

Navigating the Impostor Phenomenon in Computer Science Education: Insights from Two Major Southeastern Institutions in the United States

Pedro Guillermo Feijóo-García[§]
School of Computing Instruction
Georgia Institute of Technology
Atlanta, GA, USA
pfeijoogarcia@gatech.edu

Alexandre Gomes de Siqueira
Tomás Delclaux Rodríguez-Rey
Department of CISE
University of Florida
Gainesville, FL, USA
(agomesdesiqueira, tomas.delcaluxro)@ufl.edu

Olufisayo Omojokun
School of Computing Instruction
Georgia Institute of Technology
Atlanta, GA, USA
omojokun@cc.gatech.edu

Abstract—This research paper explores the prevalence of the Impostor Phenomenon (IP) among undergraduate college students in computer science (CS) courses, addressing its variations concerning different student demographics such as gender, ethnicity, and institutional background. We surveyed 502 students from two Southeastern U.S. institutions—one in Georgia and one in Florida—using the Clance Impostor Phenomenon Scale (CIPS). We found that 63% of our participants reported experiencing IP, with higher rates among female students (68%) compared to males (62%) and those of other gender identities (46%). Our findings also suggest that IP experiences are significantly influenced by the interplay of students’ gender and their institutional context. At the first institution (Georgia Institute of Technology), IP was found in 58% of female students and 65% of male students, compared to 29% among students with other gender identities. At the second institution (University of Florida), these figures were 80% for females, 57% for males, and 67% for students with other gender identities. Our study underscores the importance of developing targeted support strategies within the CS education community to address the high prevalence of IP, particularly considering its varying impact across different demographics and institutional contexts.

Index Terms—impostor phenomenon, impostor syndrome, computing education, well-being, mental health

I. INTRODUCTION

Computer science education (CS Ed) has been an area of research for decades, with scholars exploring and reporting on how to effectively deliver computer science (CS) at different academic levels. Nonetheless, students’ mental health has only come to the community’s attention since 2018, with recent research mainly published during and after the COVID-19 pandemic [1]–[4]. This shift in focus highlights an evolving interest in understanding the holistic needs of students undertaking computing curricula.

One topic that has been introduced and explored in the CS Ed community concerns the prevalence of the Impostor Phenomenon (IP—i.e., highly-accomplished individuals perceiving themselves as frauds [5]) among college students in computing degrees. Previous research suggests a high prevalence of IP

feelings among CS students [1]–[3], particularly concerning gender and ethnic backgrounds [1], [2], rooting their causes to social comparisons and unrealistic expectations [3] and especially impacting students from underrepresented demographic groups: e.g., female CS students [1]–[3].

Looking to explore this phenomenon further and serve the CS Ed community, we conducted a study with 502 college students undertaking computing courses at two major Southeastern institutions in the United States (USA). Our study extends and adapts from previous research in the CS Ed community: Rosenstein et al. [1] and Zavaleta Bernuy et al. [2]. However, unlike previous efforts, we added to the recipe students’ institutional background to investigate how IP feelings relate to whether students are from the same institution in the USA, as well as the interplay of students’ demographic characteristics and their institutional background. Both institutions are located in the Southeast of the USA and in two separate states: Florida and Georgia. We addressed the following research questions:

- 1) **RQ1:** To what extent is the Impostor Phenomenon prevalent among college students enrolled in computing courses in the USA?
- 2) **RQ2:** What differences exist among demographic subgroups concerning the Impostor Phenomenon among college students undertaking computing courses in the USA?
- 3) **RQ3:** How does the institutional background influence the occurrence of impostor feelings among college students enrolled in computing courses in the USA?

II. RELATED WORK

Recent efforts explored students’ well-being in computing fields, with studies focused on understanding phenomena [1]–[4], as well as designing solutions to assist college students undertaking computing degrees, with novel interfaces such as virtual humans (i.e., embodied conversational agents) [6]–[9] or strategies to directly support some for their subgroups: e.g., seminars to help computer science (CS) doctoral students [10].

[§]Corresponding author

Concerning the understanding of phenomena, in 2020, Soares Passos et al. [4] published a study focused on the prevalence and associated factors of anxiety and depression symptoms among Brazilian CS students. Using two standardized scales (the Beck Anxiety Inventory (BAI) [11] and the Beck Depression Inventory (BDI) [12]), the authors reported that their anxiety and depression symptoms were higher than the Brazilian general population and among medical students. Notably, they found higher BAI and BDI scores among female CS students, indicating gender as a crucial factor when studying students' well-being in computing degrees.

