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Rutgers, The State University of New Jersey

Research Internship In Science Education: Engineering Education

15:256:592 Section H1 - 3 Credits
Syllabus - Summer 2015

July 20th – August 12th, 2015
Mondays, Tuesdays, Wednesdays & Thursdays 5:00 – 7:45pm
Room 211, Graduate School of Education, College Avenue Campus

Instructor - Mr. Tovi Spero, Ed.M.	tdspero@gmail.com
Office Hours - by appointment	Prerequisites or other limitations - Background in physics, physical science, or engineering.
Mode of Instruction - Seminar	Permission Required - No

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentations: https://ods.rutgers.edu/students/documentation-guidelines.

If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at: https://ods.rutgers.edu/students/registration-form.

Course Catalog Description

This course will afford pre-service teachers the opportunity to learn about the exciting world of engineering through hands-on investigation and link to their future classrooms through lesson development. By the end of the course, each participant should be able to give a sophisticated definition of engineering, give examples of how to apply physics content knowledge to engineering applications, and identify various ways to infuse engineering into the physics high school curriculum.

Learning Goals

1. Learn about real-life engineering research through **shadowing** of Rutgers Engineering Faculty.
2. Be able to define and relate different types of engineering to **high school level physics curricula**.
3. Understand the process of engineering and how it relates to the **Investigative Science Learning Environment Cycle** (ISLE cycle).
4. Understand expectations for engineering-based learning in high school science classrooms under the **Next Generation Science Standards** (NGSS).
5. Develop **real lesson plans** for a high school physics classroom that incorporates engineering-based activities and projects.
6. View and practice **standards-based grading** in real context.

Attendance Policy

Attendance to every class is required. Absence/lateness is only accepted with a valid excuse.

Reading Materials

1. Next Generation Science Standards
2. Select articles published in peer-reviewed journals and conference proceedings

Online Resources

https://edmo.do/j/vaiikc (join URL)

Academic Integrity Policy

Any violation of academic honesty is a serious offense and is therefore subject to an appropriate penalty. Refer to http://academicintegrity.rutgers.edu/integrity.shtml for a full explanation of policies.

New Jersey Professional Standards for Teachers (2014)[1]

- Standard One: Learner Development
- Standard Two: Learning Differences
- Standard Three: Learning Environments
- Standard Four: Content Knowledge
- Standard Five: Application of Content
- Standard Six: Assessment
- Standard Seven: Planning for Instruction
- Standard Eight: Instructional Strategies
- Standard Nine: Professional Learning
- Standard Ten: Leadership and Collaboration
- Standard Eleven: Ethical Practice

[1] http://www.state.nj.us/education/code/current/title6a/chap9.pdf

Council for the Accreditation of Educational Professionals (2013)[2]

- Standard 1: CONTENT AND PEDAGOGICAL KNOWLEDGE
- Standard 3: CANDIDATE QUALITY, RECRUITMENT, AND SELECTIVITY
- Standard 4: PROGRAM IMPACT
- Standard 5: PROVIDER QUALITY ASSURANCE AND CONTINUOUS IMPROVEMENT

[2]http://caepnet.files.wordpress.com/2013/09/final_board_approved1.pdf

Assessments

Assessment in this course will be a mix of in-class engineering design projects, written homework, research shadow reflections, written lesson plans, and final exam. All assessments will be scored using a **standards-based assessment** approach.

Lesson Plans

- Teacher Name
- Title of lesson
- Date of lesson (date the lesson plan is due)
- Physics Unit (that the lesson fits in)
- Lesson Objective
- NJCCCS, NGSS Standards, & NGSS Performance Expectations
- Lesson Description (content of the lesson)
    - Include time intervals for each activity to estimate length of lesson
    - Indicate placement of and type of formative assessments planned
    - Indicate where activities are differentiated and how
    - Include common modifications made for students with specific needs
- Homework assigned (if applicable)

Make sure the lesson plans are formatted appropriately and submitted to www.edmodo.com. Also share them with me at tdspero@gmail.com via Google Drive so that I can give direct feedback and suggestions for each lesson plan.

Literature Review

Select articles from peer-reviewed journals and conference proceedings will introduce students to engineering education. Topics will relate to the P-12 classroom and focus on professional development and student learning. All pre-service teachers must read each assigned article and be prepared to engage in meaningful discussion.

Articles will be distributed online (via Google Drive and/or Edmodo) and in person.

All will be responsible for facilitating class discussion on a select article, which includes composing a concise summary and preparing a list of 5 to 10 discussion questions for the class.

