



Unravelling Dropout Intentions: Multifaceted Factors Influencing Student Retention in Computer Science Education

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Abstract. This paper investigates the multifaceted factors influencing student intentions to drop out of Computer Science (CS) programs. A comprehensive analysis of various studies highlights the significant role of expected GPA, which negatively impacts student retention, whereas variables such as “Year of studies left” and “Effort” exhibit positive effects. The analysis further identifies specific challenges faced by CS minor students, including time constraints and motivational deficits. Early academic performance emerges as a critical indicator of future success or failure within the discipline. Gender-specific challenges are particularly pronounced, with female students experiencing higher rates of dropout linked to “belonging uncertainty” and lower academic achievements in initial courses. Additionally, this study explores the impact of poor teaching quality, excessive workload, and lack of supportive academic environments on dropout rates, noting that these factors disproportionately affect female students. The research also examines dropout factors among doctoral CS students, emphasizing the importance of advisor support and the perceived meaningfulness of work tasks. Lastly, the underrepresentation of women in CS is scrutinized through the lens of societal stereotypes, personal values, and initial preparedness for college-level CS studies. By integrating these diverse factors, this paper aims to provide a holistic understanding of the dropout phenomenon in CS education, offering insights for developing more inclusive and supportive educational practices.

Keywords: CS dropout factors · underrepresentation of women in CS

1 Introduction

The field of Computer Science (CS) has experienced substantial growth over the past decades, becoming central to technological advancement and innovation. However, alongside its expansion, CS education faces significant challenges in student retention and completion rates. This paper explores the myriad factors that influence students’ intentions to discontinue their CS studies, an issue that has critical implications for the workforce and diversity within the tech industry.

Previous research has highlighted several variables that affect student persistence in CS, ranging from individual academic performance to broader socio-cultural influences.

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H. R. Arabnia et al. (Eds.): CSCE 2024, CCIS 2261, pp. 289–297, 2025.

https://doi.org/10.1007/978-3-031-85930-4_27

Notably, students' expected grade point average (GPA) and their remaining years of study have been shown to correlate with their decisions to either persevere or drop out. Additionally, specific challenges such as lack of time, insufficient motivation, and initial academic performances serve as early indicators of potential dropout.

Gender disparities present another layer of complexity, with female students often facing greater challenges that lead to higher dropout rates. Issues such as “belonging uncertainty,” gender biases, and initial preparation levels disproportionately impact women, contributing to their underrepresentation in the field. Moreover, the quality of teaching, workload, and the educational environment are recognized as pivotal factors that can either hinder or facilitate student success.

This introduction sets the stage for a detailed discussion on these influences, aiming to uncover the nuanced interplay of factors that deter students from continuing their CS education. By identifying and understanding these elements, stakeholders in the educational ecosystem can develop targeted interventions to enhance student retention and foster a more inclusive and diverse CS community.

2 Methods

2.1 Search Criteria

A systematic search was performed on the Google Scholar Search Engine. The search criteria identified below were used to search the database. Multiple searches were performed using different keywords. Combinations of the following keywords were used to identify the relevant articles: “*Computer Science*” AND “*interpersonal*” AND (“*change career paths*” OR “*change occupation*” OR “*abandon computer science*” OR “*leaving computer science*” OR “*dropout*”).

2.2 Inclusion and Exclusion Criteria

The inclusion criteria for the articles included were: (a) the articles that discussed the reasons for CS students dropping out and (b) articles published after 2000. The exclusion criteria for the articles included were (a) articles that reported dropout rates but didn't discuss the reasons and (b) articles published before 2000.

3 Results

3.1 Study Selection

Figure 1 shows the PRISMA flow diagram for the systematic review of stress measurement. A total of 92 were found initially, with the first search performed. After refining the search criteria, 78 studies were identified and screened for inclusion in the analysis. Out of these, 27 were found to be relevant to this paper's topic. Based on the inclusion and exclusion criteria and the deletion of duplicates, 12 studies were included in the systematic review in Fig. 1

