Application for Support:
Scholarship of Teaching and Learning Mini-grants

Submit completed form with signatures via email (mary-ann.winkelmes@unlv.edu)

Applicant Information

Name: Erdogan Kaya **Department:** Teaching and Learning

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Departmental Contact Information (this person will be responsible for completing and submitting an IDR to Mary Brady)

Name: Dr. Hasan Deniz **Phone:** 702-895-1324

Email:hasan.deniz@unlv.edu

Project Title: Introducing Engineering to Elementary Pre-service Teachers through 3D Printing and Educational Robotics

Scope of Project:

Rationale

To meet the demand for engineering professionals, the United States needs more focus on science, technology, engineering and mathematics (STEM) teacher training to keep its leading role in the world. (e.g., Breiner, Harkness, Johnson & Koehler, 2012; Subotnik, Tai, Rickoff & Almarode, 2009; Wendler et al., 2010). Since most high school students have already made career decisions by their senior year (Inkson, 2007; Koetters, 2007), and students are influenced by their teachers (Bogue & Marra, 2009; Bahar & Adiguzel, 2016), creating interest in engineering should start as early as elementary school to motivate students to consider a career in STEM. However, it is rare for elementary teachers to introduce engineering. Perhaps teachers do not have the confidence, or they are not well-equipped with knowledge and skills necessary to integrate engineering (American Society for Engineering Education [ASEE], 2006; Nathan et al., 2010), but due to changes in the rigor of educational standards, teacher professional development in STEM must be considered.

Comprehensive training for educators is essential since teachers have been assigned the purpose of developing academic skills for college success, and also later in the competitive job market. If teachers are prepared, then their students will become equipped for the challenging tasks that take place in the real world. The increasing demands for STEM professionals (International Technology and Engineering Educators Association [ITEEA], 2009; Langdon et al., 2011) and the release of Next Generation Science Standards (NGSS) compels teachers to update their curriculum knowledge to provide students with the skill set to fulfill those needs (Moore et al., 2015). As states adopt NGSS, universities take the initiative to prepare pre-service and in-service teachers. Through integration of engineering in science methods courses, educators are building upon the skills they currently have to increase student success. Robotics and 3D printing education combines engineering and science, in a way that also motivates

students towards STEM careers.
Teachers with high self-efficacy beliefs adopted more student-centered and constructivist approach. In line with this, considering the importance of inquiry based learning approach in successful engineering integration, it is essential to increase pre-service teachers' self-efficacy beliefs for teaching engineering. Thus, it is necessary to pay attention to examine PSTs engineering self-efficacy beliefs in a pedagogical manner.

Project

The purpose of this study is to investigate the changes in pre-service elementary teachers' engineering teaching efficacy beliefs after experiencing an authentic engineering unit.
We will collect quantitative data from 75 undergraduate senior level PSTs who are enrolled in three sections of EDEL443: elementary science teaching methods course offered at University of Nevada, Las Vegas during the Spring 2017 semester. We will keep collecting data for the Fall 2017 and Spring 2018 semesters as well. Approximately 200 UNLV undergraduate level pre-service elementary teachers will be impacted from this study. We will conduct this study within the context of an elementary science teaching methods course designed for PSTs. This course lasts for 15 weeks and it includes topics such as nature of science (NOS), students' misconceptions in science, concept mapping, teaching science through inquiry, 5-E lesson planning, integrating science, engineering and language arts, technology applications in elementary science-engineering teaching, assessment, nature of engineering (NOE), and next generation science standards (NGSS). We will spend two weeks on this engineering unit and it will allow us to address three of the nine major topics that we cover in the course: (a) technology applications in elementary science and engineering teaching, (b) nature of engineering, and (c) Next Generation Science Standards (NGSS).
We will analyze PSTs Engineering Teaching Efficacy Beliefs Instrument (ETEBI) (see Appendix A) scores. In our research, we will use 5 point Likert type scale (1-Strongly Disagree, 2- Disagree, 3- Neutral, 4- Agree, 5- Strongly Agree) ETEBI instrument to investigate PSTs engineering teaching efficacy beliefs. We modified the Science Teaching Efficacy Beliefs Instrument Version B (STEBI-B) (Enoch and Riggs, 1990) to measure participants' engineering teaching efficacy beliefs. To address our research question, we will analyze the Data in SPSS 24.0 Mac version. We will provide the subscales results: personal engineering teaching efficacy (PETE) and engineering teaching outcome expectancy (ETOE). We will also provide the means for each question. We will investigate the influence of engineering instruction with 3D printing and robotics by analyzing two paired samples t-tests scores for pre and post test results. We already granted the robots by CMSEE grant, we request a 3D printer to conduct our investigation. This semester, 3D printer will be used by 75 students and it will be used for future years and sustain itself.
My research will make a contribution to research that informs our understanding of effective training of PSTs in STEM education. I will examine whether authentic engineering instruction influences PSTs teaching self-efficacy beliefs and content knowledge. I have received the approved IRB and will collect data in April 2017 during the intervention. I am planning to analyze the data and complete the literature review during summer term. I think that this study will be of interest to researchers who are particularly interested in STEM education. My study will also be beneficial for other UNLV science instructors who are teaching elementary and middle school science teaching methods courses that address STEM education. My research will be presented in conferences such as American Society of Engineering Education (ASEE) and will be submitted to peer-reviewed STEM education journals to contribute to STEM education community to inform future research efforts.

