

## **Board 70: Impact of First Co-op Experience on Student Retention and Learning: A Work in Progress**

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# Impact of first COOP experience on student retention and learning: A work in progress

## Abstract

*This work-in-progress research paper examines the impact of the first COOP experience on engineering student retention and students' learning as measured by overall GPA. Engineering student retention rates at US academic institutions range from 40 to 80%. The intervention presented in literature to address the retention problem in engineering schools may be generally divided into different themes. While improving mathematics and physics skills have been used in some initiatives to reduce attrition, some included first-year interventions based on hands-on projects. Others focused on inculcating a more collaborative, interactive, and supportive learning environment. Also, COOP programs have been designed to introduce students to the actual workplace environment and help them to be more engaged with real-world problems. There is a significant dearth of literature on the impact of COOP on retention in engineering. It has been demonstrated that after completing a COOP, students are more inclined to continue in an engineering degree because they experience first-hand their future working conditions and feel empowered to pursue their career goals with more confidence. Since most engineering students follow careers in industry, of particular importance is how cooperative experiences help to make better engineers. Specific to multi-COOP experiences, the first COOP as a first-facing actual work experience and work environment can be more significant because ineffective first COOP experiences might lead to attrition. Additionally, relatively few universities in the US require COOP programs as part of their engineering curricula. Society's need for engineers, the proportion of engineering students that drop out after their first year, and optional COOP in some universities and mandatory COOP in others, are the main reasons that motivated this study. The specific research question investigated in this study is: to what degree does a student's first COOP experience impact retention and student learning?*

*To address this research question, we looked at the retention of students in a large, midwestern, public, R1 university where COOP is mandatory. We analyzed GPA and retention patterns on five years of data that were recorded by the university using t-tests. Differences in retention based on sex were investigated. Differences in GPA of all cohorts were examined at different points in the degree. Results will include a discussion of retention and GPA patterns over the five years. Future work will involve the investigation of student's COOP experiences and its impact on the change in attitude toward their major and career goals.*

## Introduction

There is currently a dearth of skilled engineering graduates due to fewer students enrolling in and continuing in engineering schools, endangering the stability of the American economy and national security [1], [2]. And also, an international issue of concern has been the retention of engineering students. Significant research has been conducted to address this issue. Researchers look at this topic from a variety of lenses, demonstrating its importance. US academic institutions are currently reporting engineering student retention rates ranging from 40 to 80% [3]. There is no clear agreement on the precise reasons behind these rates. Given that most schools still have trouble keeping engineering students, further study into strategies for increasing student retention is unquestionably warranted [4]. Programs put out to alleviate the retention problem in engineering schools can be generally divided into several categories. Some methods entail helping students develop their math and physics abilities, while others involve

practical projects in the first year. Additionally, some programs have worked to develop a more supportive, engaging, and collaborative learning atmosphere where students may engage with one another, and their instructors more frequently and not feel alone. Also, COOP, short for "cooperative education" or "cooperative program," is a structured educational strategy that combines classroom learning with practical work experience in a field related to the student's major or area of study [5]. In a COOP program, students alternate periods of academic study with periods of paid work experience, usually with a company or organization related to their field of study. have been developed to familiarize students with the business setting and encourage greater engagement with real-world problems [2], [6]. For instance, Branoff and Mohammed [7] reported that collaborative learning is one of the factors influencing students' decision to retain in engineering. Additionally, Ricks and their colleagues [8] talked about the impact of non-academic initiatives like the Peer Mentors Program or the Peer Tutor Program as well as some academic programs like engineering student designated (ESD) on students' retention in engineering majors. In a study, researchers discovered that developing academically stimulating courses, such as special seminar-style courses taught by engineering professors, can help retain and inspire first-year students in the engineering profession by immersing them in modern engineering challenges [9], [10]. One of the most important lenses of view is the students' concept of engineering. A study revealed that students' conceptions of engineering were disassociated with real-world problems. Initially, they had a basic and simple idea of what it meant to be an engineer, which changed after facing real engineering courses and problems [11]. Collaborative learning has been identified as positively impacting retention, with COOP being one type of collaborative learning experience [12]. COOP programs have been developed to expose students to the workplace environment and help them engage with real-world problems. This type of hands-on learning gives engineering students practical experience in industry, which has been shown to be valuable for their academic and employment outcomes [12], [13].

