



# Investigating the influencing factors of study retention for the CSE undergraduate students

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### Abstract

In the modern era, Computer science and engineering (CSE) is a demandable subject to study. Despite the rising demand for computer scientists, there is a concern about the high dropout rates in CSE. Several pieces of research have concentrated on understanding why students do not complete their studies in CSE. This study aims to experimentally investigate the crucial factors in higher education that affect students' study retention to complete their studies in CSE or which variables contribute to dropout in CSE studies. That's why this research work applied purposive and convenience sampling techniques to gather quantitative data from 252 CSE undergraduate students. The researchers investigate the impact of students' gender, age, permanent residence, financial problems, academic year, study effort, study pressure, class absence, current CGPA, and expected CGPA on students' study retention. By employing structural equation modeling, the study results revealed that students' gender, age, study effort, study pressure, class absence, and expected CGPA significantly affect students' intention to complete their CSE education. Surprisingly, students' tendency to complete their education is negatively influenced by their projected CGPA. Furthermore, permanent residence, financial problems, academic year, and current CGPA do not substantially impact study retention. The findings add to theory and practice by providing CSE educators and policymakers with insights that may increase student retention and decrease dropout rates.

### Keywords

Computer Science and engineering; student dropout; study retention; SEM; Bangladesh.

## Introduction

Over the last decade, there has been a surge in degrees in Computer, Information Science, and Technology (Zweben & Bizot, 2015). This area has garnered increasing attention due to the growing demand for CSE workers (Giannakos et al., 2015; Wilson et al., 2012). Based on employment estimates from the Bureau of Labor Statistics 2010 (Lockard & Wolf, 2012; Pappas et al., 2016), students in computer science are reconsidering finishing their studies, receiving their degrees, and finding a career in the field of computer science. According to Grigorescu et al. (2021), a shortfall of more than 800,000 CSE professionals is projected in Europe by 2025. Extant literature in the area has examined students' retention and suggests that students with high levels of academic and social integration are more likely to be retained and graduate (Cohoon & Aspray, 2008; Doll et al., 2013; Gramling, 2013; Islam et al., 2021; Rosson et al., 2011; Xenos et al., 2002). That's why there is a need to uncover the factors that can help students complete their CSE studies. To that aim, it is essential to understand better and explain how CSE students choose to stay and finish their studies or drop out throughout their studies (Biggers et al., 2008).

Previous research in computer science on student attrition and retention suggests that the first two years are essential for students because they have the highest dropout rate (Huang & Brainard, 2001). The statistics imply a nearly 40% dropout rate during these years, varying from 30% to 40% depending on the institution (Ohland et al., 2008). Higher workloads, study pressure, poor teaching quality, and poor performance are the critical factors in students' decision to drop out of STEM (Science, Technology, Engineering, and Mathematics) related fields and major in something else (Seymour et al., 2019). This study aims to look into students' intentions to finish their CSE education degrees. In particular, which factors are essential for influencing dropout in CSE studies were identified and empirically assessed. The researchers evaluated how the academic year, students' effort, study pressure, Current CGPA, Expected CGPA, Absence from Classes, Gender, and Age, financial problem, permanent resident affect students' intention to complete their CSE studies. See figure 01. The study applied structural equation modeling (PLS-SEM) to test the inter relationships between the variables.

