Comparative Performance of Junior and Senior Pharmacy Students in a Malaysian Pharmacotherapy Course

Mohd Izani Othman[1,2*], Mohd Nadzri Mohd Najib[1], Suraya Sulaiman[1], Wong Yuet Yen[1,3], Nursyuhadah Othman[1,2], Netti Kemala Sari[4], Norasyikin Mohaiyuddin[5] and Ahmad Hasif Mhd Shukeri[6]

[1]Faculty of Pharmacy, Universiti Teknologi MARA Cawangan Pulau Pinang, Bertam Campus, 13200 Kepala Batas, Pulau Pinang, Malaysia

[2]Telehealth and Remote Patient Care Research Interest Group, Faculty of Pharmacy, Universiti Teknologi MARA Cawangan Selangor, Puncak Alam Campus, 42300 Bandar Puncak Alam, Selangor, Malaysia

[3]Collaborative Drug Discovery Research (CDDR) Group, Faculty of Pharmacy, Universiti Teknologi MARA Cawangan Selangor, Puncak Alam Campus, 42300 Bandar Puncak Alam, Selangor, Malaysia

[4]Program Studi DIII, Sekolah Tinggi Ilmu Kesehatan Ranah Minang, Padang, Sumatera Barat 25171, Indonesia

[5]School of Education, College of Arts and Sciences, Universiti Utara Malaysia, 06010 Sintok, Kedah, Malaysia

[6]HOE Pharmaceuticals Sdn. Bhd., 42000 Port Klang, Selangor, Malaysia

***Corresponding Author**

DOI: https://doi.org/10.47772/IJRISS.2026.100400240

Received: 08 April 2026; Accepted: 14 April 2026; Published: 05 May 2026

ABSTRACT

Pharmacotherapy education requires integration of pharmacological knowledge with clinical application, yet performance differences between junior and senior pharmacy students within the same course remain underexplored. This study compared assessment outcomes between Semester 2 and Semester 4 Diploma in Pharmacy students enrolled in a pharmacotherapy course and examined predictors of performance. A cross-sectional study involving 159 students (Semester 2, n = 81; Semester 4, n = 78) was conducted. Assessments comprised a midterm test (20%), group assignment (20%), and final examination (60%). Semester 4 students achieved significantly higher scores in the midterm ($p < 0.001$), final examination ($p = 0.011$), and overall weighted marks ($p = 0.004$), while Semester 2 students scored higher in group assignments ($p = 0.014$). Failure rates were higher among Semester 2 students (11.1% vs. 1.3%). Regression analysis identified midterm performance as a strong predictor of final examination scores ($\beta = 0.727$, $p < 0.001$). Overall, senior students outperformed junior students, underscoring the diagnostic value of early assessments and the need for targeted academic support for junior cohorts.

Keywords: Academic Performance, Pharmacotherapy, Pharmacy Education

INTRODUCTION

Pharmacy education has evolved significantly in response to the increasing complexity of healthcare delivery and medication management. A key challenge lies in teaching pharmacotherapy, where students must integrate pharmacological knowledge with clinical reasoning and patient-centred application. Globally, case-based and integrated teaching approaches have been shown to enhance student understanding and clinical competence (Nezhad et al. 2024). Within Southeast Asia, pharmacy programs have adopted varied strategies to improve

quality, yet persistent challenges remain in aligning curriculum with healthcare needs (Paraidathathu et al. 2022; Etukakpan et al. 2023).

In Malaysia, curriculum reviews have highlighted that students perceive pharmacotherapy education as both relevant and challenging, particularly when transitioning from basic sciences to applied courses (Othman et al. 2024). The COVID-19 pandemic further accelerated the adoption of online and blended learning, with mixed effects on students' confidence, engagement, and performance (Othman et al. 2022; Abubakar et al. 2022; Othman et al. 2023). Other regional studies have also shown that readiness for interprofessional learning and satisfaction with teaching quality are important determinants of educational outcomes (Zainal et al. 2023; Thanh-Thao et al. 2024). Beyond curriculum design and delivery, student-level factors strongly influence academic achievement. Non-cognitive skills such as grit, resilience, time management, and empathy have been consistently linked to improved academic performance (Abubakar et al. 2021; Halimi et al. 2024; Masnan et al. 2025). Importantly, knowledge gaps between junior and senior students suggest that prior exposure to pharmacology and therapeutics significantly shapes performance in advanced pharmacotherapy courses (Khurshid et al. 2023).

