GEORGIA SOUTHERN UNIVERSITY INSTITUTIONAL REVIEW BOARD

INSTRUCTIONS FOR PREPARATION OF PROPOSAL NARRATIVE

Instructions: *Please respond to the following as briefly as possible, but keep in mind that your responses will affect the actions of the Board. Clearly label your responses in sections that correspond to the specific information requested. The Narrative should include a step by step plan of how you will obtain your subjects, conduct the research and analyze the data. Make sure the narrative clearly explains aspects of the methodology that provide protections for your human subjects. You may insert your responses in each section on this page in bold text, leaving a space between the question and your answers. Narrative should not exceed 5 pages.*

Personnel. *Please list any individuals who will be participating in the research beyond the PI and advisor. Also please detail the experience, level of involvement in the process and the access to information that each may have.*

None

Purpose. *1. Briefly describe in one or two sentences the purpose of your research. 2. What questions are you trying to answer in this experiment? Please include your hypothesis in this section. The jurisdiction of the IRB requires that we ensure the appropriateness of research. It is unethical to put participants at risk without the possibility of sound scientific result. For this reason, you should be very clear on how participants and others will benefit from knowledge gained in this project. 3. What current literature have you reviewed regarding this topic of research? How does it help you to frame the hypothesis and research you will be doing? Include citations in the description.*

1. Research suggests learning experiences offering secondary students the opportunity to explore Social Cognitive Career Theory(SCCT)-based activities in special university or industry sponsored programs increase the likelihood students will choose science, technology, engineering and mathematics (STEM) majors and remain in them (Bachman, Bischoff, Gallagher, Labroo, & Schaumloffel, 2008; Yelamarthi & Mawasha, 2008). The NSF (2010) called on teachers of secondary students to implement actions designed to increase enrollment in STEM majors, yet little research exists to indicate whether these interventions are successful in traditional secondary school classroom settings. The purpose of this study is to examine the effect SCCT theory-based activities will have on secondary students' attitude toward STEM fields when the activities are implemented in a traditional secondary classroom setting. The results of the study will help identify activities secondary classroom teachers can incorporate into the curriculum to improve students' knowledge of and attitude toward STEM.

2. Research Questions: Do Social Cognitive Career Theory (SCCT)-based activities in the traditional high school classroom increase students' intrinsic and extrinsic motivation to learn STEM? Do these activities increase students' opinions of the personal relevance of learning STEM? Do these activities increase students' self-efficacy for learning STEM and decrease their anxiety about STEM assessments?

Hypothesis: Social Cognitive Career Theory (SCCT)-based activities in a traditional high school classroom increase students' intrinsic motivation to learn STEM, extrinsic motivation to learn STEM, self-efficacy for learning STEM, opinion of the personal relevance of learning STEM, and decrease their anxiety about STEM assessments.

3. For the past decade, enrollment in STEM majors has dropped at a steady rate. Empirical studies and career development theories point to students' inadequate math and science backgrounds (Leuwerke, Robbins, Sawyer, & Hovland, 2004), students' low mathematics self-efficacy (Gore Jr, 2006), students' lack of understanding of STEM careers and opportunities (National Research Council of the National Academies, 2007), and students' perception of initial STEM courses as weed-out classes in colleges and universities (van Langen & Dekkers, 2005) as primary reasons for under-enrollment in STEM majors. The low enrollment rate of U.S. students in STEM majors is a cause for concern on several fronts. The United States' solid industrial base (Smith, 2008), its global competitiveness (NSF, 2010), its position as a leader in creativity and innovation (Crosby & Pomeroy, 2004), its national security, and its principles of social justice and equal education (Zhao, Carini, & Kuh, 2005) are affected by the number of people working in STEM careers and in the number of people majoring in STEM fields.

Interventions targeted to address under-enrollment in STEM majors have their roots in social cognitive theory, career development theory, and Social Cognitive Career Theory (SCCT). Lent, Brown, and Hackett formulated SCCT as an extension of social cognition theory to generate a framework for designing career development interventions. Lent (2007) posited four elements—self-efficacy, outcome expectations, goals, and contextual supports and barriers—are critical in forming a person's on-going academic and career-related interests. According to Lent, SCCT-based interventions are designed to influence a student's self-efficacy, to manage a student's outcome expectations, to build a student's perseverance and resilience in the student's efforts

