Experiential Learning of Manufacturing Standards: from Lectures to Labs and Industrial Internships

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Team Background

Yue Zhang, Ph.D Assistant professor	Haijun Gong, Ph.D. Associate Professor	Lianjun Wu, Ph.D. Assistant professor
Polymer Processing Additive manufacturing Nanomanufacturing	**Additive manufacturing** Lightweight structure design High-performance material applications	**Robotics** Smart materials Actuators Soft multi-material manufacturing via 3d printing
Program evaluator (PEV) for the EAC of **ABET**	**ASME** Additive Manufacturing for Nonmetallic Materials Working Group	Curriculum development committee of CEC college Emerging Professional Group and Student Relation Committee at **SME**

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Main Goals

- Create a systematic framework that includes lectures, labs, and industrial experience to strengthen education and learning about **robotics** and **additive manufacturing standards** among engineering students.

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Project Objectives

1. Develop innovative **course modules** (lecture, lab, and project) to advance students' professional preparedness
2. Develop **virtual learning materials** to improve students' career readiness
3. Create a sustainable **online course structure** to enhance education and learning impacts.

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Design of Curriculum

- Course Modules
- New Course
- Plant Tours
- Webinar from Guest Speakers

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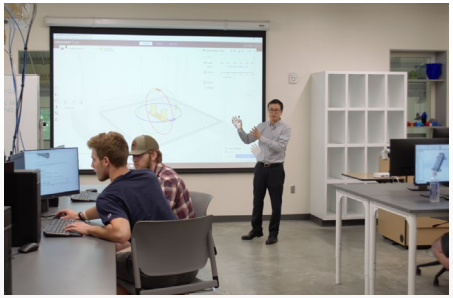
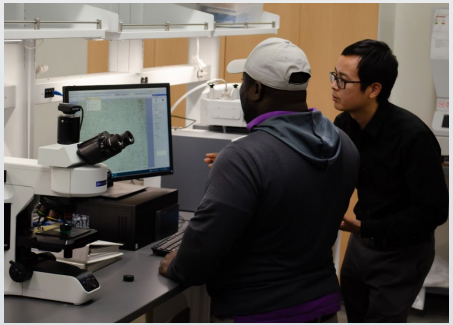
Curriculum Design

	Additive Manufacturing	Robotics	New Course
Entry Level (Lecture)	MFGE 2421 Intro. to AM (Spring 2022&Fall 2022)	FYE 1220 First-Year Seminar (Fall 2022) MFGE 4533 Industrial Robotics and Automation (Spring 2022 & Fall 2022)	
Medium Level (Lab)	MFGE 5333 AM Studio (Fall 2022)	MFGE 4533 Industrial Robotics and Automation (Fall 2022)	
Graduate Level (Project)	MFGE 5334G AM of Lightweight Structure (Spring 2023)	MFGE 5337G: Adv. PLC Hardware and Programming (Spring 2023)	MFGE 5339G Manufacturing Standards and Standardization Fall 2022

Course Modules (AM)

- Lecture module in MFGE 2421
  - Lecture topics cover “what is a “standard”?”, “why does AM need standards?”, “how are AM standards developed?”, and “how to use AM standards”.
  - Course assignment requires students to follow AM standards (such as ISO/ASTM 52910) to complete a simple design project.
- Lab module in MFGE 5333
  - Evaluate tensile strength of FDM 3D printed plastic materials (for university without metal AM facility), referring to ISO/ASTM 52903 and 52921, ASTM D638, etc.
  - Evaluate microstructural characteristics of 3D printed stainless steel 316L materials (for university with metal AM facility), referring to ASTM F3049, F3184, F3122, etc.





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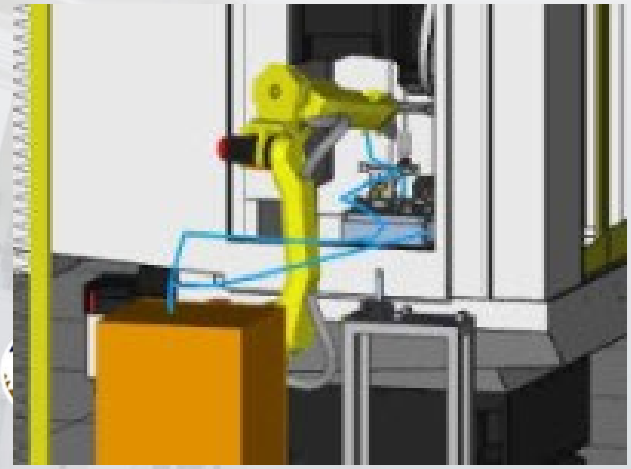
Course Modules (Robotics)



