Project Proposal

Ecampus Research Fellows Program Proposal (2020-21 Cohort)

Project Title

"Impacting the Inclusivity Mindset of Online Computer Science Students"

Sponsoring School and College

School of Electrical Engineering & Computer Science

College of Engineering

Principal Investigator

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Inclusive Design Researcher

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Project Description

Abstract

Online learning environments perpetuate gender bias in Computer Science education. Although previous research has identified exacerbating factors (e.g., language and visual design cues that trigger stereotype threat), more can be done to help students of all genders feel more included in their virtual classrooms. To explore this problem and a potential mitigation, I propose to (1) adapt and develop an inclusive software design learning module for online, (2) incorporate the module into existing undergraduate-level online Computer Science courses, (3) measure how completion of the module affects how included students feel in their online classroom, how inclusive they feel toward others, and their overall experience of their major, and (4) analyze results by student demographic and background factors, such as gender. The findings of this study will help inform future research and give faculty guidance on how to create inclusive online Computer Science classrooms.

Teaching and Learning Problem or Question

Online learning environment would seem to insulate students from stereotype threat, implicit bias, and other factors that might threaten their desire to continue with Computer Science. Unfortunately, factors that widen participation gaps are present in online learning STEM environments [1, 5, 6, 7, 8].

The purpose of this research is to investigate how to actively counteract some of these factors by enhancing inclusivity within online Computer Science courses (students feeling included and feeling inclusive toward others). I propose to do this by introducing an inclusive design learning module based on The GenderMag Method [2, 3].
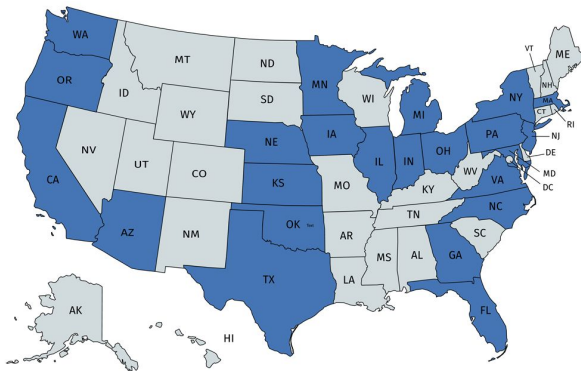
The GenderMag Method ("GenderMag")

GenderMag neutralizes gender bias in software design. In a study with 20 men and women, women initially failed twice as much as men when trying to complete a task in a Microsoft Academic prototype. After GenderMag was used to improve the prototype, the gender gap vanished and both women and men failed less [12]. Preliminary previous work suggests GenderMag can help combat stereotyping within classrooms [11].

GenderMag [2, 3] is used within and outside of academia to find and fix gender-inclusivity bias in software. It combines two software usability evaluation methods—personas and the cognitive walkthrough—which researchers adapted for GenderMag. There are two primary GenderMag personas: Abi and Tim. Each represents a set of cognitive styles people bring to their use of software. The cognitive styles are stated as different sets of values for five cognitive facets: motivation, computer self-efficacy, attitude toward risk, learning style, and information processing style. Abi's facet values represent how women tend to use software and Tim is the analogous representation for men (however, people of any gender identity may feel represented by either of, or parts of, the personas). The GenderMag cognitive walkthrough entails attempting a software task while channeling one of the personas with the goal of uncovering usability bugs.

GenderMag.org reports that GenderMag is used in 24 US states and 20 countries (as of September 2019, see maps below). GenderMag has been *taught* in at least 4 continents and in New Zealand, at more than 20 educational institutions [4]. The GenderMag Teach [4] collaborative wiki and resource repository provides materials and pedagogy educators can use and adapt freely for their classrooms. GenderMag was also used as the basis for developing InclusiveMag, a meta-method for generating inclusive design usability evaluation methods across any diversity dimension (e.g., autism, age, visual ability). InclusiveMag is being taught

right now on-campus at OSU (CS 468/568 HCI 2: Inclusive Design). However, there are no known resources specific to teaching GenderMag online.