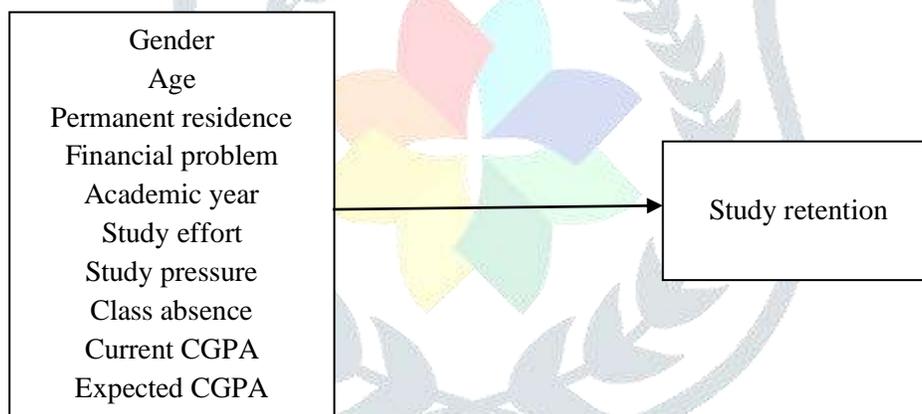


Figure 01: Proposed model

## Literature review and hypotheses development

Computer science students must learn various competencies and abilities to pursue a career in the sector, such as hardware, software, electronics, communications, and networks (Pappas et al., 2016). Software estimation, communication, project, and progress management are examples of competencies and skills that can be acquired through CSE education. Because it provides a wide range of knowledge, for example, software design, programming, information retrieval, and so on (Sahami et al., 2013), CSE education can assist students in developing creative thinking skills that will allow them to give solutions to industrial problems. Students in computer science may be able to detect technical advancements, innovate themselves, and build a career in the top sections of the industry, such as government organizations or high-tech firms. Again, competencies and skills such as computation thinking, problem solving, and human behavior are known as computing education. Such abilities are among the most significant in the twenty-first century since they allow pupils to create objects using computers.

Regardless of how crucial the skills learned in CSE are, dropout rates remain significantly high, despite increasing demand for CSE experts. Previous research has found that about 40% of students who enroll in a computer science degree program drop out (Ohland et al., 2008). The drop in the number of computer science graduates will result in a lesser workforce in the IT industry. So, it is necessary to discover the crucial factors that decrease the dropout rates in CSE education and influence students' intention to continue their studies and explore how these affect their behavior.

### **Demographics and academic year**

Various factors influence students' conduct in their studies and their intent to major in CSE (Barker et al., 2009; Rosson et al., 2011), including demographic features (e.g., age, gender) as well as elements that reflect students' academic level (e.g., academic year). Thus, in this study, the researchers look at the CSE students' demographic variables as well as the academic year. These constructs include their age, gender, permanent residence, financial problem, and academic year. Students' perceptions about their future in CSE are anticipated to vary, and sometimes shift during their education. Students with insufficient knowledge of CSE are less likely to be interested in continuing their studies in CSE (Carter, 2006). It would be the case for students in their first year (two bi-semester or three trimesters) of studies compared to older students in their second or third year. Again, the demographics and academic year are likely to influence student intention to complete their CSE degrees (Pappas et al., 2016). Therefore, the researchers proposed the hypotheses:

- H1: Gender significantly impacts CSE students' study retention.
- H2: Age significantly impacts CSE students' study retention.
- H3: Permanent residence significantly impacts CSE students' study retention.
- H4: Financial problem significantly impacts CSE students' study retention.
- H5: Academic year significantly impacts CSE students' study retention.

### **Effort, pressure, and performance**

Several studies have identified rigid learning material, study pressure, and rigorous exams as factors that may influence students' behavior in CSE and STEM studies (Jacobs, 2005). Because course difficulty is likely to influence CSE persistence, students' effort and time in their studies and courses are related to their performance and behavior (Araque et al., 2009). Again, students' study effort, study pressure, class absence, current GPA, and expected GPA are all examples of performance. Furthermore, academic preparation, which has a significant effort, is a crucial predictor of persistence in students' decision to continue studying in CSE (Mau, 2003). When students feel studying in CSE is a mental and physical pressure for them, it tends them to drop out. Students are present in class for good academic preparation. Still, absence from class negatively influences. When students put more effort into their studies, their performance suffers, resulting in a different learning outcome (Yu & Jo, 2014). When students compare their performance to their peers or their exceptional achievement in high school, they develop high expectations for themselves (Cohoon & Aspray, 2008). As a result, students who have achieved success in their studies are more likely to have strong intentions to continue their education. Therefore, the researchers proposed the hypotheses:

- H6: Study effort significantly impacts CSE students' study retention.
- H7: Study pressure significantly impacts CSE students' study retention.
- H8: Class absence significantly impacts CSE students' study retention.
- H9: Current CGPA significantly impacts CSE students' study retention.
- H10: Expected CGPA significantly impacts CSE students' study retention.

