Assessment of Co-Curricular activities in STEM domain to improve Student Learning

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Abstract

This paper investigates the impact of extracurricular activities within the STEM (Science, Technology, Engineering, and Mathematics) domain on student outcomes. These outcomes are:

1. Analyze a broadly defined problem within the program's domain and apply principles of the discipline to identify solutions. (**Leveraging STEM)**

2. Recognize professional responsibilities and make informed judgments in computing practice based on appropriate legal and ethical principles. (**Evaluation)**

3. Utilize systematic approaches to select, develop, apply, integrate, and administer secure computing technologies to accomplish user objectives. (**Advanced Application)**

Formal student outcome statements are provided with concise descriptors to facilitate meaningful discussions. Listing lengthy descriptions can be cumbersome to follow, and simple enumeration of student outcomes (e.g., SO#1 lacks clarity) is more effective. For instance:

Student Outcome (SO#1): Analyze a broadly defined problem within the program's domain and apply principles of the discipline to identify solutions.

SO, Descriptor: Leveraging STEM

It was observed a decline in the following three student outcomes for CEIS106 in May 2024:

Leveraging STEM: This outcome has been particularly challenging for freshman students enrolled in CEIS106, which is a Linux operating system course.

Evaluation: The performance of students in this area has also been affected.

Advanced Application: This outcome has not shown significant improvement.

To address these issues, a series of remediation activities were implemented.

Activity 1: User Account Management in Linux: This activity was conducted on June 6, 2024, as part of the IEEE and CompTIA student branch event held virtually at DeVry University using the Engageli platform. Six students participated in this event, and the recorded session was shared with all students.

Activity 2: File Permissions and Ownership in Linux: A second workshop was held on September 19, 2024, with 22 students in attendance. This workshop utilized the Kahoot learning platform to administer a five-question quiz.

The performance data from these activities was analyzed to establish performance criteria and develop a rubric that aligns with the program curriculum, course objectives, and student outcomes.

These activities were recommended by key stakeholders such as students and faculty to improve students experience in CEIS106.

Passing percentage, Persistence, and Withdrawal Rates were also examined. The results show positive trend for Passing percentage and course Withdrawal Rates for the July 2024 session.

As a part of continuous improvement, the Co-Curricular workshops played a key role in improving and enhancing student learning in the CEIS106 course.

Introduction

The CEIS106 course, Linux Operating System, presents operating system concepts by examining Windows, Linux, mobile, and virtual-based systems. Computing system architectures and devices are also considered. Basic scripting is introduced. As part of our Outcomes Assessment Process, which involves data monitoring, enabling rapid response, and continuous improvement of course effectiveness, this paper examines the impact of co-curricular activities in the STEM (Science, Technology, Engineering, and Mathematics) domain on student outcomes. These outcomes are:

1. Analyze a broadly defined problem within the program's domain and apply principles of the discipline to identify solutions. (**Leveraging STEM**)

2. Recognize professional responsibilities and make informed judgments in computing practice based on appropriate legal and ethical principles. (**Evaluation**)

3. Utilize systematic approaches to select, develop, apply, integrate, and administer secure computing technologies to accomplish user goals. (**Advanced Application**)

Based on Wildman, "theories collectively reinforce the idea that student affairs professionals are integral in providing a co-curricular experience that not only complements academic learning but also promotes student success, retention, and personal development within higher education" [1].

According to Sutcher, "High-quality programs have curricula focused on instruction and school improvement. Research has shown a positive link between instructional leadership, influencing curricula, assessing student learning, and other practices –and student achievement" [2].

Based on Zeeman "Evaluation of activities in the context of curricular outcomes can provide a more comprehensive understanding of how the co-curriculum complements the curriculum, thereby complying with accreditation expectations" [3].

According to Gardner "When students are educated on the benefits of participating in out-of-class activities and encouraged by faculty and staff to take advantage of these experiences, they will be more apt to engage early and often" [4].

Assessment Methodology

The student outcomes are assessed every session based on the following criteria:

i.   The average student outcome and performance criteria (PC) achieves a score of at least 3.0 out of 4.

ii.   A minimum of 80% of students assessed have achieved at least the 3.0 milestone on the assessment.

Other Measures:

i.   The passing percentage is 80% or more.

ii. The withdrawal rate is 10% or less.

iii. The persistence rate is 82% or more.

Based on the assessment results, there was a decline in the following three student outcomes for CEIS106 in May 2024:

Student Outcome Assessment: The Linux operating system course has been a challenging experience for freshman students.

