

Choices, Concerns, and Connections: Computing Students' AI Use and Links to Imposter Syndrome Subtypes

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Abstract—*Imposter syndrome is a persistent issue in computing education, shaping how students perceive their abilities, belonging, and potential place within computing-related subfields. Artificial intelligence (AI) tools have become increasingly common in tertiary education coursework and are often assumed to support learning and confidence. However, their growing presence raises questions about how learning, effort, and competence are evaluated in academic work. Little is known about how students experience them in relation to imposter syndrome, which centers on doubts about competence and legitimacy. This mixed-methods study examined how AI use relates to imposter syndrome experiences among computing students. Quantitative survey data were collected from N = 285 computing students from historically marginalized racial and ethnic backgrounds across three U.S. institutions. Measures included the Clance Imposter Phenomenon Scale, items aligned with Valerie Young's imposter syndrome subtypes, and questions assessing AI-related legitimacy concern focused on authenticity and independence. Results indicated that AI use-related concerns are common and positively associated with all imposter syndrome subtypes. Perfectionist and Natural Genius beliefs emerged as the strongest predictors of AI-related concerns. Concern varied with imposter belief intensity rather than subtype classification. Qualitative analysis of open-ended responses (N = 254) demonstrated that students rarely described AI as reassuring. Instead, AI use often intensified concerns about authenticity and independence. Together, these findings suggest that AI tools do not uniformly build confidence. Instead, imposter beliefs shaped how AI was interpreted, highlighting the need for clear instructional guidance and attention to legitimacy as an equity concern.*

Keywords—*computing education, artificial intelligence, imposter syndrome, legitimacy and belonging, women and diversity.*

I. INTRODUCTION

Prior work in computing and engineering education has shown that imposter syndrome is a common experience for students, particularly for women and students from historically marginalized racial and ethnic backgrounds [1]–[4]. These experiences are often tied to questions of belonging and legitimacy rather than to differences in ability or performance [2], [5]. In computing classrooms, where independence and technical mastery are frequently emphasized, students may be especially sensitive to how their competence is perceived [6].

At the same time, artificial intelligence (AI)-based tools have become a routine part of computing coursework. Students increasingly report using these tools to support tasks such as debugging, studying, and completing assignments [7], [8]. Most existing research on AI in computing education has focused on

productivity, access, or ethical concerns [8], [9], with far less attention paid to how students experience these tools in relation to their academic identities. This gap is particularly important for students who already question whether they belong or are competent enough to succeed.

Imposter syndrome is also not experienced uniformly across students. Prior research has identified distinct imposter syndrome subtypes—Expert, Natural Genius, Perfectionist, Soloist, and Superhuman—that reflect different beliefs about expertise, perfectionism, independence, and ability [10]. These beliefs shape how students evaluate their own competence and are therefore likely to influence how they interpret academic supports, including AI tools. However, this relationship has not been examined in detail within computing education, and it remains unclear whether AI tools are experienced as neutral supports or raise legitimacy concerns that interact with existing imposter beliefs.

This study examines the relationship between AI use-related opportunities, concerns, and imposter syndrome among computing students. In particular, we focus on how different imposter syndrome subtypes shape students' experiences with AI. Drawing on a sample of computing students from historically marginalized racial and ethnic backgrounds (with regard to their gender, racial, and/or ethnic identification), the study explores **how beliefs about competence, legitimacy, and belonging intersect with emerging uses of AI tools in academic contexts**. Specifically, this study addresses the following research questions (RQs):

- **RQ1:** How does AI use-related concern vary across imposter syndrome subtypes among computing students?
- **RQ2:** How do computing students describe the role of AI tools in relation to feelings of legitimacy, competence, and belonging?

II. RELATED WORK

A. Imposter Syndrome, Onlyness and Belonging

Imposter syndrome was originally described as a pattern of persistent self-doubt in which individuals attribute success to luck or external factors rather than to their own ability [11]. Research across higher education and professional settings has since shown that these experiences are common even among high-achieving individuals [1]. They are also more closely

related to questions of identity and belonging than to objective measures of performance.

A key mechanism through which computing and engineering fields can amplify imposter feelings is the discipline's cultural emphasis on independence, technical mastery, and individual performance. Prior work suggests that these values can make it difficult for students to interpret struggle or help-seeking as part of the learning process, instead framing these experiences as evidence that they are not competent or do not belong [2], [6]. Such framing is particularly salient in classroom environments where progress and competence are highly visible.

Studies have also shown that imposter experiences are not evenly distributed across students in computing fields. Women and students from historically marginalized racial and ethnic backgrounds report higher levels of self-doubt, heightened visibility, and greater pressure to prove their competence, often in the context of limited representation and comparison with peers [3]–[5]. Recent multi-institutional work in computing education also indicates that imposter phenomenon is common among undergraduate computing students across different institution types and demographic groups [12]. Together, these findings suggest that imposter syndrome in computing is shaped by a combination of individual beliefs and structural features of computing education, rather than by isolated student characteristics. Relevant work on “onlyness” offers a complementary lens for understanding how these social dynamics become internalized as competence doubts—when students are “the only one,” or one of a few in a setting—they may experience hypervisibility and representational burden that undermines psychological safety and belonging, particularly for populations minoritized in the discipline [3], [4], [6].

In computing specifically, qualitative studies of Black women in computer science (CS) higher education described how navigating underrepresented spaces involves constant negotiation of legitimacy and belonging [13]. More recently, Joshi et al. explicitly theorized “onlyness” among Black women doctoral students in computing and engineering and described how isolation and visibility pressures can contribute to cycles of imposter feeling and emotional distress [14]. At the undergraduate level, quantitative work has highlighted that a sense of belonging in introductory computing courses is patterned by gender and classification as being minoritized and depends on both student characteristics and departmental climates, reinforcing that belonging is a key structural component of persistence [15]. Taken together, the relevant work on imposter syndrome, onlyness, and belonging suggests a plausible psychosocial pathway for computing students: who already experience onlyness or low belonging may be especially likely to interpret AI tool usage through legitimacy concerns—mapping onto imposter subtype belief patterns.