### **Methodology**

#### **Measures**

The questionnaire was designed to assess students' intent to complete their CSE studies. First, it includes demographic questions about the sample, for example, gender and age, and also includes the permanent residence variable with two categories- rural and urban. In the questionnaire, the financial problem construct also includes two levels – yes or no. It also includes indicators that could influence students' decision to discontinue their studies in CSE (current CGPA, study effort, expected CGPA, and study pressure). Their absence from class measures the number of times they missed a course (i.e., 0-1, 2- 3, 4-5). Finally, the researchers include students' study retention as a dependent variable. The researchers took Measurement items from the work of Pappas et al. (2016). A 7-point Likert scale assessed students' study effort and their goals to complete their education. Here, one represents strongly disagree, and 7 represents strongly agree.

#### **Data collection**

The primary data was collected through the use of personal interviews. The data was composed using convenience and purposive sampling techniques (S. H. Chowdhury et al., 2019; Roy et al., 2021). A structured questionnaire was sent to approximately 400 City University, Bangladesh CSE students. The researchers utilized a well-structured questionnaire since it facilitates the collection of pertinent data (M. R. Khan et al., 2019; Roy & Ahmed, 2016). After removing missing and incomplete information from the respondents, 252 responses were applicable for further analysis. The sample for this study was the CSE students. To be consistent, we only include students in their first, second, or third year of study. Table 01 represents the descriptive information.

### Descriptive analysis

Males comprised the majority of responders (68.70 percent), and the rest were female. Regarding age, 50.40 percent were less than 21, 47.60 percent were 21 to 25, and the remainder (2.0 percent) were 26 or older. Finally, about 43 percent were in their first year of studies, with the remainder (57 percent) in their second or third year. An almost equal number of students from rural and urban. Again, 47.20 percent of respondents have a financial problem studying CSE education. 36.10 percent of the students were 1<sup>st</sup>-year students, and the others were 2<sup>nd</sup> and 3<sup>rd</sup>-year students. Most respondents (65.90 percent) miss class only 0 – 1 day, and 5.6 percent miss five or more days. Most students (88.90 percent) put full effort into their studies, and 68.9 percent feel no pressure to study CSE. 38.90 percent of pupils have a current CGPA of 2.50 to 3.00, and 18.30 percent have more than 3.50. The majority of the students (65.90 percent) expect CGPA to be more than 3.50, and only 3.60 percent expect 3.00 or less.

Table 01: Students' profile

Constructs	Items	Frequency	Percent	Cumulative Percent
Gender	Female	79	31.30	31.30
	Male	173	68.70	100.00
Age (in years)	< 21	127	50.40	50.40
	21 – 25	120	47.60	98.00
	25 +	5	2.00	100.00
Permanent resident	Rural	101	40.10	40.10
	Urban	151	59.90	100.00
Financial problem	No	119	47.20	47.20
	Yes	133	52.80	100.00
Academic year	1 <sup>st</sup> year	91	36.10	36.10
	2 <sup>nd</sup> year	94	37.30	73.40
	3 <sup>rd</sup> year	67	26.60	100.00
Class absence (in days)	0 – 1	166	65.90	65.90
	2 – 3	47	18.70	84.50
	4 – 5	25	9.90	94.40
	5 +	14	5.60	100.00
Study effort (put full effort)	No	28	11.10	11.10
	Yes	224	88.90	100.00
Study pressure (feel pressure)	No	176	69.80	69.80
	Yes	76	30.20	100.00
Current CGPA	< 2.50	37	14.70	14.70
	2.50 – 3.00	98	38.90	53.60
	3.01 – 3.50	71	28.20	81.70
	3.50 +	46	18.30	100.00
Expected CGPA	< 3.00	9	3.60	3.60
	3.00 – 3.50	77	30.60	34.10
	3.50 +	166	65.90	100.00

### Data Analysis

The study applied MS Excel (V, 2019), SPSS (V, 22), and SmartPLS (V, 3.3.5) software (Ringle et al., 2015) to analyze the data. The researchers used structural equation modeling to execute and evaluate the suggested model and test various hypotheses. In this research, the student's academic years had two groups: those in their first year of studies and those in their second or third year. For that purpose, the researchers chose only students in their first three years of study, excluding students from the sample in their fourth year of a four-year program. Males and females were separated. There were two categories for the permanent residence variable - rural and urban. The financial problem, study effort, and pressure variables also had two levels, yes or no. Again, low (1 to 3 days) and high (four or more days) are two levels of

the class absence factor. For coding, see table 02. The continuous variables were age, current CGPA, and expected CGPA.

