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The Impostor Phenomenon in the Global Computing Graduate Student Population

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Abstract

Several studies have confirmed that undergraduates in computing programs frequently experience the Impostor Phenomenon (IP). However, this work has largely focused on North America and Europe, and no work has evaluated graduate students in computing. This study evaluates the rate of IP experiences in graduate programs globally to determine whether rates of IP experiences are consistent and whether there are institutions or locations with lower rates of IP that might inform the development of support systems to reduce its prevalence. We perform a multi-institutional, multi-national survey-based study of 11 institutions, with at least one on every populated continent. The survey asks graduate students to complete the Clance IP scale (CIPS), which is the standard

evaluation instrument for IP, as well as to answer a number of demographic questions that establish their experience level, gender, and ethnicity. We evaluate the overall level of IP experiences at each institution as well as across regions, and we explore the interaction between CIPS scores, region, and demographic factors.

CCS Concepts

• **Social and professional topics** → **Computing education.**

Keywords

impostor phenomenon, impostor syndrome, IP

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1 Introduction

The Impostor Phenomenon (IP) refers to the experience of feeling that others perceive you as more successful and competent than you perceive yourself to be. The phenomenon was identified by Clance and Imes [11] in 1978 and has been found to be a common experience for people across a range of age groups [3], including both students [23] and working professionals [20]. Unfortunately, IP has been linked to anxiety [1], lower self-efficacy [22], and reduced performance and burnout [3], making it a useful indicator.

In computing, two studies at North American research institutions have found high rates of students experiencing IP at high levels [31, 38]. Rosenstein et al. [31] suggested that it could be possible that computing undergraduates experience IP at higher rates than students in other fields. Rosenstein et al. [31] found that 57.4% of computing students experienced IP at high rates, and an even higher proportion of women (71%) frequently experienced IP feelings. Zavaleta Bernuy et al. [38] confirmed that the higher rates reported by Rosenstein et al. [31] were present at a second institution. However, with just these two studies on North American (primarily) undergraduate populations, as well as a few studies focusing on working professionals (see, e.g., [19, 28]), it is unclear if computing students in graduate programs across the world experience IP at similar rates.

We believe that graduate students in computing experience IP at high rates, similar to findings reported for other fields (see the review by Bravata et al. [3]). However, factors that contribute to *uncharacteristically high* rates in undergraduate computing students may not apply. Zavaleta Bernuy et al. [39] found that social comparisons to peers combined with unrealistic expectations of success fostered by unfamiliarity with computing led to IP experiences of students in their population, and graduate students will be more familiar with the expectations and norms in computing.

In this paper, we investigate the following research question:

RQ: To what extent do graduate students in computing programs in universities around the world experience IP?

Our research question is framed with a global perspective. We intentionally collect data from institutions with diverse missions and geographic locations.

This observational study aims to understand how IP manifests among computing graduate students globally. To inform future studies, we also collect qualitative responses that hint at differences in students' experiences that could be explored in more depth in future work. Our goal is set a baseline for the prevalence of IP in computing graduate students and to inspire future research and intervention design in this space.

By understanding the prevalence of IP among computing graduate students, academics can observe potential causes and can design interventions targeting it. If IP is experienced by computing graduate students around the world, the issue is at the global scale and should be addressed broadly.

2 Related Work

The Impostor Phenomenon (IP) was first defined by Clance and Imes [11] in 1978. This phenomenon is prevalent among high-achieving people from various backgrounds [11, 12, 15, 29]. However, despite

the prevalence of IP, the literature does not agree on its conceptualization. Kolligan Jr. and Sternberg [24] classified IP as an illusion of fraudulence that causes an individual to be wary of the impressions others have of them, and Leary et al. [26] suggested a unidimensional conceptualization where the individual feels inauthentic within a group that is not restricted to successful individuals. Regardless of the exact conceptualization, IP is characterized by an individual disregarding internal factors that lead to success, believing instead that their successes are a result of external factors such as luck. People experiencing IP doubt themselves and fear that others will consider them undeserving of their accomplishments [12]. As mentioned in the introduction, IP has been found to connect to burnout, lower performance, depression and anxiety [3]. Individuals experiencing IP struggle with perfectionism, putting in significant effort into unrealistic or unachievable goals [10].

The Clance Impostor Phenomenon Scale (CIPS) is the most reported method for determining the prevalence of IP experiences. Other scales exist, such as the Harvey Impostor Phenomenon Scale (HIPS), Perceived Fraudulence Scale (PFS) and the Impostor Phenomenon Assessment (IPA). However, the PFS is lengthy (containing 51 items), the HIPS does not differentiate between individuals with frequent IP experiences and infrequent experiences, and the IPA has not yet been widely validated [17, 27, 37]. In contrast, the CIPS is brief and measures the distinction between low and high impostorism more effectively than the HIPS [27].

Despite its widespread use, the CIPS has significant limitations, particularly in its failure to account for cultural and racial contexts. Recent research suggests that the traditional conceptualization of IP may contribute to marginalization by pathologizing individuals rather than recognizing systemic barriers [35]. Moreover, there has been increasing recognition of the need for a culturally informed IP measure, as existing scales may underestimate the prevalence of IP among racially and ethnically minoritized individuals [14]. While efforts are underway to develop new scales that incorporate these cultural dimensions, no validated alternative currently exists [14]. Given this gap, we rely on the CIPS while supplementing our study with qualitative data to capture aspects of IP that may not be fully reflected in existing quantitative measures. Other studies have used qualitative methodologies to examine the cultural dimensions of IP experiences, such as the prevalence of IP in Native American PhD students in STEM [5].

The CIPS is often used in studies measuring the prevalence of IP experiences in STEM. Within STEM fields, IP feelings are tied to an underestimation of accomplishments and talents [12, 15, 22, 32], which increases the difficulty of retaining individuals in this field [33]. Within computing, a recent study by Guenes et al. [19] surveyed 624 software engineers working in corporations around the world using the CIPS. 52.7% of participants reported frequent to intense levels of IP experiences, with 60.6% of women reporting the prevalence of IP, compared to 48.8% of men. Furthermore, Guenes et al. [19] found that perceived productivity among participants was negatively affected by the prevalence of IP.