Passing Percentages: Passing percentages have been declining since January 2024.

Withdrawal Rates: Withdrawal rates have been increasing since January 2024.

In addition to these assessments, passing percentages and withdrawal rates are monitored during each session.

To address the identified issue, the inaugural activity, which involved managing user accounts in Linux, was conducted on June 6, 2024, as part of the IEEE and CompTIA student branch event.

This virtual event was hosted by DeVry University utilizing the Engageli platform. Six students participated in this event, and the recorded session was subsequently shared with all participants. As a result of these activities, positive trends were observed for two outcomes: leveraging STEM and evaluation. However, the Advanced Application outcome did not demonstrate substantial improvement. A subsequent workshop, focused on managing file permissions and ownership in Linux, was held on September 19, 2024. Twenty-two students attended this workshop.

These activities were recommended by esteemed stakeholders, including students and faculty, to enhance the student experience in CEIS106.

Analysis

A five-question Kahoot quiz was administered in each workshop, utilizing the Kahoot learning platform to facilitate the quiz. The collected data was subsequently analyzed to establish performance benchmarks that align with the program curriculum, course objectives, and student outcomes. Table 1 presents the program outcome, assessment domain, rating, benchmark, and sample size for the "Managing Users Accounts in Linux" workshop, which was held on June 6th, 2024. The sample size for this workshop was five students.

Table 1. Managing users accounts in Linux Assessment

Program Outcome	Assessment Domain	Rating	Benchmark	Sample Size
Leveraging STEM	Account Management	0%	70%	3
Leveraging STEM	Account Management	80%	70%	5
Evaluation	User Verification	60%	70%	5
Evaluation	User Verification	60%	70%	5
Advanced Application	User Security	75%	70%	4

A comparable approach was implemented using Kahoot! on September 19, 2024. Table 2 presents the program's outcomes, assessment domains, ratings, benchmarks, and sample size for managing file permissions and ownership in Linux. The sample size consisted of ten students. Please be advised that the benchmark was set at 70%.

Table 2. Manage file permission and ownership in Linux Assessment

Program Outcome	Assessment Domain	Rating	Benchmark	Sample Size
Leveraging STEM	Account Management	90%	70%	10
Leveraging STEM	Account Management	90%	70%	10
Evaluation	File permission	70%	70%	10
Evaluation	File permission	70%	70%	10
Advanced Application	File ownership	70%	70%	10

The figure below illustrates the two outcomes of Managing file permissions (Leveraging STEM and Evaluation) that met or exceeded the benchmark of 70% but failed to meet the benchmark of advanced application.

Conversely, the outcomes of Managing user accounts (Leveraging STEM and Evaluation) missed the benchmark of 70% but surpassed the benchmark of advanced application
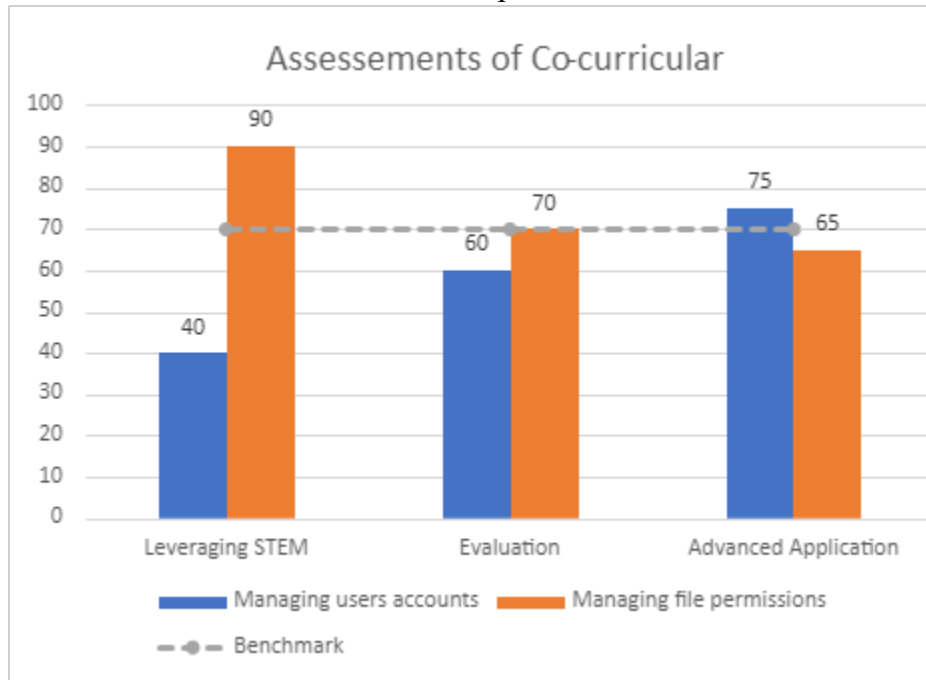
Figure 1. Outcomes for Managing users accounts vs Managing file permissions.