B. AI Tools in Learning

Recent studies in computing education have described the growing presence of AI-based tools in coursework. Much of this work has emphasized issues such as productivity, academic integrity, access, and ethics, with less attention given to how students experience these tools at a psychosocial level,

especially in computing education contexts where competence signaling and legitimacy are already salient [7]–[9]. Several scholars have noted that LLM-based tools may not only reshape assessment practices and instructional strategies, but also students' interpretations of what it means to learn and demonstrate competence in programming [7], [19]. Further empirical studies also suggest that students' adoption of generative AI is entangled with normative boundary-making (e.g., distinguishing legitimate use from illegitimate misuse), indicating that AI tool use is not merely technical assistance but also a site of identity- and legitimacy-related negotiation [20]. Hence, there is a need to additionally explore the psychosocial dimensions of AI use, particularly how AI use in computing spaces affects students' confidence, perceived legitimacy, and beliefs on their abilities and alignment with the field.

C. AI, Legitimacy, and Help-Seeking Tensions

Help-seeking is not always experienced as a neutral or supportive practice in computing education. Students who equate competence with independence or expertise may view asking for help as a threat to their identity, particularly in settings that emphasize individual mastery [6], [21]. Generative AI tools introduce help seeking feelings in students that they are immediate, private, and socially safe, but also may be ambiguous in legitimacy. Recent work on AI use in computing classrooms suggests a similar pattern: rather than easing these tensions, AI tools can raise concerns about authenticity and validity [7], [8]. Some recent literature explicitly examines how GenAI is reshaping help-seeking preferences among computing students. A key finding across this emerging literature is that AI tools have not fully replaced human resources; rather, students use AI as one of many help channels and choose resources based on task difficulty, trust, latency, and perceived risk of judgment [22], [23], and AI mediated help-seeking [24], [25].

D. Ally or Liability?

Although prior research has examined imposter syndrome in computing education and the growing presence of AI tools in academic settings, little work has empirically explored how AI tool use relates to imposter syndrome, particularly for women and students from historically marginalized racial and ethnic backgrounds (e.g., those who identify as Black or African American, Hispanic or Latine, or as Indigenous People). Recent relevant computing education research shows that students are actively negotiating AI use through legitimacy, identity, and boundary-making practices. Rogers et al. demonstrate that students distinguish between “use” and “misuse” of ChatGPT in ways that reflect normative judgments about acceptable support and what counts as authentic work [20]. Similarly, Prather et al. describe generative AI as broadly disruptive to computing education, including concerns that these tools may reshape what it means to learn, and demonstrate competence [19]. At the level of tool interaction, novice-focused studies of AI pair programmers suggest that learners often struggle with uncertainty about when to trust AI tool's output and how to incorporate it into problem-solving processes that contribute to self-doubt and competence-related anxiety [26]. Despite these important advances, it remains unclear whether AI tools are

experienced by students as supportive allies or as sources of additional pressure and legitimacy concerns, particularly in relation to existing beliefs about competence. As allies, AI tools can provide rapid feedback, explanations, debugging support, and private assistance that lowers the interpersonal cost of asking for help—potentially supporting persistence and confidence, especially when students are uncertain or stuck [23]. Yet, AI tool use can also become a liability by amplifying concerns about legitimacy and authorship, reinforcing beliefs that competence must be demonstrated independently, and triggering fears of being exposed as less capable than peers [19], [20]. Moreover, few studies integrate quantitative measures with qualitative accounts to examine both prevalence and lived experience. This study addresses these gaps through a mixed-methods approach that examines **how computing students experience AI tool use in relation to imposter syndrome**.

III. THEORETICAL FRAMEWORK

In this research, we consider imposter syndrome as a set of beliefs about competence that are shaped by context rather than seen as a fixed individual trait. Imposter experiences vary across individuals because they reflect different expectations about what being competent and legitimate means in academic settings. Prior work identifies distinct imposter syndrome subtypes—such as beliefs centered on expertise, perfectionism, independence, natural ability, and discounting success—that represent different internal standards students use to evaluate their achievements [10], [11]. These subtypes form the starting point of the conceptual framework applied in our research, illustrated in Fig. 1.

A useful foundation for this perspective is **Identity-Based Motivation (IBM)**, which posits that students’ motivation and interpretation of academic tasks are influenced by their self-conceptions and the perceived congruence of actions with those identities [27]. From this view, academic tools and strategies are not neutral; students assess their use based on whether they feel these tools align with their sense of themselves as legitimate and capable learners. Accordingly, Fig. 1 positions **AI tool use as a context in which identity-linked beliefs about competence are activated**.

Within computing education, research shows that norms emphasizing individual mastery, technical performance, and independence shape how students interpret competence and help-seeking [5], [6]. These norms intersect with students’ imposter beliefs: for example, students who equate competence with flawless performance or innate ability may view external support as threatening to their legitimacy. Recent work in education suggests that, beyond productivity or access concerns, students often evaluate AI tools in terms of authenticity and independence, raising questions about whether AI-assisted outcomes reflect genuine understanding [7], [8]. In the conceptual framework (Fig. 1), these interpretations contribute to **AI-related legitimacy concern rather than being treated as direct effects of AI use**.

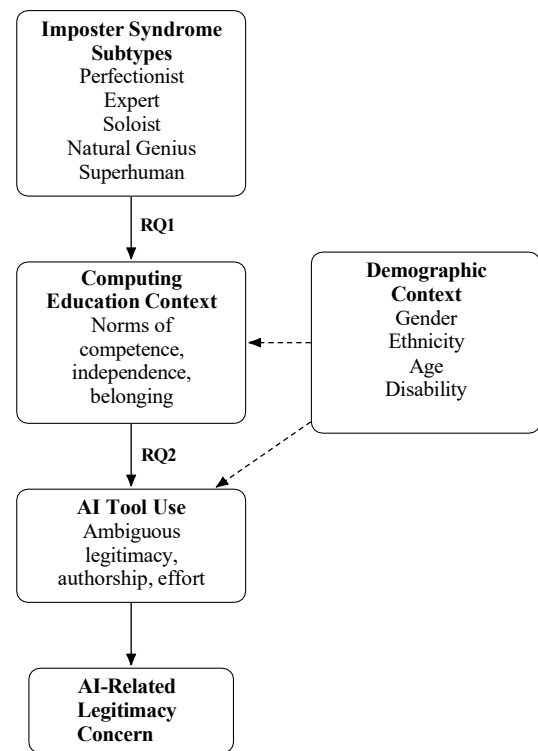


Fig. 1. Conceptual Framework

Research on social belonging and representation further contextualizes these beliefs. Women and students from historically marginalized racial or ethnic backgrounds frequently report heightened visibility, comparison, and experiences of “onlyness” in computing classrooms, which can intensify doubts about belonging and competence [1]–[4]. These conditions may activate or amplify imposter belief patterns—for example, increasing pressure to demonstrate expertise or discouraging help-seeking—especially in environments that implicitly valorize independence. Help-seeking itself has been framed as identity-relevant rather than purely instrumental. Students often interpret academic supports through beliefs about independence, authenticity, and competence, and this interpretation influences whether supports are seen as legitimate or threatening [21]. As reflected in Fig. 1, **demographic characteristics shape these contexts without being modeled as direct causes of AI-related concern**. AI tools, by introducing ambiguity about the origin of academic output, may heighten these legitimacy concerns for students whose imposter beliefs emphasize independence or natural ability.