24 states, as of Sept. 2019 **20 countries, as of Sept. 2019**
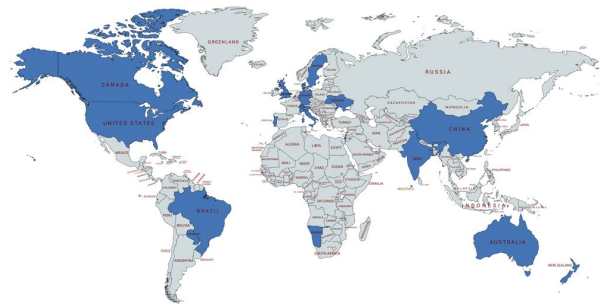
Source: GenderMag.org

Research Questions
- RQ1: What are some effective approaches for incorporating GenderMag into online Computer Science courses?
- RQ2: How does learning GenderMag affect online Computer Science students' inclusivity mindset? I use the term "inclusivity mindset" to refer to feelings of being included and wanting to include others. By "included", I mean feeling welcomed, heard, accommodated, treated equitably, and/or feeling a sense of belonging.
- RQ3: How does learning GenderMag affect online Computer Science students' perceptions of their major?

Planned Intervention

Study Type
- Quasi-experimental user study
- Exploratory (Phase I) and confirmatory (Phase III)
- Quantitative and qualitative
- Between-subjects

Target Population
- Students enrolled in online Computer Science courses
- Students across diverse gender identities and backgrounds

Recruitment

As the proposed research is new, and exploratory in its first phase, I will recruit participants within a large and convenient population: Students enrolled in undergraduate-level online Computer Science courses at OSU. This is reasonable because I teach Computer Science online at OSU and have colleagues who are already interested in making their online classrooms more inclusive. Also, I am compelled to first improve my own university before spreading benefits to other institutions, a future goal.

Course Curricula

I propose to incorporate new curricula into two online Computer Science courses. The curriculum will be tailored for Canvas and online learning.

The GenderMag Method for Designing Usable and Inclusive Software
Students will have the option of learning about a portion of GenderMag: the Abi and Tim personas. The curriculum will include a discussion of Abi's and Tim's cognitive facet values (5 for each persona, 10 total) and the applicability the personas to designing usable and inclusive software.

Nielsen's Heuristics ("Nielsen's") for Designing Usable Software
Sometimes talking about gender and inclusivity is uncomfortable. Because making people uncomfortable is antithetical to the intention of the study, students will have another choice of curriculum: Nielsen's Heuristics [10], 10 well-known principles for designing usable software.

Both GenderMag and Nielsen's are about making software more usable, but only GenderMag is directly about inclusivity. This makes Nielsen's suitable for a control group.

Phase I: Modular Curriculum (Exploratory)

Summary

I plan to incorporate the GenderMag and Nielsen's curriculum into CS340: Introduction to Databases (online) during Spring Term 2020. Students will have the option of completing an extra credit learning module and reflection assignment, both of which I will develop.

The course instructor(s) will announce the opportunity to participate in the research study, which can happen independently from the extra credit assignment: Students can complete the assignment without participating in the research and can also participate in the research without completing the assignment; study participation is decoupled from student grades.

Study Groups

Students who consent to and qualify for the study will have self-selected into one of three study groups:

- Treatment: Extra credit, GenderMag
    a. Watch a short (10 to 20 minute) video module about the Abi and Tim personas and their cognitive facet values (RQ1)
    b. Write a reflection about the module and how the concept might be applied to a software user interface design within CS340
    c. Complete a post questionnaire toward the end of the course, which will ask questions about inclusivity (RQ2), the student's experience of their major (RQ3), and the extra credit assignment, including the reflection (RQ1)
    d. Receive incentive
- Control 1: Extra credit, Nielsen's Heuristics
    a. Watch a short (10 to 20 minute) video module about Nielsen's Heuristics
    b. Write a reflection about the module and how the concept might be applied to a software user interface design within CS340
    c. Complete a post questionnaire toward the end of the course, which will ask questions about inclusivity (RQ2), the student's experience of their major (RQ3), and the extra credit assignment, including the reflection (RQ1)
    d. Receive incentive
- Control 2: No extra credit
    a. Complete a post questionnaire toward the end of the course, which will ask questions about inclusivity (RQ2) and the student's experience of their major (RQ3)
    b. Receive incentive

Students will be given a description of the GenderMag and Nielsen's modules upfront so they can make an informed choice about which to experience. Students may also choose to complete both modules, but will only be given extra credit for one. Students may choose not to complete the extra credit assignment after viewing one or more of the modules.