Beyond international evidence, local studies underscore this pattern. In Malaysia, students with more foundational exposure in pharmacogenetics performed better on knowledge tests than those without such exposure (Thiagarajan et al. 2023). Additionally, a study exploring student feedback on curriculum design revealed that earlier semesters report feeling less prepared for applied pharmacotherapy compared to more advanced cohorts (Othman et al. 2024). Therefore, establishing core pharmacology competencies may therefore help bridge these gaps and ensure students are adequately prepared for clinical decision-making (Werners & Fajt 2021). In addition to knowledge and skills, quantitative studies have demonstrated that academic outcomes in pharmacy education can be predicted using baseline, behavioural, and program-related variables. Regression models have been widely applied to identify predictors of examination performance and to inform student support strategies (Lyons et al. 2020; Maerten-Rivera et al. 2022; Jegede et al. 2024).

Despite these insights, little is known about how performance outcomes differ when students with varying levels of prior knowledge are enrolled in the same pharmacotherapy course. This study addresses this gap by comparing the academic performance of two independent cohorts i.e. Semester 2 and Semester 4 Diploma in Pharmacy students, who were concurrently enrolled in the same pharmacotherapy course. Importantly, this is a cross-sectional comparison of students at different stages of academic progression, not a longitudinal tracking of the same students over time. As such, observed differences reflect both curricular exposure and potential selection effects arising from academic attrition across semesters.

MATERIALS AND METHOD

Study Design and Setting

This cross-sectional study was conducted among Diploma in Pharmacy students enrolled in the *Pharmacotherapy of Endocrine System, Muscle and Joints* course at Universiti Teknologi MARA, Cawangan Pulau Pinang, Kampus Bertam, during the March–August 2025 semester. (Note: data collection was completed at the end of the semester i.e., August-September 2025 and manuscript preparation commenced thereafter). The course was co-taught by two lecturers, each with over 15 years of experience in pharmacotherapy education.

The course was delivered sequentially by two lecturers, each with over 15 years of experience in pharmacotherapy education. Lecturer 1 was responsible for Weeks 1 until 4, covering endocrine system pharmacotherapy, while Lecturer 2 taught Weeks 5 until 14, covering endocrine system and musculoskeletal pharmacotherapy. All students, regardless of semester cohort attended the same lecture and tutorial sessions. The midterm test, administered after Week 6, assessed content from Weeks 1 until 6, thereby encompassing the complete teaching block of Lecturer 1 and the initial two weeks of Lecturer 2's block. The final examination covered all 14 weeks of course content. Assessment questions were mapped to topics taught by each respective lecturer with no content overlap between the two teaching blocks. This arrangement ensured that all students received identical instructional exposure, effectively ruling out differential teaching experience as a confounding variable in performance comparisons between cohorts.

The course was offered concurrently to two cohorts. Semester 2 students were simultaneously enrolled in Basic Pharmacology, while Semester 4 students had previously completed Basic Pharmacology as well as Pharmacotherapy of the Cardiovascular and Respiratory Systems. In addition, Semester 4 students were concurrently undertaking Pharmacotherapy of the Central Nervous System and Gastrointestinal System and Chemotherapeutics, Dermatologicals, and Immunologicals.

Course Assessments

Student performance was evaluated using three summative assessments:

1. Midterm test (MT) – 50 marks (20%)
2. Group assignment (GA) – 50 marks (20%)
3. Final examination (FE) – 100 marks (60%)

Final course grades were calculated as the weighted sum of these assessments. This assessment structure is consistent with established practice in pharmacotherapy courses, where a combination of written tests, group-based learning, and final examinations is used to evaluate both individual mastery and collaborative learning outcomes (Abubakar et al. 2022; Othman et al. 2024).

Data Collection

De-identified assessment scores were retrieved from course records at the end of the semester. Data were grouped according to student cohort (Semester 2 vs. Semester 4). The primary outcome was overall course performance (pass/fail), while secondary outcomes included mean scores across the three assessments. All registered students who completed the assessments were included, with no missing data.

Data Analysis

Data were entered and analysed using IBM SPSS Statistics version 26 (IBM Corp., Armonk, NY, USA). Descriptive statistics (means, standard deviations, frequencies) were used to summarise assessment outcomes. Independent-samples *t*-tests compared mean scores between Semester 2 and Semester 4 students, while chi-square tests assessed differences in pass/fail rates. Multiple linear regression was used to explore predictors of final examination performance, with midterm, group assignment, and semester level as predictors.

