

Enhancing Linux Education for Entry-Level College Students: A Pilot Study

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Enhancing Linux Education for Entry-Level College Students: A Pilot Study

Abstract

This abstract describes a pilot redesign of a freshman-level Operating Systems course aimed at improving engagement and learning outcomes for first-time learners. The course integrates the LPI Linux Essentials certification (010-160) with Windows 11 content to provide an accessible, prerequisite-free introduction to operating systems, addressing a gap left by more advanced certifications such as CompTIA Linux+. By leveraging the uCertify platform, the course offers structured content, test preparation, simulations, and cloud-based virtual labs that allow students to apply theoretical concepts in practical, real-world scenarios. This approach is particularly beneficial for first-generation and college-readiness-challenged students, aligning with research that emphasizes the need for student-ready institutional practices.

The pilot was implemented during the May and July 2024 sessions and emphasizes continuous improvement through periodic assessment and data-driven review. Grounded in literature highlighting the importance of supportive first-year experiences, the evaluation focuses on program outcomes including pass rates, persistence, and withdrawal trends. Data were analyzed across multiple academic pathways—the undergraduate certificate in Information Technology Essentials, the Associate of Applied Science in IT and Networking, and the Bachelor of Science in IT and Networking—from May 2024 to May 2025. These assessments aim to determine the effectiveness of the redesigned course in supporting student success and long-term retention in IT programs.

Introduction

The university operates on a semester calendar, with each semester consisting of 16 weeks, divided into two 8-week sessions. Courses are awarded semester credit hours and are primarily delivered online.

Introduction Operating Systems course provides concepts in foundational operating system concepts, examining Windows, Linux, mobile, and virtual-based systems. The course explores computing system architectures and devices, introduces basic scripting, and covers topics including Windows fundamentals, Linux basics, command-line operations, file systems, shell scripting, security, administrative tasks, and networking concepts.

University Definitions of Student Outcome Metrics

Pass Rate

Pass Rate measures course completion with a passing outcome, where passing grades include A, B, C, and D. This metric reflects whether students who enroll are able to complete the course at a minimum acceptable academic level. While it captures overall completion, it does not differentiate between strong and marginal performance, as a D grade is considered passing.

- Primary focus: Course completion
- Key distinction: Includes D grades

Withdrawal Rate

Withdrawal Rate captures the proportion of students who formally withdraw after the add/drop period. This metric highlights issues related to student engagement, readiness, or external barriers, rather than academic performance. Because withdrawn students remain in the denominator for other course outcome metrics, withdrawal rates directly influence pass and success rates.

- Primary focus: Student attrition during the course
- Key distinction: Reflects disengagement, not academic failure

Course Success Rate

Course Success Rate is the institution's primary academic quality metric, measuring the percentage of students who earn A, B, or C grades. It reflects meaningful mastery of course learning outcomes and excludes marginal passes (D), failures, withdrawals, and incompletes. This metric is commonly used for program evaluation, instructional effectiveness, and accreditation reporting.

- Primary focus: Academic achievement and learning outcomes
- Key distinction: Higher performance standard than pass rate

Course-Specific Persistence

Course-Specific Persistence measures student retention within an individual course, independent of academic performance. It answers the question: Did the student remain enrolled through course completion? This metric is particularly useful for identifying early disengagement, pacing challenges, or course design concerns.

- Primary focus: In-course retention
- Key distinction: Measures continued enrollment, not passing or success

Course Design and Content Structure

The Introduction to Operating Systems standard course uses a customized content model, supplemented by MindTap and aligned with intermediate-level certification material (Cloud+). This design allows instructional flexibility but results in variation in content depth and emphasis across sections. In contrast, the pilot course employs fixed content delivered through uCertify, aligned to beginner-level certification objectives, ensuring a consistent and standardized learning experience across all sections. According to Mena-Guacas, "Educational transformation is increasingly influenced by emerging technologies, which offer unique opportunities to redefine

learning. Maximize the positive impact of these technologies, an informed pedagogical approach that considers the advantages and challenges they entail is essential.”, (Mena-Guacas, 2025).

Certification Alignment and Cognitive Load

The standard course’s alignment with Cloud+ (intermediate certification) introduces a higher cognitive load, particularly for students early in their academic pathway. When combined with flexible content delivery, this can challenge students who are still developing foundational operating system and scripting skills. The pilot course, by contrast, intentionally aligns with beginner-level certification content, which better scaffolds learning for entry-level students. The structured progression in uCertify supports incremental skill development and clearer alignment between instruction, practice, and assessment.