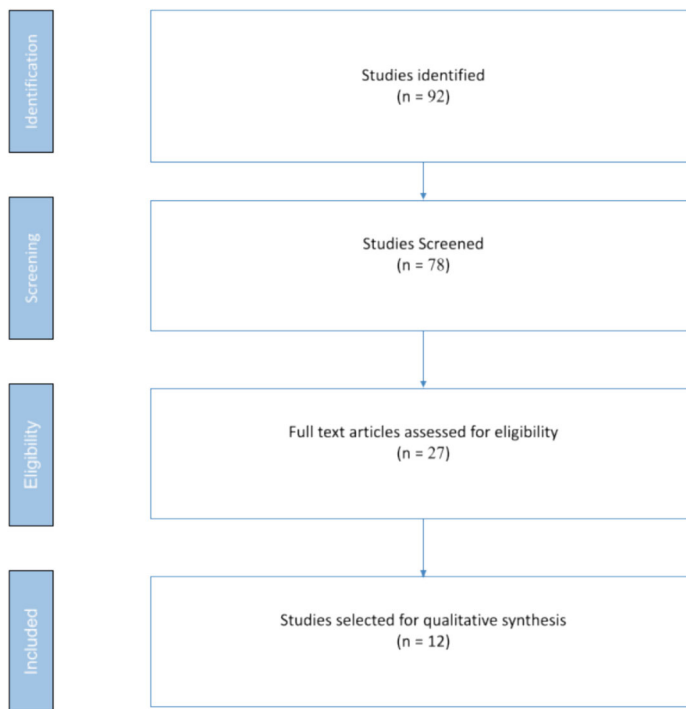


Fig. 1. Prisma Flowchart

3.2 Study Characteristics

Factors influencing students' intention to drop Computer Science were investigated, which revealed that the expected GPA has a negative effect. In contrast, variables like "Year of studies left" and "Effort" have positive effects [1]. CS minor students identified lack of time and motivation as the primary reasons for dropping out [2]. Another study revealed that students' performance in their first semester indicates their success—or failure—in their later study path [3]. Other factors include perception of gender biases in the classroom, not receiving timely feedback, negative satisfaction with coursework, and negative team experiences [4]. Several studies [3–5] identified that the success rate of female students is significantly lower than male students. Female students experienced greater "belonging uncertainty" about their belonging within the domain of computer science than male students and that belonging uncertainty significantly predicted students' dropout intentions [5]. Achievement is a factor that influences the decision to leave. Women who earned less than a B were less likely to take the next course compared to men who earned less than a B [6] (Table 1).

Poor teaching, external factors, workload, quality of the studies, time required, grades, boring courses, and focus on high performers were reported as factors of dropout [7]. Females were found to be impacted more by poor teaching, difficulty of the subject, excessive workload, low grades, and focus on high performers.

Table 1. Study Characteristics

Study Title	Year	Participants' Characteristics	Reasons	Findings
Investigating Factors Influencing Students' Intention to Dropout Computer Science Studies	2016	CS students	The expected GPA has a negative effect on students' intentions to finish their studies	Year of studies and Effort have positive effects on students' intention to finish their studies in CS
Why Students Drop Out CS1 Course?	2006	CS minor students	The reasons were the lack of time and the lack of motivation	--
Applying Data Analysis to Identify Early Indicators for Potential Risk of Dropout in CS Students Axel Bottcher	2020	CS students	Student's performance in their first semester is pretty much indicative for their success – or failure – in their later study path	- The success rate of female students is significantly lower than that of their male fellow students
Considerations for switching: exploring factors behind CS students' desire to leave a CS major	2018	CS undergraduate students	factors included: perception of the presence of gender biases in the classroom, not receiving timely feedback, negative satisfaction in coursework, and negative team experiences	females were twice as likely to consider leaving a CS major as compared to males
Belonging uncertainty as predictor of dropout intentions among first-semester students of the computer sciences	2019	CS first semester students	belonging uncertainty in computer science	female students experienced greater uncertainty about their belonging within the domain of computer science than male students and that belonging uncertainty significantly predicted students' dropout intentions

(continued)

Table 1. *(continued)*

Study Title	Year	Participants' Characteristics	Reasons	Findings
Gender, achievement, and persistence in an undergraduate computer science program	2006	CS students	Achievement is a factor which influences the decision to leave. Women who earned less than a B were less likely to take the next course compared to men who earned less than a B	Math, verbal SAT score, number of Calculus courses taken, prior computing experience, home access to computer predicted achievement in CS
Identifying dropout factors in information technology education: A case study	2017	CS graduate students	poor teaching, external factors, workload, quality of the studies, time required, grades, boring courses, and focus on high performers	Females were found to be impacted more from poor teaching, difficulty of the subject, excessive workload, low grades and focus in high performers
"Should I Stay or Should I Go?" Indicators of Dropout Thoughts of Doctoral Students in Computer Science	2021	Doctoral Students in Computer Science	"Satisfaction with advisor's support," "experiencing a crisis," "professional self-efficacy," "choice of advisor," and "perceived meaningfulness of additional work tasks" proved to be of central importance	Study suggests suggest taking steps to improve professional and social support for doctoral students
Full article: Why are women underrepresented in Computer Science? Gender differences in stereotypes, self-efficacy, values, and interests and predictors of future CS course-taking and grades	2014	First-year college students	factors for not taking CS or leaving CS included stereotypes about CS, values and interests, lack of passion, lack of awareness	Students who were interested in CS, had high computer self-efficacy, were low in family orientation, low in conscientiousness, and low in openness to experiences were more likely to take CS courses

