109th Meeting of the 1909 Conference: Advancing Thought, Research, and Practice in Technology and Engineering Education
Clarion Hotel, Nashville Downtown Stadium, Nashville, TN
November 16 – 17, 2023

Thursday, November 16, 2023

9:00 a.m. Welcome, Introductions and Announcements
Michael Daugherty, 8th Life Chair, 1909 Conference
Dominick Manusos, President-Elect, STEC

9:30 a.m. **SESSION I: Innovative Ideas and Making**

Presiding: **David Rouch**, Ohio Northern University

1. Why Students Make: A Qualitative Investigation into Student Motivation Toward Making and Doing in Technology and Engineering Education

The researcher, using a hermeneutic phenomenological methodology, conducted a series of two interviews with six undergraduate students enrolled in a making and doing-centered Materials and Processes Technology course at a Research 1 university in the Southeastern United States. Using this qualitative approach, the researcher found that undergraduate students were motivated by the making and doing project, feedback and growth they experienced, and the mental health impacts they experienced while making and doing. These findings can be used to direct future research and impact the T&E classroom through modified curriculum, pre-service and in-service teacher training, and through modified classroom practices that engender greater motivation in students.

Presenter: Justin Egresitz, Millersville University of Pennsylvania

2. Engaging Anthropology in the Human-Centered Technology Design Classroom
To train design technology students in ethnography, this presentation looks at one model for doing this in a human-centered design course. "Designing Technology for People," an undergraduate-level course offered at Purdue University, is co-taught by faculty from the Department of Anthropology and Purdue Polytechnic. During the course, students gain experience conducting basic ethnographic research and analysis, in addition to developing a comprehensive engineer's notebook and a design mock-up, shaped by their ethnographic findings. This presentation will examine how the course is taught, in addition to considering the value of teaching a human-design course with instructors from both anthropology and technology design.

Presenters: Jung Han, Sarah Renkert, and Todd Kelley, Purdue University

3. Innovative Labs: Problem Solving, Prototyping, and the Impact of Technology Course

The "Technology in Your World" course at ODU was created to develop skills and knowledge in the development, selection, and use of technology. The course is offered online and in person with eight

sections each semester. The course teaches technological literacy skills with a focus on problem solving, prototyping, and the impact of technology.

Presenter: M. Kathleen Ferguson, Old Dominion University

11:30 a.m. **SESSION II: Teacher Education Focus**
Lunch Session - (lunch provided for members/guests**)**

Presiding: **Paul Post**, The Ohio State University

4. Exploring P-6 Integrated STEM Education: Insights from a Teacher Educator Delphi Panel

Over the past two decades, efforts have been made to improve STEM education for P-12 students, yet patterns of engagement remain persistently unchanged, potentially hindering interest in STEM careers. This research reports findings from a modified Delphi study involving expert teacher educators across the US. The research focuses on identifying crucial practices used by teacher educators to prepare candidates for integrated STEM teaching in P-6 classrooms. Additionally, the research highlights key attributes of integrated P-6 STEM education compared to single-discipline curricula. The study reveals 16 interconnected essential practices and 9 differentiating attributes that define integrated P-6 STEM education, offering insights for researchers, practitioners, and policymakers.

Presenters: Leah R. Cheek, Vinson Carter, Michael K. Daugherty, and Christian Z. Goering, University of Arkansas

5. Filling in the Gaps: Holistic Support Emphasizing the Value of Making and Doing Survival for Non-traditional Technology Engineering and Design Teachers

Being long-standing makers and doers, we have come to a point in our careers, where we need to hone our high-tech skills in the "doing" of digital file preparation and 3D printing, as well as the "making" through CNC machining, and other materials processing technologies. The national crisis of teacher preparation has spurred us to look at our experiences and to seek effective ways to help other traditionally and non-traditionally prepared Technology, Engineering, and Design teachers. We are heavily invested in our Critical Action Research.