Multiple studies have investigated IP experiences within computing contexts at educational institutions [6, 25, 31, 38, 39]. Rosenstein et al. [31] surveyed over 200 computer science students at a research-intensive North-American university, and Zavaleta Bernuy et al. [38] surveyed about 750 students at a different university. Similarly

to Guenes et al. [19], the CIPS was used to evaluate the prevalence of IP experiences. Rosenstein et al. [31] found that 57.4% of computer science students had a CIPS score that meets the diagnostic criteria for IP, while Zavaleta Bernuy et al. [38] found that 69-70% of participants met the diagnostic criteria. On the other hand, research conducted between 1998 and 2019 showed that 27-48% of students in other fields of study had CIPS results that met the diagnostic criteria [31]. Both studies found that the rate of IP experiences among computer science students was high across all years of study, and that IP-related feelings were more frequent among female-identifying students than their male counterparts [31, 38]. A later multi-institutional study of IP gathered data from computing undergraduates at 18 institutions and found that IP is prevalent across a range of different university settings and that feelings of imposterism persist throughout the undergraduate curriculum [25]. However, while large, this study primarily draws from North American universities, and it calls for future work in other settings. Chen et al. [6] studied the frequency of IP experiences in computer science undergraduates completing their final year at a university in Oceania. Participants filled out a survey with a modified CIPS that focused on feelings about troubleshotting and code analysis, as well as a demographic survey which included questions about their prior programming experience. The study found that female-identifying participants had higher CIPS scores than male-identifying participants, which aligns with Rosenstein et al. [31] and Zavaleta Bernuy et al. [38]’s findings. Chen et al. [6] did not detect an influence of prior coding and software industry experience on the prevalence of IP among participants. Zavaleta Bernuy et al. [39] also reported on computer science students’ observations of sources of IP. Participants reported that school or internship environments, their identity, and internalized expectations contributed to IP feelings. These findings highlight the importance of studying IP in computing graduate students, as graduate education can exacerbate feelings of self-doubt due to increased academic competition, isolation, and higher expectations [13]. The prevalence of IP in graduate students is closely linked to their motivation, sense of belonging, and perceptions of mentorship quality [13, 36].

3 Methods

Table 1: Participating institutions categorized using the Carnegie Classification¹.

Region (ID)	Student Count	Carnegie Classification	Survey Language
Africa (A)	20-50k	Doctoral / Professional	English
Asia (B)	20-50k	High research activity	English
Europe (C)	10-20k	High research activity	English
Europe (D)	20-50k	High research activity	English
Europe (E)	20-50k	High research activity	English
North America (F)	>50k	High research activity	English
North America (G)	20-50k	High research activity	English
North America (H)	20-50k	High research activity	English
Oceania (I)	<10k	Baccalaureate college	Indonesian
Oceania (J)	>50k	High research activity	English
South America (K)	20-50k	Baccalaureate college	Spanish

This study replicates prior studies [31, 38] examining the prevalence of IP in a different population: graduate students, rather than undergraduates. Consequently, we designed the data collection and analysis processes to be comparable to these prior studies. Our goal is purely observational: we seek to provide a snapshot of the prevalence of IP among graduate students and compare it to prior studies conducted on undergraduate populations. By quantifying the range of IP experiences in graduate computing students, we aim to inform future research on interventions and support strategies.

3.1 Data Collection

We deployed a single survey, aiming for the end of a semester, prior to final exams. This timing is comparable to the timing used by Rosenstein et al. [31]. While some graduate students may be less sensitive to timing than undergraduates (who are more likely to take exams), we chose the earlier date to avoid having students experience a significant assessment of their ability prior to the survey and because students in some phases of their graduate programs may have exam pressures.

The survey was delivered using the Qualtrics platform and was strictly voluntary. After confirmation of consent, the survey begins with the Clance Impostor Phenomenon Scale (CIPS) [8]. The CIPS is the original scale for evaluating the prevalence of the Impostor Phenomenon, and despite some concerns about the conceptual clarity of impostorism [27], the CIPS is generally considered to be valid [7, 17] and more reliable than alternatives [21]. This scale was also used by both Rosenstein et al. [31] and Zavaleta Bernuy et al. [38]. Like Rosenstein et al. [31] and unlike Zavaleta Bernuy et al. [38], our survey does not introduce the concept of IP prior to the scale, to avoid introducing bias.

After the CIPS scale, the survey asks a set of questions about (1) the graduate program the student has enrolled in, (2) their progress in the program, (3) the student’s experience with computing and with research prior to entering graduate studies, (4) the student’s perceptions about their research community, and (5) their demographic data, including gender, age, and ethnicity. Like Zavaleta Bernuy et al. [38], we used an open-text response field for gender and a multi-select question for ethnicity to allow respondents maximum flexibility to define their identity.

The survey was delivered at 11 different institutions that have graduate-level computing programs. Table 1 contains a list of the participating institutions, categorized using the Carnegie Classification¹. The population skews to larger universities with higher research presence due to the requirement of there being a graduate population to study.

The protocol for this study was first approved at the University of Toronto, as the host site. Depending on the regulations for ethics review at each institution, the team either: (a) obtained separate approval at the institution, using the the original protocol as a model or (b) added the institution (and a researcher from the institution) to the original protocol as a secondary data collection site.

¹The Carnegie Classification is used to characterize US institutions, and we apply its criteria, which consider amount of funding and number and diversity of graduate programs, to non-American institutions. We did not differentiate between High and Very High Research Activity due to the difficulty of collecting comparable data on research expenditures. While all the participating institutions have graduate programs, some are categorized as Baccalaureate Colleges due to the number of graduate programs.