to reach goals, and to manage the climate in which the student pursues their goals. SCCT-based interventions form a powerful portfolio of techniques for designing interventions to improve interest in STEM. Several researchers have examined students' attitudes, opinions, and behaviors for insight into the effectiveness of SCCT interventions on students' STEM-related academic and career decisions. Their research has covered a large portion of the STEM pipeline, ranging from short term and longitudinal studies based on the effect of summer programs and after-school programs (Bachman, et al, 2008; Bowen, et al, 2007; Lee, 2002; Yelamarthi & Mawasha, 2008), to data analysis of information from surveys of students at multiple universities (Brown, Garavalia, & Olson, 2006; Colbeck, Cabrera, & Terenzini, 2001; Vogt, Hocevar, & Hagedorn, 2007), to analysis of national longitudinal surveys of college students (Sax, 2001; Zhao, Carini, & Kuh, 2005), to focused interviews with women at different stages in the STEM pipeline (Kekelis, Ancheta, & Heber, 2005; Zeldin & Pajares, 2000).

These researchers reported the importance of SCCT-based interventions designed to raise students' vocational interest in STEM careers. The primary goal of these interventions was to help students understand the relevance and importance of STEM careers. In his report on innovative STEM recruiting strategies used in the manufacturing industry, Smith (2008) reported the effectiveness of activities which generated enthusiasm about STEM careers in helping recruit students into the STEM fields. Yelamarthi and Mawasha (2008) reported profound results from a long term, extensive pre-engineering program for students under represented in STEM (Wright Science Technology and Engineering Preparatory Program– Wright STEPPS). Almost 50% of the students from the Wright STEPPS program chose STEM majors, and when those students went to college, they graduated with a 59.7% retention rate (versus Wright State University's overall retention rate of 44.69%). Each of these researchers' findings support the impact raising vocational interests and creating realistic outcome expectations has on improving the STEM pipeline.

Research suggests learning experiences offering secondary students the opportunity to explore SCCT-based activities in special university or industry sponsored programs increase the likelihood students will choose STEM majors and remain in them (Bachman, Bischoff, Gallagher, Labroo, & Schaumloffel, 2008; Yelamarthi & Mawasha, 2008). The NSF (2010) called on teachers of secondary students to implement actions designed to increase enrollment in STEM majors, yet little research exists to indicate whether these interventions are successful in traditional secondary school classroom settings.

The purpose of this study is to examine the effect SCCT theory-based activities will have on secondary students' attitude toward STEM fields when the activities are implemented in a traditional secondary classroom setting. This will be done through the No Boundaries project (NASA; USA Today Education, 2009), a hands-on, carefully thought out project developed by NASA and USA Today Education to introduce students to STEM careers. The project's design reflects the characteristics of SCCT interventions: the project work is meaningful; students work in a collaborative learning environment; the project is hands-on; technology is incorporated into the project; and the project allows for creative expression. The project is designed within Lent (2007)'s framework for SCCT interventions: its purpose is to raise vocational interest, help create realistic outcome expectations, provide a wealth of information for setting career goals; and provide students with tools for managing environmental barriers.

The No Boundaries materials include lesson plans, graphic organizers, rubrics, and web pages to guide students through the project. Some of these materials are found in Appendix A. The teacher serves as a facilitator on the project. The availability of the materials and the design of No Boundaries make this project replicable in almost any classroom, which strengthens the generalizability of the study.

The results of the study will help identify activities secondary classroom teachers can incorporate into the curriculum to improve students' knowledge of and attitude toward STEM.

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Outcome. *Please state what results you expect to achieve? Who will benefit from this study? How will the participants benefit (if at all). Remember that the participants do not necessarily have to benefit directly. The results of your study may have broadly stated outcomes for a large number of people or society in general.*

I expect to find that a SCCT-based careers project used in a traditional secondary classroom, without extensive outside resources or time commitments, increases students' interest in and attitude toward STEM, thereby increasing the likelihood the students will choose a STEM major and remain in it. If this expectation holds true, the participants will benefit personally and academically with the discovery of a new career interest. The results could also be generalized to schools with similar populations, providing a technique for increasing students' interest in and improving students' attitude toward STEM on a larger scale. This technique could be an effective step in countering the declining enrollment in STEM majors.

Describe your subjects. *Give number of participants, approximate ages, gender requirements (if any).*
Describe how they will be recruited, how data will be collected (i.e., will names or social security numbers be collected, or will there be any other identification process used that might jeopardize confidentiality?), and/or describe any inducement (payment, etc.) that will be used to recruit subjects. Please use this section to justify how limits and inclusions to the population are going to be used and how they might affect the result (in general).