Work Expectations and Student Clarity

In the standard course, work expectations are loosely defined, often varying by instructor and section, particularly within a team-teaching (TT) environment. While this can encourage instructional autonomy, it may create ambiguity for students, affecting time management and perceived workload. The pilot course establishes well-defined, standardized work expectations, with clear deliverables and pacing. Additionally, it is designed to function independently of team teaching, reducing instructional variability and enhancing clarity for students.

Instructional Delivery Model

The team-teaching approach employed in the standard course offers several pedagogical advantages, including shared instructional expertise and enhanced faculty support; however, it may also introduce coordination challenges and inconsistencies in student communication. By contrast, the pilot course utilized a stand-alone instructional model, which streamlined course management and ensured a single, unified instructional voice. This structure may be particularly advantageous for novice learners engaging with technical content.

Randomly selected course sections were used for pilot implementation from May 2024 through March 2025. Although students from multiple academic programs were enrolled in the pilot sections, the analysis was limited to students from the Undergraduate Certificate in Information Technology Essentials (UC_ITE), the Associate of Applied Science in Information Technology and Networking (AITN), and the Bachelor of Science in Information Technology and Networking (BITN) programs.

Rationale

To enhance student learning outcomes and engagement, a redesigned Operating Systems course is being piloted to better cater to the needs of first-time learners. Unlike CompTIA Linux+, which presumes prior technical knowledge, the LPI Linux Essentials certification (LPI 010-160) does not require prerequisites, making it more accessible to students with limited operating system experience. By integrating LPI Linux Essentials with Windows 11 course material, students can establish a robust and practical foundation in knowledge.

This Operating systems course is primarily taken by freshman students, and the integration of the UCertify platform has made significant improvements. According to Lewis, “first-generation students often have barriers related to their ability to adjust to college due to a college readiness deficiency. They encounter more significant challenges than continuing-generation college students (CGCS)” (Lewis, 2022). According to Josiah, “There is extreme pressure on post-secondary institutions to redesign policies and practices to align with the institution’s goals. Colleges are expected to be more accountable by creating a ‘student-ready’ culture and environment” (Josiah, 2024).

The pilot also utilizes uCertify, an integrated e-learning platform that provides LPI Linux Essentials and Windows 11 content alongside test preparation, simulations, and virtual labs. Through cloud-based labs and sandbox environments, students gain valuable hands-on practice applying theoretical knowledge to real-world scenarios. Initial pilots utilizing LPI Linux Essentials were conducted in the May 2024 and July 2024 sessions.

Periodic assessment and review play a major role in continuous improvement. According to Espirito, “Continuous improvement is necessary to provide excellent first-year experience to make students feel they belong in college and the profession” (Dr. Doris J. Espirito, 2024).

Virtualization plays a major role in the emerging technology for education. Technologies such as Virtual Reality and Extended Reality could be implemented in future to enhance the delivery. According to Cabrera, “Global technological advancements have unveiled many opportunities within the educational sector, with VR as a technology capable of crafting interactive, three-dimensional environments. This technology offers immersive learning experiences, propelling educational methodologies beyond traditional boundaries.”, (Cabrera-Duffaut, 2024).

Research Implications

- Beginner-aligned certification content in the pilot course may improve course success and persistence, especially for students with limited prior technical experience.
- Clear, consistent expectations in the pilot model support student self-regulation, engagement, and persistence, especially in an online environment.
- The stand-alone model may reduce confusion and improve student satisfaction and retention, while the TT model requires stronger coordination to achieve comparable outcomes.

Analysis and Results

To assess the impact, we analyzed program outcomes, pass rates, persistence, and withdrawal rates for students enrolled in the undergraduate certificate program in Information Technology Essentials (UC_ITE), Associate of Applied Science in Information Technology and Networking (AITN) and Bachelor of Science in Information Technology and Networking (BITN) programs between May 2024 to May 2025.

Results for the Information Technology Essentials Certificate Program (UC_ITE)

Enrollment Trend for UC_ITE Program

Table 1. Undergraduate Certificate in Information Technology Essentials Enrollment

UC_ITE Enrollment							
	May-24	Jul-24	Sept-24	Nov-24	Jan-25	Mar-25	May-25
Pilot	2	4	14	10	21	44	101
Standard	75	96	95	104	71	51	N/A

