework and set of criteria for selecting instruments that best suit their needs. Participants will become familiar with five different classroom observation protocols and have a good understanding of what kind of data each provides, have experience using at least one classroom observation protocol, and develop criteria for determining which classroom observation protocol is most suitable for a given context and research question.

Getting Started in the Scholarship of Teaching and Learning (SoTL)

Krista E. Wood (University of Cincinnati), Kathleen A. Harper (The Ohio State University)

The Scholarship of Teaching and Learning (SoTL) refers to the rigorous examination of one's own teaching as related to student learning. The number of STEM faculty engaged in such practices is increasing, but many find they have little prior training to guide such efforts. This workshop will provide a guide for how to design a SoTL project; including constructing a research question for an identified problem, discussing methods for the collection of data on measurable outcomes and the role of the Institutional Review Board (IRB) in SoTL Research. There will also be a discussion of how data analysis techniques are sometimes similar to and other times quite different from the ones typically employed in traditional STEM research. Participants will become acquainted with a wealth of resources on the web for guiding SoTL projects in their own disciplines. Bringing a laptop to the session is highly recommended.