Together, these perspectives position AI tool use not as a uniform solution to imposter feelings but as part of the identity and belief context in which imposter syndrome subtypes are experienced and negotiated. AI tools may interact with existing beliefs about competence and legitimacy, shaping how students respond to and integrate these tools into their learning practices.

IV. METHODS

To investigate whether AI tools are perceived as allies or liabilities in relation to imposter syndrome, this study employs a mixed-methods design combining survey data with qualitative student reflections. We administered a survey across three institutions in the United States: a Hispanic-Serving Institution (HSI) community college (Miami Dade College), a public R1 (Carnegie Classification: very high research activity) HSI university (Florida International University), and a private, not-for-profit R1 Predominantly White Institution (Syracuse University). The survey instrument was hosted in Qualtrics.

A. Data Collection and Preparation

This study was approved by an Institutional Review Board prior to commencing data collection. Participants were recruited using convenience sampling from computing-related programs at the three institutions. The survey was distributed through academic listservs and with the assistance of computing faculty, who shared the study with students who were enrolled in computing programs.

The survey included both closed-ended and open-ended questions. The closed-ended items assessed imposter syndrome, representation and belonging, imposter syndrome subtypes, and perceptions of AI tool use. Imposter syndrome was measured using items adapted from the Clance IP Scale, along with items aligned with Valerie Young's imposter syndrome subtypes: Perfectionist, Expert, Soloist, Natural Genius, and Superhuman [10], [11]. Perceptions of AI tools were measured using two items focused on legitimacy-related concerns. These items asked whether students felt conflicted about using AI because competent computing students "should be able to figure things out without help" (i.e., an AI independence-related item), and whether using AI tools such as ChatGPT or GitHub Copilot meant they were "not truly doing the work" themselves (i.e., an AI authenticity-related item). Participants also completed demographic and background questions.

In addition, the survey included an open-ended question asking students to describe their experiences with AI tools in computing education. Students were invited to reflect on whether they had used AI-generated tools, how those tools affected their confidence or understanding of computing concepts, and whether AI use influenced their sense of belonging in computing spaces. Students were also asked to describe any benefits or challenges they encountered.

Survey responses were exported to Excel and cleaned prior to analysis. A total of 457 responses were initially collected. Responses were first filtered based on degree program to retain students enrolled in computing-related fields. Students who selected "Other" were included if they specified a computing-aligned program, such as Computer Engineering, CS Education, Cybersecurity, or Data Science. Responses were excluded if participants indicated a non-computing major or reported computing as a minor. After this step, the dataset included 340 computing students across the three institutions.

For the quantitative analyses reported, the analytic sample was further restricted based on race or ethnicity to focus on women and students from historically marginalized racial and

ethnic backgrounds in computing. Respondents who identified as White males were excluded to allow for a within-group examination of imposter syndrome subtypes and AI-related legitimacy concerns among students whose experiences are more likely to be shaped by issues of representation and belonging in computing education. This decision reflects a scope definition rather than a judgment about the relevance of other students' experiences. Limiting the sample in this way allowed the analysis to center patterns within diverse student populations without treating the majority demographic experiences as a default reference. Following this restriction, the final quantitative analytic sample consisted of 285 computing students, including men, women, and gender diverse students across multiple racial and ethnic backgrounds.

Not all participants provided responses to the open-ended question. Responses without qualitative data were excluded from the qualitative analysis. As a result, 254 responses were retained and analyzed for the qualitative portion of the study.

B. Data Analysis

1) *Quantitative*: Quantitative analyses were conducted in Python (version 3.11) using survey responses from historically underrepresented computing student sample ($N = 285$). All survey items used five-point Likert scales. Responses marked as "Not applicable," "N/A," or equivalent were treated as missing. Composite scores were calculated as scale means based on available items, resulting in minor variation in sample size across analyses.

Composite scores were computed for general imposter syndrome, five imposter syndrome subtypes (i.e., **Perfectionist, Expert, Soloist, Natural Genius, Superhuman**), representation and belonging, and AI-related legitimacy concern. Subtype and composite scores were calculated as item means. The AI-related concern composite was based on two items assessing **discomfort and uncertainty about AI use in academic work**; respondents with no valid AI item responses were excluded from analyses involving this measure.

Internal consistency was evaluated descriptively through item coherence and scale behavior rather than reliability coefficients, given the use of short, theoretically defined scales. Descriptive statistics were also calculated for all composites. Pearson correlations examined associations between AI-related concern, imposter syndrome subtypes, and representation and belonging (RQ1).

For exploratory analyses, respondents were assigned a **dominant imposter syndrome subtype** based on their highest subtype mean. One-way ANOVAs tested differences in AI-related concern across dominant subtype groups. A tie indicator was retained, and sensitivity analyses excluding tied cases were conducted to assess robustness.

Respondents were also grouped into **low, medium, and high AI-related concern** tertiles using complete cases. One-way ANOVAs compared mean subtype scores across concern levels, with effect sizes reported using η^2 . Item-level analyses examined AI-related concern items separately to distinguish **independence-related and authenticity-related concerns**, using correlation and regression analyses. Demographic subgroup analyses were conducted by gender identity, ethnicity,

age group, and disability status, examining mean differences and consistency of subtype–AI concern relationships. Findings for small subgroups were interpreted cautiously.

Finally, response rates to the open-ended AI question were reported to contextualize RQ2, excluding non-substantive responses. Subsequently, qualitative analysis of the substantive responses is presented in the following section.

2) *Qualitative*: We conducted a deductive content analysis [28], [29] of the qualitative data. In our approach, we followed the steps described by [29]: (1) and (2) we began by applying the conceptual framework to identify the propositions under examination; (3) we established a code book mapping based on our conceptual model and aspects related to imposter syndrome subtypes, computing education context, demographic context, and AI tool use; (4) we created a question matrix to ensure that the items posed aligned with the RQs; (5) we collected the data through closed- and open-ended questions related to imposter syndrome; and (6) we conducted the analysis in three stages. The code book was first applied to identify examples and confirm their presence. We distinguished between “confirmed” and “added” themes, recognizing that the goal was to apply extant theory rather than establish new themes. We then identified themes based on the evidence present in the dataset and the patterns relevant to our study’s propositions. We also assessed the potential for triangulation regarding how the theories in the conceptual model may complement each other; and (7) reporting focused on how the theories worked together while also noting any tensions observed in our data.