Care was taken to provide as similar a survey as possible at all institutions. However, small changes to the survey were required. For example, some European institutions were unable to collect data on ethnicity, and the question about ethnicity was localized to use terms familiar to students at each context. The questions about program of study were also customized to match the programs available at a particular institution. In both cases, the research team worked with the local contact at each institution to make sure that questions about ethnicity and program of study were appropriately localized while providing data that could be analyzed with the other institutions. In addition to these changes, significant deviations include:

- Africa (A) removed questions about prior experience.
- Asia (B) simplified the English used in the CIPS.
- Europe (C) was unable to share raw individual data and, instead, ran analyses as requested and provided only results on aggregate data.
- North America (F)’s data collection occurred earlier than the other institutions, as it piloted the survey.

The survey was translated into a local language at two locations (see Table 1 for the survey language). When translation was required, the survey was first translated by a member of the research team and then reviewed by a faculty member at the local institution. These faculty members are fluent in both the local language and English, providing support to ensure the accuracy and appropriateness of the translation.

A local contact at each institution recruited the participants for the study by emailing two invitations to participate (the second one week after the first) to graduate students in computing at their institution. The same invitation emails were used at all institutions (modulo translation), and the contact inviting participation was not given information on which students chose to participate (or not) in the study, to reduce pressure to participate.

3.2 Analysis Plan

We analyze CIPS data first, without considering any other factors. Prior work has raised concerns about the factor structure of CIPS [17] and the conceptualization of impostorism in general [27]. Thus, like [31] and [38], we evaluate the instrument as a single score obtained by summing the responses. Since the CIPS is composed of 20 5-point questions, the score has a value between 20 and 100. According to Clance’s original interpretation, 41-60 represents “moderate” impostor experiences, a score of 61-80 represents “frequent” IP experiences, and 81-100 represents “intense” impostor experiences [9]. We analyze the CIPS data both (a) separately (by institution) and (b) in aggregate. We anticipate at least some of the data to not be normally distributed, based on past results [38], so we use non-parametric statistical tests after verifying deviation from normality using D’Agostino’s K-squared test and visual inspection.

First, we combine all of the data to create a single distribution. We compare the median and IQR to previously reported data from undergraduates in computing to determine if graduates in computing experience IP to a different extent.

Second, we use the Kruskal-Wallis H test to compare the data from each institution. The Kruskal-Wallis H test indicates if the

samples are likely to be drawn from the same underlying distribution. If the Kruskal-Wallis test indicates that samples may be drawn from different distributions, then the Dunn-Bonferroni post-hoc test is used to identify which samples differ. Additionally, we compute effect sizes and perform power analyses to determine whether our sample size is sufficient to detect meaningful differences and patterns in IP experiences.

After analysis of the CIPS data alone, we investigate the relationship between IP score and other factors collected in the survey. We code gender, ethnicity, progress in the program, prior experience with computing, prior experience with research, and the individual questions about perception about the field and used them as categorical predictor variables. We calculate a correlation matrix for the independent variables and removed items with high correlation (>.7) to avoid issues of multicollinearity. We use a multiple regression with the predictor values and IP score as the dependent variable. Predictor variables with high p-values were considered for removal, and the R^2 for the model is reported.

Moreover, we perform a thematic data analysis to identify underlying themes in participants’ responses. This analysis, presented in Section 5, provides additional depth to our understanding of the experiences that influence IP in graduate students and captures additional factors not explored in the quantitative data.

4 Data

4.1 IP Prevalence

Table 2: IP rates at each institution, including the percent of respondents reporting a IP score above the diagnostic criteria of 61 (%DC).

Institution ²	N	Mean	StDev	Med	IQR	%DC
Africa (A)	41	53.20	13.89	52	14	22.0
Asia (B)	15	56.20	15.89	56	18	33.3
Europe (C)	117	63.36	14.66	62	19	59.0
Europe (D)	36	61.78	12.57	60	17	50.0
Europe (E)	15	65.73	14.51	67	19	73.3
North America (F)	67	69.33	14.66	72	15	77.6
North America (G)	23	62.09	15.61	63	16	52.2
North America (H)	17	74.53	15.74	74	15	82.4
Oceania (I)	12	63.50	15.04	62	12	50.0
Oceania (J)	50	68.88	13.47	70	20	70.0
South America (K)	30	55.03	18.77	56	28	36.7
Overall	423	63.46	16.01	63	22	57.2

This observational study provides insight into the current state of IP experiences among computing graduate students. We first analyze the full set of data (across all institutions) to determine if graduates in computing appear to experience IP at different rates than in previously published studies. We collected data from 423 students (across all institutions).² To assess whether parametric statistical tests are appropriate, we applied the D’Agostino’s K-squared test (7.682, p=0.021). We chose this test over alternatives

²We use the continent in which the institution is located as an identifier, but we note that a single institution cannot be seen as representative of the breadth of experiences in such a broad geographic area.

such as the Shapiro-Wilk or Kolmogorov-Smirnov tests because of its robustness to larger sample sizes and its joint consideration of multiple distributional moments. The test revealed a significant deviation from normality, consistent with findings from prior work. Our sample had a median of 63 with an interquartile range (IQR) of 22. The diagnostic criterion suggested by Clance is $IP \geq 61$ [11], so the median IP score we observed is above the diagnostic criterion. This result suggests that experiences of IP are prevalent across the entire (global) population we surveyed.

In total, 57.2% of the sample population reported an IP score at or above the diagnostic criterion. While this percentage is comparable to the 57.8% reported by Rosenstein et al. [31] and slightly lower than the 68% reported by Zavaleta Bernuy et al. [38], both of whom studied students from undergraduate computing programs in North America, it remains notably higher than the 27-48% typically found in fields outside of computing [31].³

We were also able to compare IP scores reported by the undergraduate and graduate populations at the institutions of Rosenstein et al. [31] and Zavaleta Bernuy et al. [38]. In one case, the percentage of undergraduates reporting IP scores above the diagnostic criteria was slightly higher (57.8% vs. the 52.2% reported by graduate students), but in the other, the percentage of undergraduates reporting above the diagnostic criteria was lower (68% vs. 77.6%). These samples were collected from the undergraduate and graduate populations at different times, which is a threat, but these results suggest that IP scores reported by undergraduate and graduate populations are comparable.