Pass Rates for UC_ITE Program

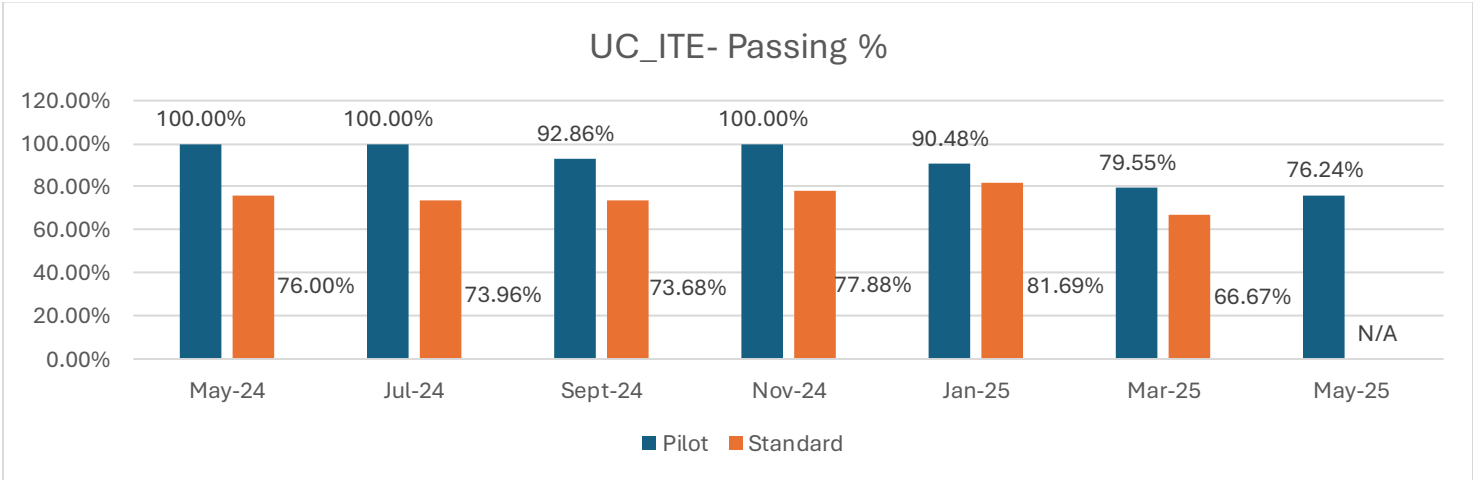


Figure 1. Undergraduate Certificate in Information Technology Essentials Passing Percentages

The Information Technology Essentials program demonstrates that the pilot sections consistently outperformed the standard sections from May 2024 through March 2025. Notably, the overall pilot program showed a 9.57% improvement compared to the March 2025 standard program.

Withdrawal Rates for UC_ITE Program

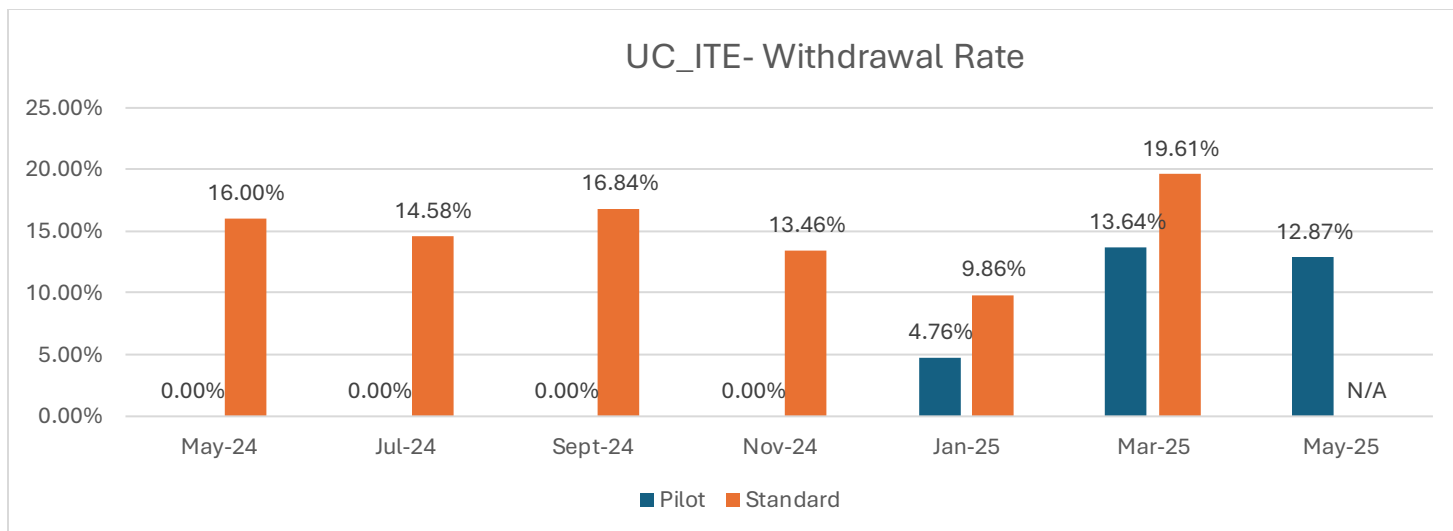


Figure 2. Undergraduate Certificate in Information Technology Essentials Withdrawal Rate