Additionally, the passing percentage, persistence, and withdrawal rates were also analyzed. The results indicate a positive trend for the passing percentage and course withdrawal rates for the July 2024 session.

As part of ongoing efforts to enhance student learning, the Co-Curricular workshops played a pivotal role in improving and augmenting student engagement in the CEIS106 course.
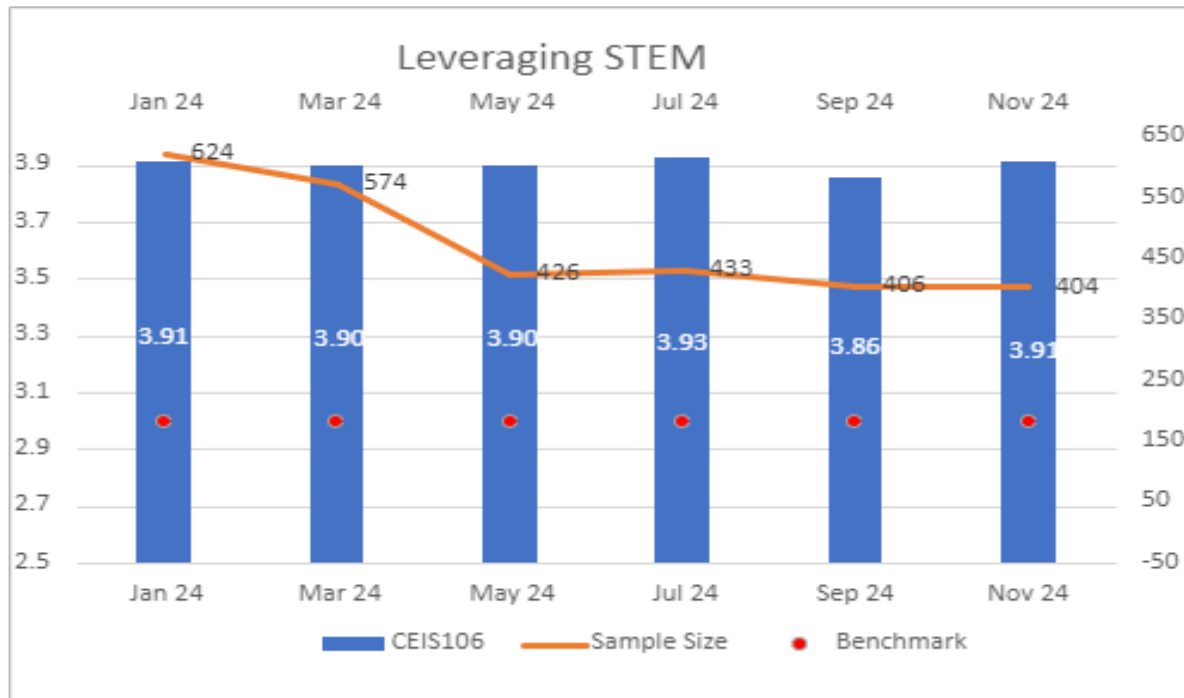

Figure 2. Leveraging STEM (Jan 24 – Nov 24)