PROPOSED BUDGET*

	Costs
Personnel (Kaya, Yesilyrt, Deniz)	In-kind contribution
Equipment	In-kind contribution
Computers	In-kind contribution
Lego Mindstorms Kit	In-kind contribution
Travel	In-kind contribution
Supplies	In-kind contribution
Publication Costs	In-kind contribution
Other Resources	In-kind contribution
Data Management	In-kind contribution
3D printer (excluding taxes and shipping)	$2500
Filaments	$379
Total requested*:	**$2879**

***Budget Details:**
Personnel: Salaries of the personnel. These expenses will be paid by UNLV's in-kind contribution to the project.

- Erdogan Kaya, PhD. Student and instructor of the elementary science teaching methods course, will devote his time to lead the research, develop the course curriculum, writing practitioner and/or research oriented manuscripts and overall research administration.
- Other Personnel
    - Graduate Student – Another Doctoral Graduate Assistant, Ezgi Yesilyurt will assist with the research, writing practitioner and/or research oriented manuscripts and overall program administration
    - PI: Dr. Hasan Deniz will devote his time to mentor and contribute to professional development of graduate assistants as well as he will oversee the entire research process.

Equipment/Supplies: The following equipment will be used for the engineering education program:

- 30 Laptop Computers. Standard office computers, printers, and other technical equipment will be used to support the project.
- Robotics Programs' Equipment: 8 Lego Mindstorms EV3 robotic kits received by CMSEE grant and will be in-kind contribution to this project.
- Robotics Programs supplies: Supplies necessary to carry out the program

Travel: to attend conferences such as AERA, NARST and ASEE for dissemination of research results.

Publication Costs/Documentation/distribution – N/A

OTHER RESOURCES
Campus classrooms will be used for the project.
Office: Erdogan Kaya, College of Education, Carlson Education Building, Room 399J

Data Management Plan
Erdogan Kaya will be responsible for the generation all data. The computer used for this project will include a backup storage device and all data will be backed up on a regular basis. Data will be stored in a password protected, local computer and will be accessible only to project personnel. Dr. Deniz will oversee and lead the overall project.
Requested Funding
3D printer: Makerbot Replicator+ Desktop printer is requested for this project. Below is the link for the 3D printer: https://store.makerbot.com/printers/replicator/
PLA Filament: https://store.makerbot.com/filament/tough-pla-filament-bundle/

If we receive the mini-grant, we agree to provide the selection committee with a written summary of our research results within one year of receipt of the grant.

Start and End Dates of Project: 04/05/2017 and 3D printer will be continuously used each term.

Applicant's Signature

3/1/2017

Signature Date

Unit Leader's Approval

3/1/2017

Signature Date

Dean's Approval

Dainea Gilday 3-2-2017

Signature Date

UNLV Social/Behavioral IRB - Exempt Review
Exempt Notice

DATE:	July 17, 2015
TO:	Hasan Deniz
FROM:	Office of Research Integrity - Human Subjects
PROTOCOL TITLE:	[780144-1] Developing Integrated Elementary Science, Engineering, and Language Arts Curricula Aligned with Next Generation Science Standards
ACTION:	DETERMINATION OF EXEMPT STATUS
EXEMPT DATE:	July 17, 2015
REVIEW CATEGORY:	Exemption category #1&2

Thank you for your submission of New Project materials for this protocol. This memorandum is notification that the protocol referenced above has been reviewed as indicated in Federal regulatory statutes 45CFR46.101(b) and deemed exempt.

We will retain a copy of this correspondence with our records.

PLEASE NOTE:
Upon final determination of exempt status, the research team is responsible for conducting the research as stated in the exempt application reviewed by the ORI - HS and/or the IRB which shall include using the most recently submitted Informed Consent/Assent Forms (Information Sheet) and recruitment materials. The official versions of these forms are indicated by footer which contains the date exempted.

