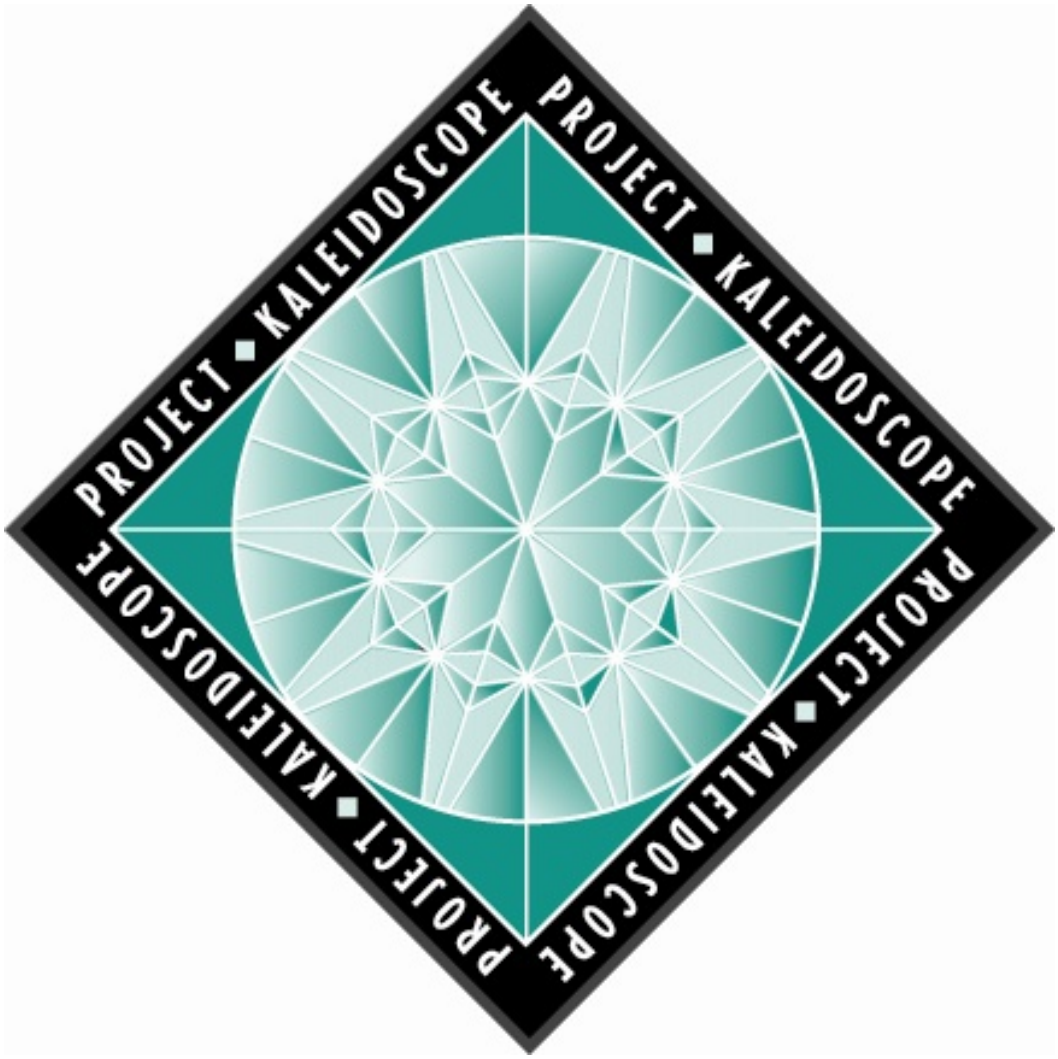


Ohio Project Kaleidoscope

Evidence-Based STEM Education: Teaching and Student Success

University of Findlay, Findlay, OH

May 20, 2017

Association of American Colleges and Universities

PKAL Regional Network: Ohio (OH-PKAL)

Vision

Ohio-PKAL's vision is to create a regional community of practice to promote and enhance learner-centered STEM (science, technology, engineering and mathematics) education through evidenced-based best practices, faculty development, and community engagement & education.

Mission

Ohio-PKAL's mission is to become a central conduit for providing information, communication, and resources focused on the enhancement of STEM education. Ohio-PKAL desires to be the foremost leader in connecting people within institutions of higher education, organizations, and the business community around the shared goals of producing highly qualified STEM professionals and improving scientific literacy among all students and graduates of Ohio schools.

You can get involved with OH-PKAL

- Serve on the annual conference committee
- Contribute to professional development of STEM faculty
- Collaborate in identifying and securing funding, and sharing resources for projects to improve STEM education;
- Engage community partnerships between local agencies and businesses interested in improving undergraduate STEM education
- Promote undergraduate STEM research opportunities
- Develop, maintain, and disseminate avenues for sharing of information, resources, and best practices for promoting and improving STEM education in Ohio
- Engage in strategic planning for policy decisions concerning STEM education in Ohio
- Partner with local, regional and national organizations to promote STEM outreach in Ohio

To learn more about contributing to OH-PKAL, contact Nominations & Elections Chair Joyce Fernandes, joyce.fernandes@miamioh.edu or any of the Governing Board members.

Ohio Project Kaleidoscope 3rd Annual Conference
Evidence-Based STEM Education: Teaching and Student Success
University of Findlay | Findlay, OH

May 20, 2017

Welcome to the 3rd OH-PKAL Annual Conference!

After a very successful conference last year at Capital University, we are very much looking forward to the conference at the University of Findlay and to another productive year. OH-PKAL is a regional affiliate of National Project Kaleidoscope (PKAL), which has a long history of supporting transformation in STEM education. PKAL is partnered with the American Association of Colleges and Universities (AAC&U) and is under the leadership of Kelly Mack, Vice President for Undergraduate STEM Education, and Executive Director, Project Kaleidoscope.

We are especially excited that at this year's conference we will be presenting for the first time an award to an outstanding Ohio STEM educator. This individual is someone who has been nominated by their peers and has demonstrated excellence and innovation in the field of STEM education at the college level. Over the past year, we have also expanded our reach outside of Ohio by soliciting conference presentations from those at institutions in neighboring states. It is hoped that these participants will find the conference of benefit and be inspired to start a PKAL regional network in their own home state.

The Conference Committee has compiled a vibrant program promoting evidence-based practices across four explicit threads and one general thread under the broader conference title:

- Teaching STEM Service Courses to Non-majors
- Integration of Effective Mathematics Teaching across the STEM Curriculum
- Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)
- Increasing Retention and Graduation Rates of Underprepared STEM Students
- Contribute-a-Theme

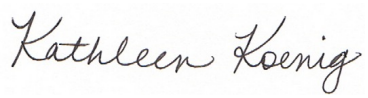
We are excited to have Dr. Daniel Brahier as our Keynote Speaker this year. He is a professor and director of Science and Math Education in ACTION at the Bowling Green State University. Dr. Brahier is a leader in mathematics education, and we look forward to hearing and learning about his insights for preparing highly-qualified STEM educators.