The Leveraging graph exhibits a slight upward movement between May 24 (3.90) and July 24 (3.93). Additionally, there is another minor increase between September 24 (3.86) and November 24 (3.91).
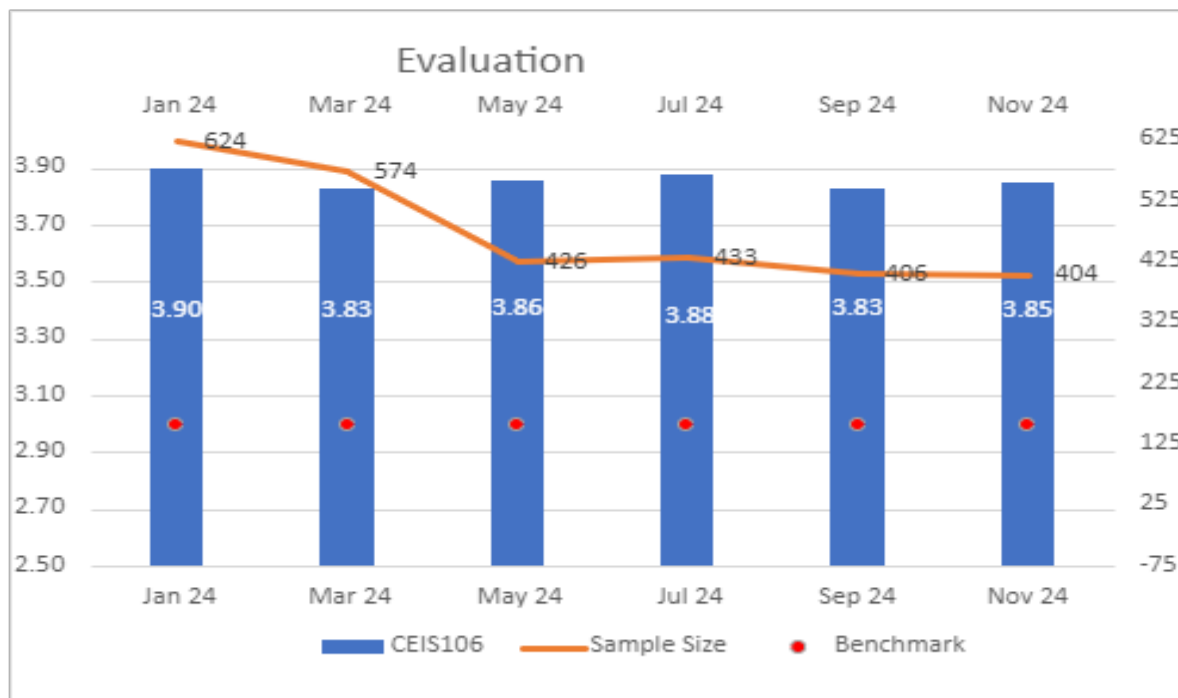
Figure 3. Evaluation (Jan 24 – Nov 24)

The Evaluation graph exhibits a slight increment between May 24 (3.86) and July 24 (3.88). Additionally, there is another small rise between September 24 (3.83) and November 24 (3.85).
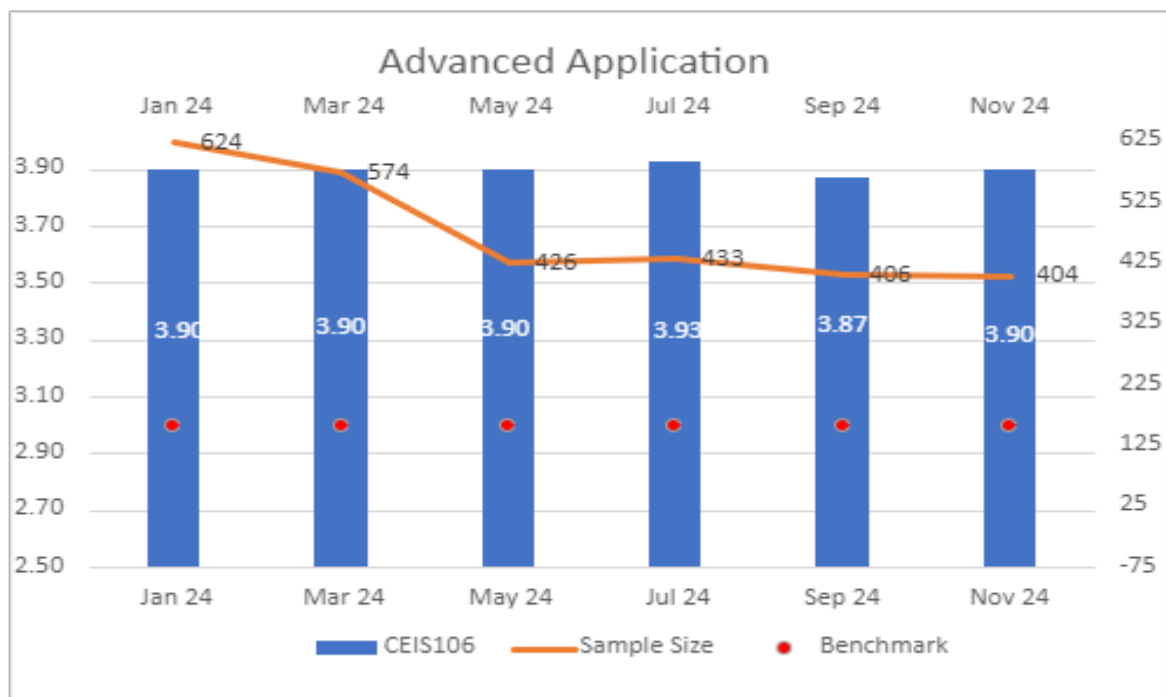

