INTRODUCTION TO TEACHING

ENGINEERING AND TECHNOLOGY DESIGN AT THE K-12 IN THE CONTEXT OF INTEGRATED STEM

Associate Professor
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Dept. of Technology Leadership & Innovation
Dept. of Curriculum & Instruction

INSTRUCTOR'S ONLINE HOURS

Greetings and welcome to the class! I will be working with you this term as your course instructor. Please feel free to contact me during the course period. I will respond as soon as available (generally within 24-48 hours). Virtual Office Hours are available by appointment (or office hour information here). Please contact me via email to set up a MsTEAMS session. Email is typically the fastest way to get a hold of me, especially if it is a quick item or urgent issue.

COURSE WEBSITE

Brightspace is our course management system. You can access the course website at http://purdue.brightspace.com It is strongly suggested that you explore and become familiar not only with the site navigation, but with content and resources available for this course.

COURSE DESCRIPTION

Engineering and technology design has gained considerable traction in many K-12 schools. Examination of where and how integrated engineering and technology design best fits in the curriculum; how to include it authentically and appropriately; and how best to prepare teachers are discussed. Students design, develop, deliver integrated lessons utilizing engineering and technology design principles.

PURDUE UNIVERSITY

W/S I 2024: 1/8/24 - 3/3/24
Instructor: Paul Asunda | pasunda@purdue.edu
EDCI 55850 Syllabus
Introduction to Teaching Engineering and Technology Design at the K-12 in the context of Integrated STEM

COURSE INSTRUCTIONAL GOALS

After completing this course, you should be able to:

- Describe the importance of the integrative nature of K-12 STEM curriculum.
- Describe how technology and engineering can be integrated with K-12 mathematics and science.
- Demonstrate hands-on learning activities appropriate to integrate technology and engineering design into the K-12 STEM curriculum.
- Develop competencies related to teaching and assessing engineering and technology design in the context of integrated STEM.

COURSE READINGS AND RESOURCES (SUBJECT TO REVISION)

Additional required and optional readings provided in the Brightspace and are subject to change as the course progresses.

ASSIGNMENTS

TIME MANAGEMENT AND LATE ASSIGNMENTS

Deadlines are an unavoidable part of being a professional and this course is no exception. Avoid any inclination to procrastinate. To encourage you to stay on schedule, due dates have been established for each assignment; ***20% of the total points may be deducted for assignments received late without instructor approval; assignments received more than 1 week late without approval will receive 0 points.***

Note – Electronic individual assignment rubrics are included within the Brightspace course.

Points are distributed as indicated in the following table:

Assignments	**Points**
DISCUSSION PARTICIPATION (Discussion post and video post)	
Week 1 Discussion - Integrated STEM Approach	15
Week 1 Discussion - State STEM Standards	15
Week 2 Discussion: Integrated STEM Lesson Plan	15
Week 3 Discussion - Article Presentation	15
Week 5 Discussion - Informal STEM Environments	15
Week 6 Discussion - Modeling Software In the Classroom	15
Week 8 Discussion - Integrated STEM Lesson Plan and Assessment Plan Presentations	15
PROJECT	

Week 3 Project - Lesson Plan Topic Due Week 6 Project - Integrated STEM Lesson Plan and Assessment Plan Draft Week 7 Project - Integrated STEM Lesson Plan and Assessment Plan	15 30 80
ASSIGNMENTS	
Week 1 Assignment - Engineering Journaling	20
Week 2 Assignment - Exploring Integrated STEM Lesson Plans	20
Week 3 Assignment - Article Summaries	25
Week 4 Assignment - K-12 Environment Report	25
Week 4 Assignment - Teacher Observation - STEM Focus	30
Week 5 Assignment - Informal Learning Environment Observations	25
Week 8 Assignment - Journal Reflection	25
Total	**400**

STUDENT STATEMENT OF COMMITMENT (COMPLETE/INCOMPLETE)

Re-submit the Statement of Commitment you signed from the New Student Orientation. This is a required activity prior to receiving credit for all other assignments. Keep a copy of this document, you may need to for other courses.

COURSE DISCUSSIONS (105 POINTS)

Active participation is a must in this course. Throughout the course one or more key discussion questions, activities, debates, etc. will be posted. Generally, you will be required to respond to the main discussion question and then also make comments (a minimum of 2) on the responses of others in the course. *Making the minimum number of postings should not be your only goal. The* ***quality*** *of your postings is critically important.* Furthermore, you are expected to participate throughout the week in the discussions.