(continued)

Table 1. (continued)

Study Title	Year	Participants' Characteristics	Reasons	Findings
Identifying dropout factors in information technology education: A case study	2017	IT students	Respondents expressed that, poor teaching, external factors, workload, quality of the studies, time required, grades, boring courses, and focus on high performers might somehow impact their decision to leave their studies	
Unlocking the Barriers to Women and Minorities in Computer Science and Information Systems Studies: Results from a Multi-Methodological Study Conducted at Two Minority Serving Institutions Nicole A. Buzzetto-More	2010	Undergraduate computer science and information systems programs	According to the findings the students attending the private minority-serving institution reported greater access to technology, skill levels, and computing studies prior to entering college	The respondents reported that they did not come to college with the adequate programming skills and/or prior training to succeed as a CS major, with females found to be less prepared than males. In the third phase of the study, a focus group was held with CS students in order to consider changes that would increase the enrollment and retention of underrepresented students
Understanding Sources of Student Struggle in Early Computer Science Courses	2021	CS students	personal obligations, lack of sense of belonging, in-class confusion, and lack of confidence contribute to the struggle in early computer science courses	students from traditionally underrepresented groups report struggling more across all four factors

A study done with doctoral students of computer science reported that satisfaction with the advisor's support, experiencing a crisis, professional self-efficacy, choice of advisor, and perceived meaningfulness of additional work tasks play an important role [8]. It was suggested that steps should be taken to improve professional and social support for doctoral students.

Gender differences were studied to see why women are underrepresented in computer science and its factors reported for not taking CS or leaving CS included stereotypes about CS, values, and interests, lack of passion, and lack of awareness [9]. It was also found that students who were interested in CS had high computer self-efficacy, were low in family orientation, low in conscientiousness, and low in openness to experiences, and were more likely to take CS courses. A case study done to identify dropout factors in information technology reported that, poor teaching, external factors, workload, quality of the studies, time required, grades, boring courses, and focus on high performers might somehow impact their decision to leave their studies [7].

According to the findings of a study, the students attending private minority-serving institutions reported greater access to technology, skill levels, and computing studies before entering college [10]. Females were more likely to be less prepared before coming to college.

Research done to understand the sources of struggle among early computer science courses reported that personal obligations, lack of sense of belonging, in-class confusion, and lack of confidence contribute to the struggle in early computer science courses [11]. Students from traditionally underrepresented groups report struggling more across all four factors.

4 Discussion

The findings reveal a multifaceted set of factors that influence students' decisions to drop out or leave the field of computer science. One prominent theme across the studies is the impact of academic performance and expected GPA on students' intentions to persist in computer science. Poor performance in early courses can lead to a lack of confidence and motivation, contributing to dropout rates.

Another significant factor is the experience of gender biases and belonging uncertainty among female students. Studies indicate that women face challenges such as perceived gender biases in the classroom and negative team experiences, which contribute to higher dropout intentions. Female students are also more impacted by poor teaching, excessive workload, low grades, and a focus on high performers, highlighting the need for more inclusive and supportive learning environments.

Students' subjective experiences, such as lack of time and motivation, also play a role in dropout intentions. Negative satisfaction with coursework and experiences of boredom further exacerbate students' disinterest in continuing with computer science studies. External factors, such as personal obligations and struggles with balancing workload, also contribute to students' decisions to leave the field.

Additionally, students' perceptions of computer science, including stereotypes, values, and interests, influence their decision to enter or remain in the field. Lack of passion and awareness about computer science contribute to the underrepresentation of certain groups, such as women, in the field.

Overall, these findings highlight the complex interplay of academic, social, and personal factors that influence students' decisions to drop out or leave computer science. Addressing these factors requires a multifaceted approach that includes creating inclusive and supportive learning environments, providing timely feedback and mentorship, and working to dismantle stereotypes and biases in the field. By addressing these challenges, educational institutions can work towards retaining a diverse and talented group of students in computer science.

5 Conclusion

In conclusion, this study highlights the multifaceted factors influencing student dropout rates in Computer Science (CS) programs. Anticipated GPA, year of study, and effort play significant roles. Challenges faced by CS minor students, gender-specific hurdles, and issues like poor teaching quality and excessive workload all contribute to dropout rates. By understanding these factors, stakeholders can work towards more inclusive and supportive educational practices to improve retention in CS programs.

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