Previous research has established a correlation between COOP participation and positive academic and employment outcomes. Moreover, studies have shown that completing a COOP program empowers students to pursue their career goals with more confidence and positively impacts their retention in engineering programs [14]. But the availability of COOP opportunities varies across academic institutions especially in whether the program is voluntary or mandatory [12]. While certain universities in the US don't make it obligatory for engineering students to take part in COOP programs, other universities do require their students to participate in at least one COOP program. Yet, there are some institutions that include multiple COOP programs as part of their mandatory curriculum.

In this regard, the first COOP experience can be especially significant because it provides students with their first exposure to the workplace and work environment. Ineffective first COOP experiences can lead to attrition, whereas positive experiences can encourage students to continue with their engineering degree [12], [13]. Given the importance of the first COOP experience for engineering students' retention, it is imperative to understand how different institutional formats in the context of COOPs impact student retention. Generalizable results in this regard can be difficult to construct from research given the complexities of differences in curriculum across different institutions. There is also a significant dearth of literature on the

impact of first COOP on retention in specific institutional contexts. This study aims to fill this gap by investigating the impact of the first COOP experience on both retention and student learning in the specific context of an institution that has mandatory multiple COOPs in their undergraduate engineering curriculum. Specifically, the research question of this study is: *to what degree does a student's first COOP experience impact retention and student learning?* The work-in-progress paper investigates the trends of differences in retention and student learning outcomes measured by the students' cumulative GPAs before and after their first COOP. This research question is critical in identifying the importance of the first COOP experience in shaping engineering students' academic and professional development. By examining the potential effects of the first COOP experience, this study can provide insights that may help improve COOP programs and promote better outcomes for engineering students.

## **Methods**

The following section provides details regarding the educational context of the research, the attributes of the participants who participated in the study, and the techniques utilized for data analysis.

This research was conducted at a large, public, urban, Midwestern R1 institution where COOP is a mandatory part of the curriculum. After completing their first year, students are required to participate in COOP every alternate semester. The engineering curriculum for the first two semesters includes fundamental engineering and disciplinary courses in addition to physics, math, and chemistry.

The research aimed to investigate the impact of Cooperative Education (COOP) on engineering student retention and learning, with an emphasis on gender differences. To achieve this, data from five cohorts of engineering students between 2016 and 2020 were analyzed. The sample size for the study comprised a total of 5,990 students, of whom 4,799 were male, 1,187 were female, and 4 were unknown. Student data was gathered from the university records, which included enrollment in COOP courses throughout their degree, their GPAs, and demographic data. The analysis of the data included examining the enrollment of students in their degree programs through the second year of study in the College of Engineering, as well as their GPA at the end of the first year. The research specifically aimed to investigate whether there were any notable changes in the retention rates and learning by investigating the GPAs of students after their first COOP experience. To gain a better understanding of the various factors that contribute to student success and retention, a range of information was analyzed.

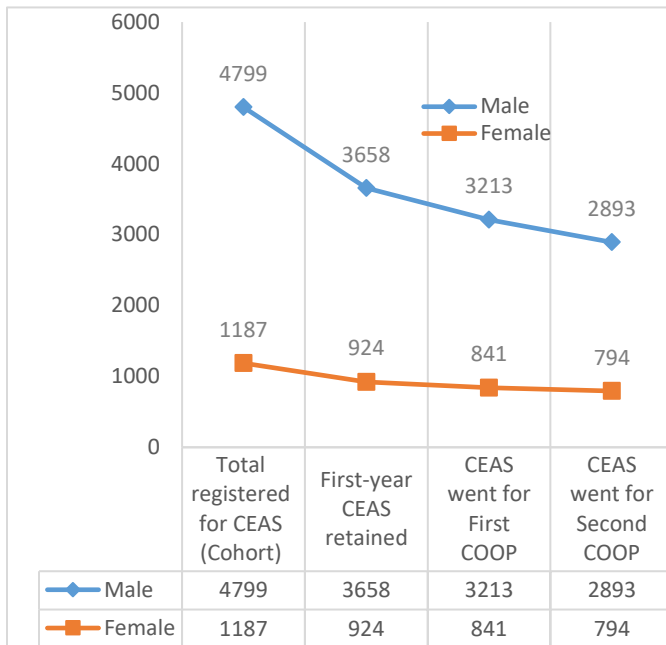
The analysis also looked at the number of students who completed their first COOP, including those in the College of Engineering and Applied Science (CEAS) and those not retained in CEAS to find the rate of retention after the first COOP. To further understand student learning, the GPAs of students at the end of their first year, before first COOP, and before their second COOP were examined. The aim of the analysis was to understand the impact of a student's first COOP experience on their retention and learning. Analysis of the differences in GPA before and after first co-op experiences is the first step to understand the impact of co-op on student learning