This analytical approach has been widely applied in pharmacy education studies investigating academic performance predictors (Jegede et al. 2024). Similar studies have also modelled exam performance using regression analysis to identify the influence of baseline, demographic, and program-level factors (Lyons et al. 2020; Maerten-Rivera et al. 2022). All data were anonymised prior to analysis, and no identifying information was included. As this study involved secondary analysis of routinely collected assessment data, informed consent from students was not required. The study was conducted in accordance with the principles of the Declaration of Helsinki.

RESULTS AND DISCUSSION

Student Performance Overview

A total of 159 students (36 males and 123 females) were enrolled in the course (Semester 2 = 81; Semester 4 = 78). Clear differences were observed between cohorts. Semester 4 students performed significantly better in the midterm (M = 29.06, SD = 8.20) compared to Semester 2 (M = 22.98, SD = 8.72), $t(157) = -4.53$, $p < .001$. Similarly, Semester 4 students outperformed Semester 2 in the final examination (M = 70.71, SD = 15.30 vs. M = 64.32, SD = 15.99), $t(157) = -2.58$, $p = .011$, and in overall weighted ($\Sigma wx/\Sigma w$) scores (M = 70.41, SD = 11.96 vs. M = 64.74, SD = 12.68), $t(157) = -2.91$, $p = .004$. Interestingly, Semester 2 students achieved slightly higher scores in the group assignment (M = 42.38, SD = 3.18 vs. M = 40.91, SD = 4.24), $t(157) = 2.47$, $p = .014$. Figure 1 shows the mean assessment scores by semester, while Table 1 compares mean scores between cohorts.