Table 2. The variables of the two groups

Variables	Group 1(code)	Group 2 (code)
Gender	Female (0)	Male (1)
Permanent residence	Rural (0)	Urban (1)
Financial problem	No (0)	Yes (1)
Academic year	1 <sup>st</sup> year (0)	2 <sup>nd</sup> and 3 <sup>rd</sup> year (1)
Class absence	Low (0)	High (1)
Study effort	No (0)	Yes (1)
Study pressure	No (0)	Yes (1)

Cronbach alpha ( $\alpha$ ) and composite reliability (CR) indicators were used to assess the dependent variable's dependability. These values need to be more than 0.70 (Cronbach, 1951; Roy, 2023a). Additionally, the item validity was evaluated by calculating each item's factor loadings ( $\lambda$ ) on the construct. The loadings should be more than 0.70 (Hair et al., 2019; Roy, 2023b, 2023c). Following that, demonstrating construct validity necessitates that the extracted average variance (AVE) be larger than 0.50 and that the correlation between the different variables in the confirmatory models not exceed 0.8 points, as this indicates low discrimination criteria (Fornell & Larcker, 1981; Khatun & Roy, 2023; Roy, 2022). Again, Heterotrait-Monotrait ratio (HTMT) values used to evaluate discriminant validity and values should be less than 0.85 (M. R. Khan et al., 2022; M. R. Khan & Roy, 2022; Kline, 2015).

### Measurement model evaluation

Reliability assessment using the Cronbach alpha indicator indicates satisfactory internal consistency indices, as the  $\alpha$  value of the study retention construct was greater than the 0.70 cut-off criterion. Furthermore, items' loading ( $\lambda$ ) into the construct was greater than 0.70 (Hair et al., 2019; S. K. R. M. R. Khan & Hossain, 2016), indicating substantial item validity. The study retention AVE value is 0.80, higher than the cut-off value of 0.50. Table 3 summarizes the findings. The correlation between the constructs is also investigated, as shown in Table 4. All correlations are less than 0.80 and meet the discriminant criteria. Again, HTMT values are less than the cut-off value of 0.85, so there are no discriminant issues.

Table 03. Measurement of items for study retention

Construct	Items	Mean (SD)	$\lambda$	$\alpha$	CR	AVE
Study Retention	I plan to continue to work toward my degree	6.15 (1.38)	0.94	0.94	0.96	0.89
	It is likely to finish my studies	6.06 (1.41)	0.94			
	I plan to complete my degree	6.33 (1.31)	0.96			

Table 04. Fornell Larker criteria and HTMT values

Fornell & Larcker	1	2	3	4	5	6	7	8	9	10	11
Academic Year	1										
Age	0.64	1									
Class Absence	0.03	-0.01	1								
Current CGPA	0.13	0.18	-0.11	1							
Effort	-0.16	0.06	-0.12	-0.02	1						
Expected CGPA	-0.16	-0.10	-0.09	0.41	-0.04	1					
Financial Problem	0.05	0.00	-0.01	0.09	0.07	0.04	1				
Gender	0.20	0.25	0.04	-0.03	0.03	-0.20	-0.06	1			
Resident	-0.01	-0.03	0.11	0.05	0.07	0.08	-0.13	-0.26	1		
Study Pressure	0.26	0.30	0.23	0.05	-0.18	-0.09	0.14	0.15	-0.08	1	
Study Retention	-0.03	0.13	-0.45	0.04	0.31	-0.12	0.00	-0.12	-0.01	-0.30	0.95
HTMT	1	2	3	4	5	6	7	8	9	10	11