As described in Table 2 and represented visually in Figure 1, IP scores vary widely. Three institutions (Africa (A), Asia (B), and South America (K)) stand out for particularly low median IP scores (≤ 56). They are moderate-sized relative to the other institutions in our sample. Another group of four institutions report median scores near the diagnostic criteria (60-63): Europe (C), Europe (D), North America (G), and Oceania (I). This institution includes our smallest institutions and another moderate-sized institution. The final four institutions (Europe (E), North America (F), North America (H), and Oceania (J)) report relatively high (≥ 70) IP scores.

A Kruskal-Wallis H test indicated statistically significant differences in IPScore across institutions, $H = 53.237$, $p < .001$. This nonparametric test was selected because the distribution deviated significantly from normality (as shown previously), which makes ANOVA inappropriate. The H test assumes that the samples are independent and that the distributions of the dependent variable have similar shapes across groups; visual inspection of score distributions indicated that these assumptions were reasonably justified.

To estimate the magnitude of the differences identified by the H test, we computed the effect size (ϵ^2) [34]. The resulting value, $\epsilon^2 = 0.149$, exceeds the threshold of 0.14 typically interpreted as a large effect [18], suggesting that institutional affiliation accounts for a substantial portion of the variance in scores. To evaluate the adequacy of the study's design, we conducted a post-hoc power analysis. Converting ϵ^2 to Cohen's f ($f = 0.42$) and using the observed sample size ($N = 306$) and $\alpha = .05$, we estimated the

statistical power to be 0.999, indicating that the analysis was sufficiently powered to detect an effect of this magnitude.

Dunn-Bonferroni post-hoc tests were conducted to identify which institutional pairs showed significant differences in IP scores. Dunn's test is appropriate following a Kruskal-Wallis H-test, and we conservatively applied a Bonferroni correction to reduce the risk of false positives. The analysis indicates that there are significant differences (at $\alpha < 0.05$) between two of the institutions with the lowest reported IP scores (Africa (A) and South America (K)) and three of the institutions with the highest scores (North America (F) and (H) and Oceania (J)). Asia (B) and Europe (E) were not found to vary significantly from the other institutions due to the relatively small sample sizes at both. These results suggest that there may be effects related to size and geographic location, as smaller institutions tended to report lower IP scores and European and North American institutions tended to report higher IP scores.

4.2 IP and Demographic Factors

Next, we performed a multiple regression to investigate the potential relationship between IP score and other factors collected in the survey. This method was selected to evaluate the unique contribution of each predictor, assuming a linear relationship between predictors and outcome. We dummy-coded categorical variables such as gender, ethnicity, and institution and converted Likert-style responses to numeric values (1-5) for analysis. While Likert responses are ordinal, transformation to numeric values is common, based on the assumption that the scale approximately reflects interval-level measurement.

Prior to modeling, we examined a correlation matrix to detect multicollinearity. Several of the factors were highly ($>|0.7|$) correlated, so we removed one question from each highly-correlated pair. The resulting model had an R^2 close to 1, indicating extreme overfitting. We performed manual stepwise pruning, ultimately reducing the model to consider only gender, the number of years the student had been a graduate student (which acts as a proxy for Ph.D./masters program), and the number of years in computing (as a proxy for prior experience). These were retained due to theoretical relevance and improved model parsimony. This model, which had the highest fit of the models we tried, had an R^2 of only 0.037, indicating that these observable factors do not strongly predict IP scores. Notably, neither the number of years in computing (prior experience) or number of years in graduate programs were correlated with feelings of imposterism, indicating that students across a range of backgrounds and at levels of the program experience IP feelings. More generally, the lack of a strong model suggests that the causes of IP experiences either (a) vary across contexts or (b) are not reflected in the questions about visual characteristics, experience, or belonging that we asked.

Since prior work (see, e.g., [31]) has suggested that gender is correlated with the rate of IP experiences reported, we conducted a post-hoc analysis to specifically investigate the relationship between gender and IP scores. Table 3 describes the proportion of men and women at each institution⁴ and the average IP score for

³Since this analysis is performed on individuals, rather than across institutions, it is sensitive to the number of responses at each institution. Weighing each institution equally reduces the average slightly, but we come to a similar conclusion that IP rates are elevated in relation to past work.

⁴Europe (C) is only partially included, as its ethics protocol prohibits it from reporting data at an individual level.