and retention. In order to determine if there were significant differences in learning as measured by cumulative GPA at the end of first year and after the first COOP experience, a two-sample t-test was performed after confirming the normality of the data.

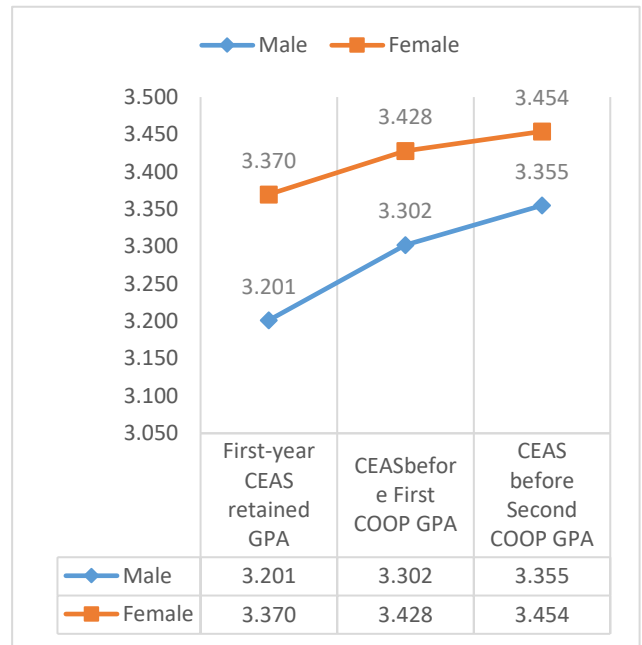
## **Results and discussion**

In terms of the demographic composition of the sample, 19.72% of the students were female, 80.12% were male, and 0.07% had an unknown gender identity (Note: We have removed four records with unknown gender as their population was very low). From the data, according to Fig. 1, it is clear that there is a trend of higher retention rates among students who participated in the COOP program compared to students at the end of the first year. Looking specifically at the retention rates after the first year, we can see that 76.51% of the total 5990 students registered for CEAS from 2016 to 2020 were retained after the first year (See Table 1). Furthermore, of students who were retained after the first year, 88.45% went for their first COOP experience. Overall, for all five cohorts, this proportion was 67.68%. Additionally, of those who completed their first COOP, 90.97% went for their second COOP, suggesting that students who participate in the COOP program are likely to continue with the program. The data also suggests that the COOP program may have a positive impact on the academic performance of students in the absence of confounding factors. Findings indicate that there was an increase in GPAs after the first COOP experience for all five cohorts (3.235 to 3.380, See Table 2). As the second objective was to compare the GPA of students who participated in their first co-op program to their GPA at the end of their first year, in order to determine the statistical significance of our findings, we utilized the two-sample t-test. To test significant differences in learning, measured by cumulative GPA at the end of semesters before and after the first COOP, a two-sample t-test was conducted after checking the normality of data. The t-test results showed a significant increase in GPAs after the first COOP experience for all five cohorts, with test statistics ranging from 3.69 to 9.26, p-value of 0.00, and degrees of freedom ranging from 1,644 to 1,707. Given the large sample size of students and research findings that suggest that COOP has a positive impact on engineering student retention and learning, with a significant increase in GPAs after the first COOP experience for all five cohorts (See Fig 2), our research could have important implications for both students and educational institutions. For students, participating in a COOP program may lead to higher GPAs, potentially improving their chances of successfully completing their studies. For educational institutions, offering COOP programs may prove to be a valuable strategy to retain students and improve overall program outcomes.