Coding was conducted by two researchers using a deductive content analysis approach guided by the conceptual framework and imposter syndrome subtypes. An initial codebook was developed to capture subtype-specific beliefs (e.g., perfectionism, expertise, natural ability), AI-related legitimacy concerns (e.g., authenticity, independence), and aspects of the computing education context. Both coders independently coded the dataset, and discrepancies were resolved through discussion to reach consensus. Observed agreement in dominant subtype assignment was high (83.51%), and Cohen’s κ was approximately 0.76, indicating substantial agreement according to Landis and Koch [30]. During analysis, responses were examined both within and across imposter syndrome subtypes to identify patterns in how students described AI use in relation to legitimacy, competence, and belonging. Analytic notes were maintained to document coding decisions, theme development, and connections between qualitative patterns and quantitative findings.

C. Positionality

The first author, Dr. Elodie V. Billionniere, is a Professor of Computer Science at Miami Dade College, whose career spans both industry and academia. She is a Black/Caribbean, non-Hispanic woman and a U.S. immigrant, and her experiences navigating computing spaces where she has often been one of the few have shaped her interest in imposter syndrome, onliness, and how students understand belonging and legitimacy in computing education. She has experienced imposter feelings throughout her career and tends to align with

a Perfectionist subtype, reflected in heightened concern with correctness, performance, and meeting internal standards. This perspective shapes how she attends to students’ beliefs about what it means to do computing “correctly,” including how those beliefs affect their willingness to seek help, acknowledge uncertainty, or use tools such as AI in their coursework. Her leadership in funded initiatives focused on broadening participation in computing further grounds this study’s focus on students’ lived experiences within diverse computing pathways.

The second author, Dr. Stephanie J. Lunn, is an Assistant Professor of Computing and Engineering Education at Florida International University, who has experience in both industry and academia. However, her industry work was in a non-computing field. She identifies as a White, non-Hispanic woman. Her academic and professional experiences have shaped her perspective around not only what it means to be a woman in computing, but also how this may compare to expectations, attitudes, and values in other fields. She has struggled with imposter syndrome throughout her trajectory and tends to align with a Superhuman subtype, seeking to excel in every role simultaneously. She feels guilt or anxiety when not productive and has similarly high expectations for others around task completion. While she recognizes the benefits of various AI applications and values deliberate pedagogical efforts to foster AI-related competencies that will enhance students’ technical and professional development, she is also concerned with responsible use and consideration of AI’s potential limitations and impact. She is driven to better understand students’ perspectives and support their aspirations while considering broader societal implications.

The third author, Ashmita Thapaliya, is a CS PhD student at Florida International University. As an international student and woman of color, she has experienced firsthand the psychological and emotional challenges that accompany advanced academic work, including moments of self-doubt and imposter feelings. She recognizes alignment with the Superhuman subtype, marked by pressure to excel across multiple roles simultaneously. This pattern informs her sensitivity to how computing students may interpret AI tool use as both a potential support and a source of guilt, fear of dependence, or legitimacy concerns—particularly when using AI might conflict with internalized expectations about independent achievement and comprehensive competence. The isolation and pressures inherent in doctoral programs have provided her with both personal insight and critical distance to examine how these factors shape students’ experiences with AI tools and related concerns about authenticity and independence.

The fourth author, Dr. Farzana Rahman, is a professor in the teaching stream at Syracuse University and has prior experience teaching at a public R1 HSI. She identifies as a woman of color and an international scholar in the United States, shaping her attention to how computing students experience belonging, legitimacy, and marginalization across institutional contexts. She has experienced imposter feelings throughout her trajectory and recognizes alignment with the Superhuman subtype, marked by pressure to excel across roles and difficulty feeling “enough” without constant productivity. This pattern

informs her sensitivity to how computing students may interpret AI tool use as both support and a potential trigger for guilt, fear of dependence, legitimacy concerns, or feelings about being perceived as less capable. Her teaching of large undergraduate computing courses, service on an institutional AI task force, and leadership in federally and industry funded AI literacy initiatives further ground her interest in how instructional norms, institutional policies, and ethical considerations shape students AI use and related imposter experiences.

D. Participants

1) *Quantitative*: The quantitative sample consisted of 285 computing students from historically underrepresented backgrounds. As shown in Table I, over one-third of participants identified as women, and approximately 10% identified as having a disability or long-term health condition.

TABLE I
PARTICIPANT DEMOGRAPHICS (QUANTITATIVE SAMPLE, $N = 285$)

Characteristic	<i>n</i>	%
Gender		
Men	163	57.2
Women	107	37.5
Gender diverse	9	3.2
Prefer not to answer	6	2.1
Race / Ethnicity		
Hispanic / Latinx	72	25.3
Asian	67	23.5
Black / African American	51	17.9
Multiracial	43	15.1
White (non-Hispanic)	26	9.1
Other (incl. MENA, Indigenous)	18	6.3
Prefer not to answer	8	2.8
Age		
18–24	229	80.4
25–34	33	11.6
35–49	20	7.0
50+	2	0.7
Prefer not to answer	1	0.3
Disability status		
Yes	29	10.2
No	243	85.3
Prefer not to answer	13	4.6

Note. Respondents selecting more than one racial or ethnic category were classified as multiracial.

2) *Qualitative*: The quantitative subsample consisted of 254 computing students who provided substantive responses to the open-ended question on AI tool use. As shown in Table II, over one-third of participants identified as women, and the majority were between the ages of 18 and 24, reflecting the undergraduate focus. Approximately one in ten participants identified as having a disability or long-term health condition. Representation across racial and ethnic groups remained consistent with the broader sample ($N = 285$).