Although introduced in 1978 by Clance and Imes, and studied for different backgrounds [5], [13]–[16] including Science, Technology, Engineering, and Mathematics (STEM) disciplines [17]–[20], the Impostor Phenomenon (IP) has only recently been studied by the computer science education (CS Ed) community to assess college students' well-being when undertaking computing curricula (e.g., computer science–CS, computer engineering). Rosenstein et al. [1] introduced this phenomenon in 2020 to the CS Ed community, investigating the prevalence of IP in CS students at one major college in the United States (USA)—presumably the authors' institution in California. They used the Clance IP Scale [5] to assess their participants to explore IP prevalence among them, differences among sub-populations in the CS student community, as well as comparing IP prevalence among CS and non-CS students [1]. The authors found over half of their participants experienced frequent IP feelings higher than students in other disciplines. Moreover, they observed that female CS students experienced higher levels of IP than male ones, discussing how these impostor feelings could be associated with students' gender, particularly among underrepresented sub-populations.

In 2022, Zavaleta Bernuy et al. [2] published a study that replicated the work by Rosenstein et al. [1], examining the relationship between IP feelings, students' academic years, and their ethnic groups. Their work took place at two North American research-intensive public institutions—presumably the authors' institutions in Canada (both in Toronto). Using the Clance IP Scale [5] too, the authors also reported high IP scores in CS students, particularly among female students, and described a correlation between IP scores and students' ethnicities [2]. The authors extended their work one year later, exploring the prevalence and root problems of IP among undergraduate computing students with a method that analyzed students' experiences qualitatively through thematic analysis of open-ended responses. The authors found that experiences of IP feelings were rooted in students responding to social comparisons and unrealistic expectations, leading to loss of motivation, failure cycles, and potential drop-out scenarios—particularly among underrepresented populations [3].

Our study extends the work by Rosenstein et al. [1] and Zavaleta Bernuy et al. [2], to explore the prevalence of IP among college students undertaking computing courses. Nonetheless, differently from them and in addition to their contributions, we assessed students from two different institutions located in two separate Southeastern states in the

USA—Florida and Georgia. We aimed to replicate findings from previous studies, as well as to observe the interplay between students' demographic characteristics based on their institutional backgrounds.

III. METHOD

We conducted an online, asynchronous study in the Fall of 2023, with undergraduate college students undertaking college courses at two major Southeastern institutions in the USA. Data was collected through a questionnaire, distributed by instructors through their Learning Management Systems (LMS). Participation required no more than 30 minutes, with all communication handled via email. The study received approval from the Institutional Review Boards (IRBs) at both institutions.

A. Participants

Our study included 502 undergraduate students from two institutions in the USA, with 293 from the Georgia Institute of Technology (state of Georgia) and 209 from the University of Florida (state of Florida). Both institutions are major public universities in the USA. All participants were 18 or older and recruited without demographic filters for gender, age, language, ethnicity, or origin. At the study's end, we collected demographic data, allowing participants to identify with one or more ethnic groups. We categorized them as either White (Non-Hispanic/Latin American) or BIPOC (Black, Indigenous, or People of Color). Different from previous studies on this topic [1], [2], we did not consider both, Asian and White American participants, as “ethnic or racially represented groups.” We made this decision due to the unique discrimination experiences Asian Americans endured during the COVID-19 pandemic, as reported in previous studies [21]–[24]. This is also based on findings by Zavaleta Bernuy et al. concerning Asian students: “...*domestic-status Asian students have a very different experience from domestic students of European origin...*” [2].

Table I details participants' demographics per institution, academic year, ethnicity, and gender (female, male, or other). The table also includes subgroups based on language proficiency (monolingual, multilingual) and student origin (domestic USA, international). Additionally, it presents participants' relationship status (single or partnered) and living arrangements (with friends, parents, partner, or alone).

At the Georgia Institute of Technology, a majority of participants ($n=278$) were enrolled in computing programs like computer science or computer engineering. The remaining 15 students came from majors in engineering, economics, and business administration. We had 217 students mentioning the USA as their country of origin, with 122 from the state of Florida. International students from this institution ($n=38$) primarily came from China ($n=6$), India ($n=5$), Canada ($n=2$), Spain ($n=2$), Lebanon ($n=2$), and Vietnam ($n=2$). Two students opted not to disclose their place of origin.