Presenters: **Steven L. Miller**, North Carolina State University; **Glenn R. Moore, III**, New Hanover High School, Wilmington, NC

12:45 p.m. **Traditional 1909 Conference Group Photo**

1:15 p.m. **SESSION III: Higher Education/Faculty Focus**

Presiding: **Tyler Love**, University of Maryland Eastern Shore

6. Botswana Mentor Experiences in a STEM-based eMentoring Program

eSTEM is a 16-week program which relies on an innovative research-based four-pronged mentoring protocol that features: 1) access to eMentoring via mobile communication with near-peer minority STEM majors, 2) opportunities for field experiences that connect formal learning to the authentic

representations of STEM fields, 3) exposure to visual media depicting minority professionals in STEM fields, and 4) participating in an 8-week short course designed to enhance student's STEM competence beliefs and self-efficacy. In this model students' self-efficacy and value for STEM and their STEM intentions, enrollment, and persistence are supported through one-on-one near-peer mentoring sessions, shared STEM experiences with a relatable model of STEM success, and engagement in a STEM short course.

Presenters: Cameron Denson and Niloufar Bayati, North Carolina State University

7. STEM Faculty Institute: Improving Higher Education Teaching

STEMFI was an initially NSF funded project designed to improve STEM faculty instruction, by training them on student-centered teaching techniques. In short, STEMFI provided 15 faculty annually with an intensive one-week workshop with hands-on experimentation with various student-centered teaching strategies, as well as deep instruction into the basic science of learning and assessment, course redesign support, and cohorted and one-on-one mentoring. This mentoring continued throughout the school year as the faculty transitioned at least one major course to student-centered methods.

Presenter: Geoffrey Wright, Brigham Young University

2:30 p.m. **SESSION IV: New Initiatives**

Presiding: **Leah Cheek**, University of Arkansas

8. Revisioning and Rebranding to Fortify Our Place in Higher Education

By looking for opportunities, revisiting past models, and expanding to meet the needs of non-traditional students; Appalachian State University's Career and Technical Education (AppState CTE) program set the stage for program vitality and expansion. This session will tell the recent story of AppState CTE and allow you to consider possible initiatives for program growth.

Presenters: Jerianne Taylor, Kevin Sutton, Dominick Manusos, and Teena Coats, Appalachian State University

9. Recreational Charging Stations via Renewable Energy: An Undergraduate Research Experience, Service-Learning Project

This paper delves into a groundbreaking academic initiative, the Undergraduate Research Experience (URE) coupled with a Service-Learning Project (S-LP), spanning multiple semesters at Fort Hays State University (FHSU). The project, steered by two dedicated instructors and a team of undergraduate students, undertook the challenge of defining an issue, conducting research on Recreational Charging Stations (RCS) infused with renewable energy, and securing Institutional Review Board (IRB) approval. Subsequently, students designed, administered, and analyzed a comprehensive survey, which served as the foundation for the creation of a 3D prototype of an RCS.

Presenter: Eric Deneault, Fort Hays State University

3:45 p.m. SESSION V: 1909 Conference Business Meeting

Presiding: Michael Daugherty, 8th Life Chair, 1909 Conference

1. Report of the Membership Committee
    a. Vinson Carter, University of Arkansas
2. Consideration of nominations for membership
3. Transition Committee Report
    a. Dominick Manusos, Appalachian State University
4. Logo Contest
5. Outstanding Presentation Award
6. 1909 Conference Benefactors
7. Other Business

4:45 p.m. STEC Business Meeting

Presiding: Dominick Manusos, President-Elect, STEC

1. Report of the Membership Committee
2. Consideration of nominations for membership
3. Other Business

Friday, November 17, 2023

8:30 a.m. Installation of New 1909 Conference Members

Master of Induction Ceremony: Aaron Clark, North Carolina State University

9:15 a.m. SESSION VI: Design Thinking and Practice

Presiding: Byron McKay, Pittsburg State University

10. Assessing the Development of Design Thinking Mindset in Secondary Students

This research project investigates the potential development of design thinking mindset among secondary students in an introductory technology and engineering course. Specifically, it seeks to appraise the validity of an existing design thinking mindset survey when used in the secondary-education context and report descriptive statistics related to students' design thinking mindset. Dosi et al. (2018) worked on measuring design thinking mindset resulting in a 71-item instrument to assess design thinking mindset based on 22 constructs. Our ongoing research involves design thinking mindset and we had interest in the questionnaire. However, the original questionnaire developed was lengthy and a shorter one may be appropriate for the study. Furthermore, we are working in a secondary education context that differs from the original audience of the questionnaire. By verifying the quality of the instrument in a secondary education context, researchers and practitioners may be better equipped to determine changes in this mindset among secondary students who are beginning their journey as designers.