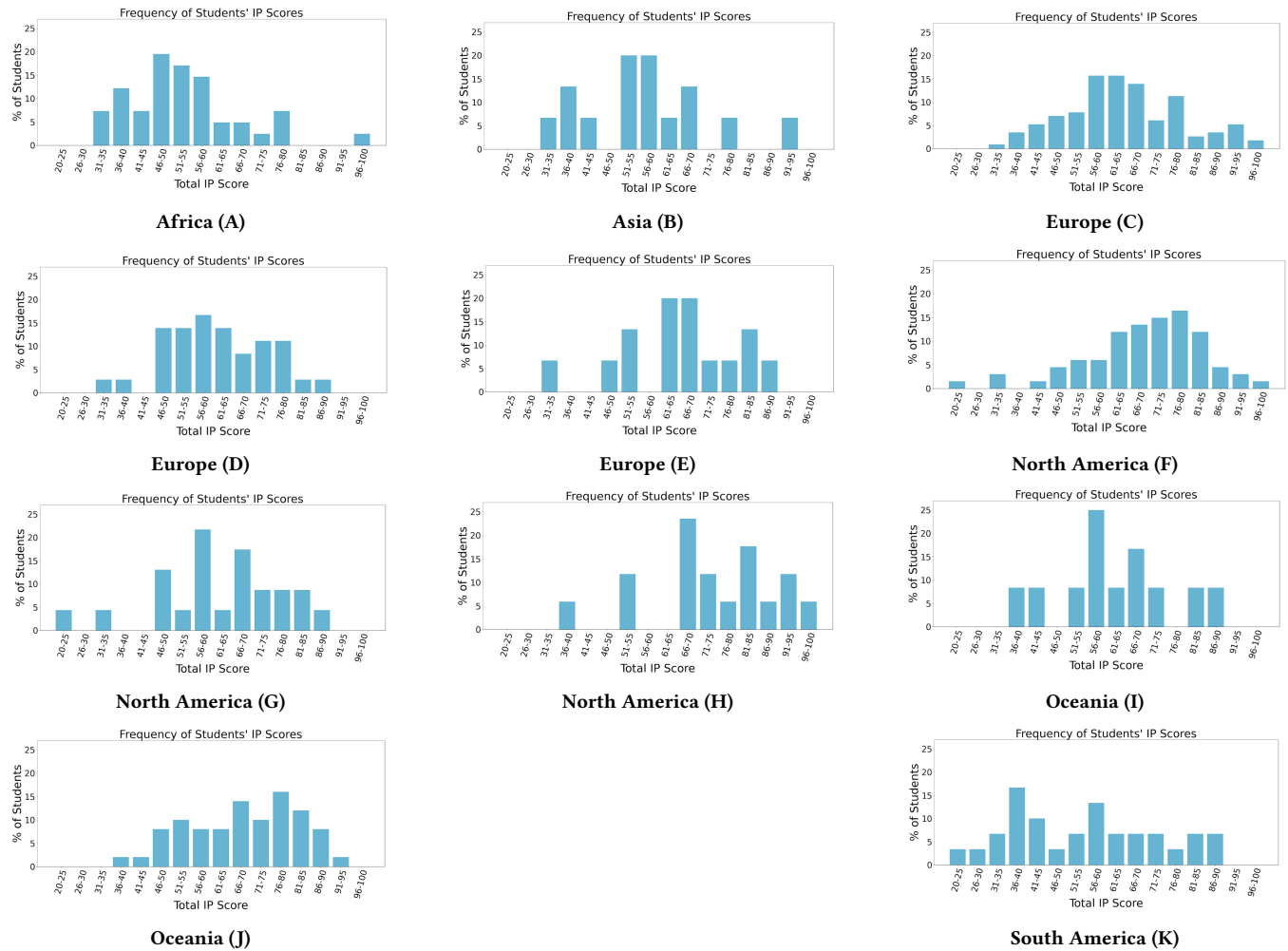


Figure 1: Imposter Phenomenon (IP) Score per Institution

Table 3: IP rates for men and women at each institution.

Institution	% Men	Median IP (Men)	% Women	Median IP (Women)	% No Response	Median (No Response)
Africa (A)	48.8	50.5	17.1	50.0	34.1	52.5
Asia (B)	40.0	56.5	46.7	51.0	13.3	64.5
Europe (C)	-	59.7	-	71.5	-	-
Europe (D)	33.3	60.5	41.7	63.0	25.0	57.0
Europe (E)	40.0	65.0	26.7	64.5	33.3	69.0
North America (F)	28.4	64.0	20.9	74.0	50.7	73.5
North America (G)	82.6	63.0	17.4	60.5	0.0	-
North America (H)	35.3	69.0	35.3	83.5	29.4	72.0
Oceania (I)	16.7	62.0	33.3	62.0	50.0	64.5
Oceania (J)	42.0	66.0	20.0	78.0	36.0	72.0
South America (K)	53.3	56.0	26.7	59.5	20.0	39.5
Overall (excluding Europe (C))	41.5	61.0	25.8	66.0	32.4	66.0

men and women at the institution.⁵ Across the entire population, men (n=127) reported a median IP score of 61, and women (n=79) reported a median IP score of 66. Because, as noted earlier, the IP scores were not normally distributed, we used the Mann-Whitney U test to assess whether the scores differ significantly between genders. This test assumes that the distributions have similar shapes; visual inspection of the distributions supports this assumption. The Mann-Whitney U test ($U=4289.5$, $p=0.080$), while suggestive, does not provide strong evidence that the distributions differ between genders across all of our institutions.

Earlier, we found that there was significant variation in IP scores between institutions, and visual inspection of Table 3 identifies a few institutions where the median IP score for men and women vary (see, e.g., North America (F) and (H)). To examine whether gender differences in IP scores vary across institutions, we conducted separate Mann-Whitney U tests within each institution, comparing the IP scores of men and women. We applied the Benjamini-Hochberg procedure to adjust for multiple comparisons across institutions. After correction, no institution showed a statistically significant difference in IP scores between men and women. A larger sample may be required to provide stronger evidence for or against the hypothesis that IP scores are distributed differently across genders. Regardless, the lack of statistically significant difference—globally or at any single institution—suggests that any difference, if it were to exist, would be small.

Table 4: Responses to an open-ended question about resources available to support sense of belonging.

Code	Examples
Sense of community	Clubs, friendly classmates
Encouragement from faculty	Encouragement from lecturers, mentors
Listening to students	Wellness surveys, academic advisors
Well-being programs	
Pride	
Support for student endeavors	Funding for projects, faculty works with students
Unfriendly environment	Fellow students unwilling to communicate
Not satisfactory	Some support exists, but it's not good enough

5 Thematic Analysis

The survey questions we asked about visual characteristics (ethnicity, gender, and age), belonging, and experience did not identify any factors consistently related to higher rates of IP experiences. Nevertheless, we observe some variation between institutions. To better identify potential sources of these differences for future investigations, we performed a thematic analysis of the open-ended

question, “Does your institution do anything to support your sense of belonging? If yes, please describe what your institution does.”

Thematic analysis followed a structured, iterative approach. A single reviewer initially read all participant responses and identified preliminary codes. These codes, along with example quotes, were discussed with a second reviewer to develop consensus and to refine the coding framework. Following this discussion, the entire dataset was recoded using the finalized set of codes. This approach is consistent with the thematic analysis framework described by Braun and Clarke [2], which emphasizes identifying, analyzing, and reporting patterns (themes) within qualitative data.