Similarly, at the University of Florida, most participants ($n=183$) came from computing majors, such as computer

TABLE I
DESCRIPTIVE STATISTICS PER DEMOGRAPHIC GROUP

Subgroup	Institutions Count (% of Total)	
	Georgia Tech	U. Florida
All Participants	293 (100%)	209 (100%)
USA Domestic	255 (87%)	188 (90%)
International	38 (13%)	21 (10%)
From the USA	217 (74%)	159 (76%)
From the Same State	122 (42%)	122 (58%)
From a Different State	95 (32%)	37 (18%)
Age: 18 - 20	225 (77%)	137 (66%)
Age: 21 - 25	63 (22%)	69 (33%)
Age: 26 - 30	4 (1.4%)	2 (1.0%)
Age: >31	1 (0.3%)	1 (0.5%)
First Year	33 (11%)	3 (1.4%)
Second Year	97 (33%)	82 (39%)
Third Year	116 (40%)	73 (35%)
Fourth Year	39 (13%)	34 (16%)
Fifth Year or Beyond	7 (2.4%)	17 (8.1%)
Male	200 (68%)	128 (61%)
Female	86 (29%)	75 (36%)
Other (e.g., Non-Binary)	7 (2.4%)	6 (2.9%)
White	52 (18%)	61 (29%)
BIPOC	241 (82%)	148 (71%)
Afro/Black American	13 (4.4%)	12 (5.7%)
Asian	184 (63%)	70 (33%)
Hispanic/Latin American	12 (4.1%)	32 (15%)
Native American	0 (0.0%)	0 (0.0%)
Middle Eastern/North African	5 (1.7%)	3 (1.4%)
Pacific Islander	0 (0.0%)	0 (0.0%)
Mixed Ethnicity	27 (9.2%)	28 (13%)
Alone	71 (24%)	55 (26%)
With Parents	53 (18%)	13 (6.2%)
With Partner	14 (4.8%)	12 (5.7%)
With Friends	155 (53%)	129 (62%)
Single	223 (76%)	141 (67%)
Partnered	70 (24%)	68 (33%)
Computing Major	278 (95%)	183 (88%)
Non-Computing Major	15 (5%)	25 (12%)

science, computer engineering, or data science. Participants from other majors (n=25) were from diverse fields, including mechanical and aerospace engineering, psychology, and political science. We had 159 students mentioning the USA as their country of origin, with 122 from the state of Georgia. International students (n=21) from this institution mostly came from China (n=6), Colombia (n=2), Venezuela (n=2), Vietnam (n=2), and Brazil (n=2). One student opted not to disclose their place or origin.

B. Data Collection and Analysis

Inspired by Rosenstein et al. [1] and Zavaleta Bernuy et al. [2], our study was conducted online and asynchronously in the Fall of 2023, during the semester's final weeks (last two weeks of November and first week of December). Participants completed a two-part questionnaire. The first part featured the Clance Impostor Phenomenon Scale (CIPS)¹ [5], comprising 20 close-ended questions with 5-point Likert scales. As noted

¹Note. From The Impostor Phenomenon: When Success Makes You Feel Like A Fake (pp. 20-22), by P.R. Clance, 1985, Toronto: Bantam Books. Copyright 1985 by Pauline Rose Clance. Reprinted by permission. Do not reproduce without permission from Pauline Rose Clance, drpaulinerose@comcast.net.

by Rosenstein et al. [1], the CIPS [5] has a strong internal consistency (Cronbach's alpha = 0.92–0.96) and external validity [25], [26].

The second part featured demographic questions on age, gender, ethnicity, major, origin status (international or domestic), academic year (e.g., fourth-year), geographic origin (country, state, city), languages spoken, relationship status (single, partnered), and living arrangements (alone, with a partner, parents, or friends).

We recruited our participants with the help of their instructors, and to minimize social desirability bias—responses biased due to respondents' perceptions of what may be socially acceptable [27], [28], the study's communication focused on students' *self-perception in academic contexts* without explicitly mentioning the "Impostor Phenomenon"—an approach similar to the one by Rosenstein et al. [1]. Student participation was 30 minutes at maximum.