The Information Technology Essentials program clearly demonstrates that the pilot sections had significantly lower withdrawal rates compared to the standard program. Notably, the withdrawal rate remained at 0% from May 2024 through November 2025.

Persistence for UC_ITE Program

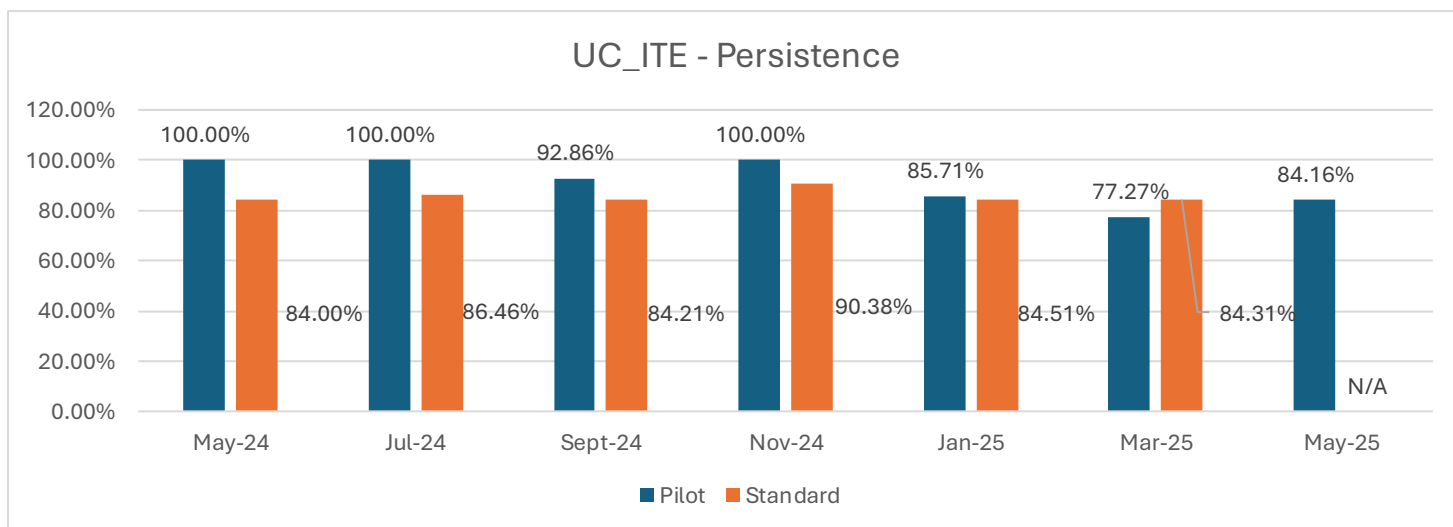


Figure 3. Undergraduate Certificate in Information Technology Essentials Persistence

Persistence rates for the pilot sections were higher across all sessions, with the exception of the March 2025 session.

Results for the Information Technology and Networking Associate Degree Program (AITN)

Enrollment Trend for AITN Program

Table 2. Associate Degree in Information Technology and Networking Enrollment

AITN Enrollment							
	May-24	Jul-24	Sept-24	Nov-24	Jan-25	Mar-25	May-25
Pilot	2	8	8	7	10	25	55
Standard	68	56	65	60	37	33	N/A