The resulting codes and their descriptions are presented in Table 4. The analysis suggests that graduate students often develop a sense of belonging through support from their community (other students and faculty). However, many believe that their institutions are not doing enough to actively support their sense of belonging.

The source of the sense of community may play a meaningful role in shaping their experiences with IP. Students from all institutions mentioned developing belonging through their communities. However, we identified a pattern when comparing institutions with differing IP prevalence. At institutions with higher IP scores, students described the sense of community as coming from peers, while students at institutions with lower IP scores indicated that community was being fostered by faculty and staff. One student states that, “our professors often give us projects to work in groups ... we get to build relationships from there,” and another noted that their lecturers provide significant encouragement and are highly engaged. Although we are unable to determine whether the role of peers in the development of community is a reaction to IP experiences or their source, the data suggests that **more engaged faculty involvement in creating and supporting the community is linked with lower perceived feelings of imposterism.**

Several students also discussed the existence—or the lack—of support programs. While we are unable to determine whether the presence of support programs is a response to existing negative aspects of the community that might cause IP feelings, **the existence of support programs does not appear to be related to lower IP experiences.** Several of the institutions with the highest rates of reported IP experiences had at least some well-being programs (though perhaps “not enough”). One student stated that there were multiple “events that celebrate and support different identities” as well as “clubs get together and semesterly celebrations.” However, another student at the same institution shared that these events were “not very successful and the attempts are somewhat half put together,” while another student suggested that the sense of belonging is purposefully absent “to make [students] work harder.” In contrast, institutions with the lowest rate of IP experiences appears to have no such programs, and several of the other institutions with lower rates of reported IP experiences also appear to have little or no support of this type available. Taken together, **this emphasizes the importance of individual community members, rather than institutional programs, in supporting the development of the community.**

⁵We report only men and women, since we received a very small number of responses that identified as a gender other than man or woman. We hope that future work will be able to investigate IP rates across a full spectrum of gender identities.

6 Discussion

Our findings confirm that the Impostor Phenomenon (IP) remains a prevalent and impactful experience for graduate students globally. Consistent with prior studies using the Clance Impostor Phenomenon Scale (CIPS) in computing [19, 31, 38], we observe high rates of IP across the majority of institutions in our study. We were also able to compare the IP experiences reported by graduate students in our sample with previously collected data from undergraduates at the same institution. At the two institutions where we could compare graduates and undergraduates, the two populations had comparable scores, with graduates reporting higher rates of IP at one institution and lower rates at the other. Taken together, this suggests that IP experiences persist through the undergraduate population to both graduate and professional [19] contexts.

While rates of IP experiences were generally high, we observed geographic variability. Previous large-scale studies have focused on North American institutions [31, 38]. Our data suggest that institutions in Europe, North America, and other culturally aligned regions report higher IP scores compared to institutions elsewhere. However, this observation is based on a limited amount of sampling (only one institution in a *continent* in multiple cases), and we expect that experiences will vary widely within each geographic region. As a result, this pattern requires validation by further sampling underrepresented regions such as Africa, Asia, and South America. Nevertheless, the result aligns with other research that appears to show that rates of impostor feelings vary across cultures, with IP experiences found to be less pervasive in Korea than in the United States [4]. These results raise important questions about the extent to which cultural, structural, or educational differences shape the manifestation and intensity of IP. They also align with recent critiques of the CIPS and IP conceptualizations that highlight the need for more culturally sensitive frameworks [14, 35]. Our findings reinforce the argument that global IP research must move beyond Western-centric constructs and measurement tools.

We also evaluated IP rates for both men and women. Clance and Imes [11]’s original work suggested that women are more likely than their male counterparts to experience impostor feelings, and previous work [6, 31, 38] in computing contexts have generally found that women report higher IP scores than men. However, while rates of IP appeared (visually) to differ between men and women at some of the institutions we observed, we were unable to find statistical evidence of a difference. While unexpected, other work outside of computing has failed to find a difference between men and women, leading Rohrmann et al. [30] to consider the issue of whether women experience IP more frequently than men to be unsettled. It is possible that the experiences of men and women may be more similar in graduate computing contexts than in undergraduate contexts. However, it is also possible that a larger data set is required to identify differences. These results also invite further exploration asking whether prior findings in computing contexts are driven by the unique cultural norms and gender imbalances in those environments.

Unfortunately, our open-ended questions did not elicit responses that revealed cultural differences that might explain variation between institutions in different regions. However, our qualitative analysis was able to examine the supports that students identified at

their institutions. Students frequently described finding belonging through building relationships with peers and faculty mentors, but many also expressed that their institutions were not actively providing support or fostering that sense of belonging. These open-ended responses suggest that informal community support, particularly faculty engagement, may play an important role in mitigating IP experiences. This observation is in line with prior work that found that the prevalence of IP in graduate students is linked to mentorship quality [13, 36] and echoes broader research that emphasizes the protective effect of strong mentoring relationships—in addition to supportive networks—in building healthy self-concept [16].

In sum, our findings both support and extend existing literature. They reaffirm the high prevalence of IP in computing contexts and the value of mentorship. At the same time, they suggest that both men and women experience IP at similar rates in graduate contexts, so the effect of gender may be less consistent than previously reported. Our results also hint at the possibility that there is regional variation in the rates at which IP experiences are felt, which highlights the need for more international and relational approaches to understanding and mitigating the impostor phenomenon.

7 Threats to Validity

We have previously identified a number of potential threats, including differences in the surveys distributed (due to translation, the desire of particular institutions to not ask specific questions, and restrictions on what data can be collected and reported). We have also cautioned against drawing broad conclusions about the experiences of students in a particular region from a single (or small number) of observations. While our study has demonstrated that there is variance in IP experiences and while our data suggests that those differences may be related to region and institutional size or mission, more data—and more rich qualitative data—will be required to understand the diverse range of experiences of students across the globe. Our data is particularly skewed toward larger universities with higher research activity, due to the need to recruit graduate students for the survey and based on the personal networks we used to recruit participating institutions; smaller or differently-classified institutions may have different IP rates.