Figure 4. Advanced Application (Jan 24 – Nov 24)

The graph of the Advanced Application exhibits a slight increase between May 24 (3.90) and July 24 (3.93), followed by another modest rise between September 24 (3.87) and November 24 (3.90).
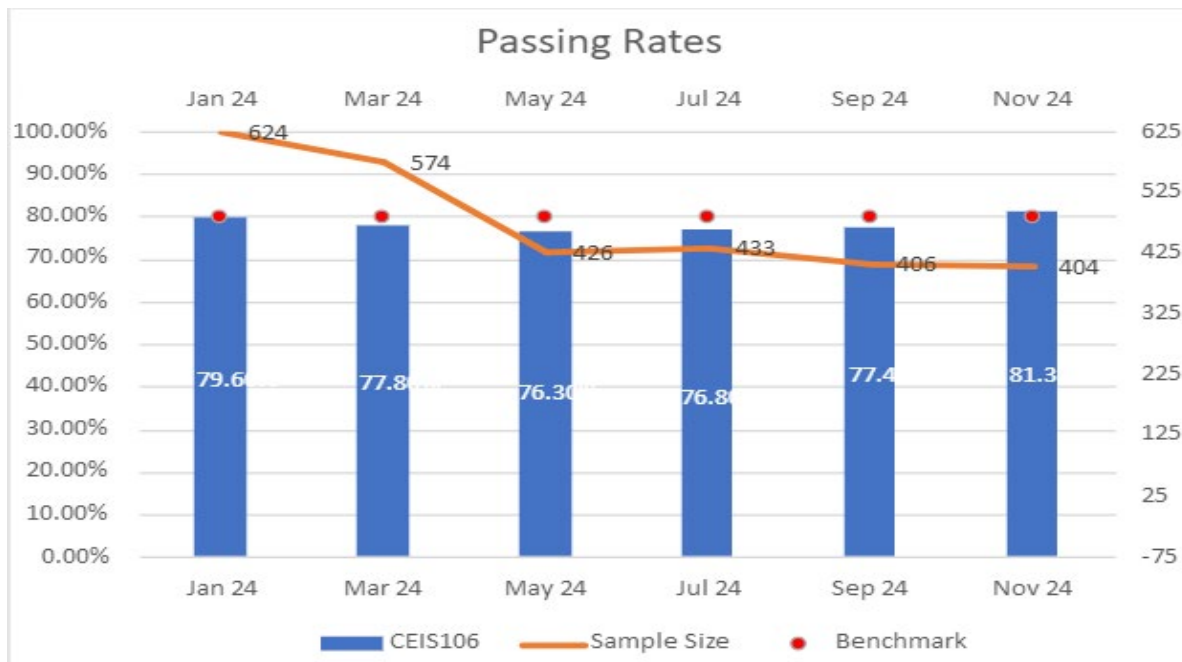

Figure 5. Passing Rates (Jan 24 – Nov 24)

The Passing Rates graph exhibits a slight upward trend, with a notable increase from May 24 (76.36) to November 24 (81.30).
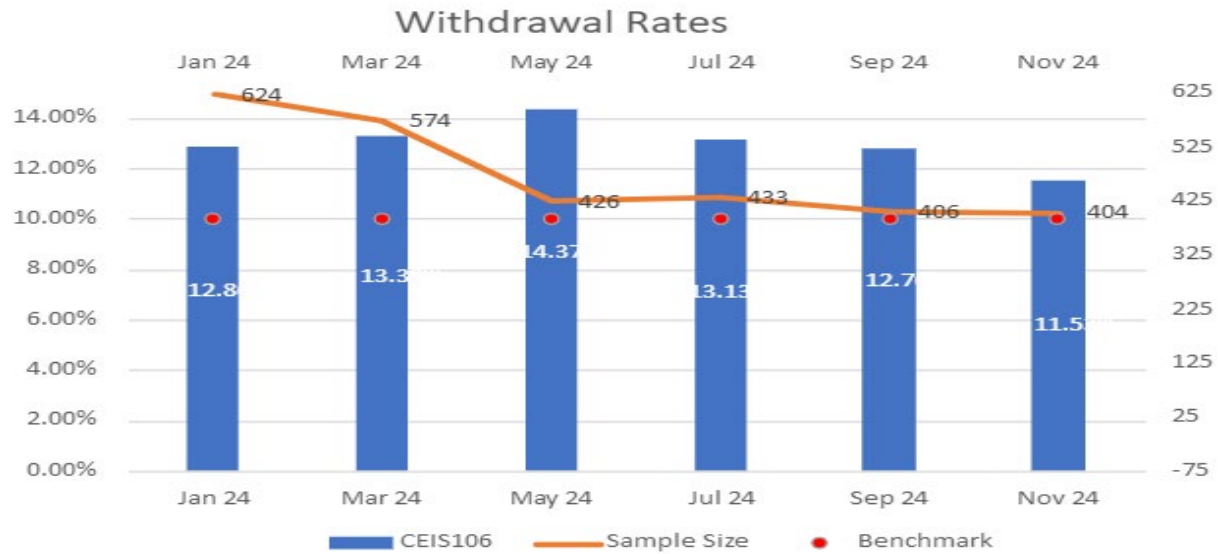
Figure 6. Withdrawal Rates (Jan 24 – Nov 24)