OH-PKAL is committed to ensuring a broad diversity of participation among higher education STEM instructors from all regions of the state. To help facilitate this, we are interested in having the annual conference hosted in different locations across Ohio. To this point, we are happy to announce that the University of Mount Union will host the 2018 OH-PKAL conference on May 19, 2018 (mark your calendars!). A location for the 2019 conference has yet to be determined. If you wish to nominate your home institution, please visit http://www.aacu.org/pkal/regional/ohio for the link to the application materials.

We thank this year's host, University of Findlay, and especially the excellent leadership and efforts of the conference committee; Jeffrey Frye (Conference Chair), Aaron Blodgett, Andrea Karkowski, Bradford Mallory, Mark McNaught (Conference Co-Chair), Cheryl Vaughn, and Christopher White. We also thank the presenters and all of the attendees who make this a special event.

This is an exciting time for STEM education. Transformative teaching materials and methods are emerging from discipline-based education research each year, and there is a substantial amount of interest, expertise and exploration in STEM instruction occurring across our region. This 3rd annual conference will provide an excellent venue to meet with colleagues, make new contacts, share ideas, and participate in a collaborative community of practice in undergraduate STEM education.

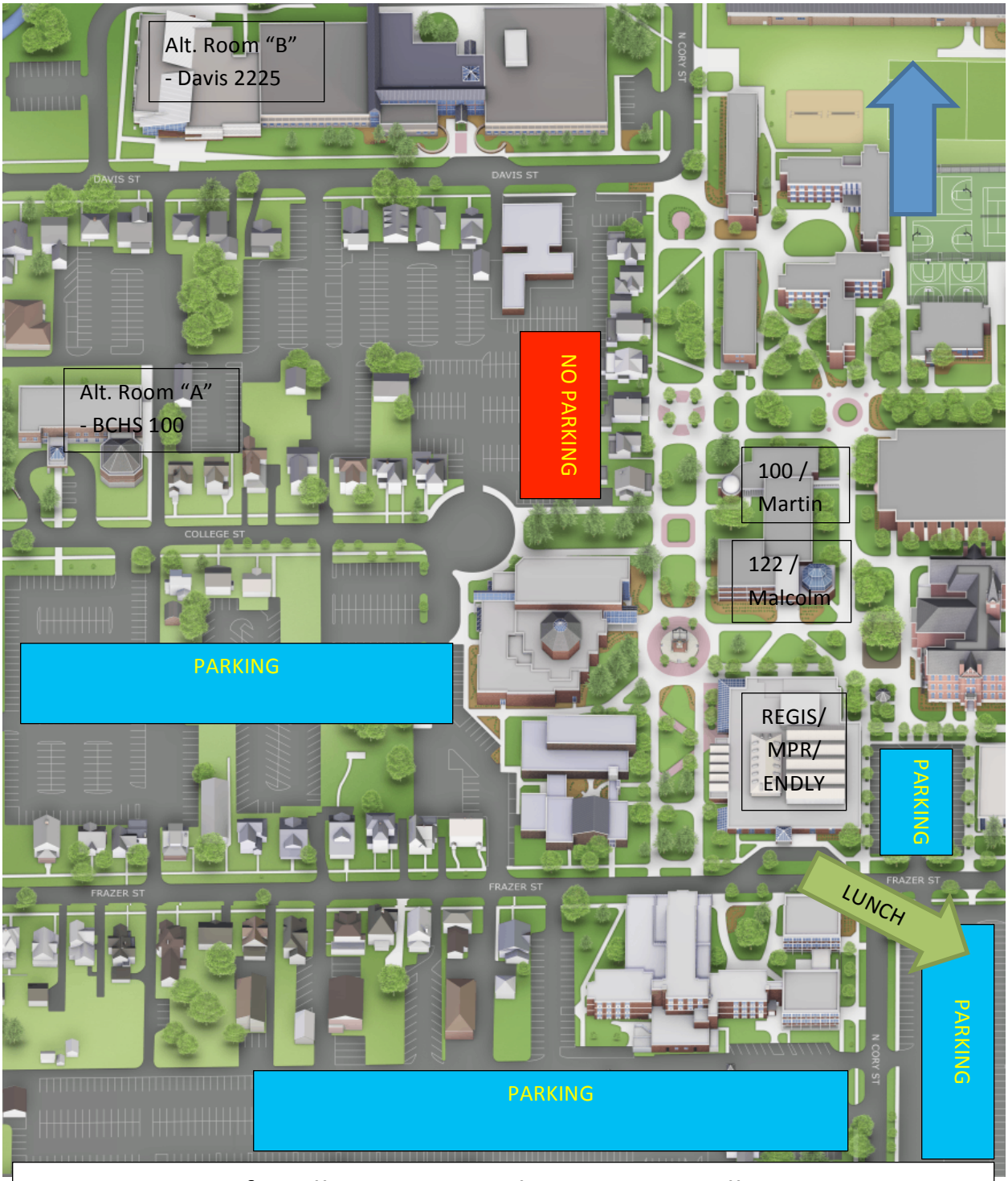
In closing, we would like to get your feedback about what OH PKAL can do for you. We will provide an opportunity to provide input in a conference post-survey, but feel free to contact me or any other board member directly with your ideas. We hope that you find the conference a rewarding and fruitful experience!



Kathleen Koenig
OH-PKAL Chair 2016-2017
Associate Professor of Physics, University of Cincinnati

Ohio Project Kaleidoscope Governing Board

Campus Map



University of Findlay, 1000 North Main St., Findlay, OH 45840

Schedule-at-a-Glance
Ohio Project Kaleidoscope 3rd Annual Conference
May 20, 2017

8:00 – 8:30 AM	**Alumni Memorial Union (AMU) - Atrium**	**Conference Registration**
8:30 – 8:45 AM	**AMU - Multipurpose Room**	**Opening Welcome**
8:45 – 9:45 AM	**AMU - Multipurpose Room**	**Plenary Speaker – Dr. Daniel Brahier**

10:00 – 11:00 AM **Concurrent Sessions I**

AMU - Endly **Increasing Retention and Graduation Rates of Underprepared STEM Students**

10:00 AM 80% Four-Year Graduation Rate for Under-Represented Minority Students in STEM Degree Programs
W. Robert Midden

10:20 AM Leveling the Playing Field; Identifying and Preparing Underprepared Students for Success in General Chemistry and Beyond
Kimberly Trick, Daniel Turner, Mark Masthay, Garry Crosson

Integration of Effective Mathematics Teaching across the STEM Curriculum

10:40 AM Review of Calculus and Differential Equations in Fluid Mechanics
Brett Batson

AMU/Multipurpose **Contribute-a-Theme**

10:00 AM A Systematic Approach to Laboratory Analysis and Modification: A Path to Reform - Part A
Paul Wendel, Joan Esson, Anna Young, Kathryn Plank

10:20 AM A Systematic Approach to Laboratory Analysis and Modification: A Path to Reform - Part B
Paul Wendel, Joan Esson, Anna Young, Kathryn Plank