In addition to these previously discussed threats, our study design also admits the possibility of selection bias. Students experiencing IP might avoid participating due to fear or anxiety related to the disclosure of their feelings to institutional contacts, resulting in an underestimation of the prevalence of IP. It’s also possible that students who feel IP experiences more frequently respond to the survey rates, as the ideas in the survey resonate with them.

8 Conclusions

This study highlights the prevalence of IP among graduate students globally, with significant variation between institutions and potential variation across geographic regions. Institutions in Europe, North America, and culturally aligned regions report higher rates of IP compared to those in other parts of the world, although these regional trends require further validation, especially in understudied regions such as Africa, Asia, and South America. We paid special attention to interactions between IP and gender but found little evidence that reported IP varies between men and women.

Our analysis suggests that differences in IP prevalence are not strongly associated with institutional support programs but, rather, appear to be linked to community engagement within institutions. Specifically, a faculty-driven sense of belonging correlates with lower IP scores. This underscores the critical role that faculty and staff engagement play in mitigating feelings of imposterism, consistent with prior research emphasizing the importance of mentorship.

Future research should prioritize expanding and diversifying data collection across institutions and regions, to better understand why students in some regions report lower levels of IP than others. In addition, future studies should expand on our findings by collecting richer qualitative data to examine how faculty involvement can be effectively fostered and what specific forms of support most strongly promote a sense of belonging that reduces IP. Additionally, longitudinal and qualitative studies could explore the relationships between community sources and IP experiences, clarifying whether peer-driven communities emerge as a response to IP or contribute to its development. Given that institutional programs alone do not appear sufficient to reduce IP, future work might also focus on the interpersonal dynamics and cultural factors that shape graduate students' experiences. Broadening geographic and institutional representation and better understanding the role that faculty involvement plays will be essential to capture the diversity of graduate experiences and to design targeted interventions that address IP in specific contexts.