The graph of Withdrawal Rates exhibits a downward trend, with a decrease from May 24 (14.37) to November 24 (11.5).
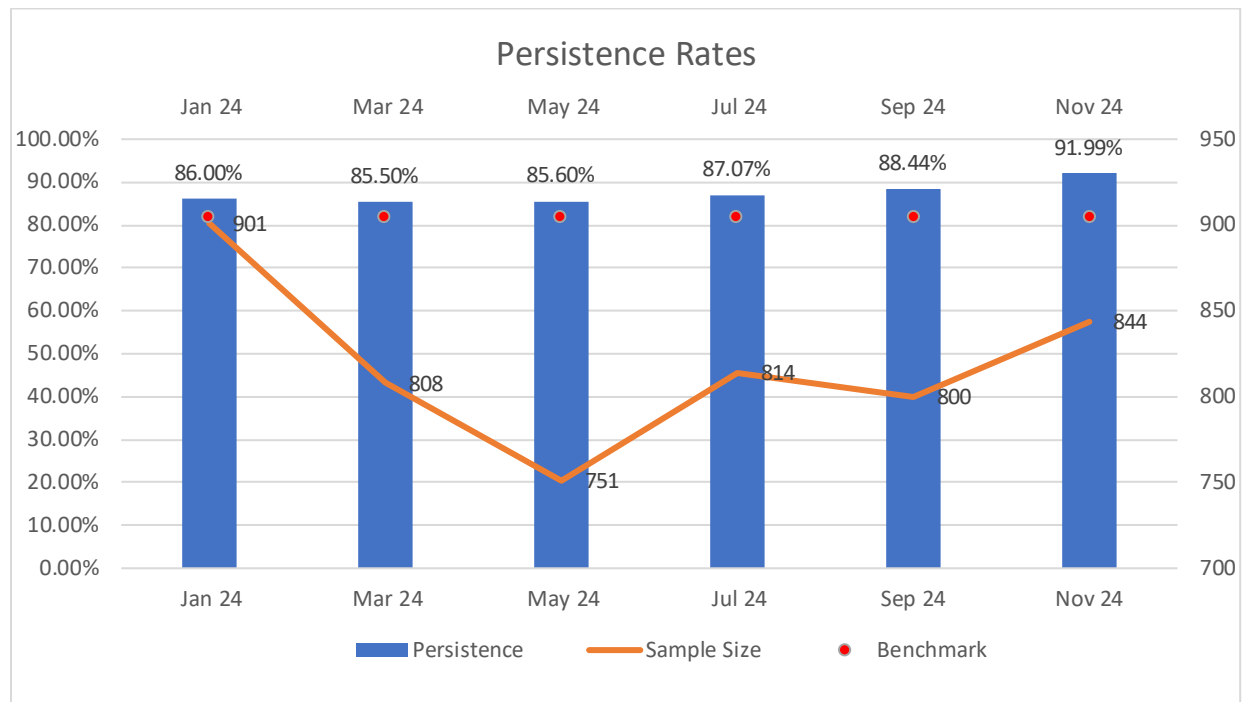

Figure 7. Persistence (Jan 24 – Nov 24)

The Persistence graph exhibits an upward trend, with a notable increase from May 24 (85.06) to November 24 (91.99).