V. RESULTS

A. Quantitative

Across the sample $n = 285$, students reported moderate to high levels of general imposter syndrome ($M = 3.30$). Among the five subtypes (Table III), **Expert ($M = 3.62$) and Perfectionist**

TABLE II
PARTICIPANT DEMOGRAPHICS (QUALITATIVE SUBSAMPLE, $N = 254$)

Characteristic	<i>n</i>	%
Gender		
Men	146	57.5
Women	95	37.4
Gender diverse	7	2.8
Prefer not to answer	6	2.4
Race / Ethnicity		
Hispanic / Latinx	64	25.2
Asian	60	23.6
Black / African American	40	15.7
Multiracial	38	15.0
White (non-Hispanic)	24	9.4
Other (incl. MENA, Indigenous)	21	8.3
Prefer not to answer	7	2.8
Age		
18–24	202	79.5
25–34	30	11.8
35–49	19	7.5
50+	2	0.8
Prefer not to answer	1	0.4
Disability status		
Yes	24	9.4
No	217	85.4
Prefer not to answer	13	5.1

Note. Respondents selecting more than one racial or ethnic category were classified as multiracial.

($M = 3.51$) exhibited the highest mean scores, whereas Soloist scores were comparatively lower. Superhuman and Natural Genius scores fell between these values.

AI-related legitimacy concern was also above the midpoint ($M = 3.47$), suggesting that discomfort with AI use was relatively common among participants. Participants showed stronger agreement with concerns about whether AI-assisted work counts as “real” work than concerns with independence. This pattern indicated that **concerns about authenticity were more prominent than concerns about autonomy**.

In relation to **RQ1**, as shown Table IV, AI-related legitimacy concern was positively associated with general imposter syndrome and all five IP subtypes (all $p < .001$), with the strongest associations observed for Perfectionist and Natural Genius beliefs. Associations with Soloist, Expert, and Superhuman beliefs were also statistically significant. Together, these results indicate that **AI-related concern varies across multiple imposter syndrome subtypes**.

When the imposter syndrome subtypes and representation and belonging were considered together (complete cases, $n = 272$; Table V), the results were statistically significant and accounted for 27% of the variance in AI-related legitimacy concern. Perfectionist ($\beta = .19$) and Natural Genius ($\beta = .17$) beliefs emerged as significant unique predictors, while other subtypes and representation and belonging were not significant once shared variance was taken into account. This finding suggests that **beliefs centered on flawless performance and innate ability are most directly implicated in AI-related legitimacy concerns**.

Comparisons based on dominant imposter syndrome subtypes showed no statistically significant differences in AI-related concern across groups ($F = 0.92, p = .453, \eta^2 = 0.01$). As a result,

subsequent analyses focused on the *intensity* of imposter beliefs rather than assigned subtype. AI-related concern was divided into low, medium, and high tertiles, and subtype scores were compared across these levels (see Table VI). Across all five subtypes, mean scores increased monotonically from the low- to high-concern groups. Differences were statistically significant for all subtypes, with the largest effect sizes observed for Natural Genius ($\eta^2 = .18$) and Perfectionist ($\eta^2 = .16$). This suggests that **AI-related legitimacy concerns are more closely tied to the intensity of imposter beliefs than to the assigned subtype alone.**

TABLE III
DESCRIPTIVE STATISTICS FOR COMPOSITE MEASURES (5-POINT SCALE)

Scale	<i>n</i>	Mean	SD
General imposter syndrome	284	3.30	1.01
Representation and belonging	283	2.99	1.00
Perfectionist subtype	281	3.51	1.21
Expert subtype	280	3.62	1.18
Soloist subtype	283	3.05	1.23
Natural Genius subtype	282	3.31	1.11
Superhuman subtype	282	3.38	1.16
AI-related legitimacy concern	275	3.47	1.18

TABLE IV
PEARSON CORRELATIONS BETWEEN AI-RELATED LEGITIMACY CONCERN AND IMPOSTER MEASURES

Predictor	<i>n</i>	<i>r</i>
General imposter syndrome	275	0.45***
Representation and belonging	275	0.33***
Perfectionist subtype	274	0.46***
Expert subtype	274	0.39***
Soloist subtype	275	0.40***
Natural Genius subtype	275	0.45***
Superhuman subtype	274	0.38***

Note. Values are Pearson correlation coefficients. *** $p < .001$.

TABLE V
MULTIPLE REGRESSION PREDICTING AI-RELATED LEGITIMACY CONCERN

Predictor	β	<i>SE</i>	<i>t</i>
Perfectionist	.19*	.08	2.42
Natural Genius	.17*	.08	2.17
Expert	.09	.08	1.14
Soloist	.07	.07	0.98
Superhuman	.06	.07	0.87
Representation & Belonging	.08	.07	1.10

Note. Values are Pearson correlation coefficients. * $p < .05$.

TABLE VI
IMPOSTER SYNDROME SUBTYPE SCORES BY AI-RELATED CONCERN LEVEL

Subtype	Low Concern	Medium Concern	High Concern	η^2
Perfectionist	2.94	3.46	4.08	.16
Expert	3.11	3.61	4.05	.13
Soloist	2.61	3.04	3.58	.12
Natural Genius	2.78	3.37	4.12	.18
Superhuman	3.01	3.42	3.85	.11

Additional analyses distinguishing between independence-focused and authenticity-focused AI-related concerns suggested that different IP subtypes map onto distinct legitimacy tensions (see Table VII). **Independence-related AI concern showed its strongest association with Natural Genius beliefs, with Perfectionist and Soloist beliefs also exhibiting strong relationships.** In contrast, **authenticity-focused concern—whether AI-assisted work counts as legitimate effort—was most strongly associated with Perfectionist beliefs.**

TABLE VII
ITEM-LEVEL CORRELATIONS BETWEEN AI-RELATED CONCERNS AND IMPOSTER SYNDROME SUBTYPES

Imposter Syndrome Subtype	AI Independence-Related Concern	AI Authenticity-Related Concern
Perfectionist	0.38***	0.44***
Expert	0.31***	0.36***
Soloist	0.37***	0.33***
Natural Genius	0.41***	0.39***
Superhuman	0.34***	0.32***

Note. Values are Pearson correlation coefficients. *** $p < .001$.

Finally, subgroup analyses by gender and ethnicity showed no statistically significant differences in overall AI-related concern or mean subtype scores, and the **same subtype pattern—strongest associations for Perfectionist and Natural Genius beliefs—was observed across groups.** Across ethnic groups, this pattern persisted, indicating that AI-related concern is structured more strongly by imposter beliefs than by ethnicity alone. Exploratory analyses suggested some variation by age and disability status, with **stronger associations between Natural Genius and Soloist beliefs and AI-related concern among students aged 18–24, and stronger associations between Perfectionist beliefs and AI-related concern among students reporting a disability.** Although subgroup sizes were smaller and these findings should be interpreted cautiously, they suggest that educational stage and accessibility context may shape how imposter beliefs interact with AI-related legitimacy concerns.