We summed responses to the CIPS [5], obtaining Impostor Phenomenon (IP) scores ranging from 20 to 400 [1], [2]. According to Clance, scores above 62 indicate '*frequent*' impostor feelings, and those over 81 suggest '*intense*' impostor feelings [5].

We used the non-parametric Kruskal-Wallis test to compare IP scores across the different demographic characteristics detailed in Table I, primarily due to its robustness against violations of underlying assumptions expected in parametric tests—this test was used in the study by Zavaleta Bernuy et al. [2], which extended the work by Rosenstein et al. [1]. We used the post hoc Dunn's test to follow up on significant differences in outcomes from the Kruskal-Wallis test.

In line with previous literature [1], [2], we examined demographic subgroups to identify patterns in '*frequent*' and '*intense*' impostor feelings, using descriptive statistics for our analysis and insights.

IV. FINDINGS AND RESULTS

Following the analysis strategy described in Section III-B, and with the use of the Kruskal-Wallis Test, we observed no significant differences in students' Impostor Phenomenon (IP) scores across various demographics:

- 1) Institution ($H(1)=2.12$, $p=0.15$)
- 2) Age groups ($H(3)=1.42$, $p=0.70$)
- 3) Origin status (domestic or international, $H(1)=2.31$, $p=0.13$)
- 4) State matching (same state, different state, $H(2)=0.69$, $p=0.71$).
- 5) Academic year ($H(4)=5.39$, $p=0.25$)—results aligned with Zavaleta Bernuy et al. [2].
- 6) Gender ($H(2)=4.84$, $p=0.09$).
- 7) Ethnic representation (White American or BIPOC, $H(1)=1.21$, $p=0.27$).
- 8) Ethnic groups ($H(5)=5.45$, $p=0.36$).
- 9) Living arrangements ($H(3)=5.52$, $p=0.14$).
- 10) Relationship status ($H(1)=0.86$, $p=0.36$).
- 11) Academic major (CS or non-CS, $H(1)=1.80$, $p=0.18$).

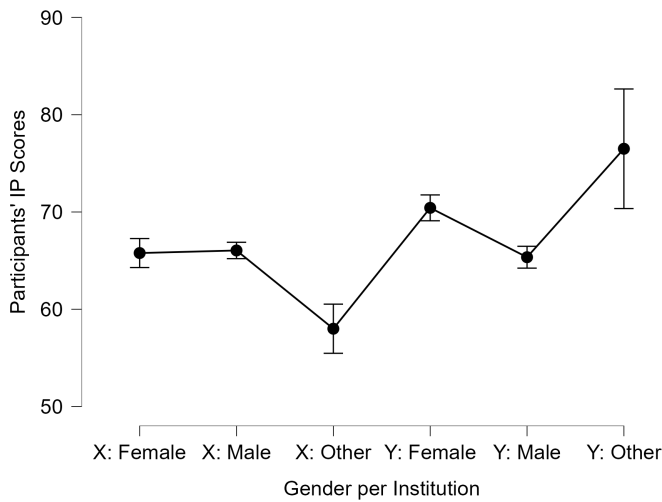


Fig. 1. Participants' IP Scores per Gender and Institution (X-Georgia Institute of Technology, Y-University of Florida)–Error Bars Represent Standard Errors (SE)

We found a significant difference in participants' IP scores related to **gender** when grouped by **institution** (*Kruskal-Wallis Test*, $H(5)=17.3$, $p<0.01$). No other significant differences emerged in IP scores across various demographic characteristics when compared across institutions.

Figure 1 illustrates participants' IP scores by gender and institution. Using Dunns's Test for post hoc analysis, we observed no significant difference in IP scores between female and male participants at the Georgia Institute of Technology ($p>0.05$), nor between these groups and the Other (e.g., Non-Binary) group ($p>0.05$). However, at the University of Florida, significant differences were noted between female and male students ($p<0.01$), aligning with findings from Rosenstein et al. [1] and Zavaleta Bernuy et al. [2].

Significant differences in IP scores were also seen between institutions: female students from the University of Florida differed significantly from those at the Georgia Institute of Technology ($p=0.02$), as did participants in the *other* group between the two institutions ($p=0.01$): Female and students from the *other* group at the University of Florida reported significantly higher IP scores than their peers at the Georgia Institute of Technology. We consider these findings to correspond to differences in state and institutional policies concerning diversity, equity, and inclusion (DEI) initiatives, as Florida has recently been fierce against them. Further research is needed to fully elucidate this phenomenon and help raise students' voices and experiences concerning their impostor feelings.