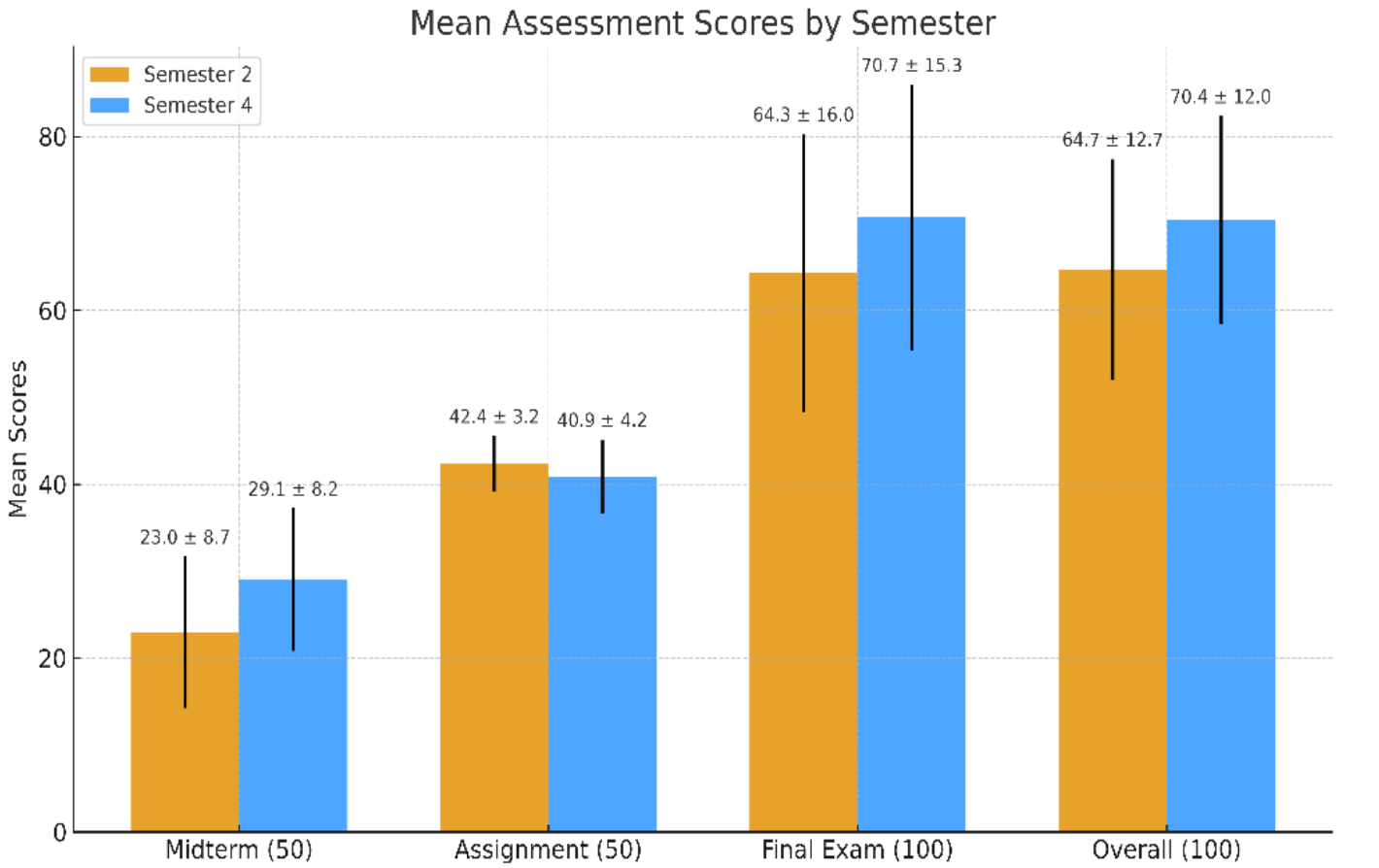

Figure 1. Mean assessment scores by semester

Table 1. Comparison of mean scores between Semester 2 and Semester 4 students

Assessment	Semester 2 (n= 81) Mean ± SD	Semester 4 (n= 78) Mean ± SD	t(df)	*p* value
MT (50)	22.98 ± 8.72	29.06 ± 8.20	-4.53	<0.001***
GA (50)	42.38 ± 3.18	40.91 ±4.24	2.47	0.014*
FE (100)	64.32 ± 15.99	70.71 ± 15.30	- 2.58	0.011*
Σwx/ Σw (100)	64.74 ± 12.68	70.41 ± 11.96	- 2.91	0.004**

(Note: Values are mean ± SD. Independent samples t-test used. $p < .05$, $p < .01$**, $p < .001$***. Cohen's d for between-group differences: midterm = 0.72 (medium–large), group assignment = 0.39 (small–moderate), final exam = 0.41, overall weighted (Σwx/Σw) = 0.46.*)

The between-group difference in midterm performance carried practical significance, with a Cohen's d of 0.72 (medium–large), equivalent to moving a student from the 50th to approximately the 76th percentile, a magnitude that is educationally meaningful beyond statistical significance. Similarly, effect sizes for the final examination (d = 0.41) and overall weighted scores (d = 0.46) were in the small-to-moderate range, indicating that, while statistically significant, the practical magnitude of these gaps is moderate and potentially addressable through targeted pedagogical intervention. The smallest effect was observed for group assignments (d = 0.39), consistent with the more equitable performance observed across cohorts on this collaborative task.

Pass/Fail Analysis

Table 2 illustrates that failures were concentrated in Semester 2. Among 81 Semester 2 students, 9 failed (11.1%), while only 1 Semester 4 student (1.3%) failed out of 78. A chi-square test of independence confirmed that the difference in failure rates between cohorts was statistically significant, $\chi^2(1, N = 159) = 6.52$, $p = 0.011$, with a small–moderate association ($\varphi = 0.20$). These results indicate that junior students were disproportionately represented among failures in this course.

This finding suggests that Semester 2 students struggled more, likely due to their limited prior exposure to pharmacology. Prior studies confirm that senior students tend to perform better in pharmacogenomics and pharmacotherapy due to stronger foundational knowledge (Maerten-Rivera et al. 2022).

Table 2. Pass/fail outcomes by semester

Semester	Total Students	Pass, n (%)	Fail, n (%)
2	81	72 (88.9)	9 (11.1)
4	78	77 (98.7)	1 (1.3)
Total	159	149 (93.7)	10 (6.3)

Grade Distribution

Table 3 shows that Semester 4 students were more likely to achieve higher grades, with 6.4% attaining an A+ and 15.4% an A, compared to Semester 2 where no student achieved an A+. Semester 4 also had a higher proportion of students in the A– and B+ categories, indicating stronger overall performance. In contrast, Semester 2 students were more concentrated in the mid-grade range, particularly at grade B (17.3%). Failures were more frequent in Semester 2 (11.1%) compared to Semester 4 (1.3%). Overall, these patterns suggest that Semester 4 produced a greater proportion of high achievers, while failures were concentrated in Semester 2.