Next analysis, we will discuss the Passing and Persistence Rates for the three undergraduate programs shown below:

- UC_CBS (Undergraduate Certificate Program in Cyber Security)
- AITN (Associate Degree in Information Technology and Networking Program)
- BITN (Bachelor's Degree in Information Technology and Networking Program)
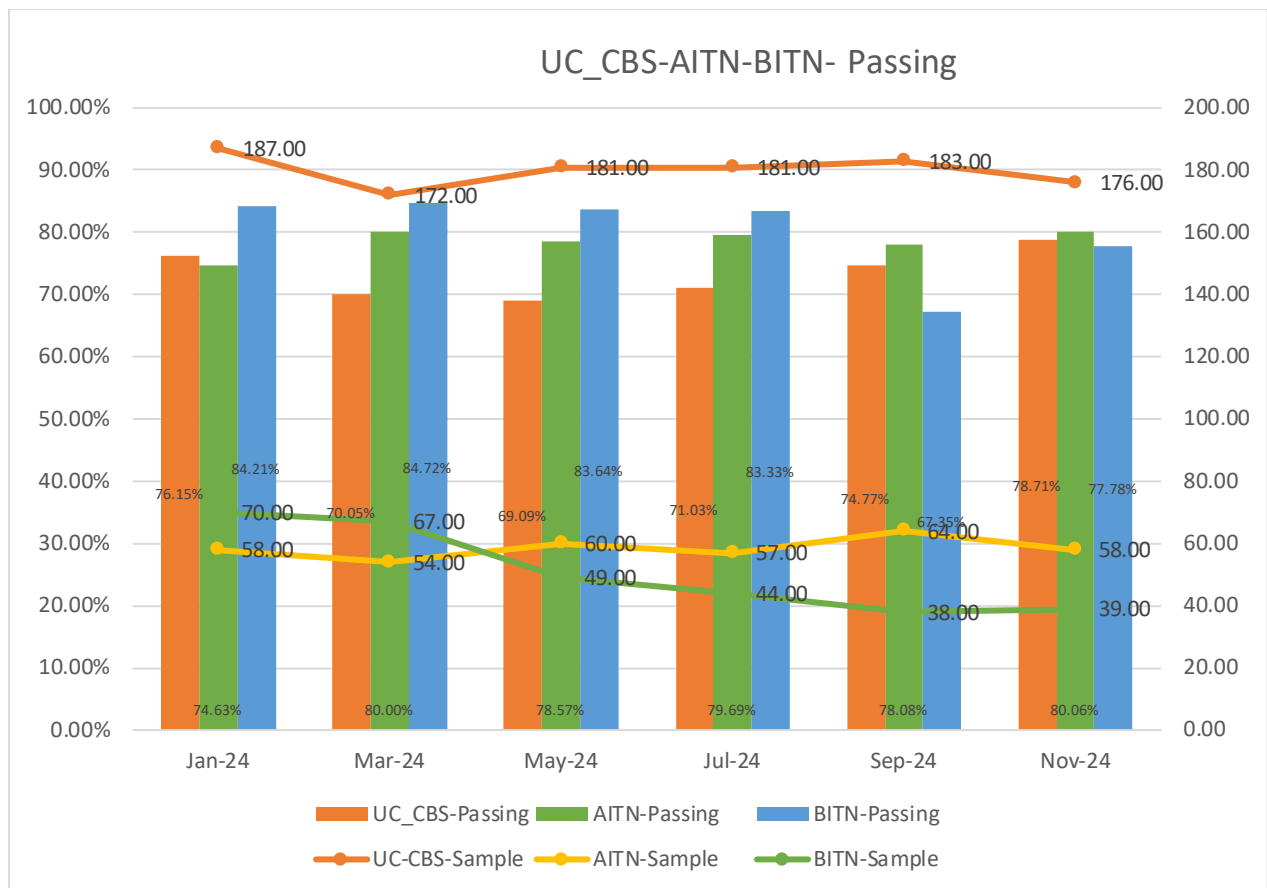
Passing Rates