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There will be approximately 97 participants in the study. This study is being done as part of the regular curriculum, so participants will come from four intact AP Computer Science classes. The population consists of: tenth (26.8%), eleventh (46.4%), and twelfth (26.8%) graders; gifted (56.7%), regular education (41.2%), and special education (2.1%) students; girls (19.59%) and boys (80.41%); Asian (11.34%), African American (3.09%), Caucasian (81.44%), and Hispanic (4.12%) students. All students are welcome to be participants in the study–the design is intended to be inclusive. This inclusion lends strength to the results and increases their generalizability.

Group projects on Ethics in Computing, the History of Computing, and Careers in Computing are part of the normal (required) curriculum for Industry Certification courses. Due to the demands of the AP Computer Science curriculum, students are only required to participate in a group project for one of the three areas. The Careers in Computing project, which is an SCCT-based activity, is the No Boundaries Project. Due to their purpose, neither the ethics project nor the history project is an SCCT-based activity. Since group activities on careers, ethics, and history are a required part of the curriculum, my study consists solely of measuring student attitudes about STEM before and after the normal curriculum group activities. None of the normal instructional procedures are being modified in any way for these courses.

Students will be told about the study (the questionnaires). Students will then be given the assent form to take home, reflect upon and complete. Participation in the study (completing the pre- and post-questionnaires) is completely voluntary. It is anticipated that most of the students will choose to take part in the study since the study consists of pre- and post-surveys of their attitude and there will be no demographic data on the questionnaires.

Students will complete the STEM Motivation Questionnaire (see Appendix B) to measure their interest in and attitude toward STEM both before and after the group projects. The only identifying information on the survey will be a code students make up themselves. Students will enter their unique code on both the pre- and post-survey to link the surveys together. However, no one except the student will know who used a particular code.

After the results are analyzed, the surveys will be mailed to [redacted], committee chair, for storage in a secure location at Georgia Southern.

The inducement for the study is intrinsic, drawing on the students' interest in helping advance knowledge of how students' career interest is developed. This is a topic the students find interesting in and of itself.

Methodology (Procedures). *Enumerate specifically what will you be doing in this study, what kind of experimental manipulations you will use, what kinds of questions or recording of behavior you will use. If appropriate, attach a questionnaire to each submitted copy of this proposal. Describe in detail any physical procedures you may be performing.*

1. **Students will receive an assent form and a consent form to take home to review and discuss with their parent/guardian.**
2. **Students who choose to participate in the study will be given the STEM motivation questionnaire (see Appendix B) to complete at home, return to school, and place in a collection envelope. They will have the option to place a blank copy of the questionnaire in the collection envelope.**
3. **Project flow... not part of study... (normal course procedures, followed every year for this project)**
    a. **Two AP Computer Science course sections will be randomly assigned to the careers project; the other sections will randomly be assigned the history and ethics project (the number of classes assigned to each topic varies each year depending on the number of sections for the course)**
    b. **Students will be assigned to project groups. Students who are not completing questionnaires (participating in the study) will be mixed in groups with students who are participating.**
    c. **All groups will be assigned focus areas for their projects (careers/history/ethics topics). Students will have three class periods to work together on the projects.**
    d. **Student groups complete their work outside of class (2 weeks), then make class presentations.**
    e. **As a note, at the end of the school year, after the AP exams, all students have an Open House and present their projects to each other, so all students benefit from hearing each other's findings.**
4. **After the class presentations, students who chose to participate in the study will complete the STEM motivation questionnaire as a post-survey.**

5. **Data from the STEM motivation questionnaire pre/post survey will be keyed and composite scores will be calculated for the five sub-scales of the STEM motivation questionnaire.**
6. **The independent samples t-test will be used on the pre-assessment scores to determine whether there is a statistically significant difference between the control (history and ethics) and treatment (careers) groups. If there is no statistically significant difference between the groups, the independent samples t-test will be used on the post-measures to infer the impact of the treatment. If the pre-assessment measures show a significant difference between the control and treatment group, ANCOVA will be used with the pre-assessment as covariate. All statistical tests will be performed at the .05 level of significance.**
7. **The researcher will submit the research findings and the survey documents to [redacted]. The documents will be stored in a secure location at Georgia Southern.**

Special Conditions:

