A Methodology for Investigating Women's Module Choices in Computer Science

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ABSTRACT

At ITiCSE 2021, Working Group 3 examined the evidence for teaching practices that broaden participation for women in computing, based on the National Center for Women & Information Technology (NCWIT) Engagement Practices framework. One of the report's recommendations was "*Make connections from computing to your students' lives and interests (Make it Matter) but don't assume you know what those interests are; find out!*" The goal of this 2023 working group is to find out what interests women students by bringing together data from our institutions on undergraduate module enrollment, seeing how they differ for women and men, and what drives those choices. We will code published module content based on ACM curriculum guidelines and combine these data to build a hierarchical statistical model of factors affecting student choice. This model should be able to tell us how interesting or valuable different topics are to women, and to what extent topic affects choice of module – as opposed to other factors such as the instructor, the timetable, or the mode of assessment. Equipped with this knowledge we can advise departments how to focus curriculum

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development on areas that are of value to women, and hence work towards making the discipline more inclusive.

CCS CONCEPTS

• **Social and professional topics** → **Women**; *Model curricula*; • **Mathematics of computing** → *Bayesian networks.*

KEYWORDS

computing education, inclusion, women, curriculum

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1 BACKGROUND

Modules (also known as classes or courses) are the curriculum components of a degree program (also known as a major or course). With a program, some modules will be taken by all students (core modules), while some will be optional (elective modules), with students choosing to take some and not others. Computing is a very broad discipline, with different institutions offering different elective modules, often based on the value perceived by faculty current and past as well as perceived student interests.

Working Group 3 at ITiCSE 2021 used the NCWIT (National Center for Women & Information Technology) Engagement Practices Framework [1] as the basis of their systematic review of evidence of effectiveness in broadening participation [5]. Their recommendations included:

"*Make connections from computing to your students' lives and interests (Make it Matter) but don't assume you know what those interests are; find out! [5, p. 80]*"

They also noted that "*most of the work [. . .] evaluated interventions implemented at only one institution*" and identified the need to "*disentangle effects*".

In this working group, we aim to explore data on the proportions of women and men choosing elective modules. In doing so, we will identify whether there are any gender-influenced trends based on the content of the curriculum. We will use Bayesian networks to disentangle effects, such as the popularity of individual instructors, from curriculum content. We will harness the resources available to each group member and combine data from multiple institutions and countries.

2 OBJECTIVES

- To collate a multi-institutional, multi-national data set on undergraduate computing elective module enrollment, including module topic content and student numbers by gender
- To build a Bayesian model of this data to identify how and to what extent module enrollment is related to topic and gender
- To explore how the results of the model could support reshaping computing curricula to be more gender inclusive

3 METHOD

Participants will provide data from their own institutions on student enrollment numbers for elective modules, along with textual descriptions of the module content as provided to students. Module descriptions are very often publicly available documents, but aggregate student numbers broken down by gender are not usually available and so would need to be accessed locally, with ethics board approval, and shared within the group. To maintain anonymity, small numbers will have to be excluded, meaning that it is unlikely for us to be able to include any data on students identifying as non-binary. Further work on how to provide inclusive curricula for these students will most likely have to focus on alternative qualitative analyses.

To provide quantitative module characteristic data, we will code the topic areas covered by each module based on the ACM curriculum guidelines from 2013 [3] and/or 2023 [4]. Each module will be coded by at least two participants, identifying as many ACM topic areas as they believe to be relevant. Application areas taken from the top level of the Common Aggregation Hierarchy (CAH), developed by the UK Higher Education Standards Agency (HESA) [2]. An initial set of codings will be analysed for outliers and consistency, with any identified issues over coding decisions discussed by the group before completing the coding.

These data will then be combined in a hierarchical Bayesian network, in which topic-related and non-topic-related factors will be represented as latent variables. The popularity of a module will be constructed by summing together non-topic-related scores with topic-related scores derived from the topics associated with the module. By using Monte Carlo Markov Chain simulation we can estimate the relative importance of the topic and non-topic factors in module selection and whether these are different for women and men.

We will explore how the model results can be used to help departments develop more inclusive curricula. We will also discuss other ways to extend the work, including application of the method to other demographic characteristics associated with historically underrepresented groups in computing, e.g., race and ethnicity and disability.

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