Taken together, these quantitative patterns point to the importance of understanding how students make sense of AI tools in practice. To better understand how students interpret AI tools in relation to competence, legitimacy, and belonging, we analyzed open-ended responses for the qualitative subsample ($N = 254$). Examining these responses through the lens of students' dominant imposter syndrome subtype provides insight into how AI tools are experienced and negotiated in practice, helping to contextualize and explain the subtype-level patterns observed in the quantitative results.

B. Qualitative

The qualitative subsample included 254 computing students who shared more detailed reflections on their use of AI tools. As shown in Table VIII, most participants were classified as having Perfectionist or Expert imposter syndrome subtypes, while smaller groups aligned with Superhuman, Natural Genius, or Soloist patterns. This distribution helps frame the analysis that follows, as students' dominant imposter beliefs influence how they think about using AI tools and what those tools mean for their sense of competence, legitimacy, and belonging.

TABLE VIII
DOMINANT IMPOSTER SYNDROME SUBTYPES (N = 254)

Dominant Subtype	n	%
Perfectionist	108	42.5
Expert	80	31.5
Superhuman	32	12.6
Natural Genius	17	6.7
Soloist	16	6.3
Unassigned / missing dominant subtype	1	0.4

1) *RQ1: How does AI use-related concern vary across imposter syndrome subtypes among computing students?:*

a) *Perfectionist Subtype (n = 108):* Students with a dominant Perfectionist subtype **frequently described AI tools as potentially useful but emphasized careful and limited use.** Their responses reflected concern about accuracy, depth of understanding, and whether AI-assisted work met internal standards of quality. A male Hispanic/Latinx student (ages 45–49) noted, “*I think it’s a great idea. The tools will be powerful, but you still need to understand what you’re doing.*” Similarly, a male Hispanic/Latinx and White student (ages 18–24) framed AI as a supplementary learning aid rather than a replacement for effort: “*I feel AI could be used as an extra tool to teach you in a certain topic [...] explaining details in very simple ways.*” These responses illustrate how AI use among Perfectionist-oriented students is accompanied by self-monitoring and concern about doing work “the right way,” reinforcing perfectionism-related imposter beliefs.

b) *Expert Subtype (n = 80):* Expert-oriented students often **reported frequent AI use but emphasized the importance of maintaining mastery and conceptual understanding.** AI was framed as acceptable only when it supported—not replaced—learning. A Black male student (ages 18–24) explained, “*I’ve used AI generated tools in most of my classes [...] I think they belong in computing spaces as long as you can ensure students understand the core principles being taught.*” A female Asian student (ages 18–24) expressed similar conditional acceptance: “*I keep a positive attitude towards using them, but only if I understand what it’s doing.*” For Expert subtype students, AI-related concern centered on whether reliance on AI undermined perceptions of expertise and legitimacy.

c) *Superhuman Subtype (n = 32):* Students with a Superhuman dominant subtype **tended to frame AI tools instrumentally, emphasizing productivity and workload management, while also expressing concern about dependency.** An Asian male student (ages 18–24) stated, “*I have used AI tools. I believe that they can help, but you have to be careful not to rely on them too much.*” A female Hispanic/Latinx and White student (ages 18–24) echoed this tension: “*That’s a tricky question. If not used well, AI tools become more of a crutch than a tool.*” These responses suggest that Superhuman-oriented students evaluate AI through a lens of efficiency while remaining concerned about authenticity and potential overreliance.

d) *Natural Genius Subtype (n = 17):* Responses from Natural Geniuses revealed strong identity-related concerns about effortlessness and authenticity. AI use was **often interpreted as evidence that learning was not occurring**

naturally. A female Black student (ages 18–24) described AI as acceptable only in limited roles: “*AI is fine to use as a tool. More like a tutor, not something that does the work for you.*” In contrast, a Black and White male student (ages 18–24) rejected AI outright, stating, “*AI is horrible. It does nothing but lie and cause people to not learn.*” For these students, AI-related concern was closely tied to beliefs about innate ability and what counts as “real” competence.

e) *Soloist Subtype (n = 16):* Soloist-oriented students expressed the strongest discomfort with AI use, **frequently framing it as undermining independence.** A female Black student (ages 18–24) shared, “*I’ve only recently gotten more comfortable with it, but it still feels like I should be able to do it on my own.*” Another female Asian student (ages 25–29) emphasized independence, noting, “*Yes, I never felt it make me unconfident, instead it made me more independent.*” Even when AI was acknowledged as helpful, its use conflicted with deeply held beliefs about self-reliance and legitimate achievement.

2) *RQ2: How do students describe AI tools in relation to legitimacy, competence, and belonging?:* Across all dominant imposter syndrome subtypes, students rarely described AI tools as sources of reassurance or belonging. Instead, responses consistently framed AI use in relation to legitimacy and competence, often questioning whether AI-assisted work truly reflected individual ability. Concerns about legitimacy were most explicit among Soloist and Natural Genius subtypes, where **AI use was associated with guilt, cheating, or lack of authenticity.** Among Expert and Perfectionist students, **legitimacy was tied to independent verification and conceptual understanding,** while Superhuman responses emphasized efficiency alongside unease about dependency.

Belonging was largely absent from students’ discussions of AI. None of the quoted responses framed AI tools as contributing to feeling included, supported, or validated within computing environments. Instead, belonging appeared to be shaped by classroom climate, peer interactions, and instructor practices rather than by technological tools. Overall, the qualitative findings reinforce the quantitative results by showing that **AI tools do not function as uniform confidence-building supports. Instead, students’ dominant imposter syndrome subtypes shape how AI is used, evaluated, and experienced.** AI-related concern varies not by use alone, but by how students define competence, legitimacy, and effort. For many students, **AI becomes a mirror where existing imposter beliefs are negotiated rather than resolved.**

VI. DISCUSSION

A. AI Use Reflects Existing Imposter Beliefs

AI-related legitimacy concerns were consistently associated with imposter syndrome beliefs among computing students from historically marginalized racial and ethnic backgrounds. Although AI-related concern was positively associated with all five imposter syndrome subtypes, Perfectionist and Natural Genius beliefs were the most prominent. These two subtypes showed the strongest associations and remained significant, unique predictors when

all subtypes, representation, and belonging were considered together. This indicates that students who equate competence with flawless performance or innate ability are more likely to experience discomfort with AI use. Furthermore, AI was rarely described as a source of reassurance or emotional support; instead, students evaluated it against internal standards about what competent computing students "should" be able to do. Rather than reshaping imposter beliefs, AI use tended to surface and reinforce them in how students described their work.