Figure 8. Passing Rates (Jan 24 – Nov 24) for UC_CBS, AITN, and BITN

The Passing Rates graph exhibits an upward trend, with a notable increase from September 24 to November 24 for the UC_CBS (74.77% to 78.71%) and AITN (78.08% to 80.06%) programs.
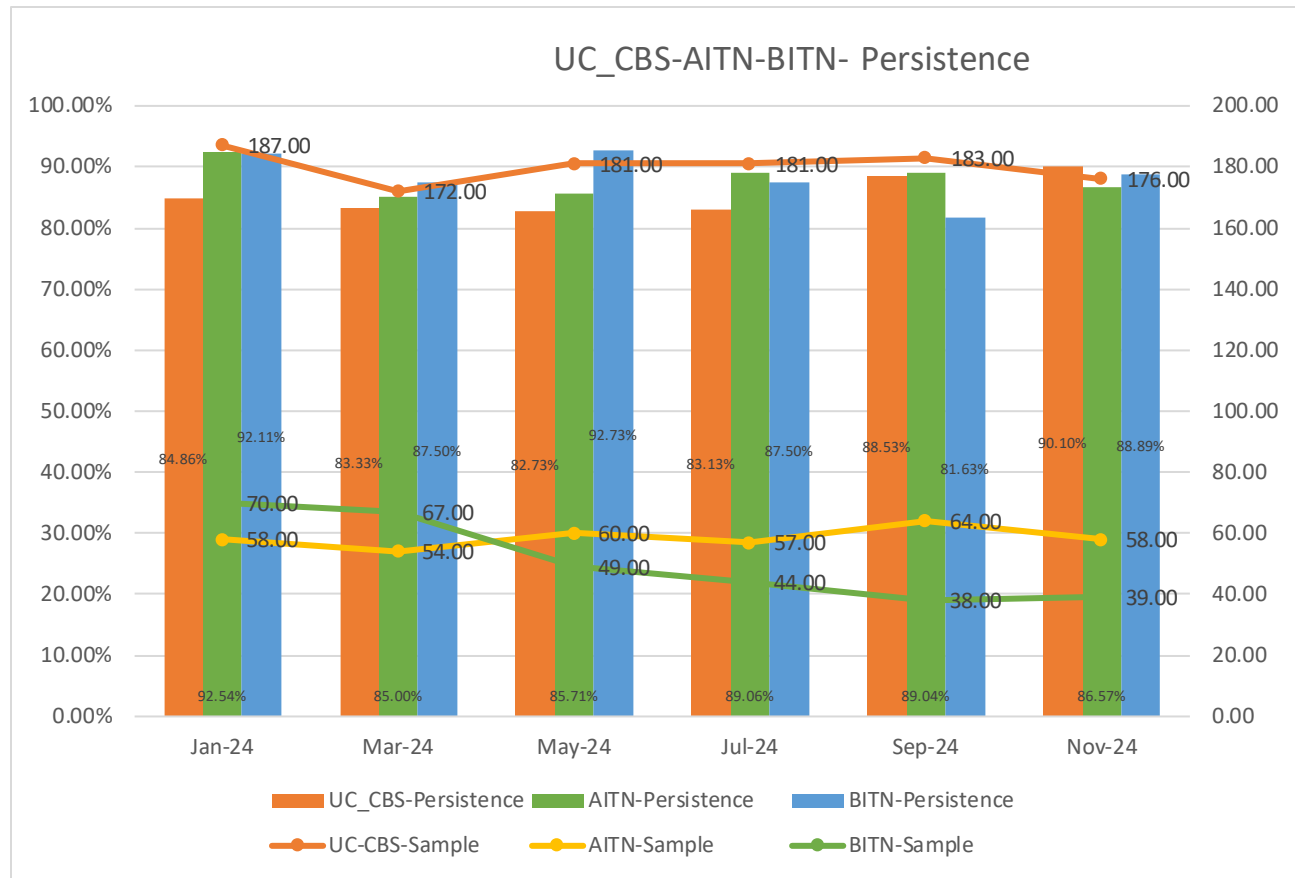
Persistence Rates

Figure 9. Persistence Rates (Jan 24 – Nov 24) for UC_CBS, AITN, and BITN

The Persistence Rates graph exhibits an upward trend, with a notable increase from September 24 to November 24 for the UC_CBS (88.53% to 90.10%) and BITN (81.63% to 88.89%) programs.

Conclusion

Based on the analysis of direct outcomes assessments and other measures, it is evident that student achievement has been trending upward since the introduction of the co-curricular activities facilitated during the May 2024 and July 2024 sessions. It is evident from the data that passing rates and persistence percentages have shown an upward trend for undergraduate certificate in Cyber Security, associate degree in Information Technology and Networking, and bachelor's degree in Information Technology and Networking Programs. Active participation in the workshops has significantly enhanced students' learning experiences and enabled them to attain their educational objectives. The faculty team has consistently provided additional workshops and seminars to engage students in co-curricular activities, with assessments incorporated to evaluate their progress. Student organizations such as IEEE-Student Branch and CompTIA student clubs have played a vital role in organizing and providing events for students.

The team will continue to assess the outcomes, monitor the results, and make appropriate modifications to the course to enhance student learning and academic achievement.

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