Notably, no Semester 2 student achieved an A+ grade, compared to 6.4% of Semester 4 students. This ceiling effect for junior students warrants consideration: it may reflect the authentic difficulty of achieving the highest performance standard without prior pharmacotherapy exposure, suggesting that the course's upper grade thresholds require a level of conceptual integration that is genuinely unattainable without advanced foundational knowledge. Alternatively, it may indicate that the assessment design is calibrated in a manner that structurally disadvantages novice learners – for instance, if higher-order application questions predominate, as would be expected in a pharmacotherapy course at this level. Future studies might examine item-level response patterns to determine whether A+ attainment requires advanced synthesis skills that junior students are still developing, or whether additional scaffolding could enable high-performing junior students to reach this grade tier.

Table 3. Grade distribution by semester

Grade	**Semester 2** (n= 81) n (%)	**Semester 4** (n=78) n (%)
A+	0 (0.0)	5 (6.4)
A	12 (14.8)	12 (15.4)
A-	9 (11.1)	12 (15.4)
B+	11 (13.6)	18 (23.1)
B	14 (17.3)	6 (7.7)
B-	9 (11.1)	11 (14.1)
C+	12 (14.8)	6 (7.7)
C	5 (6.2)	7 (9.0)
C-	1 (1.2)	0 (0.0)
D+	3 (3.7)	0 (0.0)
D	3 (3.7)	1 (1.3)
E	1 (1.2)	0 (0.0)
F	1 (1.2)	0 (0.0)

(Note: Pass = A+ to C; Fail = C–, D+, D, E, F)

Correlations and Predictors

Pearson's correlation analysis (Table 4) showed strong positive associations: midterm and final exam scores ($r = 0.717$, $p < 0.001$), final exam and overall weighted ($\Sigma wx/\Sigma w$) scores ($r = 0.973$, $p < 0.001$), and a weaker but significant link between group assignment and overall scores ($r = 0.209$, $p = 0.008$).

Table 4. Pearson correlation coefficients among assessment

Variable	MT	GA	FE	Σwx/Σw
MT	1	0.092	0.717***	0.733***
GA	0.092	1	0.130	0.209**
FE	0.717***	0.130	1	0.973***
Σwx/Σw	0.733***	0.209**	0.973***	1

(Note: *p < 0.05, **p < 0.01, ***p < 0.001)

Regression analysis (Table 5) revealed that midterm performance strongly predicted final exam scores (β = 0.727, p < 0.001). Group assignments (β = 0.047, p = 0.413) and semester level (β = –0.037, p = 0.546) were not significant predictors. The model explained 52.9% of the variance (adjusted R^2 = 0.519). Diagnostics indicated no multicollinearity (VIFs < 2), normally distributed residuals, and no influential cases (maximum Cook's D < 4/N).

Table 5. Multiple regression predicting final exam scores

Predictor	B	SE B	β	t	*p* value
Constant	21.672	5.732	-	3.782	<0.001***
MT score	1.364	0.128	0.727	10.690	<0.001***
GA	0.205	0.248	0.047	0.820	0.413
Semester (2 vs. 4)	-1.077	1.791	-0.037	-0.606	0.546

(Note: R^2 = 0.529, adjusted R^2 = 0.519, F(3,155) = 58.11, p < 0.001*)*

The adjusted R^2 of 0.519 indicates that the model, while robust, leaves approximately 48% of variance in final examination scores unexplained. This residual variance likely reflects factors not captured in the current dataset, including non-cognitive attributes such as student motivation, self-regulated learning, academic resilience, and time management skills, all of which have been linked to pharmacy student performance in prior literature (Abubakar et al. 2021; Halimi et al. 2024; Masnan et al. 2025).

Beyond the unexplained variance, the nature of the midterm's predictive power is itself noteworthy. The midterm assessment covered Weeks 1 until 6, representing approximately 43% of the total course content, yet it strongly predicted performance in the final examination which assessed the full 14-week curriculum (β = 0.727, p < 0.001). This suggests that mastery of the earlier portion of the course, spanning the first six weeks of instruction across both teaching blocks serves as a reliable early signal of a student's capacity to engage with and succeed across the complete course. The predictive strength of the midterm therefore likely reflects not just content knowledge, but underlying academic competencies such as study skills, engagement, and pharmacological reasoning that persist and generalise across subsequent course content.