B. Legitimacy, Not Ability, Drives AI Concern

Concerns about legitimacy emerged as the dominant tension shaping how students evaluated AI. Concerns that AI-assisted work might not count as "real" work were more prominent than concerns about independence [8], [16]. Further analyses indicated that different imposter subtypes aligned with different legitimacy tensions. These patterns suggest that the main issue is not whether students can complete tasks using AI, but whether AI use aligns with internal and disciplinary norms about legitimate effort and competence in computing. As a result, AI use functions as a lens for evaluating legitimacy rather than ability. This framing helps explain why AI-related concerns were widespread even among students who reported using AI tools. When expectations around AI use are ambiguous, students who already question their legitimacy may interpret AI use as evidence that their success is not earned, regardless of whether AI use is permitted or encouraged.

C. Instructional Implications for Computing Education

Instructional expectations around AI use should be explicit. For example, instructors might redesign assessments to require students to explain and critique AI-generated outputs, incorporate reflective assignments where students justify their AI use, or adopt process-oriented grading that evaluates reasoning alongside final answers. Clear guidance about acceptable AI use, expectations for verification or explanation, and how learning will be evaluated can reduce ambiguity that contributes to legitimacy concerns, particularly for students with strong Perfectionist or Natural Genius beliefs. In addition, assignments that position AI as a learning support rather than a shortcut may help shift how AI is evaluated. For example, requiring students to explain, test, or critique AI-generated output emphasizes reasoning and understanding rather than tool use alone while aligning assessment with learning goals. Finally, because students did not describe AI as contributing to belonging, instructional and relational supports remain essential; peer interaction, instructor approachability, and messages that normalize struggle and revision continue to play a central role in shaping students' sense of competence and belonging in computing courses.

D. Equity Implications

Legitimacy emerged as the primary tension. Legitimacy is a well-documented equity issue in computing environments, where women and students from historically marginalized racial and ethnic backgrounds often experience heightened visibility, comparison, and pressure to prove competence. From this perspective, AI tools may reduce barriers to access or

provide private forms of assistance, but they can also introduce new sources of doubt when students worry that using AI will be interpreted as cheating, weakness, or lack of ability. Therefore, this requires attention not only to access and ethics, but also to how legitimacy is defined, communicated, and evaluated in computing classrooms.

VII. LIMITATIONS

Several limitations should be considered when interpreting these findings. The analyses rely on self-reported survey data, which capture students' perceptions rather than observed AI use. While these perceptions are central to imposter syndrome, they may not fully reflect how students engage with AI tools in practice.

The dataset is limited to computing students from historically marginalized racial and ethnic backgrounds, enabling within-group analyses of ethnicity but preventing comparisons with White students. Because the analytic sample was restricted in this way, the findings should be interpreted as describing within-group variation rather than population-level prevalence or cross-group differences. Gender analyses included men, women, and gender diverse students; however, uneven subgroup sizes may limit the detection of smaller effects. As a result, the absence of statistically significant differences should not be taken as evidence that no differences exist.

Some constructs, including imposter syndrome subtypes and AI-related concerns, were measured using a small number of items. The AI-related legitimacy construct, measured using two items focused on authenticity and independence, limits dimensional coverage and constrains traditional reliability assessment; future work should develop more comprehensive, multi-dimensional instruments (e.g., fairness, surveillance, policy clarity, peer norms) to improve explanatory power and analytical nuance.

Furthermore, the dominant subtype classification was used for exploratory purposes only. Imposter syndrome beliefs are best understood as overlapping and continuous, and the primary conclusions of this study rely on subtype intensity rather than discrete subtype labels. Finally, the cross-sectional design does not allow for causal inference. It remains unclear how AI use and imposter beliefs influence one another over time, highlighting the need for longitudinal and experimental studies.

VII. CONCLUSION

This study illustrated that AI tools are not experienced as neutral or uniformly supportive in computing education. Instead, students interpret AI use through existing beliefs about competence and legitimacy, with imposter syndrome subtypes shaping how AI is evaluated and used. Rather than reducing imposter feelings, AI can surface or intensify concerns about authenticity and independence, particularly in environments that emphasize mastery and individual performance. These findings suggest that the impact of AI in computing education depends less on the tools themselves and more on how instructional norms and support structures frame what counts as legitimate learning.