10:40 AM A Systematic Approach to Laboratory Analysis and Modification: A Path to Reform - Part C
Paul Wendel, Joan Esson, Anna Young, Kathryn Plank

Frost/Brewer 122 **Teaching STEM Service Courses to Non-majors**

10:00 AM Sticky Innovation: Problem Solving through Engineering and Art Students
Whitney Gaskins, Nandita Shetth

10:20 AM Sins against Science: An Interdisciplinary Approach to Scientific and Rhetorical Literacy
Anjali Gray, Susan Shelangoskie

10:40 AM The Chemistry of Art: Development of a College-level Course for Non-science Majors
Elizabeth Wise

Frost/Brewer 100 **Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)**

10:00 AM Engaging Nursing Students Utilizing Collaborative Learning Process
Theresa Hatten Jackson

10:20 AM (session for this time converted to poster – presenter unable to attend)

10:40 AM Prioritize Metacognition in your STEM Course and "Teach Students How to Learn"
Ted Clark

11:15 AM – 12:15 PM Alumni Memorial Union - Lounges Poster Session

1. Evaluation of Positive Student Impacts When Implementing Higher Science Standards
   Kimberly Loscko
2. Assessment of Undergraduate Research and Mentorship Experiences
   Christine Anderson
3. Developing Scientific Models and Arguments with Non-STEM Students
   Scott Bonham
4. A Recitation Component Improved Student Analytical Skills and Course Performance in STEM Courses
   Jessica Cottrell
5. How the Maker Movement Will Change STEM Education
   Greg Kufner, Richard Superfine, Giancarlo Del Vita
6. Mapping the Problem-Solving Process
   Calvin Stubbins
7. Development of Course-Based Research Experiences in Chemistry and Biology
   Jason Belitsky, Marta Laskowski
8. Establishing a Quantitative Skills Center at a Liberal Arts College: A Case Study from Oberlin
   Marcelo Vinces, Jason Belitsky, Marta Laskowski
9. Teaching and Assessing Conceptual Change in the Active Learning Biochemistry Classroom
   Tracey Arnold Murray, Rodney Austin
10. Technology Integration for Blending, Flipping, and Overall Mastery
    Kerri Williams (presenter unable to attend)

12:15 – 1:30 PM Winebrenner Theological Seminary - TLB Lunch and Roundtables

Moderated Discussion: Integrating Climate Change Education into Science Courses throughout the Undergraduate Curriculum
Amy Flanagan Johnson, Katherine Ryker, Chiron Graves, Thomas Kovacs

Birds of a Feather Roundtables: Informal gatherings at tables of shared interests.
Look for topic labels on each of the tables at lunch.

1:45 – 2:45 PM **Concurrent Sessions II**

AMU - Endly **Increasing Retention and Graduation Rates of Underprepared STEM Students**

1:45 PM Preparing High School Students To Be Successful STEM Majors: The Mobile DNA Laboratory
Christopher White, Bethany Henderson-Dean

2:05 PM Students Taking Advantage of Resources (STAR): A Model to Promote Effective Study Habits and Autonomous Learning
Manori Jayasinghe, Charlotte Skinner

Integration of Effective Mathematics Teaching across the STEM Curriculum

2:25 PM It All Adds Up! Mathematics, Science, and Natural History
Julia Robinson

Frost/Brewer 122 **Teaching STEM Service Courses to Non-majors**

1:45 PM Pioneering Renewable Energy Technologies to Non-Engineering and Engineering Students
Ahmed Elgafy

2:05 PM Infusing Computer Science and Design-Based Research into Psychology Courses to Improve Engagement and Retention
Robert Duncan

Frost/Brewer 100 **Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)**

1:45 PM Use of In-Person plus Online Recitation Programs to Increase Student Success in Introductory Science Courses
Daniel Nichols, Raffi Manjikian, Edward Tall

2:05 PM Ximera: Collaboratively Teaching Calculus with Online Tools
Jim Fowler

2:25 PM Designing Effective Questions/Problems to Assess Students' Understanding and Ability of Applying Concepts
Manori Jayasinghe

2:45 – 3:00 PM **Break – Beverages and Snacks in the Alumni Memorial Union Atrium**

3:00 – 4:00 PM **Concurrent Sessions III**

AMU - Endly **Contribute-a-Theme**

3:00 PM (session for this time withdrawn – presenters unable to attend)

3:20 PM Increasing Enrollment of Under-Represented Minorities in STEM Programs
Colleen Taylor

AMU - Multipurpose	**Increasing Retention and Graduation Rates of Underprepared STEM Students**
3:00 PM	Using Metacognition to Teach Students How to Learn *Matthew Stoltzfus*
3:20 PM	STEM Stakeholders Structured Conceptualization of Attitudes and Persistence towards STEM *Cijy Sunny, Daniel McLinden, Kathie Maynard, Kathleen Koenig*
3:40 PM	Using Concept Maps to Visualize Learning Gains in Physics *Lindsay Owens, Kathleen Koenig*
Frost/Brewer 100	**Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)**
3:00 PM	Reaching the Masses: Metacognition and Technology in Large (>350 Student) General Chemistry Lectures *Daniel Waddell*
3:20 PM	Implementation of Active Learning Strategies in the Classroom: A Case Study in Human Genetics *Joshua Gross*
4:05 – 4:30 PM	**AMU - Multipurpose Room** **Presentation of STEM Teaching Award** **Closing with Keynote Speaker – Dr. Daniel Brahier**

Opening Plenary

The Six Principles for Preparing Highly-Qualified STEM Teachers

Dr. Daniel Brahier, Bowling Green State University

8:45 – 9:45 AM / Alumni Memorial Union – Multipurpose Room

Dr. Daniel Brahier is a Professor of Mathematics Education and Director of the Science and Math Education in ACTION (training future teachers in the newest and most effective methodologies) program at Bowling Green State University. He received his B.S.Ed. in Mathematics and Earth Science Education from Bowling Green State University in 1981, his M.Ed. in Guidance and Counseling in 1988 from that same institution, and in 1995, his Ph.D. in Curriculum and Instruction from the University of Toledo. He currently holds the title of Professor of Teaching Excellence, a title awarded by Bowling Green State University to faculty at the rank of full professor who are recognized for their exceptional teaching. During his career, he has also been recognized throughout the state of Ohio by receiving the highest award for math teaching excellence and two other top state teaching awards.

Dr. Brahier's expertise includes development of algebraic thinking and reform in mathematics education, two areas counted in his numerous publications. His involvement with the National Council of Teachers of Mathematics (NCTM) encompasses a wide variety of activities. Most recently he has been involved with writing policy documents and publications on the implementation of the Common Core State Standards. He was part of the writing team which produced the 2014 NCTM publication, *Principles to Actions: Ensuring Mathematical Success for All*.

Since release of *Principles to Action*, Dr. Brahier has been focusing his energy on those principles and what they mean for schools and higher education. While focused primarily on mathematics, all six principles are equally applicable to the study of science. The principles are all about what is needed to produce highly-qualified STEM teachers and focus on best practices, so they align nicely with the mission of OH-PKAL. His presentation will examine NCTM's principles, the best practices they encourage, and the common misconceptions that STEM teachers have about education that can become obstacles to reform.