- Lecture module in FYE 1220
  - Lecture topics “Introduction of a Standard” covering “what is a standard?”, “why do we have standards”, and “how to locate important standards resources”
  - Course assignment requires students to complete a quiz.
- Lecture module in MFGE 4533
  - Lecture topics “Robots and Safety” covering “Safety Standards for industrial robots”, and “Types of safety options”
  - Hands-on activity: How to recover a robot from singularity.
- Lab module in MFGE 4533
  - Design a robotic workcell using RoboGuide that satisfies the requirements in the ANSI/RIA R15.06-2012 Robot Safety Standard.

Guest Speakers and Plant Tours

	Guest speaker	Plant Tour
Activities	• Webinars	• Trip to plant or virtual tour • Interview industrial professionals
Frequency	Spring and Fall Semester	
Sponsors	• Department Professional Advisory Committee (PAC) • Industrial professionals • Alumni • Professional Society: ASTM, SME, etc.	
Documentation	• Videos	

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Plant Tour-PAC members

Gulfstream

MAHLE®

BRIGGS & STRATTON®

Great Dane

Nordson

JTEKT

Koyo

TOYODA

MITSUBISHI POWER

DANIEL DEFENSE®

Plant Tour

Replication

- E-conference
- Class demos and seminar
- Project Website

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Replication

	E-conference	Class Demos and Seminars
Who	• GaSou faculties • IHEs: Jacksonville State University, San Jose State University, etc.	
What	• Teaching materials • Demonstration of using the modules • Curriculum Design	• Demonstration of using the modules
When	Summer 2022 and 2023	Spring & Fall 2022 and 2023
Where	Face-to-face and online simultaneously	Online for other IHEs

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E-conference

- 2022 Summer and 2023 Summer
- 11 attendees from 10 institutions in the U.S. and India

Institutions of Attendees	
Purdue University	Omex India Sales Pvt Ltd
Penn State University Erie	The University of Texas at Tyler
Jackson State University	San Jose State University
Georgia Southern University	Binghamton University - SUNY
University of Alabama in Huntsville	Oregon Institute of Technology