Academic Year										
Age	0.64									
Class Absence	0.03	0.01								
Current CGPA	0.13	0.18	0.11							
Effort	0.16	0.06	0.12	0.02						
Expected CGPA	0.16	0.10	0.09	0.41	0.04					
Financial Problem	0.05	0.00	0.01	0.09	0.07	0.04				
Gender	0.20	0.25	0.04	0.03	0.03	0.20	0.06			
Resident	0.01	0.03	0.11	0.05	0.07	0.08	0.13	0.26		
Study Pressure	0.26	0.30	0.23	0.05	0.18	0.09	0.14	0.15	0.08	
Study Retention	0.04	0.13	0.46	0.05	0.32	0.12	0.00	0.12	0.03	0.31

**Structural model evaluation**

This study applied structural equation modeling to test the various relationships. In this work, the researchers consider students' gender, age, permanent residence, financial problem, academic year, study effort, study pressure, class absence, current CGPA, and expected CGPA as independent variables and study retention as the dependent variable. Furthermore, gender, permanent residence financial problem, academic year, study effort, study pressure, and class absence have two categories and one category considered reference category. On the other hand, age, current CGPA, and expected CGPA are considered continuous variables.

Study results revealed that six of the ten factors significantly correlate with students' study retention, and the rest are nonsignificant. See figure 02 and table 05. The outcomes of the investigation exhibit that gender ( $\beta = -0.167, p < 0.01$ ), age ( $\beta = 0.254, p < 0.01$ ), study effort ( $\beta = 0.191, p < 0.05$ ), study pressure ( $\beta = -0.232, p < 0.01$ ), class absence ( $\beta = -0.374, p < 0.01$ ), and expected CGPA ( $\beta = -0.213, p < 0.01$ ) had a substantial effect on the students' study retention. Consequently, supporting hypotheses H1, H2, H6, H7, H8, and H10. But permanent residence ( $\beta = -0.025, p > 0.05$ ), academically year ( $\beta = -0.093, p > 0.05$ ), financial problem ( $\beta = 0.009, p > 0.05$ ), and current CGPA ( $\beta = 0.068, p > 0.05$ ) had no significant relationship with students' study retention and not supporting the hypotheses H3, H4, H5, and H9.

