Designing Quantitative Solutions for Energy: An Online Application of Engineering Mathematics

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Conceptual Integration for the Online Course[1]

- **Aligning multi-disciplinary efforts and partnerships, including:**
  - ✓ The Wright State Course Model for 'Engineering Mathematics'
  - ✓ The PLTW's *e*-portfolio, the Innovation Portal
  - ✓ Engineering Design Process Portfolio Scoring Rubric (EDDPSR)
  - ✓ DOE Energy Literacy Principals and Fundamental Concepts
  - ✓ Workforce transitions

- **Utilizing a hybrid educational model to align:** competencies, performances, tasks, and self-efficacy models spanning the academic and workforce domains.

- **An online pilot for transitioning Active Duty / Veterans into the workforce.**

1. Funded by NSF PRIME & NSF INSPIRE & NSF Site RETs & DoD ADL & DOE & Kern Family Foundation



Building the Model for the Rapid Prototype

The Design Process as the Developmental, Instructional, and Assessment Framework

Problem solving

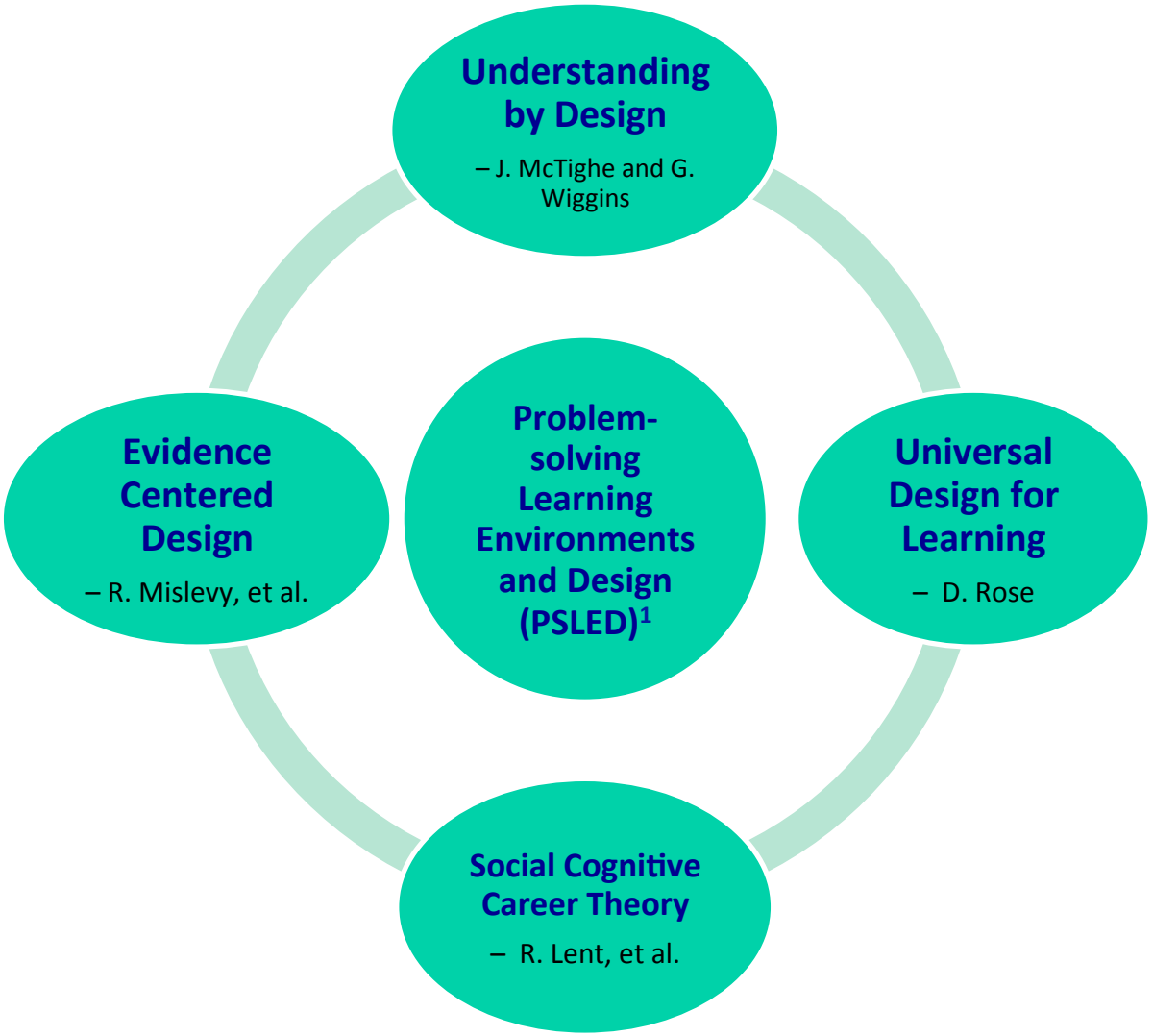
Modeling

Collaboration

Creative thinking

Communications

A Hybrid Model to align Educational Theories and Models



1. Building and expanding upon the concepts outlined by D. H. Johansen and others

Graphic developed by Dr. Laura Adolfie

Application of Hybrid Model to Develop PSLEDs

Evidence Centered Design
PSLEDs have specific assessments: Quizzes, Exams, Self-efficacy surveys, Discussions Boards, use of the Innovation Portal

Social Cognitive Career Theory

Understanding by Design

Identifying
Incorporation of Energy Literacy Standards.