Abstracts Listed By Time of Presentation

80% Four-Year Graduation Rate for Under-Represented Minority Students in STEM Degree Programs

W. Robert Midden, Bowling Green State University

10:00 AM-10:15 AM/Alumni Memorial Union – Endly Room

Format: Oral

Theme: Increasing Retention and Graduation Rates of Underprepared STEM Students

An 80% four-year graduation rate was observed for under-represented minority (URM) students in STEM undergraduate degree programs in an NSF-grant funded project conducted within an existing comprehensive support program at a research university. This graduation rate is considerably higher than the approximately 15% rate for STEM majors nationally and the even lower rate for URM STEM majors. This was a significant increase over the 65% four-year graduation rate achieved in the parent AIMS (Academic Investment in Mathematics and Science) Program. This increase in graduation rate over the AIMS program is attributed to the higher level of financial aid that was provided by the NSF grant to compensate for a high level of "unmet financial need" among the students in this special track of the AIMS program. The program features believed to account for this high level of student success will be summarized.

A Systematic Approach to Laboratory Analysis and Modification: A Path to Reform – Part A

Paul Wendel, Otterbein University; Joan Esson, Otterbein University; Anna Young, Otterbein University; Kathryn Plank, Otterbein University

10:00 AM-10:15 AM/Alumni Memorial Union – Multipurpose Room

Format: Oral

Theme: Contribute-a-Theme

A Study of Laboratory Manuals: Indications of Instructional Style and Inquiry Level. Four to six laboratory procedures were selected from each of eleven introductory science courses in multiple disciplines. Using instruments developed by three independent research groups, each procedure was evaluated for instructional style (expository, discovery, etc.) and student level of control students over questions, procedures, and interpretations. Results indicated that most of the laboratories employ an expository style characterized by minimal student control and low levels of inquiry.

Sticky Innovation: Problem Solving through Engineering and Art

Whitney Gaskins, University of Cincinnati; Nandita Shetth, University of Cincinnati

10:00 AM-10:15 AM/Frost-Brewer Science Hall – Room 122 – Malcolm Lecture Hall

Format: Oral

Theme: Teaching STEM Service Courses to Non-majors

Interested in learning about cross disciplinary teaching at the collegiate level? In this presentation you will learn how an art educator and engineering professor worked together across disciplines to craft and teach an undergraduate Honors course to students from multiple majors at the University of Cincinnati. We will discuss our planning process, present our course syllabus, discuss challenges encountered and reflect upon outcomes for our students. Our course Sticky Innovations: Solving the Problem of the Bees Through Engineering and Art, explores the question of what is happening to the bees? as a wicked problem, too complex to be solved by one discipline or a singular strategy.

Engaging Nursing Students Utilizing Collaborative Learning Process

Theresa Hatten Jackson, Shawnee State University

10:00 AM-10:15 AM/Frost-Brewer Science Hall – Room 100 – Martin Lecture Hall

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Approximately 20% to 42% of students leave nursing programs after the first year. New teaching approaches that engage students and decrease attrition are needed. The purpose of this research was to determine if student participation in a collaborative learning process resulted in decreased attrition and increased levels of academic achievement and engagement when compared with students who did not participate in a collaborative learning process. Bandura's social cognitive theory guided the investigation. A quasi-experimental after-only nonequivalent control group design was used. A Health Education Systems Incorporated Exam measured academic achievement; a Survey of Student Engagement measured student engagement. No statistical significance was found. However, odds ratios indicated traditional students in the experimental group were 5 times more likely to pass the HESI exam than traditional students in the control group. Further research, utilizing larger group sizes, is needed to determine the collaborative learning processes effect on student engagement and attrition.

Leveling the Playing Field; Identifying and Preparing Underprepared Students for Success in General Chemistry and Beyond

Kimberly Trick, University of Dayton; Daniel Turner, University of Dayton; Mark Masthay, University of Dayton; Garry Crosson, University of Dayton

10:20 AM-10:35 AM/Alumni Memorial Union – Endly Room

Format: Oral

Theme: Increasing Retention and Graduation Rates of Underprepared STEM Students

An individual student's level of preparation for success varies widely among Engineering, Science and Pre-Medical program majors enrolled in General Chemistry, a required course for nearly all STEM field majors at the University of Dayton. As part of a larger curricular change to promote success throughout the two year General/Organic chemistry sequence initiatives have been instituted to identify and prepare underprepared students for ultimate success in General Chemistry as well as other STEM courses. All students enrolled in general chemistry complete pre-semester review work and take an early assessment exam during the first two weeks of the semester. This work, exam and standardized test scores are used to identify under-prepared students. These student are invited to delay enrollment in general chemistry by one semester and as an alternate complete a specially designed chemistry fundaments/metacognition course to establish not only an understanding of foundational chemistry concepts but also effective metacognitive skills for application in all STEM courses. The content of the course is based on evidence based strategies to promote effective learning.

A Systematic Approach to Laboratory Analysis and Modification: A Path to Reform – Part B

Paul Wendel, Otterbein University; Joan Esson, Otterbein University; Anna Young, Otterbein University; Kathryn Plank, Otterbein University

10:20 AM-10:35 AM/Alumni Memorial Union – Multipurpose Room

Format: Oral

Theme: Contribute-a-Theme

A Study of Laboratory Goals: Laboratory syllabi were collected from multiple science courses and examined for (i) commonality among laboratory goals and (ii) consistency between goals and laboratory procedures. Additionally, students and faculty in these courses were surveyed about their perceptions of laboratory goals. Evidence indicates that laboratory goals were not explicitly oriented toward development of the ability to independently develop questions, design procedures, or support findings with evidence.

Sins against Science: An Interdisciplinary Approach to Scientific and Rhetorical Literacy

Anjali Gray, Lourdes University; Susan Shelangoskie, Lourdes University

10:20 AM-10:35 AM/Frost-Brewer Science Hall – Room 122 – Malcolm Lecture Hall

Format: Oral

Theme: Teaching STEM Service Courses to Non-majors

A 2014 Pew study comparing the attitudes of scientists and the public has shown wide gaps between the two groups in a variety of areas--climate, genetically modified foods, using animals in research--that impact the general public, yet in many of these areas, a majority of Americans do not believe scientific findings. Centuries earlier, Galileo and Charles Darwin faced similar outrage when they proposed their revolutionary theories. In our course "Sins against Science"— we confront these issues through an interdisciplinary approach that combines rhetorical acuity with scientific literacy. We will present a case study describing the strategies used in this class to help students learn to intervene effectively in public discourse on scientific topics. Using a focus on hoaxes, frauds, and misrepresentations involving scientific topics and the public diffusion of scientific information, we analyze connections between scientific knowledge, media, and various rhetorical principles.