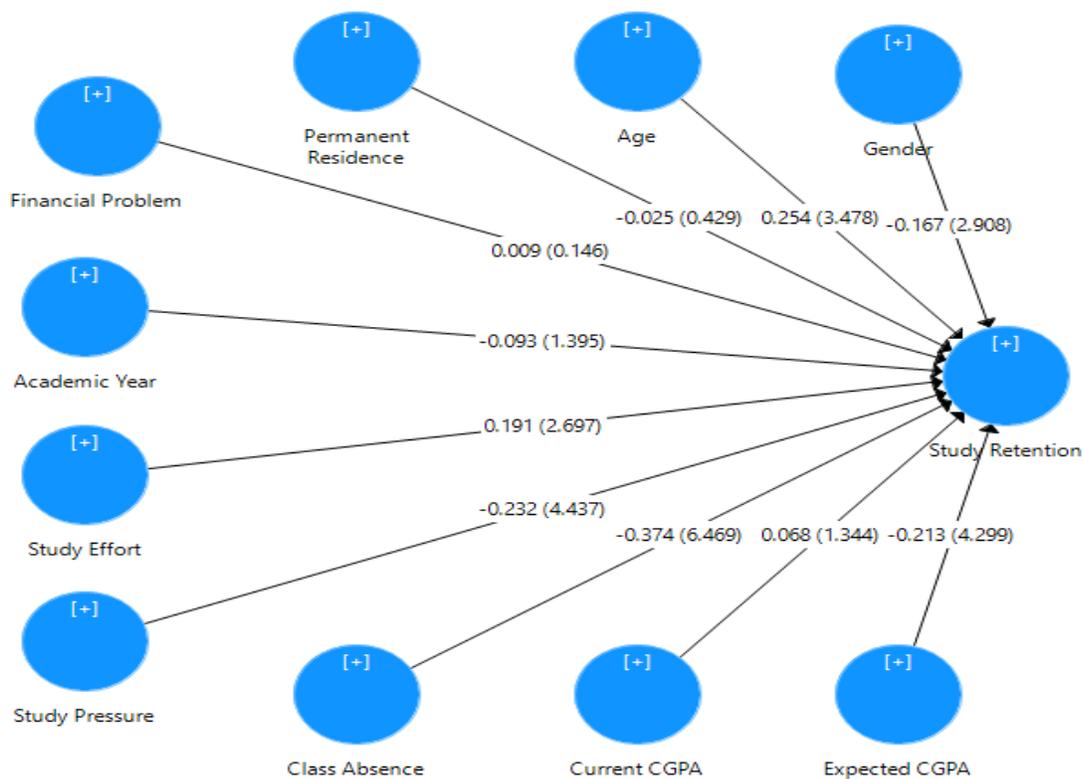


Figure 02: Structural model

Table 05. Structural model evaluation

Hypothesis	Relations	$\beta$	T values	p values	Decisions
H1	Gender -> Study Retention	-0.167	2.908	0.005	Supported
H2	Age -> Study Retention	0.254	3.478	0.001	Supported
H3	Permanent residence -> Study Retention	-0.025	0.429	0.670	Not supported
H4	Academic Year -> Study Retention	-0.093	1.395	0.169	Not supported
H5	Financial Problem -> Study Retention	0.009	0.146	0.885	Not supported
H6	Study Effort -> Study Retention	0.191	2.697	0.010	Supported
H7	Study Pressure -> Study Retention	-0.232	4.437	0.000	Supported
H8	Class Absence -> Study Retention	-0.374	6.469	0.000	Supported
H9	Current CGPA -> Study Retention	0.068	1.344	0.185	Not supported
H10	Expected CGPA -> Study Retention	-0.213	4.299	0.000	Supported

In particular, gender significantly negatively impacts study retention, implying that the higher the gender, the less intent is to complete the CSE education. That means female students have a stronger intention to continue their studies than male students. Again, the positive coefficient of age on study retention shows that older students were more likely than younger students to complete their studies. Next, there is a difference between students who put in little effort and those who put in the high effort, with the latter having stronger intentions to continue their studies, indicating that effort has a favorable effect on students' study retention. Again, there is a significant difference in the results for the students who feel study is a pressure or not. The negative beta value of study pressure implies that students who feel pressure will likely discontinue the study in CSE.

Similarly, class absence has a negative effect on students' study retention with a negative beta coefficient. So low and high absence have a different levels of study retention. Furthermore, students who expect a low CGPA are more likely to continue their studies in CSE than those who expect a high CGPA, demonstrating that the expected CGPA has a detrimental effect on student retention. In other words, the higher the expectations, the more probable the student will drop out.

On the other hand, the permanent residence has no significant impact on study retention. So, rural or urban areas do not matter for study retention or course dropout. Again, there is no significant gap between first-year students and those in their second and third years. The academic year is unimportant for intentions to complete their studies in CSE. Surprisingly, the financial problem has no impact on study retention. That means those with financial problems or not have a similar tendency to complete their CSE education. Finally, students' intention to pursue their studies is unaffected by their current GPA level, with low and high Current GPA levels nearly equal.

## Discussion

Previous research in the field of computer science and engineering has investigated numerous reasons and tactics for retaining students who major in CSE (S. Chowdhury & Roy, 2015; Cohoon & Aspray, 2008; Pappas et al., 2016; Rosson et al., 2011) or reasons why students choose to major in CSE (Barker et al., 2009). This study aims to shed light on why students may opt to discontinue their studies in CSE. The primary goal of this study is to experimentally analyze the relationship between CSE students' study intention to complete their studies and numerous aspects related to students' efforts, pressure, expectations, and academic year. The data suggest that six factors influence students' plans to complete their CSE studies: gender, age, study effort, study pressure, class absence, and expected CGPA.

The results show that students' gender significantly affects their intention to complete their CSE studies. The results are analogous to the results of Barker et al. (2009) but contradict those of Pappas et al. (2016). According to the results, female students have higher intentions to complete their studies, and male students have fewer. Most likely because the vast majority of CSE students are males, few females are interested in the subject, and the female students want to continue their studies.

Similarly, age has a positive association with study retention; it is worth noting that older students are more likely than younger students to complete their studies, and these results are different from the previous outcomes (Pappas et al., 2016). Because all students are in their second or third year of study, the findings show that the older someone begins CSE education, the more likely they are to continue the education.