Please note that many discussion questions are an opportunity to share and provide feedback on course assignments. It is encouraged to incorporate the information and insights provided by your peers from the discussions into your assignments.

ASSIGNMENTS (170 POINTS)

During each week, there will be one or more assignments for you to complete. These assignments are intended to enhance your understanding of teaching engineering and technology**.**

PROJECT - INTEGRATED STEM LESSON AND ASSESSMENT PLANS (125 POINTS)

Lesson Plan

For your lesson plan, you will need to utilize what you have learned so far to design an integrated STEM activity or lesson of choice that depicts a problem that can be solved through the engineering design process.

Your lesson plan topic should focus on integrating engineering and/or technology concepts into a science or a mathematics lesson.

You will utilize the design process to design the activity and prototype your solution using one or more of the integrated STEM education approaches shared in class.

You will also share your activity with your peers and provide your peers with feedback. As a class, you will discuss how to utilize the lesson plan activities in the classroom.

The following sections should be included in your Lesson Plan:

- Learning objectives
- Target student grade level
- Required time (e.g., number of lessons)
- Connection to NGSS and/or State Standards
- Materials - (Examples like scissors, software, textbook, etc.)
- Teacher Preparations- For example - references to other concepts, readings to prepare themselves on the topic, etc.
- Lesson Plan Introduction - What is the purpose of the lesson? How are terms defined?
- Procedure (a detailed explanation is expected in this section) - What the students are doing and which order?
- Closure- How is the lesson connected back to the learning objectives
- Assessment (both formative and summative) - A brief description of planned assessment

Assessment Plan

You will need to design an assessment plan for your STEM lesson. For your assessment (specific to your lesson plan), include the following:

- Describe the alignment of the learning objectives to your assessment plan (including the integration of engineering or technology design).
- Describe pre-activity assessment(s) (if any).
- Describe formative assessment(s) that will be used during teaching the lesson.

- Describe summative assessment(s) that will be used at the end of your lesson.
- For your assessments, show all the rubrics (i.e., scoring guides) that will be used to assess students' knowledge or skills.

GRADING SCALE

Letter Grade	Percentage of Points
A	94 - 100% of points
A-	90 - 93% of points
B+	87- 89% of points
B	84 - 86% of points
B-	80 - 83% of points
C+	77 - 79% of points
C	74 - 76% of points
C-	70 - 73% of points
D+	67 - 69% of points
D	64 - 66% of points
D-	60 - 63% of points

NOTE: This course is a core course in the C&I online master's program. A grade of B- or better is required. If a lower grade is earned, the course must be retaken.

COURSE POLICIES

ASSIGNMENT DUE DATES

Assignments, discussions, and other activities are due at the end of each week in which they are assigned. Points may be deducted for late assignments as follows: assignments that are late by 1-6 day will be penalized 20% of available points; 1 week or later 0 points will be assigned.

INCOMPLETES

A grade of Incomplete (I) grades will be given only in extenuating circumstances. To receive an "I" grade, a ***written request must be submitted prior to the Friday of week 7*** and approved by the instructor. The request must describe the circumstances, along with a proposed timeline for completing the course work. You will be required to fill out and sign an "Incomplete Contract" form that will be turned in with the course grades. Any requests made after the course is completed will not be considered for an Incomplete grade.

ETIQUETTE

Although it is not expected to be a problem in a graduate level class, students are asked to behave in the discussions and other class interactions in a professional and civil manner. If you are in doubt, do not post it! Instructors reserve the right to remove any postings deemed inappropriate, unprofessional, or otherwise distracting from the course.

COURSE EVALUATIONS

You will receive an official e-mail from Purdue with a link to the online evaluation site. Your participation is an integral part of this course, and your feedback is vital to improving education at Purdue University. I strongly urge you to participate in the evaluation system.

PURDUE POLICY STATEMENTS

ACADEMIC INTEGRITY

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breeches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern.

PURDUE HONOR PLEDGE

"As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do.

Accountable together - we are Purdue."

YOUR HEALTH AND WELL-BEING

Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, such individuals on campus should contact Counseling and Psychological Services (CAPS) at (765) 494-6995. After-hours support is available on a mental health crisis hotline (765) 494-6995, during and after hours, on weekends and holidays.

ACCESSIBILITY AND ACCOMMODATIONS

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at drc@purdue.edu or by phone: 765-494-1247.