A notable difference was also observed between male participants at the Georgia Institute of Technology and female participants at the University of Florida ($p<0.01$), but not between female participants at the Georgia Institute of Technology and male participants at the University of Florida ($p=0.60$). These findings suggest that the interplay of students' genders and institutional backgrounds have IP scores vary,

TABLE II
IP SCORES PER DEMOGRAPHIC SUBGROUP AND INSTITUTION

(*)N.A. refers to <5 participants. (**) IP Score >61 for Diagnosis

Subgroup	Institutions Mean (SD), % of them meeting Diag. Criteria	
	Georgia Tech	U. Florida
All Participants	65.8 (12.4), 62%	67.5 (12.6), 66%
USA Domestic	66.2 (12.3), 64%	67.7 (12.5), 66%
International	63.1 (13.1), 50%	66.0 (14.0), 62%
From the USA	65.8 (12.3), 62%	67.5 (12.8), 65%
From the Same State	65.9 (12.6), 66%	67.5 (12.9), 66%
From a Different State	65.5 (12.0), 57%	67.4 (12.3), 62%
Age: 18 - 20	65.9 (12.7), 62%	68.3 (12.8), 68%
Age: 21 - 25	65.4 (11.1), 60%	65.9 (12.3), 61%
Age: 26 - 30	N.A	N.A
Age: >31	N.A	N.A
First Year	68.4 (12.1), 70%	N.A
Second Year	66.4 (13.0), 65%	69.6 (12.1), 87%
Third Year	64.7 (12.2), 57%	67.7 (13.6), 63%
Fourth Year	63.5 (11.3), 62%	64.6 (11.5), 59%
Fifth Year or Beyond	70.0 (11.3), 71%	63.2 (12.3), 59%
Male	66.0 (11.9), 65%	65.4 (12.7), 57%
Female	65.8 (13.8), 58%	70.4 (11.5), 80%
Other (e.g., Non-Binary)	58.0 (6.68), 29%	76.5 (15.0), 67%
White	65.2 (13.1), 56%	65.2 (11.3), 59%
BIPOC	65.9 (12.3), 63%	68.4 (13.0), 68%
Afro/Black American	59.7 (12.4), 23%	69.5 (12.6), 75%
Asian	66.2 (12.3), 65%	69.3 (13.3), 68%
Hispanic/Latin American	66.2 (9.60), 67%	64.1 (12.5), 59%
Native American	N.A	N.A
Middle Eastern/North African	64.2 (10.5), 60%	N.A
Pacific Islander	N.A	N.A
Mixed Ethnicity	66.8 (13.4), 67%	70.1 (13.3), 79%
Alone	68.4 (12.1), 63%	66.7 (13.1), 65%
With Parents	64.0 (12.3), 58%	67.1 (13.9), 54%
With Partner	60.8 (11.3), 43%	64.5 (15.1), 58%
With Friends	65.6 (12.6), 64%	68.1 (12.1), 67%
Single	66.0 (12.2), 63%	68.0 (12.6), 66%
Partnered	64.9 (13.3), 59%	66.4 (12.7), 65%
Computing Major	65.9 (12.5), 63%	67.8 (12.8), 66%
Non-Computing Major	62.8 (10.5), 47%	64.9 (11.1), 60%

underscoring the need for future studies with larger sample sizes to explore further the relationship between the Impostor Phenomenon, gender, and the students' institutions, especially among students pursuing computing courses.

Our study reveals that 63% of our participants ($n=502$) experienced 'frequent' or 'intense' impostor feelings, echoing previous CS Ed research on the topic [1], [2]. A notable trend emerged among female students ($n=161$), with 68% reporting these feelings, higher than their male ($n=328$ –62%) and other-gender-identity peers ($n=13$ –46%). Table II shows participants' IP scores across demographic groups. As presented, a clear gender-related difference in impostor feelings was observed between both institutions. For instance, 80% of female participants from the University of Florida ($n=75$) reported 'frequent' or 'intense' feelings, compared to 58% of female participants at the Georgia Institute of Technology ($n=86$). This disparity also extends to participants of non-male and non-female identities: 29% at the Georgia Institute of Technology ($n=7$) versus 67% at the University of Florida ($n=6$). These variations could reflect cultural, political, and social differences between the two states where these institutions

belong and suggest further research to better understand this phenomenon.