Research Shadow (as available)

The research component provides an opportunity for pre-service teachers to shadow engineering graduate students and faculty. Pre-service teachers will learn about various engineering research projects by visiting labs, observing experiments, and discussing topics with hosting faculty/graduate students. At the conclusion of each shadow day, a

one-paragraph reflection on what the research is about, the necessary science needed to understand it, and its possible use in a high school classroom should be uploaded to www.edmodo.com by midnight.

Final Exam

Final exam will be a lesson plan implemented in our class in the last week of the course. The teacher(s) must come prepared with a lesson plan for a 45 min – 1 hour long lesson along with any materials necessary for the engineering design project. The teacher(s) will lead the class in their lesson (including the professor) and be evaluated on their preparation and implementation.

Standards-Based Assessment & Grading

In this course you will be learning how to use standard-based assessment & grading first-hand by designing lessons and assessments, and being graded for the course with this system.

Below you will find some important tools for understanding how you will be graded and the overall concept of standards-based assessment & grading.

Overview

Rather than assigning points to an assignment, each assignment is broken down by skills and/or understandings (standards) that are necessary for success in the task. Each standard is given a score, and all scores for a particular standard are averaged.

This will give the student a more detailed view of their understanding by standard, rather than a generic number for everything as a whole.

Standard Assessment Scale

Missing	**0**	I did not hand in the assignment or skipped a portion of the assignment related to this standard.
Page	**1**	I need significant help to improve my understanding of this standard. My current attempts do not show a solid understanding of the assignment or content assessed.
Squire	**2**	I am starting to understand this standard and need to work to improve my performance because my current work shows many errors or indicates a lack in proficiency.
Knight	**3**	I am proficient in this standard and meet the basic criteria for understanding but still make some mistakes or show a lack of complete and in-depth understanding.
Scarlet Knight 	**4**	I excel at this standard and go above and beyond what the standard requires or to a level of depth that exceeds the norm.
Dark Knight 	∞	I am the justice that flies in the night. I am the Batman.

Standards (tentative and subject to change)

Teaching as a Profession

T1	My work is submitted in a timely manner, is formatted appropriately, and checked for grammar and spelling errors.
T2	My work is executed with a high level of thought and planning and includes the most necessary items for its intended purpose.
T3	I am prepared for class (reading assigned materials or bringing in equipment…).

Science & Engineering Practices

S1	I can ask questions (for science) and define problems (for engineering).
S2	I can develop and use models.
S3	I can plan and carry out investigations.
S4	I can analyze and interpret data.
S5	I can use mathematics and computational thinking.
S6	I can construct explanations (for science) and design solutions (for engineering).
S7	I can engage in argument from evidence.
S8	I can obtain, evaluate, and communicate information.

Pedagogical Content Knowledge

P1	My formative assessments are varied and tailored to the students' task.
P2	I can find multiple ways of using a single engineering design project in a physics class (e.g. for different physics topics).
P3	I can relate the Engineering Design Process and ISLE Cycle at the conceptual level and more specifically for an individual lesson.
P4	I can modify the difficulty or purpose of an engineering design task with materials requirement or other constraints based on student understanding, reasoning ability, and availability of time and materials.

Grade Calculation

Each standard is assessed multiple times and all scores for each standard are averaged. Standards are then identified as being:

Missing	0 – 0.5
Page	0.5 – 1.5
Squire	1.5 – 2.5
Knight	2.5 – 3.5
Scarlet Knight	3.5 – 4

$$Final\ Grade = \frac{\#\ of\ Scarlet\ Knights\ acheived + 0.85 \times (\#\ of\ Knights\ acheived)}{total\ \#\ of\ standards}$$

Course Schedule by Week

Week	Topics to be covered	Assignments & Readings
7/20/15 - 7/23/15 **M, T, W, Th** **Room 211**	Standards-Based Assessment & Grading Next Generation Science Standards Differentiation ● Bridges ● Roller Coasters	To be announced.
7/27/15 - 7/30/15 **M, T, W, Th** **Room 211**	Engineering Design Process & ISLE Simulations vs. Equipment Engineering Shadowing ● Elevators ● Zombie Weapons	To be announced.
8/3/15 - 8/6/15 **M, T, W, Th** **Room 211**	Lesson Planning & Assessment-Building Student-led & Need-based Engineering ● Telescopes & Microscopes ● Catapults ● Bungee Cords	To be announced.
8/10/15 - 8/12/15 **M, T, W** **Room 211**	Final Exam Week	