Data Handling
To ensure study participation is confidential between participants and the researchers, the post questionnaire will be provided to participants outside of course communication channels. The list of participants and the database of student survey responses will only be accessible to me and other researchers IRB-approved for the study, such as a research assistant. The CS340

instructor(s) will never have access to the list of study participants or the database of student survey responses.

Incentives
Students will be offered a $10 Amazon gift certificate, to be distributed at the end of the Phase I study participation window.

Intervention Approval
The ongoing CS340 (online) course owner, Dr. Michael Curry, has agreed to place GenderMag and Nielsen's extra credit modules within the Canvas sites of the two Spring Term 2020 online sections of the course. I will coordinate with Dr. Curry to have the modules added to the course and to have the (IRB-approved) study announcement sent to students. In compliance with FERPA, I will not know who is enrolled in CS340 unless they contact me in response to the study announcement and self-report their enrollment.

Phase II: Refinement
In the second phase, I will develop a modified study design based on what I learn before and during Phase I, and based on the results of Phase I, with these two objectives:
1. Work with the CS290: Web Development (online) course owner to create online GenderMag and Nielsen's curricula in conjunction with full course redesign efforts.
2. Define study hypotheses and rework/refine study design based on what I learn from the exploratory Phase I and its results.

Phase III: Integrated Curriculum (Confirmatory)

The study design for this phase will be developed during Phase I and II. The intervention will happen within CS290: Web Development (online). CS290 will be undergoing a full redesign during Spring and Summer Term 2020; the new version will first be taught Fall Term 2020. I will work with Justin Wolford (ongoing CS290 course owner) to integrate GenderMag and Nielsen's curricula into the redesigned course. The curricula will potentially feature in multiple modules and/or assignments.

I expect to evaluate how the intervention affected students by using the same questionnaire instrument as in Phase I, but with some questions removed and some added based on Phase I findings and revised/refined study goals and hypotheses I will have developed.

Intended Project Outcomes
I expect the proposed project to yield the following:

- O1: Content (pedagogy, course materials for online) for a new section of the GenderMag Teach [4] educator learning and collaboration space (RQ1)
- O2: Data showing how GenderMag affected students' inclusivity mindset (RQ2)
- O3: Data showing how GenderMag affected students' experience of their major (RQ3)
- O4: Positive experiences and satisfaction among instructors and students involved with the study, including satisfaction with GenderMag

Plan for Evaluation

Student Post Questionnaire (O2, O3, O4)

The National Center for Women & Information Technology (NCWIT) provides a free, field-tested quantitative/qualitative "Student Experience of the Major" questionnaire instrument [9] for measuring multiple aspects (e.g, curriculum, pedagogy, support, social) of the classroom environment, as perceived and reported by students. I will adapt this instrument to the planned interventions. I will send study participants a link to the online questionnaire after all GenderMag / Nielsen's assignment submission windows have closed, toward the end of the academic term during which the intervention happens.

I am planning to make the following modifications to the questionnaire:

- Change Q60 ("Gender of the respondent") of the NCWIT questionnaire, replacing the rigid response choices ("male", "female", and "decline to answer") so that participants can specify their own gender identity, including multiple genders
- Add a question asking respondents to specify their degree program (e.g., Post-Baccalaureate CS, Undergraduate CS, Graduate CS, Other)
- Add a question asking respondents to specify which learning module they experienced (i.e., GenderMag, Nielsen's, both, or neither)
- Add these questions to help evaluate how inclusive students feel toward others (to be refined/developed) (RQ2):
  - Students in my computing classes or labs make valuable contributions to my learning [Likert response]
  - I enjoy working with other students in my computing classes or labs [Likert response]
  - Students in my computing classes of labs contribute useful ideas to group discussions [Likert response]
  - Some students in my computing classes or labs do not understand what is required to succeed in the class or lab [Likert response]