Pass Rates for AITN Program

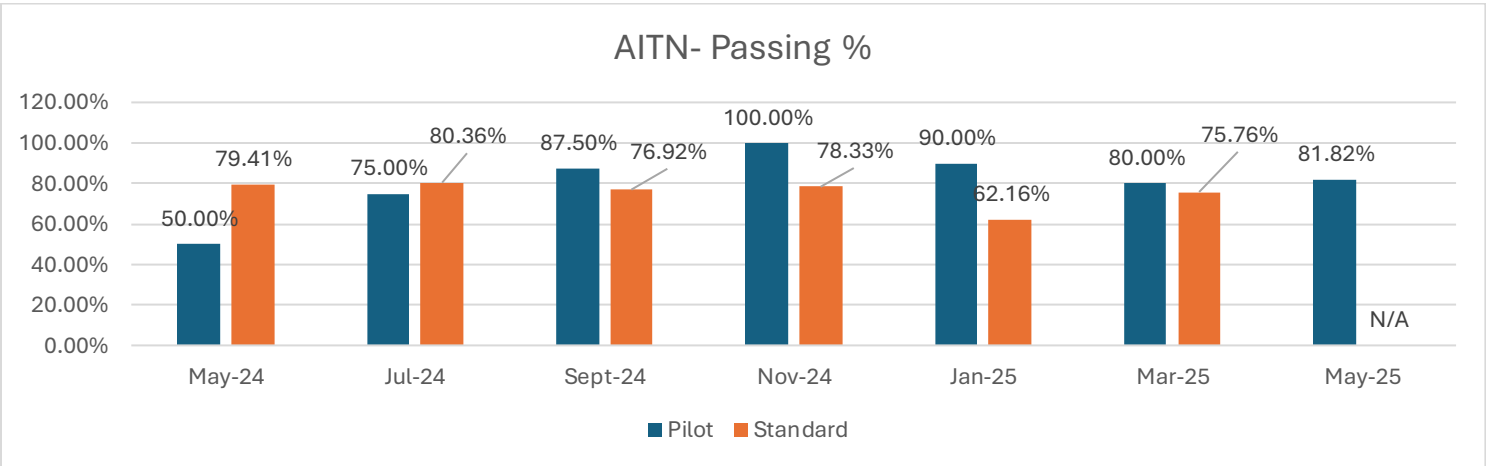


Figure 4. Associate Degree in Information Technology and Networking Passing Percentages

Pass rates for the pilot sections in the AITN program were higher from September 2024 through March 2025. Additionally, pass rates exceeded 80% compared to the standard sections from May 2024 to March 2025.

Withdrawal Rates for AITN Program

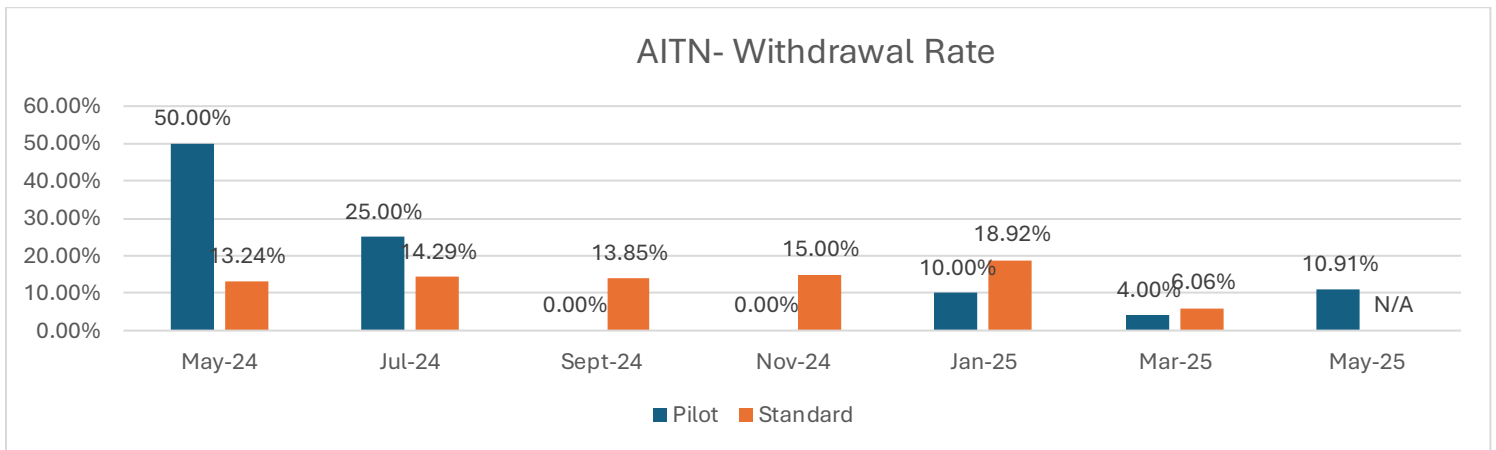


Figure 5. Associate Degree in Information Technology and Networking Withdrawal Rate

Withdrawal rates for the pilot sections were significantly lower from September 2024 through March 2025 sessions. While withdrawal rates were higher in the pilot sections during the May 2024 and July 2024 sessions, enrollment in these two sessions was very small, which likely influenced the results.