Risk. *Is there greater than minimal risk from physical, mental or social discomfort? Describe the risks and the steps taken to minimize them. Justify the risk undertaken by outlining any benefits that might result from the study, both on a participant and societal level. Even minor discomfort in answering questions on a survey may pose some risk to subjects. Carefully consider how the subjects will react and address ANY potential risks. Do not simply state that no risk exists. Carefully examine possible subject reactions. If risk is no greater than risk associated with daily life experiences state risk in these terms.*

Since the study is a pre- and post- questionnaire, the risk in participating in the study is no more than the risk involved in completing a questionnaire on any given day. Students will know there is no identifying information on the questionnaire. If a student becomes stressed by the questionnaire, they will know they have the option of turning in a blank questionnaire; therefore, answering the questions on the survey should not cause a risk to anyone. The benefits that may result from the study are significant for the students if they indeed become interested in pursuing a career or a major in one of the STEM fields.

Research involving minors. *Describe how the details of your study will be communicated to parents/guardians. If part of an in-school study (elementary, middle, or high school), describe how permission will be obtained from school officials/teachers, and indicate whether the study will be a part of the normal curriculum/school process. Please provide both parental consent letters and child assent letters (or processes for children too young to read). If not applicable indicate N/A or delete this section.*

Students will be given the letter of consent and the letter of assent in class. They will be asked to read and respond to the letter of consent and also asked to give their parent/guardian the letter of assent for review and response. Students will return the letters to school. This study is a questionnaire based on part of the normal curriculum/school process. As such, it has already been discussed with the principal. The principal has provided a letter of Institutional Cooperation.

Cover page checklist. *Please provide additional information concerning risk elements checked on the cover page and not yet addressed in the narrative. If none, please state "none of the items listed on the cover page checklist apply." The cover page can be accessed from the IRB forms page. (Note – if a student, make sure your advisor has read your application and signed your cover page. (Your advisor is responsible for the research you undertake in the name of GSU.)*

All of the items in the cover page checklist have been addressed in this narrative.

Reminder: No research can be undertaken until your proposal has been approved by the IRB.

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Appendix A

Sample Pages from the No Boundaries Project

The No Boundaries Project - Teacher Overview

The goals of NASA Education are to develop a workforce of the future; attract and retain students in science, technology, engineering and math (STEM); and find the best and the brightest young people. The No Boundaries project introduces students to the limitless opportunities at NASA and encourages them to work toward careers in STEM. No Boundaries also shows students that working in the STEM fields is an achievable goal, if you are educated, curious, creative and resourceful. By encouraging thoughtful, innovative students to undertake careers in STEM, NASA and you will contribute to individual growth and to the growth and economic security of the country.

General Info	**Appropriate grade level:** 7-12 **Suggested curriculum areas:** math, science, engineering, technology, social studies, language arts and honors courses **Applications:** Analysis, careers, advertising, competition, cooperative learning, creative thinking, data gathering, design, evaluation, knowledge, marketing, originality, research, synthesis, technology **Required time:** Approximately 3 weeks (may be extended depending on rigor) • Steps 1 & 2 – Preliminary Research – 1 class period • Step 3 – Individual Investigation – 2-3 class periods • Step 4 – No Boundaries Project – 2 weeks **Rubrics:** • Steps 1- 2 Exploring NASA Careers Rubric (located in the top right-hand corner of the Step 2 page) • Step 3 Individual Investigation Rubric (located in the top right-hand corner of the Step 3 page) • Step 4 Final Project Rubric (located in the top right-hand corner of the Step 4 page)
Overview	Teachers will assign groups of four one of the following fields: science, technology, engineering or math (STEM). Each group will then use graphic organizers and links on the No Boundaries website to research one NASA career in their assigned field. Next, individual groups will develop and present a project (website, song, podcast, etc.) that markets their career to teens. Groups will then present their project to the class and to a group of younger peers-

Steps	**Steps 1 & 2– Preliminary research** After forming small groups, students will conduct preliminary research about several NASA careers within the STEM field you assigned them. **Step 3 – Individual investigation** As a group, students will choose one career to focus on and assign each member of the group one of the four career exploration standards listed on the following page. As individuals, students will research the career their group chose, focusing on their assigned career exploration standard. For example, an individual assigned Standard 3 would find out what students need to do to prepare for the job their team chose; the student assigned Standard 2 would find out exactly what the professional does on the job. **Step 4 – Final project/National competition** As a group, students will: • Reflect on their research and share their insights. • Decide what format their final project will take and what information they will include in it. • Design and produce their project. • Present it to the class and to a group of younger peers. • ~~Enter the No Boundaries National Competition.~~

The No Boundaries Project - Student Overview

Working at the National Aeronautics and Space Administration (NASA) in the fields of science, technology, engineering or math is an achievable goal. If you are curious, creative and good at solving problems, NASA might be just the place for you. In this project, you will learn more about the agency and the careers it offers.