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References

- [1] Rebecca L Badawy, Brooke A Gazdag, Jeffrey R Bentley, and Robyn L Brouer. 2018. Are all impostors created equal? Exploring gender differences in the impostor phenomenon-performance link. *Personality and Individual Differences* 131 (2018), 156–163.
- [2] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. *Qualitative research in psychology* 3, 2 (2006), 77–101.
- [3] Dena M Bravata, Sharon A Watts, Autumn L Keefer, Divya K Madhusudhan, Katie T Taylor, Dani M Clark, Ross S Nelson, Kevin O Cokley, and Heather K Hagg. 2020. Prevalence, predictors, and treatment of impostor syndrome: a systematic review. *Journal of general internal medicine* 35 (2020), 1252–1275.
- [4] Joon-Ho Chae, Ralph L. Piedmont, Barry K. Estadt, and Robert J. Wicks. 1995. Personological Evaluation of Clance's Impostor Phenomenon Scale in a Korean Sample. *Journal of Personality Assessment* 65, 3 (1995), 468–485.
- [5] Devasmita Chakraverty. 2022. A cultural impostor? Native American experiences of impostor phenomenon in STEM. *CBE—Life Sciences Education* 21, 1 (2022).
- [6] Alyssia Chen, Carol Wong, Katy Tarrit, and Anthony Peruma. 2024. Impostor Syndrome in Final Year Computer Science Students: An Eye Tracking and Biometrics Study. In *Intl Conference on Human-Computer Interaction*. Springer, 22–41.
- [7] Sabine M Chrisman, WA Pieper, Pauline R Clance, CL Holland, and Cheryl Glickauf-Hughes. 1995. Validation of the Clance impostor phenomenon scale. *Journal of personality assessment* 65, 3 (1995), 456–467.
- [8] Pauline Rose Clance. 1985. Clance Impostor Phenomenon Scale (CIPS). In *The Impostor Phenomenon: When Success Makes You Feel Like A Fake*. Bantam Books, 20–22. Used by permission of Dr. Pauline Rose Clance. Do not reproduce/copy/distribute without permission from Pauline Rose Clance, dr-paulinerose@comcast.net, <https://www.paulineroseclance.com>.
- [9] Pauline Rose Clance. 1985. *From The Impostor Phenomenon: When Success Makes You Feel Like A Fake*. Bantam Books.
- [10] Pauline Rose Clance. 1985. *"The Impostor Phenomenon: Overcoming the Fear that Haunts Your Success"*. "Peachtree Publishers".
- [11] Pauline Rose Clance and Suzanne Ament Imes. 1978. The impostor phenomenon in high achieving women: Dynamics and therapeutic intervention. *Psychotherapy: Theory, Research & Practice* 15, 3 (1978), 241.
- [12] Pauline Rose Clance and Maureen Ann O'Toole. 1987. The impostor phenomenon: An internal barrier to empowerment and achievement. *Women & Therapy* 6, 3 (1987), 51–64.
- [13] Emma D Cohen and Will R McConnell. 2019. Fear of fraudulence: Graduate school program environments and the impostor phenomenon. *The Sociological Quarterly* 60, 3 (2019), 457–478.
- [14] Kevin O Cokley, Donte L Bernard, Steven Stone-Sabali, and Germiné H Awad. 2024. Impostor phenomenon in racially/ethnically minoritized groups: Current knowledge and future directions. *Annual Review of Clinical Psychology* 20 (2024).
- [15] Callie Womble Edwards. 2019. Overcoming impostor syndrome and stereotype threat: Reconceptualizing the definition of a scholar. *Taboo: The Journal of Culture and Education* 18, 1 (2019), 3.
- [16] D. Fernandez. 2020. You're going to need a team: Community, mentoring, self-care, and other lessons from the McNair Scholars Program. In *Degrees of Difference: Reflections of Women of Color on Graduate School*, K. D. McKee and D. A. Delgado (Eds.). University of Illinois Press, Urbana, IL.
- [17] Brian F French, Sarah C Ullrich-French, and Deborah Follman. 2008. The psychometric properties of the Clance Impostor Scale. *Personality and Individual Differences* 44, 5 (2008), 1270–1278.
- [18] Catherine O Fritz, Peter E Morris, and Jennifer J Richler. 2012. Effect size estimates: current use, calculations, and interpretation. *Journal of experimental psychology: General* 141, 1 (2012), 2.
- [19] Paloma Guenes, Rafael Tomaz, Marcos Kalinowski, Maria Teresa Baldassarre, and Margaret-Anne Storey. 2024. Impostor Phenomenon in Software Engineers. In *Proceedings of the 46th International Conference on Software Engineering: Software Engineering in Society (Lisbon, Portugal) (ICSE-SEIS'24)*. Association for Computing Machinery, New York, NY, USA, 96–106. doi:10.1145/3639475.3640114
- [20] Daniel P Gullifor, William L Gardner, Elizabeth P Karam, Farzaneh Noghani, and Claudia C Cogliser. 2024. The impostor phenomenon at work: A systematic evidence-based review, conceptual development, and agenda for future research. *Journal of Organizational Behavior* 45, 2 (2024), 234–251.
- [21] Sarah W Holmes, Les Kertay, Lauren B Adamson, CL Holland, and Pauline Rose Clance. 1993. Measuring the impostor phenomenon: A comparison of Clance's IP Scale and Harvey's IP Scale. *Journal of personality assessment* 60, 1 (1993), 48–59.
- [22] Gregor Jöstl, Evelyn Bergsmann, Marko Lüftenegger, Barbara Schober, and Christiane Spiel. 2015. When will they blow my cover? *Zeitschrift für Psychologie* (2015).
- [23] Julie E King and Eileen L Cooley. 1995. Achievement orientation and the impostor phenomenon among college students. *Contemporary Educational Psychology* 20, 3 (1995), 304–312.
- [24] John Kolligan Jr. and Robert J. Sternberg. 1991. Perceived Fraudulence in Young Adults: Is There an 'Impostor Syndrome'? *Journal of Personality Assessment* 52 (1991), 308–326.
- [25] Sophia Krause-Levy, Andrew Petersen, Oladele Campbell, William G. Griswold, Leo Porter, Oluwatoyin Adalokun-Adeyemo, Jennifer Campbell, Michelle Craig, Adrienne Decker, Carrie Demmans Epp, Sebastian Dziallas, David R. Gibson, Yekaterina Kharitonova, Devorah Kletenik, David L. Largent, Emma McDonald, Brian McSkimming, Tina L. Peterson, Cynthia Taylor, and Neena Thota. 2025. Multi-Institutional Study on Impostor Phenomenon. *ACM Trans. Comput. Educ.* (2025). <https://doi.org/10.1145/3748665> Just Accepted.
- [26] Mark R. Leary, Katharine M. Patton, Amy E. Orlando, and Wendy Wagoner Funk. 2000. The Impostor Phenomenon: Self-Perceptions, Reflected Appraisals, and Interpersonal Strategies. *Journal of Personality* 68 (2000), 725–756.
- [27] Karina KL Mak, Sabina Kleitman, and Maree J Abbott. 2019. Impostor phenomenon measurement scales: a systematic review. *Frontiers in Psychology* 10 (2019), 671.
- [28] Malissa McLean. 2016. *Impostor phenomenon and information technology: A study of demographic differences*. Capella University.
- [29] Anna Parkman. 2016. The impostor phenomenon in higher education: Incidence and impact. *Journal of Higher Education Theory and Practice* 16, 1 (2016), 51.
- [30] Sonja Rohrmann, Myriam N Bechtoldt, and Mona Leonhardt. 2016. Validation of the impostor phenomenon among managers. *Frontiers in psychology* 7 (2016).
- [31] Adam Rosenstein, Aishma Raghu, and Leo Porter. 2020. Identifying the Prevalence of the Impostor Phenomenon Among Computer Science Students. In *Proceedings of the 51st ACM Technical Symposium on Computer Science Education (Portland, OR, USA)*. Association for Computing Machinery, New York, NY, USA, 30–36.
- [32] Anna Schulze. 2020. *Examining the Relationship Among Self-Efficacy, Fear of Failure, and Impostor Phenomenon at a HBCU*. Ph. D. Dissertation. University of Louisiana at Monroe.
- [33] Karen W Tao and Alberta M Gloria. 2019. Should I stay or should I go? The role of impostorism in STEM persistence. *Psychology of Women Quarterly* 43, 2 (2019), 151–164.
- [34] Maciej Tomczak and Ewa Tomczak. 2014. The need to report effect size estimates revisited. An overview of some recommended measures of effect size. (2014).

- [35] Nellie Tran. 2023. From imposter phenomenon to infiltrator experience: Decolonizing the mind to claim space and reclaim self. *Peace and Conflict: Journal of Peace Psychology* 29, 2 (2023), 184.
- [36] Ashley R Vaughn, Gita Taasoobshirazi, and Marcus L Johnson. 2020. Impostor phenomenon and motivation: Women in higher education. *Studies in Higher Education* 45, 4 (2020), 780–795.
- [37] Deanna L Walker and Donald H Saklofske. 2023. Development, factor structure, and psychometric validation of the impostor phenomenon assessment: a novel assessment of impostor phenomenon. *Assessment* 30, 7 (2023), 2162–2183.
- [38] Angela Zavaleta Bernuy, Anna Ly, Brian Harrington, Michael Liut, Andrew Petersen, Sadia Sharmin, and Lisa Zhang. 2022. Additional Evidence for the Prevalence of the Impostor Phenomenon in Computing. In *Proceedings of the 53rd ACM Technical Symposium on Computer Science Education V. 1* (Providence, RI, USA). Association for Computing Machinery, New York, NY, USA, 654–660.
- [39] Angela Zavaleta Bernuy, Anna Ly, Brian Harrington, Michael Liut, Sadia Sharmin, Lisa Zhang, and Andrew Petersen. 2023. "I Am Not Enough": Impostor Phenomenon Experiences of University Students. In *Proceedings of the 2023 Conference on Innovation and Technology in Computer Science Education V. 1*. 313–319.