Persistence for AITN Program

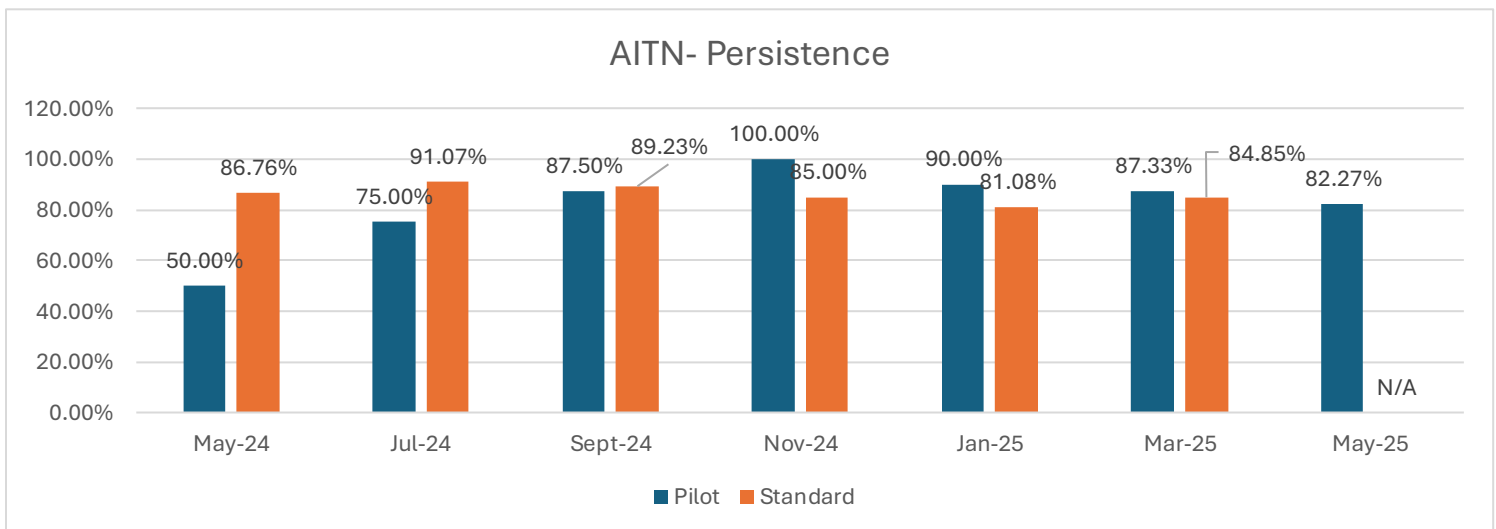


Figure 6. Associate Degree in Information Technology and Networking Persistence

Persistence rates for the pilot sections were higher during the November 2024 and January 2025 sessions. However, the standard sections demonstrated higher persistence rates in the remaining sessions.

Results for the Information Technology and Networking Bachelor’s Degree Program (BITN)

Enrollment Trend for BITN Program

Table 3. Bachelor’s degree in information technology and Networking Enrollment

BITN Enrollment							
	May-24	Jul-24	Sept-24	Nov-24	Jan-25	Mar-25	May-25
Pilot	1	4	8	5	8	22	55
Standard	54	44	41	40	27	29	N/A