Presenters: Daniel Bayah, Andrew Jackson, Nathan Mentzer, Scott Bartholomew, and Wonki Lee, University of Georgia

11. The Digital Storytelling project is a design- based research project

The Digital Storytelling project is a design- based research project which began to address this need by training both current and future teachers in CS education. Undergraduate teacher education students were partnered with elementary teachers to facilitate a unit focused on designing, building, and coding "digital storyboards." These storyboards incorporate electronics and coding. Students are given 10 weeks of guided instruction in storytelling, wiring, coding, and building. Student data from pre/post surveys related to their interest in, and aptitude for, computer science was collected, and both students and teachers were interviewed. While efforts are ongoing, the results after working with 8 classrooms show positive results in how projects such as this can help promote CS training and learning for students and teachers.

Presenters: Scott Bartholomew, Peter Rich, Emerson Barnum, Jessica Allen, Geoffrey Wright, Steven Shumway, Brigham Young University

12. Incorporating Contextual Variations: Integrated STEM Education for Rural Context Diverse Regional Settings

This presentation will provide an overview of the preliminary results from a NSF-funded project, which aims to implement place-based integrated STEM education in rural high schools. The project spans three years, starting from the summer of 2022 until the summer of 2025, with different cohorts in different regions. The presentation will showcase the summer institutes conducted for life science and engineering teachers in Cohort I (DE, MA, VA) and Cohort II (CO, KS, NM), highlighting the unique contextual differences between the two regions. It will discuss the preliminary results of teacher surveys, focusing on the changes in teacher self-efficacy and the growth of their community of practice network size.

Presenters: Jung Han, Purdue University, **J. Geoffrey Knowles**, Bryan College, **Yunjin Lim, Woongbin Park, and, Todd Kelley,** Purdue University

11:00 SESSION VII: Graduate Student Research Poster Session

Presiding: **Greg Strimel**, Purdue University

Graduate Student Research Poster Session

This is a research poster session for graduate students. It is designed to allow graduate students to share completed research and research in progress in a low-pressure environment. Participants will display posters and discuss the research with conference members and guests.

- **Democratizing the Practices of Design and Innovation through Transdisciplinary Coursework**

  Presenters: Sean Wiseman, Scott Thorne, Greg J. Strimel, Purdue University

- **Belonging & Identities in Transdisciplinary Spaces in the Pursuit of Innovation**

Presenter: Rebecca Martinez, Purdue University

- **Enhancing Motivation and Self-efficacy through Assistive Co-Robotics in Secondary STEM Education**

  Presenter: Jennifer Blackburn, Purdue University

- **A Move Toward Transdisciplinarity: Exploring Challenges and Opportunities of Cross-college Co-Teaching**

  Presenter: Deana Lucas, Purdue University

- **Navigating the Digital Frontier: A Phenomenological Study Investigating Prospective Technology Educators' Perceptions of their Training to Address ICT Standards.**

  Presenter: Joseph M. Kaskel, North Carolina State University

12:30 p.m. **SESSION VIII: Lunch provided for 1909 Conference members/guests**

Presiding: **Eric Deneault**, Fort Hays State University

13. **Expanding Career Options: Perspectives of the Role(s) of Engineering and Technology Education in Career Awareness and Development in STEM Education as Viewed Through the Lens of the Inheritability of Occupations (Career Inheritance)**.

Engineering and Technology education specifically, and STEM education generally, has a role in exposing students to the array of career options in the STEM professions and workforce. Making students aware of the array of career options is a key component in career development and in assisting students in developing their educational plans to prepare for STEM careers if that is their choice, or to learn at an early age that their career interests are not in the STEM fields. The purpose for this paper is to share an analysis of the literature surrounding the inheritability of occupations, or career inheritance, with STEM educators to provide them with expanded knowledge of career inheritance, and how it can limit student interest and engagement in STEM education and careers, with a focus on empowering STEM educators in their efforts to engage students, especially disadvantaged students, in expanding career awareness and development for students through STEM education.