Goal
In small groups, you will be developing a creative project (website, video, podcast, song, etc.) that markets careers in science, technology, engineering and math to teens. You will present your project to your class and a class of younger peers. Then, you can enter your project in the No Boundaries National Competition.

Steps
You will be working as individuals and in small groups. The steps you will follow are below. The "No Boundaries" website will guide you through them.

Steps 1 & 2
☐ **Preliminary Research.** Form small groups and conduct preliminary research about several NASA careers in the field your teacher assigned you.

Step 3

☐ **Exploring NASA careers.** As a group, choose one career to focus on and assign each member of the group one of the following career standards:

- **Self-awareness:** The personal skills, abilities, aptitudes, etc. required for the career.
- **Career research:** The roles and responsibilities of the professional.
- **Career strategy:** The appropriate courses of study in high school and college that students hoping to enter the profession should take; the job or internship opportunities that would prepare students for the career.
- **Lifelong learning:** The importance of continuing education to success in the career.

☐ **Individual investigation.** As individuals, research the career your group chose, focusing on your assigned career exploration standard. For example, if you were assigned Standard 3, you would find out what students need to do to prepare for the job your team chose; if you were assigned Standard 2, you would find out exactly what the professional does on the job.

☐ *Click on "Rubric" in the top, right-hand corner of the Step 3 page to see how you will be evaluated.*

Step 4

☐ **Final project/National competition.** As a group:

• Reflect on your research and share your insights.
• Decide what format your final project will take and what information you will include in it.
• Design and produce your project.
• Present it to your class and to a group of younger peers.

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Appendix B

Science, Technology, Engineering & Mathematics (STEM) Motivation Questionnaire

IDENTIFYING CODE: __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ (Please enter the 1st 2 letters of the last name of each of your teachers, in the order you have them, followed by the last four digits of your personal phone number... use your family phone number if you don't have your own phone number)

In order to better understand what you think and feel about your possible college major and career path, please respond to each of the following statements from the perspective of:

"**When I am in a science, technology, engineering, or math (STEM) course…**"

01. I enjoy learning the Science, Technology, Engineering, and Math (STEM) concepts.

O Never O Rarely O Sometimes O Usually O Always

02. The STEM information I learn relates to my personal goals.

O Never O Rarely O Sometimes O Usually O Always

03. I am nervous about how I will do on the STEM tests.

O Never O Rarely O Sometimes O Usually O Always

04. I become anxious when it is time to take a STEM test.

O Never O Rarely O Sometimes O Usually O Always

05. I think about how learning STEM can help me get a good job.

O Never O Rarely O Sometimes O Usually O Always

06. I think about how the STEM I learn will be helpful to me.

O Never O Rarely O Sometimes O Usually O Always

07. I worry about failing the STEM tests.

O Never O Rarely O Sometimes O Usually O Always

08. I am concerned that the other students are better in STEM.

O Never O Rarely O Sometimes O Usually O Always

09. The STEM I learn is more important to me than the grade I receive.

O Never O Rarely O Sometimes O Usually O Always

10. I think about how learning STEM can help my career.

O Never O Rarely O Sometimes O Usually O Always

11. I hate taking STEM tests.

O Never O Rarely O Sometimes O Usually O Always

12. I think about how I will use the STEM I learn.

O Never O Rarely O Sometimes O Usually O Always

13. I find learning STEM interesting.

O Never O Rarely O Sometimes O Usually O Always

14. The STEM I learn is relevant to my life.

O Never O Rarely O Sometimes O Usually O Always

15. The STEM I learn has practical value for me.

O Never O Rarely O Sometimes O Usually O Always

16. I like STEM that challenges me.

O Never O Rarely O Sometimes O Usually O Always

17. I am confident I will do well on the STEM tests.

O Never O Rarely O Sometimes O Usually O Always

18. I believe I can earn a grade of "A" in STEM courses.

O Never O Rarely O Sometimes O Usually O Always

19. Understanding STEM gives me a sense of accomplishment.

O Never O Rarely O Sometimes O Usually O Always

The End—Thank you!