Review of Calculus and Differential Equations in Fluid Mechanics

Brett Batson, Trine University

10:40 AM-10:55 AM/Alumni Memorial Union – Endly Room

Format: Oral

Theme: Integration of Effective Mathematics Teaching across the STEM Curriculum

A common complaint among engineering faculty is that students lack required mathematics skills. Despite carefully considered prerequisites, a majority of students do not retain or cannot apply the mathematical knowledge they need for their engineering courses. Fluid mechanics is a mathematically intense subject for undergraduate engineering students. Experience has proven students' lack of mathematical understanding is a handicap in learning fluid mechanics. Due to time constraints, reviewing mathematics in a conventional, lecture format class was infeasible. By inverting, or flipping, fluid mechanics, lecture time was freed to allow for multiple focused math review sessions. Reviewing calculus and differential equations as these topics become necessary for use in solving fluid mechanics problems has been astonishingly successful. Student exam scores increased in a step fashion, and have remained in their improved state through several years of experience. This model may be applied to other STEM courses in which math skills are required.

A Systematic Approach to Laboratory Analysis and Modification: A Path to Reform – Part C

Paul Wendel, Otterbein University; Joan Esson, Otterbein University; Anna Young, Otterbein University; Kathryn Plank, Otterbein University

10:40 AM-10:55 AM/Alumni Memorial Union – Multipurpose Room

Format: Oral

Theme: Contribute-a-Theme

A Study of a Laboratory Redesign: Motivated by results of the laboratory manual and goal studies, a team of faculty and students redesigned laboratory procedures for second-semester general chemistry. The reformed procedures elevated the level of inquiry in each lab, characterized by higher student control over questions, methods, and interpretations. Comparing experimental sections conducting the redesigned labs to control sections conducting the original labs, pre/post testing indicated that the new procedures produce minor differences in content knowledge, but substantial improvement in views of scientific inquiry and self-efficacy with respect to scientific inquiry.

The Chemistry of Art: Development of a College-level Course for Non-science Majors

Elizabeth Wise, Lourdes University

10:40 AM-10:55 AM/Frost-Brewer Science Hall – Room 122 – Malcolm Lecture Hall

Format: Oral

Theme: Teaching STEM Service Courses to Non-majors

Using expertise gained and resources attained at a National Science Foundation workshop, I acquired confidence to create a new undergraduate course for non-science majors, The Chemistry of Art. This introductory chemistry course explores the intersection of chemistry with the visual arts. Basic principles of chemistry are applied to the topics of color, paint, clay, glass, metals, and art conservation. Lab/studio activities are incorporated into the three-hour lecture, and numerous demonstrations that help to illustrate chemical concepts are used.

Prioritize Metacognition in your STEM Course and "Teach Students How to Learn"

Ted Clark, The Ohio State University

10:40 AM-10:55 AM/Frost-Brewer Science Hall – Room 100 – Martin Lecture Hall

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

In General Chemistry courses at OSU (Fall, 2016) a concerted effort was made to identify and support at-risk students. This effort quickly expanded to support the learning of all students in these courses by adopting strategies from Saundra McGuire's book "Teach Students How to Learn." McGuire's aim of providing students with specific metacognitive learning strategies was readily adopted by instructors given their consensus view that many students lack these skills upon entering OSU. Without metacognitive skills, "strong" students with outstanding high school resumes frequently struggle in introductory courses at the university-level. Preliminary evidence points to a dramatic shift in student performance independent of student understanding upon entering the course. Controlling for initial understanding (e.g. a pre-test score), performance on assessments within the course, like mid-term exams, were significantly improved for those students that attended a metacognition session. Both exam results and students perceptions of metacognitive learning skills will be discussed.

Technology Integration for Blending, Flipping, and Overall Mastery

Kerri Williams, Lourdes University

11:15 AM-12:15 PM/Alumni Memorial Union - Lounges

Format: Poster (change in format due to presenter being unable to attend)

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

This will be a hands-on interactive workshop to let you try out some of the newest Apps and Web Tools to enhance instruction and increase student engagement.

Evaluation of Positive Student Impacts When Implementing Higher Science Standards

Kimberly Loscko, Mount Carmel College of Nursing

11:15 AM-12:15 PM/Alumni Memorial Union - Lounges

Format: Poster

Theme: Increasing Retention and Graduation Rates of Underprepared STEM Students

Grade distributions; pass rates; retention rates; class attendance, exam score averages, and non-exam score averages were evaluated after implementing a higher science standard in a first year anatomy and physiology course. Study participants include n = 111 nursing students. SPSS Statistics (version 22) was used to analyze data collected through adaptive courseware used in this two semester sequence course. Students who failed to achieve a minimum grade of "C" in any science course were placed on academic probation and were required to repeat the course. This repeat privilege was permitted in only one science course. Students who failed a repeated science course or an additional science course were

dismissed from the program. Quantitative and qualitative student outcomes were evaluated in a pre-post policy design.

Assessment of Undergraduate Research and Mentorship Experiences

Christine Anderson, Capital University

11:15 AM-12:15 PM/Alumni Memorial Union - Lounges

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

In 2013, Capital University began a collaborative partnership with nearby Reynoldsburg City School's Environmental Science, Technology, Engineering and Mathematics (eSTEM) Academy to engage junior and senior eSTEM high school capstone students in student-driven scholarship with undergraduate mentors. All students conduct rigorous place-based original research projects at nearby parks and/or in the laboratory under the guidance of faculty to promote effective learning across teaching environments. I designed learning outcomes and assessment tools for both populations of students, and also surveyed other student researchers not involved in the partnership. Capital research mentors involved in the partnership indicated significant gains on recognizing and applying basic research methods and demonstrating scientific thinking, and developing the values and attitudes of thinking and working like a scientist, compared to other research students. They also answered open-ended questions on the pros and cons of the program.

Developing Scientific Models and Arguments with Non-STEM Students

Scott Bonham, Western Kentucky University

11:15 AM-12:15 PM/Alumni Memorial Union - Lounges

Format: Poster

Theme: Teaching STEM Service Courses to Non-majors

How can we help non-science students to understand and engage with evidence-based scientific arguements? In my Light, Color and Vision course we read and analyze historical scientific arguments, develop and evaluate models, collect evidence through guided discovery activities, and write an evidence based scientific argument. Integrated with course content, we read selections written by Aristotle, Isaac Newton, Robert Hooke and James Clerk Maxwell on the nature of color and light, analyzing the structure of the arguments and the quality of the evidence offered. Students gather evidence in guided discovery activities, including recreating Newton's prism experiments and comparing explanitory powers of the wave and particle models of light (a bitter disagreement between Newton and Hooke). In the cummulatiing activity students write a letter to a group of their choice making a scientific claim, explaining the model, and providing evidence to support that claim.