Additionally, Afro/Black American participants ($n=25$) exhibited differing trends between institutions: Of the group of Afro/Black American participants at the Georgia Institute of Technology ($n=13$), only 23% reported ‘frequent’ or ‘intense’ impostor feelings. However, among Afro/Black American participants at the University of Florida ($n=12$), 75% of them reported ‘frequent’ or ‘intense’ impostor feelings. We believe these observations might be influenced by the varying representation and socio-cultural dynamics in the states both institutions are from. Nonetheless, when comparing IP scores from both groups, we observed no significant difference between groups (*Kruskal-Wallis Test*, $H(1)=3.74$, $p=0.05$)—although close to significance. Further research is needed to understand the IP experiences of students from this ethnic group in computing courses, especially with larger populations from this ethnic group.

Our findings suggest that college students from both institutions, predominantly in computing majors, generally experience ‘frequent’ or ‘intense’ impostor feelings. These findings are consistent and echo observations initially reported by Rosenstein et al. [1]. Moreover, our findings indicate the existence of gender and institutional interplay concerning the Impostor Phenomenon, suggesting that demographic characteristics should be treated context-based as they may differ depending on different institutional backgrounds.

V. DISCUSSION

Our study’s offers insights into the dynamics of the Impostor Phenomenon (IP) among college students undertaking computing courses. Responding to the research question **RQ1**: *To what extent is the Impostor Phenomenon prevalent among college students enrolled in computing courses in the USA?*, we observed that the high percentage of students experiencing ‘frequent’ or ‘intense’ impostor feelings (63% of our participants), especially among female and other-gender-identity students, underscores the relevance of this phenomenon in higher education, particularly in computing programs. This is consistent with existing literature [1], [2], [17], [20], suggesting a need for more targeted interventions and support systems within academic institutions. These findings align with previous work in computer science education (CS Ed) on this topic [1], [2].

Responding to the research questions **RQ2**: *What differences exist among demographic subgroups concerning the Impostor Phenomenon among college students undertaking computing courses in the USA?* and **RQ3**: *How does the institutional background influence the occurrence of impostor feelings among college students enrolled in computing courses in the USA?*, we observed no significant differences when analyzing students’ demographics individually. However, when considering the intersectionality of students’ demographics, our findings suggest that IP experiences are significantly influenced by the interplay of students’ gender and their institutional context.

These findings respond to the research question The significant differences in IP scores between female and male students at the University of Florida, and the significant disparities between female students at the University of Florida and the Georgia Institute of Technology, point to the role of institutional culture and environment in shaping these experiences. For instance, there was no significant difference between female and male students from the Georgia Institute of Technology.

We consider these findings to correspond to differences in state and institutional policies concerning diversity, equity, and inclusion (DEI) initiatives, as Florida has recently been fierce against them. Further research is needed to fully elucidate this phenomenon and help raise students’ voices and experiences concerning their impostor feelings. Nonetheless, our findings suggest that gender-related experiences of impostor feelings are not merely individual psychological phenomena but could also be shaped by the institutional environment, possibly attributed to different institutional policies, cultural norms, or support systems that influence students’ perceptions and experiences of their academic processes.

Additionally, although contrasting trends in IP scores among Afro/Black American students at the two institutions were not significantly different, our observations suggest an interesting trend concerning participants from this ethnic group and a potential institutional impact possibly influenced by broader socio-cultural dynamics and diversity representation within these institutions. Nonetheless, a larger sample population is needed to conclude this, and more research is necessary to understand how racial and ethnic identity intersects with impostor feelings in different institutional contexts.

Our study not only corroborates the work of earlier research in computer science education (CS Ed) [1], [2], but also amplifies our understanding of the widespread nature of IP among college students, particularly those in computing fields. Significantly, our study provides insights into the intricate relationship between students’ gender and their experiences of impostor feelings. More importantly, our research reveals that IP experiences are not uniform across different academic institutions in the United States (USA). This observation underscores the critical need for broader, more inclusive research efforts, both within the USA and in diverse international contexts, to comprehensively grasp the nuances of this phenomenon among students pursuing computer science courses in varied institutional and cultural environments. We encourage the CS Ed community to intensify its efforts in raising awareness and crafting targeted support strategies to help our students’ well-being. Addressing the high prevalence and diverse impacts of IP, particularly given its varying intensity across genders, institutions, and cultural backgrounds, is imperative for fostering a more supportive and inclusive educational landscape in CS Ed.