EMERGENCY STATEMENT

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Any changes in this course will be announced on our course Website.

PERSONAL EMERGENCIES

Purdue University "expects both students and their instructors to approach problems with class attendance in a manner that is reasonable". If you have a personal emergency, please contact your instructor as soon as you reasonably can so that you can work out a solution together. For additional information, please review Purdue's Attendance Policy.

ADAPTIVE PROGRAMS STATEMENT

Students with disabilities must be registered with Adaptive Programs in the Office of the Dean of Students before classroom accommodations can be provided. If you are eligible for academic accommodations because you have a documented disability that will impact your work in this class, please schedule an appointment with me as soon as possible to discuss your needs.

ACADEMIC DISHONESTY STATEMENT

Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University is examples of dishonesty." [Part 5, Section III-B-2-a, University Regulations] Plagiarism, whether intended or unintended, is an extremely serious offense in academia. Be absolutely sure you are properly citing all references. Instances of plagiarism will result in failure of the assignment in question. More than one instance will result in failure of the course. ***All incidents of plagiarism, whether intentional or not, will be documented with the Dean of Students office.***

Please review Purdue's Plagiarism Policy.

COPYRIGHTED MATERIALS

Among the materials that may be protected by copyright law are the lectures, notes, and other material presented in class or as part of the course. Always assume the materials presented by an instructor are protected by copyright unless the instructor has stated otherwise. Students enrolled in, and authorized visitors to, Purdue University courses are permitted to take notes, which they may use for individual/group study or for other non-commercial purposes reasonably arising from enrollment in the course or the University generally.

Notes taken in class are, however, generally considered to be "derivative works" of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials. No individual is permitted to sell or otherwise barter notes, either to other students or to any commercial concern, for a course without the express written permission of the course instructor. To obtain permission to sell or barter notes, the individual wishing to sell or barter the notes must be registered in the course or must be an approved visitor to the class. Course instructors may choose to grant or not grant such permission at their own discretion and may require a review of the notes prior to their being sold or bartered. If they do grant such permission, they may revoke it at any time, if they so choose.

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INTELLECTUAL PROPERTY

Online educational environments, like all learning environments, should provide opportunities for students to reflect, explore new ideas, post opinions openly, and have the freedom to change those opinions over time. Students enrolled in and instructors working in online courses are the sole proprietors of their work, opinions, and ideas. It is expected that other students will not copy, reproduce or post to any other outlet (e.g., YouTube, Facebook, or other open media sources) any work in which they are not the sole author or have not obtained the permission of the author(s). Based on the success of LTD graduates, students in this course will likely be or become K-12 or university instructional technologists, instructional designers, instructors or administrators, or corporate trainers. The open, public nature of these careers is certainly unavoidable; however, our online classroom is not an open "public forum". Therefore, all opinions, ideas, and work conducted in a password-protected online educational environment like Brightspace are owned by the author, intended for educational purposes, and are not intended for public dissemination or consumption without the permission of the author(s). This includes all areas of the online academic environment, including, but not limited to email, papers, reports, presentations, videos, chats, blogs and discussion board posts.

DIVERSITY & INCLUSION

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In the pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes diversity among its many members strengthens the life. Please read Purdue's nondiscrimination policy for more information.

EDCI 558500 COURSE SCHEDULE

Week	Topic	Readings	Assignments/Activities
1	Engineering Method Approaches and Thinking: Integrated STEM Approach	● Honey, M., Pearson, G., & Schweingruber, H. (Eds.). (2014). *STEM integration in K-12 education: Status, prospects, and an agenda for research* (Vol. 500). Washington, DC: the National Academies Press. ○ Chapter 1 (pp. 13-22) ● National Assessment Governing Board. (2013). *Technology and engineering literacy framework for the 2014 National Assessment of Educational Progress*. ERIC Clearinghouse. ○ Chapter 1 and Chapter 2	● Review the Integrated STEM Lesson and Assessment Plan Overview ● Week 1 Assignment - Statement of Commitment ● Week 1 Discussion - Integrated STEM Approach ● Week 1 Discussion - State STEM Standards ● Week 1 Assignment - Engineering Journaling

2	Principles of Engineering Curriculum	● Asunda, P. A (2012) Standards for Technological Literacy and STEM Education Delivery Through Career and Technical Education Programs. Journal of Technology Education - https://doi.org/10.21061/jte.v23i2.a.3 ● Honey, M., Pearson, G., & Schweingruber, H. (Eds.). (2014). *STEM integration in K-12 education: Status, prospects, and an agenda for research* (Vol. 500). Washington, DC: the National Academies Press. ○ Chapter 2 and Chapter 3	● Week 2 Assignment - Exploring Integrated STEM Lesson Plans ● Week 2 Discussion: Integrated STEM Lesson Plan