A Recitation Component Improved Student Analytical Skills and Course Performance in STEM Courses

Jessica Cottrell, Seton Hall University

11:15 AM-12:15 PM/Alumni Memorial Union - Lounges

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

A recitation component was designed to improve the analytical reasoning skills of students in large enrollment STEM courses like genetics. The recitation component consisted of weekly active learning sessions dedicated to utilizing scientific principles taught in class to strengthen students' analytical and problem solving skills. During these problem solving sessions, the recitation instructor worked in small groups to help students actively analyze scientific problems. Quiz and exam grades of students attending the recitation session (attendees) were compared to grades of students not attending the recitation sessions (non-attendees). These comparisons were made for each exam during the semester. Attendees final grades were compared with non-attendees grades from previous years. To determine if attendance at these recitation sessions improved analytical skills and better prepared students for future STEM courses, the STEM grades of attendees were analyzed in the semester following the recitation sessions. Recitation sessions were found to improve student course performance.

How the Maker Movement Will Change STEM Education

Greg Kufner, BHDP Architecture; Richard Superfine, University of North Carolina at Chapel Hill; Giancarlo Del Vita, BHDP Architecture

11:15 AM-12:15 PM/Alumni Memorial Union - Lounges

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Our core value is to "empower teams to identify problems, create solutions, and generate ideas to address the world's greatest challenges" – UNC BeAM (Be A Maker) Program

Why maker movement is occurring: More than ever, corporations and industry are seeking innovation. These Innovations are ever becoming more specialized, skill-based, and evolutionary, making it difficult for academia to keep up with the transforming STEM fields. Both as a backlash to, and supported by, today's digital world, students of today want to make, create, and learn by doing. Desire to create the 'next big thing', access to crowdfunding and the constant exponential impact of technology have collapsed the need for an idea to be supported by big industry in order to become a reality. How maker spaces are empowering this generation of students: The University of North Carolina Be A Maker (BeAM) Program has developed and continues to refine a platform where applied sciences is blended with making and entrepreneurship. Through intensive visioning exercises the University and BHDP Architecture have created an accessible and enabling venue for students to design, test, produce, and market their ideas. The intent of this session is to facilitate a discussion about maker spaces, their value to STEM education and innovation, and how universities should be utilizing a "Making Culture" to facilitate student success.

Mapping the Problem-Solving Process

Calvin Stubbins, Franklin & Marshall College

11:15 AM-12:15 PM/Alumni Memorial Union - Lounges

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

We present a pedagogy based on a graphical structure that organizes the solution to problems by representing the connections between different subproblems, thereby promoting thinking about relationships between different parts of a problem and making it easy to identify missing parts to a solution. We implemented this pedagogy in a calculus-based introductory physics course. Results

indicate that a multiple-choice class exercise that uses this approach is as good of an indicator of a student's problem-solving abilities as free-response questions.

Development of Course-Based Research Experiences in Chemistry and Biology

Jason Belitsky, Oberlin College; Marta Laskowski, Oberlin College

11:15 AM-12:15 PM/Alumni Memorial Union - Lounges

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Bringing authentic research into the undergraduate STEM curriculum in the form of course-based research experiences (CREs) promotes student understanding and engagement, broadens participation, and has the potential to impact retention. Here we report on two attempts to offer such courses at Oberlin College. “Bioorganic Chemistry” (CHEM 254) is a second semester organic chemistry class, serving approximately 55 students per year, primarily sophomores and juniors. The five-week CRE includes parallel screening assays modified from our research lab, lecture support, a research ethics discussion, and student-designed experiments. “Plant Biology” (BIOL 221) during two weeks of data collection, teams of 2-4 studied individual aspects of plant development; then regrouped to exchange raw data and discuss the best ways in which to analyze it. Original papers read earlier in the semester served as a basis for understanding the results. Papers in the form of a research article served as the final exam.

Establishing a Quantitative Skills Center at a Liberal Arts College: A Case Study from Oberlin

Marcelo Vinces Director, Oberlin College; Jason Belitsky, Oberlin College; Marta Laskowski, Oberlin College

11:15 AM-12:15 PM/Alumni Memorial Union - Lounges

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

One goal of science and math educators at liberal arts colleges and universities is to develop in students the ability to utilize quantitative information and reasoning in their careers and to be effective civic participants in a democratic society. In this presentation, we describe our science learning center that includes a student-staffed drop-in quantitative skills center as a mechanism for providing peer-led cross-curricular student academic support. A related aim of this center is to enable faculty to add more depth to quantitative assignments throughout the science and math curriculum. Following the example of the

QMaSC Handbook (2016), we present our experience with our center as a case study including benefits and pitfalls to consider in establishing a center, assessment and data, and efforts to ensure diverse and inclusive student use of the center. In addition to the drop-in center, an associated supplemental instruction program and events series will be discussed.

Teaching and Assessing Conceptual Change in the Active Learning Biochemistry Classroom

Tracey Arnold Murray, Capital University; Rodney Austin, Geneva College

11:15 AM-12:15 PM/Alumni Memorial Union - Lounges

Format: Poster

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Concepts from introductory chemistry and biology courses are crucial for students understanding of complex biochemical topics. However, these concepts are often not fully understood when students take biochemistry. For this project, seven concepts were assessed using a standardized concept inventory. The aim was to measure student understanding before and after taking one semester of biochemistry at Capital University and Geneva College. The curriculum at both schools is delivered through the active learning methodology called Process Oriented Guided Inquiry Learning (POGIL). The results from the assessment show that for significant conceptual change to be realized, multiple strategies must be used. Strategies that improved student scores were exposing students to multiple activities on the same topic, utilizing clicker questions with common misconceptions and reminding students of the correct reasoning in class discussions. This work highlights the need for multiple interactions on key concepts, which are easily facilitated in an active learning classroom.

Integrating Climate Change Education into Science Courses throughout the Undergraduate Curriculum

Amy Flanagan Johnson, Eastern Michigan University; Katherine Ryker, Eastern Michigan University; Chiron Graves, Eastern Michigan University; Thomas Kovacs, Eastern Michigan University

12:15 PM – 1:30 PM LUNCH DISCUSSION TABLE/ Winebrenner Theological Seminary - TLB

Format: Moderated Roundtable Discussion

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

As we compose this abstract, the United States has just endured a highly contentious election season. Despite all the many issues that divide us as a country, there is at least one that unites us: humans have but one planet on which to reside and its climate is changing in harmful ways. Under these circumstances, we are all in this together, our futures inexorably intertwined in one very large, complex

system. It is factually undeniable, however, that climate change disproportionately afflicts the most vulnerable among us. As such, climate change education is not only critical for our long-term survival as a species, it is immediately applicable as a matter of social justice. The guiding question we seek to answer through this roundtable discussion is, "How do we as a diverse group of STEM educators work together to advocate for meaningful climate change education throughout our curricula?"

Preparing High School Students To Be Successful STEM Majors: The Mobile DNA Laboratory

Christopher White, University of Findlay; Bethany Henderson-Dean, University of Findlay

1:45PM-2:00PM/Alumni Memorial Union - Endly Room

Format: Oral

Theme: Increasing Retention and Graduation Rates of Underprepared STEM Students

High Schools in the state of Ohio are under increasing mandates to expand their coverage of STEM areas. Areas that schools find difficult to cover are the subjects of heredity and evolution due to the expense of laboratory equipment needed to provide hands-on experience. The University of Findlay's Mobile DNA Laboratory Program has provided access to equipment and teaching resources to 17 High School science programs in eight Ohio counties since 2009 to help science teachers reach their mandated coverage levels and to promote an interest in STEM-related careers to their students. Though the use of lecture, laboratory skills taught in the high school classroom, and visit days to work alongside researchers in college-level laboratories these students are better prepared to enter college as STEM majors and to successfully complete their Bachelor's degree in a STEM field.