VI. LIMITATIONS

While our study provides valuable insights, it has limitations that must be acknowledged. First, the study’s focus on two

institutions limits the generalizability of our findings. Additionally, our study reports on results that present the existence of impostor feelings among college students undertaking computing courses but fails to provide insights into the reasons why these feelings exist in the first place. Further research is necessary to dive into students' experiences and understand the roots of the differences observed and reported in this academic paper, including a broader range of institutions to explore the variability of IP experiences across different types of academic environments.

VII. CONCLUSIONS

In conclusion, our study not only corroborates and expands upon existing research in the computer science education (CS Ed) community. It also brings to light the significant interplay of gender and institutional context in the Impostor Phenomenon among college students, particularly in computing fields. Our study underscores the need for more comprehensive research and specific support measures across various cultural contexts to enable educational institutions to better understand and address the unique ways impostor feelings manifest in diverse student groups and help students excel free from the Impostor Phenomenon.

REFERENCES

- [1] A. Rosenstein, A. Raghu, and L. Porter, "Identifying the prevalence of the impostor phenomenon among computer science students," in *Proceedings of the 51st ACM Technical Symposium on Computer Science Education*, 2020, pp. 30–36.
- [2] A. Zavaleta Bernuy, A. Ly, B. Harrington, M. Liut, A. Petersen, S. Sharmin, and L. Zhang, "Additional evidence for the prevalence of the impostor phenomenon in computing," in *Proceedings of the 53rd ACM Technical Symposium on Computer Science Education-Volume 1*, 2022, pp. 654–660.
- [3] A. Zavaleta Bernuy, A. Ly, B. Harrington, M. Liut, S. Sharmin, L. Zhang, and A. Petersen, "'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*, 2023, pp. 313–319.
- [4] L. M. Soares Passos, C. Murphy, R. Zhen Chen, M. Gonçalves de Santana, and G. Soares Passos, "The prevalence of anxiety and depression symptoms among brazilian computer science students," in *Proceedings of the 51st ACM Technical Symposium on Computer Science Education*, 2020, pp. 316–322.
- [5] P. R. Clance, "Clance impostor phenomenon scale," *Personality and Individual Differences*, 1985.
- [6] P. G. Feijóo-García, C. Wrenn, J. Stuart, A. G. De Siqueira, and B. Lok, "Participatory design of virtual humans for mental health support among north american computer science students: Voice, appearance, and the similarity-attraction effect," *ACM Transactions on Applied Perception*, vol. 20, no. 3, pp. 1–27, 2023.
- [7] M. Zalake, A. G. de Siqueira, K. Vaddiparti, and B. Lok, "The effects of virtual human's verbal persuasion strategies on user intention and behavior," *International journal of human-computer studies*, vol. 156, p. 102708, 2021.
- [8] P. G. Feijóo-García, M. Zalake, H. Yao, A. G. de Siqueira, and B. Lok, "Can we talk about bruno? exploring virtual human counselors' spoken accents and their impact on users' conversations," pp. 1–7, 2022.
- [9] P. G. Feijóo-García, M. Zalake, A. G. de Siqueira, B. Lok, and F. Hamza-Lup, "Effects of virtual humans' gender and spoken accent on users' perceptions of expertise in mental wellness conversations," pp. 68–75, 2021.
- [10] Y. Yacoby, J. Girash, and D. C. Parkes, "Empowering first-year computer science ph.d. students to create a culture that values community and mental health," in *Proceedings of the 54th ACM Technical Symposium on Computer Science Education V. 1*, ser. SIGCSE 2023. New York, NY, USA: Association for Computing Machinery, 2023, p. 694–700. [Online]. Available: <https://doi.org/10.1145/3545945.3569751>