Know and apply the Design Process

Determining
Unit level PSLEDs mapped to specific task models.

Planning
Alignment of project-based experiences across the course to the Design Process.

Universal Design Learning
Equality of learning and practice environments

Social Cognitive Career Theory

An opportunity to develop unique, rule-based structure leading to codes

Modified graphic based on format developed with Dr. Idalis Villanueva, Dr. Rosemary Reshetar and Dr. Abts to include SCCT and to illustrate PSLED

The ‘Pilot’

The Pilot Applied the Hybrid Process

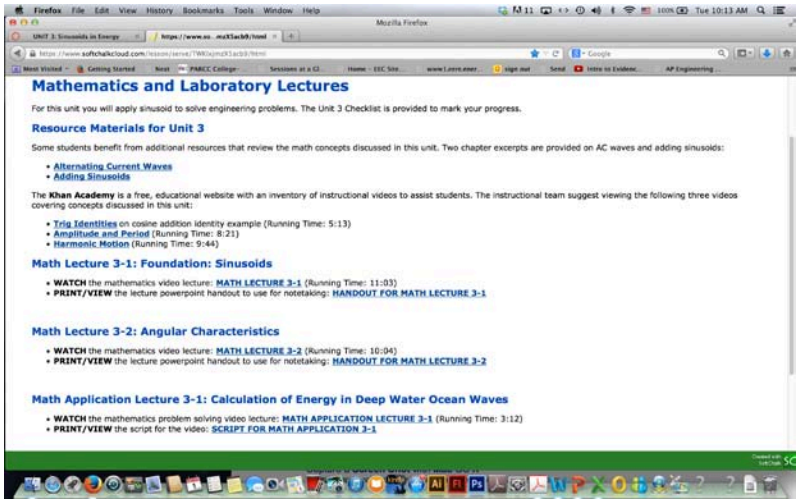
Designing Quantitative Solutions for Energy

Online, Asynchronous Course for Active Duty and Veterans[1,2]

- **24 mathematics videos** (Dr. Danny Barnes)[3] based on the Wright State Model
- **4 virtual laboratory videos** (Ms. Emily Hauser and Ms. Gail Wyant)[4]
- **12 energy-based application videos** (Ms. Toby Ratcliffe)[4]
- **7 design videos** to guide student projects submitted to Innovation Portal (Dr. Leigh Abts)[4]
- **11 Career mentoring videos** (Center for Energy Workforce Development)[5]
- **4-credits from UMD**[6]

Authored:
SoftChalk™

Delivered:
CANVAS™ LMS



1. Funded by Advanced Distributed Learning Laboratory (Army) and National Science Foundation.
2. Building upon concepts originally proposed by Dr. Ian White and Dr. Jennifer Wolk.
3. Videos production by the UMD Seigel Learning Center.
4. Video production by Vanderpool Films.
5. Videos by the Center for Workforce Development.
6. Credits offered through the UMD Office of Extended Studies.