Pioneering Renewable Energy Technologies to Non-Engineering and Engineering Students

Ahmed Elgafy, University of Cincinnati

1:45PM-2:00PM/Frost-Brewer Science Hall – Room 122 – Malcolm Lecture Hall

Format: Oral

Theme: Teaching STEM Service Courses to Non-majors

The present work examines a component of a University of Cincinnati Honors Seminar that allows non engineering and engineering students to explore the frontiers of technology needed for the 21st century in the critical area of renewable energy. In this context, Honors students, in their interdisciplinary teams, have focused on one technology, but each member of the team has explored areas related to her/his major as part of the technology studied by the team. Moreover, the entire team has studied sustainability issues related to the renewable energy technologies and has explored innovative applications and products related to these technologies. The outcomes of this class have included Integrated Educational Modules (team work problems, team projects, technical reports, and research

findings). These Integrated Educational Modules can be used to educate the broader UC student population on technologies being used/developed to solve the energy major challenges facing the world today.

Use of In-Person plus Online Recitation Programs to Increase Student Success in Introductory Science Courses

Daniel Nichols, Seton Hall University; Raffi Manjikian, Seton Hall University; Edward Tall, Seton Hall University

1:45PM-2:00PM/Frost-Brewer Science Hall – Room 100 – Martin Lecture Hall

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Students with limited scientific backgrounds struggle when transitioning to college level introductory science courses. To assist these students, we have implemented the recitation component for students enrolled in General Biology II and Introduction to Microbiology. The recitation component consists of an additional hour of facetime allowing the recitation instructor to review core concepts, demonstrate problem solving, work with students on case studies, and answer student questions in small groups. Thus, the instructor has the ability to engage students in focused discussion. Further, an online portion was developed to assist students by providing additional assessment tools and problem sets. Overall, upon implementation of the recitation program for Freshmen Biology, we have observed an increase in student performance with fewer students receiving failing grades when online exercises were paired with additional facetime with students.

Students Taking Advantage of Resources (STAR): A Model to Promote Effective Study Habits and Autonomous Learning

Manori Jayasinghe, University of Cincinnati Blue Ash College; Charlotte Skinner, University of Cincinnati Blue Ash College

2:05PM-2:20PM/Alumni Memorial Union - Endly Room

Format: Oral

Theme: Increasing Retention and Graduation Rates of Underprepared STEM Students

Research shows that the self-regulated learning creates life-long learners and this has a strong correlation with academic achievement in the college and beyond (McCombs, B. L, 2001). Two-year college students often lack the autonomy and effective study strategies and unaware of how they learn best. By providing these students with learner choices that contain study strategies with some structure

and guidance to experiment with will stimulate their natural curiosity and motivation to learn (Credé & Kuncel, 2008; Cornelius-White, 2007). This can help students take greater responsibility for their own learning and develop effective habits that they can use throughout their college education. A model that encourages students to take advantage of available academic resources (e.g. online educational systems, text book resources, tutoring services, peer assisted study sessions, instructor office hours) will be presented. The consistent, positive relationship between students' use of these strategies and their exam scores will be highlighted. Although the presenter will share her experiences using this model in General Physics classes, the model can be easily adapted to fit individual instructors' needs and resources in any discipline.

Infusing Computer Science and Design-Based Research into Psychology Courses to Improve Engagement and Retention

Robert Duncan, York College of the City University of New York

2:05PM-2:20PM/Frost-Brewer Science Hall – Room 122 – Malcolm Lecture Hall

Format: Oral

Theme: Teaching STEM Service Courses to Non-majors

This project assesses the potential of a new learning genre, Game Design Based Learning, to engage Behavioral Science students in undergraduate research. This genre is based upon theories from the Learning Sciences (Report of the NSF Task Force on Cyberlearning, 2008) and Design-Based Research (Brown, 1992). This proposal also respects the Council on Undergraduate Research (Karukstis & Elgren, 2007), which advocates infusing research-like experiences and creative scholarship into the classroom. Students designed game-based learning experiences for social or behavioral impact. In creating this learning experience, students (1) learned more about their chosen topic of interest by reviewing the primary literature; (2) learned about the rationale and methodology of design-based research; (3) generated state-of-the art digital experiences using commercial game engines and the C# programming language; (4) used advanced statistics as needed for their project; and (5) disseminated their research product via the Internet and mobile technologies.

Ximera: Collaboratively Teaching Calculus with Online Tools

Jim Fowler, The Ohio State University

2:05PM-2:20PM/Frost-Brewer Science Hall – Room 100 – Martin Lecture Hall

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

Ohio State's Department of Mathematics has begun a long-term project to improve student success and STEM retention. The mathematics department has undertaken multiple interventions (active learning, flipped lectures, open source textbooks), the effects of which are being viewed through many lenses (affective surveys, conceptual pre- and post-tests, and online event logs). This talk focuses on the online, open-source content that we have built, the platform we designed to deploy that content, and the data gathered through that online platform.

It All Adds Up! Mathematics, Science, and Natural History

Julia Robinson, Miami University

2:25PM-2:40PM/Alumni Memorial Union - Endly Room

Format: Oral

Theme: Integration of Effective Mathematics Teaching across the STEM Curriculum

The Hefner Museum of Natural History of Miami University combines inquiry-based learning and interdisciplinary synthesis in its active outreach program, "Discovery Trunks." These educational kits synthesize a diversity of topics by exploring natural history subjects through standards-based lesson plans, authentic artifacts, and associated specimens. This resource is offered free of charge to area instructors for use in the classroom, home, nature center, and community events. In one school year, educators incorporated Discovery Trunks in their programs to teach over 2,500 students concepts of math, natural history, art, and writing. Learn how we accomplished this and see how you can create your own Discovery Trunks to connect pedagogical theory to practical teaching strategies for any discipline. Use the 5Es Instructional model— Engage, Explore, Explain, Elaborate, and Evaluate—to create effective inquiry activities and select dynamic, authentic objects that bring specific content alive.

Designing Effective Questions/Problems to Assess Students' Understanding and Ability of Applying Concepts

Manori Jayasinghe, University of Cincinnati Blue Ash College

2:25PM-2:40PM/Frost-Brewer Science Hall – Room 100 – Martin Lecture Hall

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

I'm sure I'm not alone in teaching a field that is more about "how" than it is about "what." Understanding of concepts and being capable of applying them in different scenarios are crucial for students to be successful in many STEM courses including General and College Physics. Are we assessing our students' understanding effectively? Most of us use standard text book or publisher test bank

questions which results in students' "plugging-&-chugging" values into equations where they have learned to focus on answers, not process. Standard problems do little to challenge that focus, and sites like chegg.com and yahooanswers.com actually reinforce the focus that the problem solving is changing the numbers and re-doing the algebra. Moreover, students often complain that they couldn't find equations in their cheat sheets to use in questions on tests thinking that every problem can be solved with a specific equation, and they often tend to memorize solutions to problems. Changing the way we ask questions can make a big difference in their concept learning. In this talk, I will discuss non-standard model questions that will enforce deep thinking and involve multiple skills. Developing critical thinking and multiple skills with models like "information in the figure converted to an equation", "a graph converted to an equation", "find everything unknown", "predict and analyze", and "find the scenario that can be described with a given concept" will be discussed. Although I will share my experiences using these question models in General Physics classes, these models can be easily adapted to fit individual instructors' needs in any discipline.