Pass Rates for BITN Program

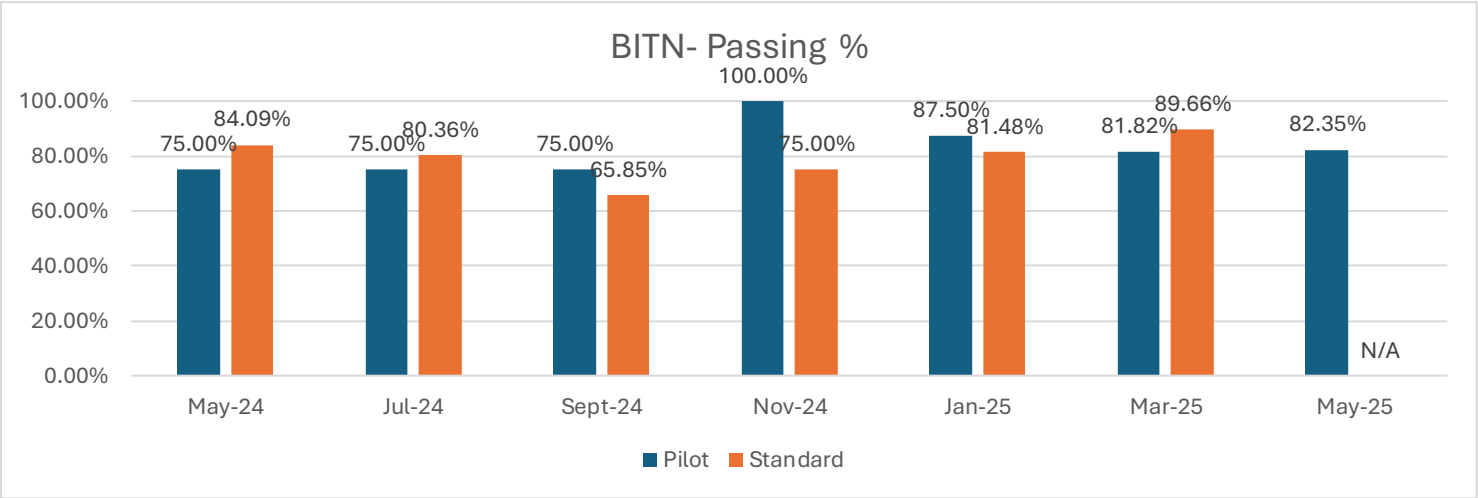


Figure 7. Bachelor’s degree in information technology and Networking Passing Percentages

Pass rates for the pilot sections in the BITN program were higher from November 2024 through January 2025 sessions. Additionally, pass rates exceeded 80% compared to the standard sections from May 2024 to March 2025

Withdrawal Rates for BITN Program

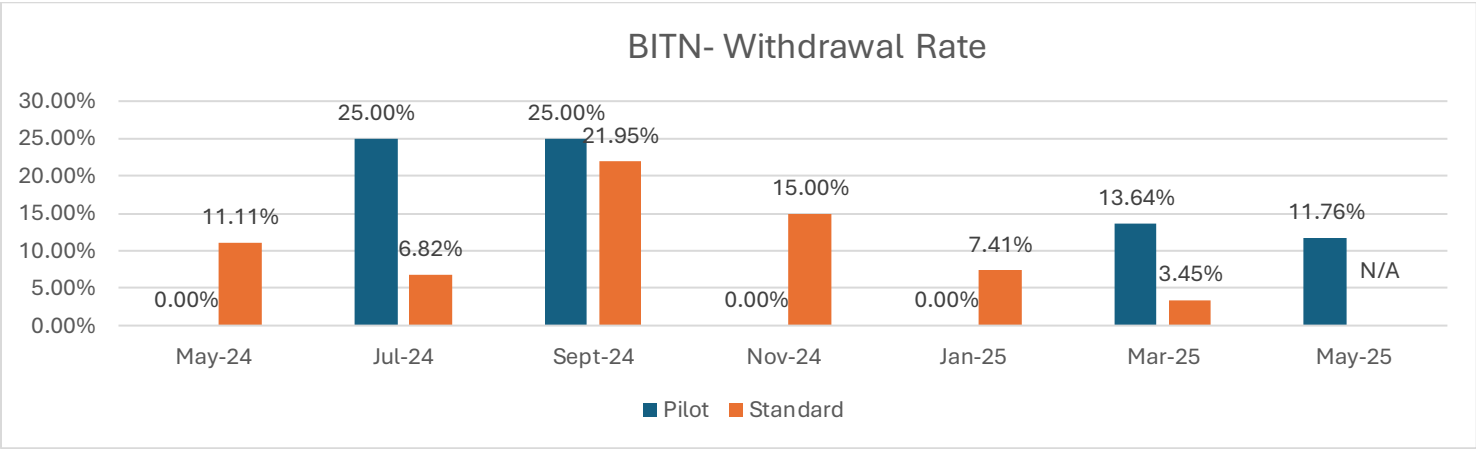


Figure 8. Bachelor’s degree in information technology and Networking Withdrawal Rate

Withdrawal rates for the pilot sections were significantly lower for May 2024 and from November 2024 through March 2025 sessions. While withdrawal rates were higher in the pilot sections during the July 2024, September 2024, and March 2025 sessions.