Presenter: Thomas L. Erekson, Western Illinois University (7th Life Chair)

14. A Review of Technology Education Teacher Needs in Virginia

There are many ways to become a certified technology education teacher throughout the US. Since the technology education teachers can have such varied training experiences, this researcher collected data on secondary technology education programs in Virginia to research teacher's needs and desires for support. This study surveyed secondary technology education teachers in Virginia to answer the following research questions: 1. What is the educational background of technology education teachers? 2. What goals are emphasized in technology education programs? 3. What are the major issues confronting technology education teachers?

Presenter: M. Kathleen Ferguson and Philip A. Reed, Old Dominion University

1:30 p.m. **SESSION IX: CAD/Graphics/Manufacturing**

Presiding: **Paul Camick**, Georgia Department of Education

15. CNC Technology in the Classroom: Why it's Important and How to Implement It

This presentation will include exemplary CNC instructional strategies. The strategies range from simplistic models developed to teach work-coordinated systems, solid-modeling activities, and will culminate in a CNC project produced by the proposal's co-author. While the barriers to accessing full-size CNC machines may be significant, affordable small-scale CNC machines are available to provide hands-on balance to virtual CNC manufacturing activities.

Presenters: Sam Munzer and Steven Miller, North Carolina State University

16. Active Learning in Engineering Graphics: A Longitudinal Study on Retention and Persistence in STEM Degree Programs

This study investigates the longitudinal influences that the inclusion of supplemental active learning modules can have on technology and engineering students within a hands-on learning environment in an engineering graphics course. Using a large sample of students over a three-year period, an evaluation of retention and persistence of participating students occurred, leading to a longitudinal analysis that can support technology and engineering degree programs. Data points included student degrees before and after experiencing the active learning structure, their grade in the course, whether the student graduated, degree programs from which they graduated, and their race, gender, and first-generation college student status.

Presenters: Erik J. Schettig, Daniel P. Kelly, Aaron C. Clark, North Carolina State University and **Jeremy Ernst**, Embry-Riddle Aeronautical University

17. Establishing an Ecosystem for Open-source Educational Computer Aided Design (CAD) Models

During the past decade, many K-12 schools have established makerspaces with 3D printers, digital die cutters, and other fabrication tools. A consortium of national education associations received a POSE Phase I award (NSF # 2229627) to develop a plan for a repository of peer-reviewed open-source educational objects. This work is being undertaken through the National Technology Leadership Summit (NTLS) coalition, which includes national teacher educator associations in science education (ASTE), educational technology (SITE), engineering education (ITEEA), and mathematics education (AMTE). During Phase I, external contributors were identified in mathematics, science, and engineering. These contributors include managers of existing repositories of CAD models developed with NSF support.

Presenters: Ryan S. Novitski, Debra Shapiro; ITEEA, **Glen Bull, and Jo Watts**; University of Virginia

3:00 p.m. **Conference Awards Program**

Presiding: **Michael Daugherty**, 8th Life Chair, 1909 Conference
Session Chair: **Kevin Howell**, Epsilon Pi Tau

During this session, members and guests will vote to select the *Epsilon Pi Tau Outstanding Conference Presentation Award* recipient and that award will be presented by *Epsilon Pi Tau*.

Following this presentation, the *Technical Foundation of America* will present the *Outstanding Publication Award*—which was determined prior to the start of the conference.

3:30 p.m. **Report from the Conference Pollution Committee**

Presiding: **Kevin Sutton**, Appalachian State University

Although not officially connected to the STEC Pollution Committee, Dr. Sutton will share the infractions from the 2023 1909 Conference. All members and guests should remember that you can and will be fined for attempting to ascertain the names of members of the Pollution Committee.

4:15 p.m. **Conference Adjournment**

Presiding: **Michael Daugherty**, 8th Life Chair, 1909 Conference
Dominick Manusos, President-Elect, STEC