Any changes to the application may cause this protocol to require a different level of IRB review. Should any changes need to be made, please submit a **Modification Form**. When the above-referenced protocol has been completed, please submit a **Continuing Review/Progress Completion report** to notify ORI - HS of its closure.

If you have questions, please contact the Office of Research Integrity - Human Subjects at IRB@unlv.edu or call 702-895-2794. Please include your protocol title and IRBNet ID in all correspondence.

Office of Research Integrity - Human Subjects
4505 Maryland Parkway . Box 451047 . Las Vegas, Nevada 89154-1047
(702) 895-2794 . FAX: (702) 895-0805 . IRB@unlv.edu

Appendix A : Pre-Service Elementary Teachers Self-Efficacy Beliefs

There are no “right” or “wrong” answers to the following questions. We are only interested in your opinion on a number of issues about engineering.

What is your age?

Ethnicity

- ❑ American Indian or Alaska Native (1)
- ❑ Asian (2)
- ❑ Black or African American (3)
- ❑ Hispanic or Latino (4)
- ❑ Native Hawaiian or Other Pacific Islander (5)
- ❑ White (6)
- ❑ Mixed (9)
- ❑ Prefer not to say (7)
- ❑ 8 (8) _____

Gender

- ❍ Female (1)
- ❍ Male (2)

	Strongly Disagree (8)	Disagree (9)	Neither Agree nor Disagree (10)	Agree (11)	Strongly Agree (12)
When a student does better than usual in engineering activities, it is often because the teacher exerted a little extra effort. * (1)	❍	❍	❍	❍	❍
I will continually find better ways to teach engineering. * (2)	❍	❍	❍	❍	❍
Even if I try very hard, I will not teach engineering as well as I will most subjects. * (3)	❍	❍	❍	❍	❍
When the students do well in engineering design projects, it is often due to their teacher having found a more effective teaching approach. * (4)	❍	❍	❍	❍	❍
I know the steps necessary to teach engineering design concepts effectively. * (5)	❍	❍	❍	❍	❍
I will not be very effective in monitoring engineering design projects. * (6)	❍	❍	❍	❍	❍
If students are	❍	❍	❍	❍	❍

underachieving in engineering design projects, it is most likely due to ineffective engineering teaching. * (7)					
I will generally teach engineering design ineffectively. * (8)	❍	❍	❍	❍	❍
The inadequacy of a student's engineering design background can be overcome by good teaching. * (24)	❍	❍	❍	❍	❍
The low performance of some students on engineering design projects cannot generally be blamed on their teachers. * (11)	❍	❍	❍	❍	❍
When a low-achieving child makes a progress in engineering, it is usually due to extra attention given by the teacher. * (12)	❍	❍	❍	❍	❍
I understand engineering design concepts well enough to be effective in teaching elementary engineering. * (13)	❍	❍	❍	❍	❍
Increased effort	❍	❍	❍	❍	❍

in engineering teaching produces little change in some students' engineering achievement. * (14)					
The teacher is generally responsible for the achievement of students in engineering. * (15)	❍	❍	❍	❍	❍
Students' achievement in engineering is directly related to their teacher's effectiveness in engineering design teaching. * (16)	❍	❍	❍	❍	❍
If parents comment that their child is showing more interest in engineering at school, it is probably due to the performance of the child's teacher. * (17)	❍	❍	❍	❍	❍
I will find it difficult to explain to students why engineering design projects are successful. * (18)	❍	❍	❍	❍	❍
I will typically be able to answer students' engineering	❍	❍	❍	❍	❍

questions. * (19)					
I wonder if I will have the necessary skills to teach engineering. * (20)	❍	❍	❍	❍	❍
Given a choice, I will not invite the principal to evaluate my engineering design teaching. * (21)	❍	❍	❍	❍	❍
When a student has difficulty understanding an engineering design concept, I will usually be at a loss as to how to help the student understand it better. * (22)	❍	❍	❍	❍	❍
When teaching engineering, I will usually welcome student questions. * (23)	❍	❍	❍	❍	❍
I do not know what to do to turn students on to engineering. * (10)	❍	❍	❍	❍	❍

To Be Completed by SoTL Funds Selection Committee

✓ **Approved** _____ **Not Approved**

April 28, 2017

SoTL Funds Selection Committee Chairperson — Date

To Be Completed by VPFA's Office

Amount Approved: $ 2879.00

May 2, 2017

VPFA Signature — Date