**Fig 1. Student Registration Over five years**



**Fig 2. Student Cumulative Average GPA**



**Table 1. Student Distribution**

	Total registered for CEAS					
	Total		Male		Female	
Cohort 2016	1230	100%	990	100%	239	100%
Cohort 2017	1166	100%	944	100%	220	100%
Cohort 2018	1161	100%	923	100%	238	100%
Cohort 2019	1172	100%	900	100%	271	100%
Cohort 2020	1261	100%	1042	100%	219	100%
Total	5990	100%	4799	100%	1187	100%
	Total Registered for CEAS second year (First year retained)					
	Total		Male		Female	
Cohort 2016	964	78.37%	772	77.98%	192	80.33%
Cohort 2017	853	73.16%	689	72.99%	163	74.09%
Cohort 2018	900	77.52%	717	77.68%	183	76.89%
Cohort 2019	902	76.96%	684	76.00%	218	80.44%
Cohort 2020	964	76.45%	796	76.39%	168	76.71%
Total	4583	76.51%	3658	76.22%	924	77.84%
	CEAS student went for First COOP					
	Total		Male		Female	
Cohort 2016	803	65.28%	629	63.54%	174	72.80%
Cohort 2017	774	66.38%	623	66.00%	151	68.64%
Cohort 2018	823	70.89%	649	70.31%	174	73.11%
Cohort 2019	822	70.14%	624	69.33%	198	73.06%
Cohort 2020	832	65.98%	688	66.03%	144	65.75%
Total	4054	67.68%	3213	66.95%	841	70.85%
	CEAS student went for Second COOP					
	Total		Male		Female	
Cohort 2016	690	56.10%	540	54.55%	150	62.76%
Cohort 2017	743	63.72%	599	63.45%	144	65.45%
Cohort 2018	732	63.05%	568	61.54%	163	68.49%
Cohort 2019	776	66.21%	582	64.67%	194	71.59%
Cohort 2020	747	59.24%	604	57.97%	143	65.30%
Total	3688	61.57%	2893	60.28%	794	66.89%

**Table 2. Result of t-test of student GPAs Before and after of First COOP**

	<b>T-Value</b>	<b>DF</b>	<b>P-Value</b>
Cohort 2016	4.74	1644	<b>0.00</b>
Cohort 2017	5.56	1699	<b>0.00</b>
Cohort 2018	9.26	1707	<b>0.00</b>
Cohort 2019	3.77	1676	<b>0.00</b>
Cohort 2020	3.69	1697	<b>0.00</b>

## **Conclusion**

This paper represents a crucial first step in a broader investigation aimed at exploring the impact of students' first COOP experiences on engineering student retention and learning. With fewer students enrolling and continuing in engineering schools, this study's findings offer an opportunity to develop strategies and insights that could enhance retention rates in engineering programs across the country and worldwide. Utilizing five years of data to analyze GPA and retention patterns in an engineering program, this study's focus on the relationship between COOP and retention is of particular interest. A noteworthy finding in this study is the consistency of the patterns over a period of five years, which suggests a probable cause-effect relationship between co-op, learning, and retention. While the exact cause behind these patterns requires further investigation – including the control of confounding factors – to come to a generalizable conclusion, the consistency points to evidence that supports further investigation. The importance of the unvarying findings over five years underscores the study's potential to make a meaningful impact on engineering education. The primary objective of this study is to examine how first COOP experiences influence GPA and retention patterns. However, it is essential to note that this paper is the preliminary investigation towards a larger work. The primary step in determining whether first COOP impacts retention is to control for confounding factors like other parts of curriculum, extra-curricular opportunities, non-academic support, and resources available, and even student's self-motivation to persist in the degree. Future work will also focus on exploring students' COOP experiences and how they impact students' attitudes toward their majors and career goals. To achieve this, we plan to collect data on students' COOP experiences and conduct surveys and interviews to understand their effects on students' perceptions. By interviewing first COOP students, it can be explored what encourages students to continue in engineering programs and what factors discourage them from pursuing their goals. The aim is to gain a better understanding of how COOP experiences can help students achieve their academic and career goals. The first COOP experience can be more impactful than subsequent COOP experiences as it is the first exposure to actual work environments. Therefore, it is crucial to investigate whether the first COOP experience is effective and meaningful to retain students in engineering programs. Additionally, we plan to further analyze the data from different perspectives, such as race and engineering major and compare it with non-mandatory COOP institutes and national data to provide valuable insights. Future plans also involve tracking student retention patterns beyond first and second coop and through their entire degree program.

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