3	I-STEM Problem Solving and Design In the Classroom	● Cunningham, C. M., & Lachapelle, C. P. (2014). Designing engineering experiences to engage all students. In Ş. Purzer, J. Strobel, & M. E. Cardella (Eds.), *Engineering in pre-college settings: Synthesizing research, policy, and practices* (pp. 117– 140). West Lafayette, IN: Purdue University Press. ● Dorst, K., & Cross, N. (2001). Creativity in the design process: co-evolution of problem–solution. *Design studies*, *22*(5), 425-437. **Readings for the Week 3 Assignment - Article Summaries** ● Berland, Leema K. (2013) "Designing for STEM Integration," *Journal of Pre-College Engineering Education Research (J-PEER)*: Vol. 3: Iss. 1, Article 3. http://dx.doi.org/10.7771/2157-9288.1078. ● Childre, A., J. R. Sands, & S. Pope. (2009). Backward design: Targeting depth of understanding for all learners. *Teaching Exceptional Children* 41, no. 5: 6–14. ● Dym, C. L., Agogino, A. M., Eris, O., Frey, D. D., & Leifer, L. (2005). Engineering design thinking, teaching, and learning, *Journal of Engineering Education*, *94 (*1*),* 103–120. ● English, L. D., Hudson, P. B., & Dawes, L. A. (2013) Engineering based problem solving in the middle school: Design and construction with simple machines. *Journal of Pre-College Engineering Education Research*, *3*(2), pp. 1-13. ● Hoadley, C. & Cox C. What is design knowledge and how do we teach it? Chapter 2, from *Educating Learning Technology*	● Week 3 Assignment - Article Summaries ● Week 3 Discussion - Article Presentation ● Week 3 Project - Lesson Plan Topic Due

4	Core Engineering Concepts, Skills, and Effective Problem Solving in K-12 Environments	● Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003). *Effects of problem-based learning: A meta-analysis. Learning and instruction*, 13(5), 533-568. ● Jonassen, D., Strobel, J., & Lee, C. B. (2006). Everyday problem solving in engineering: Lessons for engineering educators. *Journal of Engineering Education*, 95(2), 139-151.	● Week 4 Assignment - K-12 Environment Report ● Week 4 Assignment - Teacher Observation - STEM Focus
5	Informal Learning in STEM Environments	● Menekse, M., Higashi, R., Schunn, C. D., & Baehr, E. (2017). The role of robotics teams' collaboration quality on team performance in a robotics tournament. *Journal of Engineering Education*, 106(4), 564-584. ● National Research Council. (2009). *Learning science in informal environments: People, places, and pursuits*. National Academies Press. ○ Chapter 1 and Chapter 2	● Week 5 Discussion - Informal STEM Environments ● Week 5 Assignment - Informal Learning Environment Observations

6	Engineering Education Assessments	● Honey, M., Pearson, G., & Schweingruber, H. (Eds.). (2014). *STEM integration in K-12 education: Status, prospects, and an agenda for research* (Vol. 500). Washington, DC: the National Academies Press. ○ Chapter 5 ● Nikos J. Mourtos. (2012). Defining, teaching, and assessing engineering design skills*. International Journal for Quality Assurance in Engineering and Technology Education*, 14-30.	● Week 6 Discussion - Modeling Software In the Classroom ● Week 6 Project - Integrated STEM Lesson Plan and Assessment Plan Draft
7	I-STEM Assessments	● National Research Council. 2014. *Developing Assessments for the Next Generation Science Standards*. Washington, DC: The National Academies Press. https://doi.org/10.17226/18409. ○ Chapter 4 and Chapter 5	● Week 7 Project - Integrated STEM Lesson Plan and Assessment Plan
8	Reflection and Lifelong Learning	● Shernoff D. J, Sinha, S., Bressler, M.D. & Ginsburg, L. (2017) Assessing teacher education and professional development needs for the implementation of integrated approaches to STEM education. *International Journal of STEM Education* 4:13 https://doi.org/10.1186/s40594-017-0068-1	● Week 8 Discussion - Integrated STEM Lesson Plan and Assessment Plan Presentations ● Week 8 Assignment - Journal Reflection