REFERENCES

- [1] E. A. Cech, B. M. Rubineau, S. Silbey, and C. Seron, "Professional role confidence and gendered persistence in engineering," *American Sociological Review*, vol. 76, no. 5, pp. 641–666, 2011.
- [2] A. Godwin, G. Potvin, Z. Hazari, and R. Lock, "Identity, critical agency, and engineering: An affective model for predicting engineering as a career choice," *Journal of Engineering Education*, vol. 105, no. 2, pp. 312–340, 2016.
- [3] M. Ong, J. M. Smith, and L. T. Ko, "Counterspaces for women of color in STEM higher education: Marginal and central spaces for persistence and success," *Journal of Research in Science Teaching*, vol. 55, no. 2, pp. 206–245, 2018.
- [4] S. Cheryan, S. A. Ziegler, A. K. Montoya, and L. Jiang, "Why are some STEM fields more gender balanced than others?" *Psychological Bulletin*, vol. 143, no. 1, pp. 1–35, 2017.
- [5] E. Litzler, S. E. Lange, and S. Brainard, "Climate for graduate students in science and engineering departments," in *Proceedings of the 2005 ASEE Annual Conference*, 2005, pp. 10.308.1–10.308.16.
- [6] J. Margolis and A. Fisher, *Unlocking the clubhouse: Women in computing*. MIT Press, 2002.
- [7] P. Denny, V. Kumar, and N. Giacaman, "Conversing with Copilot: Exploring prompt engineering for solving CS1 problems using natural language," in *Proceedings of the 54th ACM Technical Symposium on Computer Science Education V. 1*, 2023, pp. 1136–1142, doi: 10.1145/3545945.3569823.
- [8] E. Kasneci, K. Seßler, S. Küchemann, M. Bannert, D. Dementieva, F. Fischer *et al.*, "ChatGPT for good? On opportunities and challenges of large language models in education," *Learning and Individual Differences*, vol. 103, p. 102274, 2023.
- [9] O. Zawacki-Richter, V. I. Marín, M. Bond, and F. Gouverneur, "Systematic review of research on artificial intelligence applications in higher education—where are the educators?" *International Journal of Educational Technology in Higher Education*, vol. 16, no. 1, pp. 1–27, 2019.
- [10] V. Young, *The Secret Thoughts of Successful Women: Why Capable People Suffer From the Impostor Syndrome and How to Thrive in Spite of It*. New York, NY, USA: Crown Business, 2011.
- [11] P. R. Clance and S. A. Imes, "The impostor phenomenon in high achieving women: Dynamics and therapeutic intervention," *Psychotherapy: Theory, Research & Practice*, vol. 15, no. 3, pp. 241–247, 1978, doi: 10.1037/h0086006.
- [12] S. Krause-Levy, A. Petersen, O. O. Campbell, W. G. Griswold, L. Porter *et al.*, "Multi-institutional study on impostor phenomenon among undergraduate computing students," *ACM Transactions on Computing Education*, vol. 25, no. 47, pp. 1–29, 2025, doi: 10.1145/3748665.
- [13] L. J. Charleston, P. L. George, J. F. L. Jackson, J. Berhanu, and M. H. Amechi, "Navigating underrepresented STEM spaces: Experiences of Black women in U.S. computing science higher education programs who actualize success," *Journal of Diversity in Higher Education*, vol. 7, no. 3, pp. 166–176, 2014, doi: 10.1037/a0036632.
- [14] A. P. Joshi, M. C. Shavers, S. M. Spencer, K. Artis, and L. LeSure, "Exploring the impact of "onlyness" among Black women doctoral students in computer science and engineering," *Journal of Diversity in Higher Education*, vol. 18, no. 5, pp. 715–725, 2025.
- [15] L. J. Sax, J. M. Blaney, K. J. Lehman, S. L. Rodriguez, K. L. George, and Zavala, "Sense of belonging in computing: The role of introductory courses for women and underrepresented minority students," *Social Sciences*, vol. 7, no. 8, p. 122, 2018.
- [16] C. Servin, N. V. Karichev, and M. Pagel, "Unfolding programming: How to use AI tools in introductory computing courses," in *Proc. 25th Annu. Conf. Information Technology Education (SIGITE)*, Oct. 2024, pp. 49–55.
- [17] N. Roy, O. Horiello, and O. Omojokun, "Integrating AI tools in advanced computer science curricula: A case study of course redesign," in *Proc. ACM Global Computing Education Conference (CompEd) 2025, Vol. 1*, Oct. 2025, pp. 92–98.
- [18] A. J. Gouveia, B. Machado, and C. Pendão, "Enhancing computer programming education: Integrating advanced ai tools for challenging curriculum projects," in *Proc. Int. Conf. Technology and Innovation in Learning, Teaching and Education*. Cham, Switzerland: Springer, Nov. 2024, pp. 41–55.
- [19] J. Prather, P. Denny, J. Leinonen, B. A. Becker, I. Albluwi, M. Craig, H. Keuning, N. Kiesler, T. Kohn, A. Luxton-Reilly, S. MacNeil, A. Petersen, R. Pettit, B. N. Reeves, and J. Savelka, "The robots are here: Navigating the generative AI revolution in computing education," in *Proceedings of the 2023 Working Group Reports on Innovation and Technology in Computer Science Education*, ser. ITiCSE-WGR '23. New York, NY, USA: Association for Computing Machinery, 2023, p. 108–159. [Online]. Available: <https://doi.org/10.1145/3623762.3633499>
- [20] M. P. Rogers, H. M. Hillberg, and C. L. Groves, "Attitudes towards the use (and misuse) of ChatGPT: A preliminary study," in *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1*, ser. SIGCSE 2024. New York, NY, USA: Association for Computing Machinery, 2024, p. 1147–1153. [Online]. Available: <https://doi.org/10.1145/3626252.3630784>
- [21] S. A. Karabenick, "Perceived achievement goal structure and college student help seeking," *Journal of Educational Psychology*, vol. 96, no. 3, pp. 569–581, 2004.
- [22] J. Penney, P. Acharya, P. Hilbert, P. Parekh, A. Sarma, I. Steinmacher, and M. Gerosa, "Understanding programming students' help-seeking preferences in the era of generative AI," in *Proceedings of the ACM Global on Computing Education Conference 2025 Vol 1*, ser. CompEd 2025. New York, NY, USA: Association for Computing Machinery, 2025, p. 15–21. [Online]. Available: <https://doi.org/10.1145/3736181.3747165>
- [23] I. Hou, S. Mettelle, O. Man, Z. Li, C. Zastudil, and S. MacNeil, "The effects of generative AI on computing students' help-seeking preferences," in *Proceedings of the 26th Australasian Computing Education Conference*, ser. ACE '24. New York, NY, USA: Association for Computing Machinery, 2024, p. 39–48. [Online]. Available: <https://doi.org/10.1145/3636243.3636248>
- [24] M. Amoozadeh, D. Nam, D. Prol, A. Alfageeh, J. Prather, M. Hilton, S. Srinivasa Ragavan, and A. Alipour, "Student-AI interaction: A case study of CS1 students," in *Proceedings of the 24th Koli Calling International Conference on Computing Education Research*, ser. Koli Calling '24. New York, NY, USA: Association for Computing Machinery, 2024. [Online]. Available: <https://doi.org/10.1145/3699538.3699567>
- [25] S. Hyrynsalmi, M. Tuape, and A. Knutas, "Person is a person, a tool is a tool – ChatGPT's role in student help-seeking behavior and peer support," ser. FSE Companion '25. New York, NY, USA: Association for Computing Machinery, 2025, p. 783–788. [Online]. Available: <https://doi.org/10.1145/3696630.3727235>
- [26] P. Vaithilingam, T. Zhang, and E. L. Glassman, "Expectation vs. Experience: Evaluating the usability of code generation tools powered by large language models," in *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems*, ser. CHI EA '22. New York, NY, USA: Association for Computing Machinery, 2022. [Online]. Available: <https://doi.org/10.1145/3491101.3519665>
- [27] D. Oyserman and M. Destin, "Identity-based motivation," *Emerging Trends in the Social and Behavioral Sciences*, pp. 1–11, 2015.
- [28] K. Krippendorff, *Content Analysis: An Introduction to Its Methodology*, 4th ed. Thousand Oaks, CA, USA: SAGE Publications, 2018.
- [29] N. Pearce, "An illustration of deductive analysis in qualitative research," in *Proc. 18th European Conference on Research Methodology for Business and Management Studies (ECRM)*, Johannesburg, South Africa, 2019, pp. 264–270.
- [30] J. R. Landis and G. G. Koch, "The measurement of observer agreement for categorical data," *Biometrics*, vol. 33, no. 1, pp. 159–174, 1977.