- ○ Some students in my computing classes or labs should consider a non-computing major [Likert response]
  - ○ For your next software design project, what types of users will you take into consideration? [Open ended response]
- Add these module-specific questions, where <METHOD> is either GenderMag or Nielsen's, to help answer RQ1:
  - ○ If you were asked to describe <METHOD> to a friend, what would you say? [Open-ended response]
  - ○ Would you use <METHOD> for a future software design project? Why or why not? [Likert and open-ended response]
  - ○ I know how to use <METHOD> [Likert response]
  - ○ Learning <METHOD> was worthwhile [Likert response]

In addition, I will likely hone and otherwise modify the question set between Phase I and III.

Apart from the modifications I've listed above, the NCWIT questionnaire instrument is well-suited for answering both RQ1 and RQ2. For example, Question 63 asks level of agreement with, *Some students in my computing classes or labs are treated better than others because of their gender* (RQ1), the prompt for Question 43 is, *I feel like I belong in my computing major/minor department* (RQ1, RQ2), Question 67 is, *If you could turn back time and start college over, how likely is it that you would take computing courses?* (RQ2) and the Question 5 prompt is, *I understand how the material covered in my courses relate to society* (RQ2).

Instructor Post Questionnaire (O4)

I will ask all involved instructors to provide feedback after the intervention has happened in their course. I am planning to ask the following questions, to be refined as needed:
- Was having GenderMag in your course a positive experience for you? Why or why not? [Likert and open ended response]
- Was having GenderMag in your course a positive experience for your students? Why or why not? [Likert and open ended response]
- In the future, would you be willing to have GenderMag in your course? Why or why not? [Likert and open ended response]
- Would you recommend other online CS instructors have GenderMag in their courses? Why or why not? [Likert and open ended response]

Plan for Sharing

I will work with my collaborator to impactfully share the results of this study within the OSU community:

- **OSU Office of the CIO**
  My collaborator, Dr. Margaret Burnett (Distinguished Professor of Computer Science and Co-Director of The GenderMag Project), is working with this office to systematize GenderMag training and usage within OSU Information Technology offices. If the results of this study show a positive impact on students' inclusivity mindset after exposure to GenderMag online curriculum, the Office of the CIO may be interested in the implications for OSU professional IT staff, who could also potentially learn GenderMag online through Ecampus in the future and gain inclusivity benefits.

- **OSU President and Provost's Leadership Council for Equity, Inclusion and Social Justice (PPLC)**
  Dr. Burnett is part of this committee and presents GenderMag progress and initiatives to its members. PPLC is interested in practices that promote and support student diversity and reports recommendations and data to the president on an annual basis. The results of this research could potentially reinforce and heighten the stature of Ecampus by showing its continued commitment to diversity and inclusion.

- **OSU Online Computer Science Program**
  I will report my findings to Christopher Scaffidi, EECS Associate School Head for Online Programs and Benjamin Brewster, EECS Online CS Program Director, who previously expressed interest in this project.

I will work with my collaborator to share the results of this research with the wider academic community, by submitting to one or more of these conferences:

- ACM International Computing Education Research (ICER)
- ACM Special Interest Group on Computer Science Education (SIGCSE)
- ACM Conference on Human Factors in Computing Systems (CHI)
- ACM Transactions on Computing Education (TOCE)

I plan to request conference travel funding separately.

Timeline

When		What
Pre-study	December – January	● IRB Process
	December – February	● Develop modular curriculum ● Develop post questionnaire ● Develop other study materials ● Other study preparation
Spring Term		● Phase I: Exploratory study (modular curriculum) ● Data analysis ● Study refinement ● Develop integrated curriculum
Summer Term		● Phase II: Study refinement ● Develop integrated curriculum ● Refine post questionnaire / data collection ● Refine study design
Fall Term		● Phase III: Confirmatory study (integrated curriculum)
Winter Term		● Data analysis ● Writing research paper(s) ● Reporting out

Collaborators

- Margaret Burnett, OSU Distinguished Professor of Computer Science
  - Co-Director of The GenderMag Project
  - Has the necessary connections for sharing outcomes of the research through the OSU channels listed previously

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