Example of the Elements in a Unit-level PSLED

UNIT 3: Sinusoids in Energy Theme: TECHNOLOGY and POWER TRANSMISSION **WEEK 3:** Feb. 24-Mar. 2, 2014 **- WEEK 4:** Mar. 3-9, 2014 **- WEEK 4:** Mar. 10-16, 2014	
	Date Completed
MATH LECTURES:	
Pre-assessment: Self-efficacy Assessment – **DUE: 2/27**	
Math Lecture 3-1: Foundations: Sinusoids	
Math Lecture 3-2: Angular Characteristics	
Application Lecture 3-1: Calculation of Energy in Deep Water Ocean Waves	
Math Homework 5 – **DUE**: **2/28**	
Math Lecture 3-3: Sinusoid Shifts	
Math Lecture 3-4: Addition of Sinusoids	
Application Lecture 3-2: Analysis of Current and Voltage in a Resistor-Inductor	
Math Homework 6– **DUE: 3/7**	
Post Assessment: Self-efficacy Assessment – **DUE: 3/9**	
UNIT 3 QUIZ – **DUE: 3/12**	
DESIGN PROJECT:	
Design Project Video: Design Step 3: Generate and Select Design Solutions	
Design Assignment: Design Element B: Documentation and Analysis of Prior Solution Attempts – **DUE 3/2**	
Design Assignment: Initial Design Review for Elements A and B – **DUE: 3/9**	
Design Assignment: UPLOAD Design Element C: Presentation and Justification of Solution Design to Innovation Portal - **Due 3/10**	
Design Assignment: Elements A through C for Review - **DUE: 3/15**	
TROOPS TO ENERGY JOBS:	
Troops to Energy Videos: Translate Skills and Education	
UNIT EVALUATION:	
Unit 3 Instructional Feedback Survey – DUE: 3/21	

Updated 2-11-2014 by TJI

Template developed by Ms. Tami Imbierowicz

Developed an initial Template to Organize the Process

Draft Unit 4: Stage 1 – Desired Results	
Established Goals **Course and unit goals are tied to the Energy Literacy Alignment Tool, from the US Department of Energy's publication:** *Energy Literacy - Essential Principles and Fundamental Concepts for Energy Education - Framework for Energy Education for Learners of All Ages.* **Unit 4 Goals from the Energy Literacy Alignment Tool** 1.1 Energy is a quantity that is transferred from system to system. 1.4 Energy available to do useful work decreases as it is transferred from system to system. 1.5 Energy comes in different forms and can be divided into categories. 1.8 Power is a measure of energy transfer rates. 2.1 Earth is constantly changing as energy flows through the system.	**Transfer** ***Students will be able to independently use their learning to:*** • Solve authentic engineering problems using logarithms and exponents • Use the properties of logarithms and exponents to model a physical system, compile and plot data, and estimate an unknown variable. • Use independent research to understand physical realistic values of voltage, current, and resistance. • Generate, analyze and select a design solution. • Rank order design solutions based on the Compelling Need and the stated Design Requirements. • Justify and select a design solution. • Initiate the planning process to simulate, model and test the selected solution. • Independently use knowledge of alternating current and the properties of sinusoidal functions to model a physical system, plot data, and quantify properties of voltage, magnetic field, and current produced by a transformer. • Utilize the principle that an alternating voltage produces an alternating current in a coil, and the latter produces an alternating magnetic field. • Understand the meaning of AC and DC power, the conservation of power, the phase shift of sinusoidal functions, and the physical significance of voltage, current, and magnetic field in the context of a transformer. • Gain skills at plotting and analyzing data and modeling physical systems. • Understand how to search and prepare for jobs in energy related careers. ***What kinds of long-term independent accomplishments are desired?*** When presented with an authentic real-world problem represented mathematically as a function with logarithmic or exponential behavior, the student will be able find reasonable solutions to the problem.

Template Design and Content: Dr. Stephanie Moore, Dr. Rosemary Reshetar, Ms. Toby Ratcliffe, Ms. Emily Hauser, Ms. Gail Wyant, Dr. Laura Adolfie and Dr. Leigh Abts

Observations from the Pilot

Application of the Pareto Rule:

20% of students are consume 80% of the time and resources.

Online:

Instructional versus Case Management – the triaging of students based on their needs, such as barriers to learning or obstacles to practice specific KSAs.

Case Management:

Models for the structuring of curricular, instructional, and assessments to guide learning and practice for individual students and cohorts.

Coding:

A hybrid process has the potential to create a unique, rule-based coding – similar to healthcare Procedural (Instructional) and Diagnostic (Assessment) codes.

UMD Patents Pending, inventor Leigh Abts, utilized by CredentialED, LLC.

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Course: http://ter.ps/bioe110

Contact: labts@umd.edu