Engaging Pre-Service Education Majors with Curriculum Content Development in Minecraft

Mark Stevens, Bowling Green State University; Allison Goedde, Bowling Green State University

3:00PM-3:15PM/Alumni Memorial Union - Endly Room

Format: Oral

Theme: Contribute-a-Theme

The BGSU Minecraft in Middle Childhood Pre-service teacher preparation program began in Fall 2015 with the initiative to design a model learning experience for future educators that immerses learning in a virtual content rich environment. Instructors from Bowling Green State University (BGSU) and Pandora-Gilboa Local Schools (PGS) developed the Minecraft initiative and piloted the project in Spring 2016. BGSU education students are building content for students at PGS and students at PGS are providing feedback and creating their own educational content through coding in the Minecraft mods. This initiative has a strong basis in the TPACK framework and provides an excellent example of student engagement with content, technology, and deep knowledge acquisition that may be used as a model in K12 educational environments. A mixed method study design is pending development for future investigation of the impact of Minecraft engaged learning experiences on middle-childhood educators and students' level of content acquisition. In addition, cross-curriculum integration and Minecraft mods are planned with BGSU programs such as Visual Communication Technology (VCT) as well as College of Music programs (for development of musical backgrounds) and College of Arts & Sciences for artwork and mod design.

Using Metacognition to Teach Students How to Learn

Matthew Stoltzfus, The Ohio State University

3:00PM-3:15PM/Alumni Memorial Union – Multipurpose Room

Format: Oral

Theme: Increasing Retention and Graduation Rates of Underprepared STEM Students

In the Summer of 2016, Saundra McGuire's book "Teach Students How to Learn: Strategies You Can Incorporate Into Any Course to Improve Student Metacognition, Study Skills, and Motivation," was distributed to the Ohio State Chemistry teaching faculty. Faculty members were encouraged to incorporate the practices from this book in their classrooms. During the first week of their general chemistry course, students were given a substantive chemistry pre-test. Based on their pre-test performance, they were given recommendations to attend a personalized combination of some or all of the following sessions: study skills workshop, small group meetings with peer mentors, group led study sessions, Friday happy hour sessions, and Dennis Learning Center academic coaches. This session will take a look at the performance of the students from my first semester general chemistry course and will compare and contrast which group resulted in the best pre/post test gains in student performance.

Reaching the Masses: Metacognition and Technology in Large (>350 Student) General Chemistry Lectures

Daniel Waddell, University of Cincinnati

3:00PM-3:15PM/Frost-Brewer Science Hall – Room 100 – Martin Lecture Hall

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

This presentation will explore strategies to enhance learning and engagement in large lecture chemistry classes at the University of Cincinnati. Strategies include introducing metacognition early and often, incorporating the use of undergraduate learning assistants, and utilizing video for both class and personal feedback. Collaborative efforts to make the student experience as unified as possible across multiple instructors and semesters will also be discussed. Presentation of strategies, successes and challenges will be course content agnostic and discussed in the framework of formal and informal attitude surveys as well as results from a standardized, national exam.

Increasing Enrollment of Under-Represented Minoritories in STEM Programs

Colleen Taylor, University of Toledo

3:20PM-3:35PM/Alumni Memorial Union - Endly Room

Format: Oral

Theme: Contribute-a-Theme

The purpose of this presentation is to examine the differences in the numbers and percentages of students from underrepresented groups who are admitted into some STEM areas such as healthcare programs when active rather than passive admission strategies are used by these programs.

STEM Stakeholders Structured Conceptualization of Attitudes and Persistence towards STEM

Cijy Sunny, University of Cincinnati; Daniel McLinden, Cincinnati Children's Hospital Medical Center; Kathie Maynard, University of Cincinnati; Kathleen Koenig, University of Cincinnati

3:20PM-3:35PM/Alumni Memorial Union – Multipurpose Room

Format: Oral

Theme: Increasing Retention and Graduation Rates of Underprepared STEM Students

Meeting Science, Technology, Engineering, and Mathematics (STEM) workforce (healthcare, defense, etc.) demands requires students to have positive attitudes and persist through the STEM pipeline. The current study uses concept mapping— a structured participatory approach that simultaneously balances systematic inquiry and respects stakeholders' ideas through a methodical, rigorous, stepwise, valid and reliable process involving a mixed methods approach to data collection, analysis, representation, and interpretation—to develop an Attitude and Persistence towards STEM survey. Survey will be distributed, upon request, once validated.

Implementation of Active Learning Strategies in the Classroom: A Case Study in Human Genetics

Joshua Gross, University of Cincinnati

3:20PM-3:35PM/Frost-Brewer Science Hall – Room 100 – Martin Lecture Hall

Format: Oral

Theme: Promoting Effective Learning Across Teaching Environments (e.g., lecture, lab, field, community, online)

This presentation provides a case study of implementation of several active learning strategies for a course in Human Genetics. This upper-division course has traditionally been taught with a diadactic (lecture-based) approach. In order to deepen student learning and comprehension, this course has been redesigned to incorporate a variety of active-learning based approaches. The current design promotes learning through the use of learning objectives, real-time "clicker" questions, just-in-time incorporation of news items with relevance to Human Genetics, and independent study that culminates in a scholarly presentation. The new design provides students a clear and organized approach that facilitates their learning and review of material. In sum, this revised approach enables effective learning and a rewarding teaching experience.

Using Concept Maps to Visualize Learning Gains in Physics

Lindsay Owens, University of Cincinnati; Kathleen Koenig, University of Cincinnati

3:40PM-3:55PM/Alumni Memorial Union – Multipurpose Room

Format: Oral

Theme: Increasing Retention and Graduation Rates of Underprepared STEM Students

Introductory physics students commonly associated personal learning gains directly with their performance on traditional assessments, and that increased learning solely meant increased problem solving skills. In addition, students with previous exposure to physics content, most likely from high school, saw learning as an event that already occurred, and indicated that college level physics was simply a repetition of the content of high school physics. This presentation will discuss an effort to aid students in seeing the increase in their own learning throughout an introductory physics course by using concept maps. Concept maps serve as an alternative to the traditional assessments, and focus on organization of knowledge. Students are able to see shifts in their content knowledge by reflecting on a side-by-side comparison of their pre-concept map (completed at the start of the course) and their post-concept map (completed at the end of the 12-week course) and writing a short metacognitive reflection.

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