Seminar at SJSU

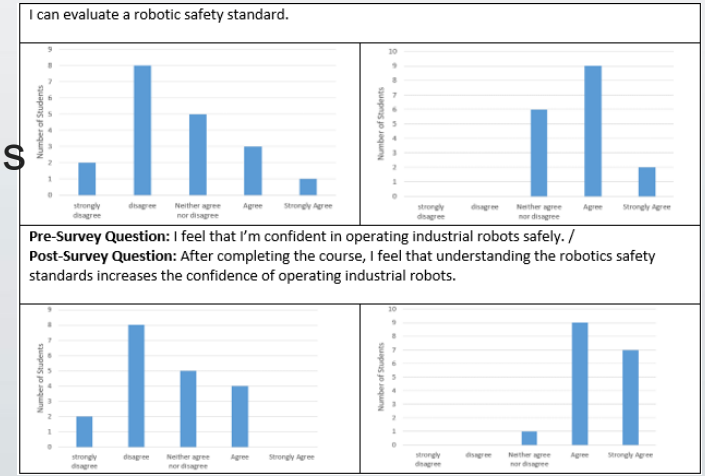
Format: Guest Lecture

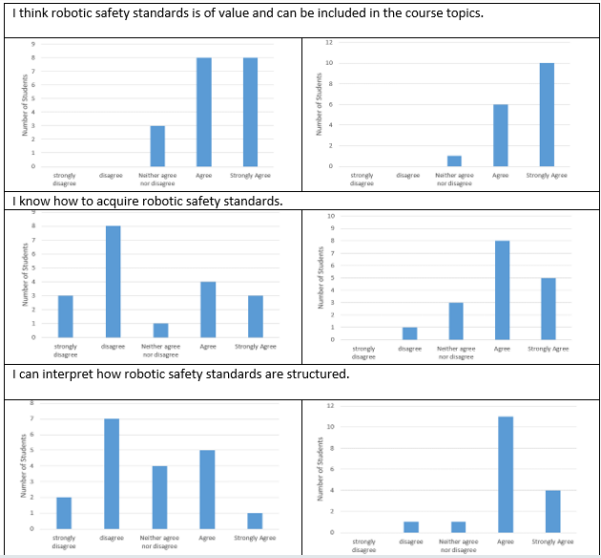
Platform: Zoom

Host University: SJSU

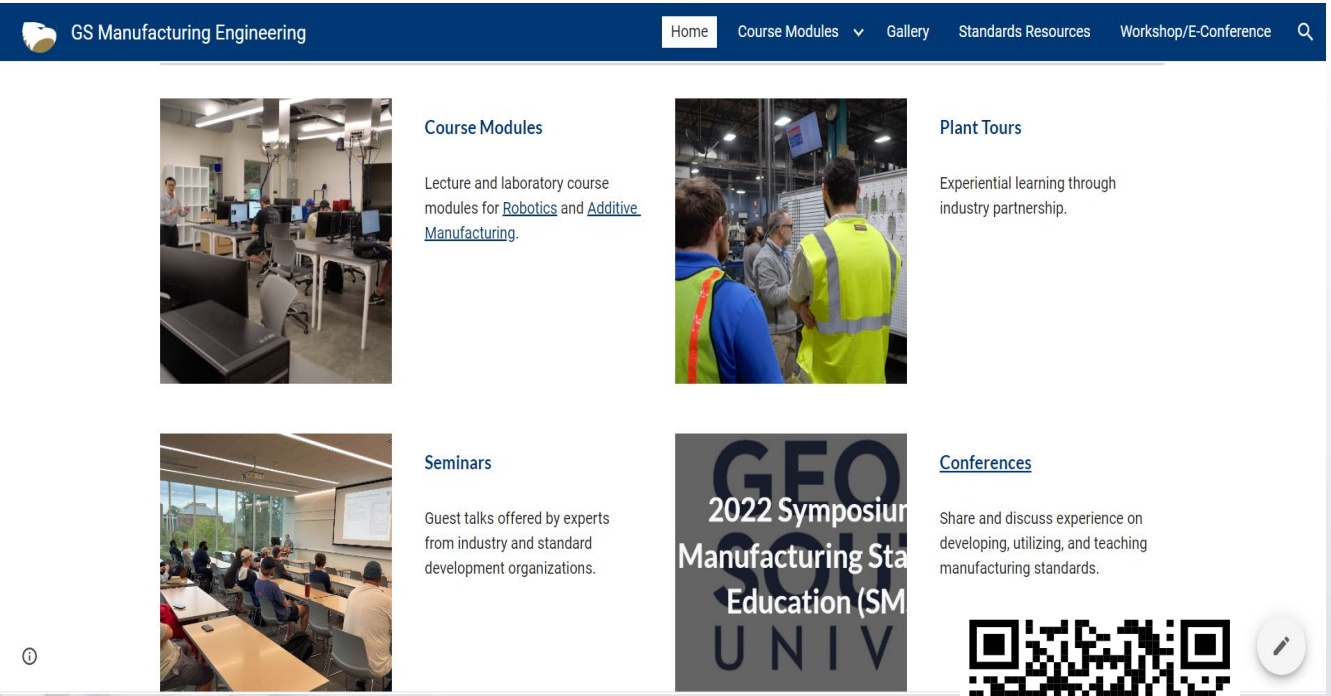
Course: ME192 Robotics and Manufacturing Systems

Students: 19





Project Website



- Download Course Modules
- E-conference Registration
- Videos records and pictures
- Student Resources
- Project news and updates

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[Website Link]

Dissemination and Sharing

- Project Website
- Conferences
- Professional Society
- Social Media

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Conferences

	2022	2023
SoTL Commons Conference	Zhang, Yue; Gong, Haijun; and Wu, Lianjun, "Development of Experiential Learning Modules for the Education of Manufacturing Standards"	Proposal Accepted for Presentation
Solid Freeform Fabrication (SFF) Symposium	Zhang, Yue; Gong, Haijun; and Wu, Lianjun, "Development of Standards Education Modules for Robotics and Additive Manufacturing"	
ASEE Annual Conference	---	Abstract Under Review

SOTL COMMONS CONFERENCE
A Conference for the Scholarship of Teaching & Learning

ASEE
AMERICAN SOCIETY FOR ENGINEERING EDUCATION

ANNUAL INTERNATIONAL SOLID FREEFORM FABRICATION SYMPOSIUM

Thank You!

Questions?

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