Next, the findings show a positive association between study effort and retention, which is expected because students who put more effort into their studies have stronger intentions to complete them. This result is supported by earlier results (Pappas et al., 2016). This discovery may be related to the student's year of studies, as finishing each year implies putting more effort into studying. In a similar vein, study pressure has a negative impact on study retention. This result implies that when students feel studying is a pressure for them, they drop the courses.

Furthermore, the researchers discovered that class absence negatively influences students' study retention since students with a high level of absence had a low level of intention to complete their studies. These results contradict with results of Pappas et al. (2016). It could imply that students who miss or skip classes impact their results or lose interest in the subject, which has a bearing on their decision not to complete their studies.

Finally, the findings show a negative link between students' expected performance (i.e., expected CGPA) and their intentions to complete their CSE studies, demonstrating that high-performance expectations lead to lower study retention and are consistent with earlier outcomes (Pappas et al., 2016). This a fascinating discovery, which may be explained by the fact that students who have set very high expectations may not be able to meet them, particularly in the CSE sector, which is complex, with several departments with high competitiveness. Previous research has revealed that when (female) students compare their exceptional high school achievement, they are prone to lose confidence in their studies (Biggers et al., 2008), establishing excessive expectations.

Again, the findings imply that whether students' performance is poor or high, their intention to continue their studies is the same. Because there is no effect of students' actual performance (for example, current CGPA) on their intentions, the results are the same as those of Pappas et al. (2016). Students with higher grades, on the other hand, are more likely to pursue their education. It could be owing to the fact that the majority of responders performed well. Nonetheless, the research implies that outstanding performance may not always explain students' behavior, as individuals may have a good CGPA but be uninterested in CSE.

Furthermore, this investigation implies that permanent residence is not significantly associated with study retention. It could be the natural result. Students from rural or urban feel an equal tendency to continue their studies in CSE. Surprisingly, current research discovered that financial problems do not impact study retention. That means there is no difference between the two groups of students. Again, the results show that student study retention was not impacted students' academic year. These outcomes are not similar to previous results (Pappas et al., 2016). Students in their first, second, or third year of studies are likely to complete their studies in CSE, which may be explained by the fact that after completing the first year, they have already adopted the philosophy (and difficulties) of CSE education. However, earlier findings revealed that the highest dropout occurred during the first year of the study (Huang & Brainard, 2001).

### **Conclusion, implication, limitation, and future directions**

The findings could help professors, administrators, and CSE policymakers better understand and confront students' dropout behavior by identifying high dropping out risk groups or groups sensitive to some specific critical factors impacting CSE students' dropout from their studies. Identifying dropout reasons to lower dropout rates is critical, as the need for CSE students in the IT business is increasing in the twenty-first century. Faculty should focus on treating first-year students differently because they have lower retention and dropout rates, for example, by offering courses with a clear relationship between the expected work and the grade and avoiding challenging courses (e.g., math courses). That may disappoint students and drop their expectations brutally. Furthermore, it may be beneficial to rethink faculty interventions in order to pique students' interest in the subject and encourage them to put more effort into their studies, which has been shown to enhance their intention to complete their studies.

Although the current study provides data on why students opt to complete their education in computer science, it is exploratory and has significant limitations. Because the sample comprises solely Bangladeshi computer science students, the results should be cautiously generalized. However, the CSE study programs in this study adhere to worldwide standards as stated by the ACM/IEEE Computer Science 2013 curriculum recommendations for undergraduate computer science programs (Sahami et al., 2013). Furthermore, the sample for this study was drawn from a single survey, restricting the generality and interpretation of the findings.

More study is needed to replicate and validate our findings and discover whether these findings apply to students who dropped out or others who graduated and currently work in the business (e.g., via an alum survey). Future studies with a larger sample size from different countries and universities (e.g., African or American nations) and educational systems using a variety of measures (e.g., observations, interviews) would be especially beneficial in understanding the factors influencing students' intentions to drop out of their CSE studies. Furthermore, we propose future research into the effect of additional factors (e.g., LMS analytics indicating learning styles and habits) on students' intention to drop out.

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