Persistence for BITN Program

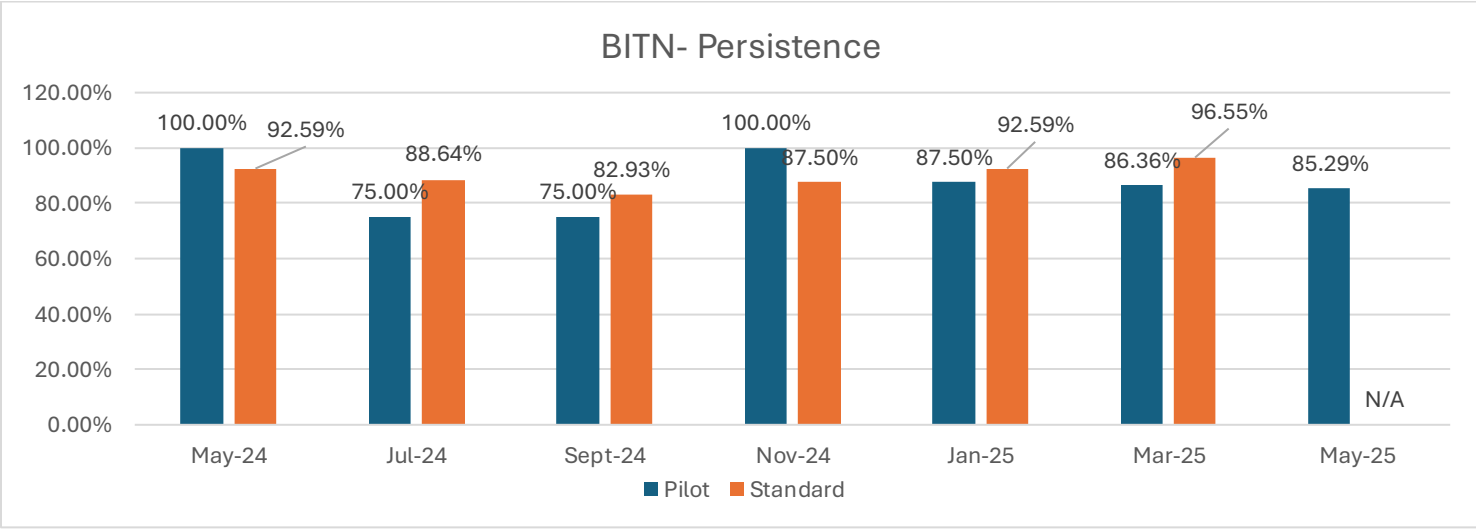


Figure 9. Bachelor’s degree in information technology and Networking Persistence

Persistence rates for the pilot sections generally exceeded the established threshold across all sessions, except for July and September 2024. The standard sections consistently met the threshold level from May 2024 through March 2025.

Student feedback:

Student feedback across the AITN, BITN, and UC_ITE programs indicates a consistently positive course experience. AITN students described the course as well-structured, informative, and appropriately challenging, emphasizing increased confidence and a strong understanding of operating systems supported by effective and consistently helpful instruction. BITN students, many of whom were new to the IT field, characterized the course as an engaging and confidence-building introduction to technology, noting that hands-on labs and interactive activities effectively connected theoretical concepts to real-world applications. UC_ITE students highlighted the course's effectiveness in teaching Linux and operating system fundamentals, citing clear explanations, supportive learning materials, and accessible resources that facilitated skill development and comprehension of core operating system concepts.

Challenges Identified

Students pointed out a few key issues:

- Information overload, especially due to technical jargon
- Difficulty identifying what information was most essential
- Desire for access to future weeks earlier, to work ahead
- Need for clearer pacing or prioritization of content

Suggestions for Improvement

Students suggested enhancements such as:

- Including more content on Windows and macOS, not just Linux
- More live lectures for real-time clarification
- Optional activities to reinforce complex topics
- Allowing access to upcoming weeks after completing current coursework

Conclusion:

For an entry-level course like Introduction to Operating Systems, the pilot model's fixed content, beginner-aligned certification focus, and clearly defined expectations are more closely aligned with student readiness, online learning best practices, and early-course retention goals.

This pilot study demonstrates that integrating the LPI Linux Essentials certification with immersive uCertify technology into an entry-level Operating Systems course can significantly improve student outcomes, particularly for first-time and first-generation college students. Pilot sections consistently showed higher pass rates, lower withdrawal rates, and stronger persistence trends compared to traditional sections. The use of uCertify's cloud-based labs, simulations, and integrated course materials enhanced student engagement and practical skill development, helping bridge the gap between theory and application while increasing student confidence and self-sufficiency.

Student feedback further reinforces the value of the redesigned course, highlighting clarity, relevance, and instructional approach. While challenges such as information overload and pacing were noted, these insights provide actionable opportunities for improvement, including clearer content prioritization, expanded platform coverage, and increased opportunities for live instruction. Overall, aligning foundational operating systems instruction with certification pathways and immersive learning technologies fosters a more inclusive, student-ready environment, supporting retention, persistence, and readiness for advanced coursework and the workforce. Enhancing the delivery with emerging technology is recommended.

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