- [11] A. T. Beck, N. Epstein, G. Brown, and R. A. Steer, "An inventory for measuring clinical anxiety: psychometric properties," *Journal of consulting and clinical psychology*, vol. 56, no. 6, p. 893, 1988.
- [12] A. T. Beck, C. H. Ward, M. Mendelson, J. Mock, and J. Erbaugh, "An inventory for measuring depression," *Archives of general psychiatry*, vol. 4, no. 6, pp. 561–571, 1961.
- [13] C. W. Edwards, "Overcoming impostor syndrome and stereotype threat: Reconceptualizing the definition of a scholar," *Taboo: The Journal of Culture and Education*, vol. 18, no. 1, p. 3, 2019.
- [14] A. Parkman, "The impostor phenomenon in higher education: Incidence and impact," *Journal of Higher Education Theory & Practice*, vol. 16, no. 1, 2016.
- [15] J. Cutri, A. Freya, Y. Karlina, S. V. Patel, M. Moharami, S. Zeng, E. Manzari, and L. Pretorius, "Academic integrity at doctoral level: the influence of the impostor phenomenon and cultural differences on academic writing," *International Journal for Educational Integrity*, vol. 17, no. 1, p. 8, 2021.
- [16] E. A. Canning, J. LaCrosse, K. M. Kroeper, and M. C. Murphy, "Feeling like an impostor: The effect of perceived classroom competition on the daily psychological experiences of first-generation college students," *Social Psychological and Personality Science*, vol. 11, no. 5, pp. 647–657, 2020.
- [17] M. Simon and Y.-J. Choi, "Using factor analysis to validate the clance impostor phenomenon scale in sample of science, technology, engineering and mathematics doctoral students," *Personality and Individual Differences*, vol. 121, pp. 173–175, 2018.
- [18] K. W. Tao and A. M. Gloria, "Should i stay or should i go? the role of impostorism in stem persistence," *Psychology of Women Quarterly*, vol. 43, no. 2, pp. 151–164, 2019.
- [19] D. Chakraverty, "Impostor phenomenon and identity-based microaggression among hispanic/latinx individuals in science, technology, engineering, and mathematics: A qualitative exploration," *Violence and Gender*, vol. 9, no. 3, pp. 135–141, 2022.
- [20] —, "A cultural impostor? native american experiences of impostor phenomenon in stem," *CBE—Life Sciences Education*, vol. 21, no. 1, p. ar15, 2022.
- [21] R. McGarity-Palmer, A. Saw, J. Y. Tsoh, and A. J. Yellow Horse, "Trends in racial discrimination experiences for asian americans during the covid-19 pandemic," *Journal of Racial and Ethnic Health Disparities*, pp. 1–16, 2023.
- [22] D. H. Chae, T. Yip, C. D. Martz, K. Chung, J. A. Richeson, A. Hajat, D. S. Curtis, L. O. Rogers, and T. A. LaVeist, "Vicarious racism and vigilance during the covid-19 pandemic: mental health implications among asian and black americans," *Public Health Reports*, vol. 136, no. 4, pp. 508–517, 2021.
- [23] T. T. Nguyen, S. Criss, P. Dwivedi, D. Huang, J. Keralis, E. Hsu, L. Phan, L. H. Nguyen, I. Yardi, M. M. Glymour *et al.*, "Exploring us shifts in anti-asian sentiment with the emergence of covid-19," *International journal of environmental research and public health*, vol. 17, no. 19, p. 7032, 2020.
- [24] M. Wei, S. Liu, S. Y. Ko, C. Wang, and Y. Du, "Impostor feelings and psychological distress among asian americans: Interpersonal shame and self-compassion," *The Counseling Psychologist*, vol. 48, no. 3, pp. 432–458, 2020.
- [25] S. M. Chrisman, W. Pieper, P. R. Clance, C. Holland, and C. Glickauf-Hughes, "Validation of the clance impostor phenomenon scale," *Journal of personality assessment*, vol. 65, no. 3, pp. 456–467, 1995.
- [26] S. W. Holmes, L. Kertay, L. B. Adamson, C. Holland, and P. R. Clance, "Measuring the impostor phenomenon: A comparison of clance's ip scale and harvey's ip scale," *Journal of personality assessment*, vol. 60, no. 1, pp. 48–59, 1993.
- [27] R. J. Fisher, "Social desirability bias and the validity of indirect questioning," *Journal of consumer research*, vol. 20, no. 2, pp. 303–315, 1993.
- [28] E. E. Maccoby and N. Maccoby, "The interview: a tool of social science," 1954.