Interpretation and Implications

The superior performance of Semester 4 students reflects the benefit of prior pharmacology and pharmacotherapy exposure, which enhances readiness for advanced courses. This finding aligns with reports that sequential curriculum design supports cumulative knowledge development in pharmacy education (Etukakpan et al. 2023; Nezhad et al. 2024). This trend is consistent with educational research showing that student knowledge and perceptions are shaped by both curricular exposure and academic progression, as demonstrated in other domains such as pharmacovigilance (Mosleh et al. 2025). Consistent with Marcinak et al. (2018), our findings suggest that earlier curricular exposure to relevant content can improve students' confidence and readiness for applied pharmacotherapy.

The stronger performance of Semester 4 students may also be attributed to their concurrent enrolment in other pharmacotherapy modules, including those covering the central nervous system, gastrointestinal system, chemotherapeutics, dermatologicals, and immunologicals. This simultaneous reinforcement of therapeutic

concepts may have provided broader integration and application opportunities, contributing to their higher overall performance compared to Semester 2 students, who were only beginning their pharmacology foundation.

Interestingly, Semester 2 students achieved slightly higher group assignment scores (M = 42.38 vs. 40.91, p = 0.014). One interpretation is that junior students relied more heavily on peer collaboration to compensate for their limited individual pharmacological knowledge, a dynamic consistent with cooperative learning theory. However, an alternative and equally plausible explanation is that Semester 4 students were managing a substantially higher concurrent academic workload, including two additional pharmacotherapy modules, which may have constrained the time and effort they could devote to this single group assignment. Without data on time allocation, cognitive load, or individual contribution to group tasks, the collaboration hypothesis remains speculative. The lower group assignment scores among Semester 4 students should therefore not be interpreted as evidence of inferior collaborative skills. Regardless of the mechanism, group work was a weak predictor of final examination performance ($\beta = 0.047$, $p = 0.413$), which is expected by design given that the final exam assesses individual mastery rather than collaborative output.

The midterm test emerged as a strong predictor of final exam outcomes, highlighting the importance of early assessment as a diagnostic tool. This finding is supported by pharmacy education studies where regression analyses have demonstrated the predictive value of early performance indicators in anticipating later success (Lyons et al. 2020; Maerten-Rivera et al. 2022; Jegede et al. 2024). Educators could therefore use midterm results to identify at-risk students and implement remedial interventions before final examinations (Halimi et al. 2024; Masnan et al. 2025). The concentration of failures in Semester 2 underscores the need for bridging modules or scaffolded tutorials to support students who have not yet completed foundational pharmacology. Non-cognitive skills such as grit, resilience, and time management also likely contributed to differences in performance (Abubakar et al. 2021; Abubakar et al. 2022; Othman et al. 2023). Embedding training in these areas could improve readiness.

Overall, these results highlight the critical role of curriculum sequencing and targeted support for junior students. Aligning teaching strategies with student preparedness will be essential to improving outcomes in Malaysian pharmacy education (Paraidathathu et al. 2022; Othman et al. 2024). Similar to studies assessing pharmacy students' knowledge and perceptions in other disciplines (Mosleh et al. 2025), our findings underscore the need for early curriculum support to strengthen foundational understanding.

Strength and Limitations

This study contributes novel evidence by directly comparing the performance of junior (Semester 2) and senior (Semester 4) pharmacy students within the same pharmacotherapy course. The inclusion of multiple assessments (midterm, group assignment, final exam) provided a comprehensive view of academic outcomes, while the use of statistical methods including regression analysis allowed for the identification of strong predictors of performance. The relatively large sample size across two cohorts further strengthens the reliability of the findings. Furthermore, the sequential co-teaching structure, where both cohorts attended identical sessions delivered by the same two lecturers across designated topic blocks minimises the risk of differential instructional exposure confounding the between-cohort performance comparison.

Despite these strengths, several limitations should be acknowledged. First, this study was conducted in a single institution, which may limit the generalisability of results to other pharmacy programs or educational contexts.

Second, non-academic factors such as motivation, study habits, and external commitments were not examined, even though they may influence performance. Third, the focus on summative assessment scores does not fully reflect students' clinical reasoning or problem-solving abilities, which are vital in pharmacotherapy education.

Fourth, the cross-sectional comparison of two independent cohorts introduces inherent selection bias. Semester 4 students represent a filtered population that has successfully navigated two additional semesters of academic demands, whereas Semester 2 students include a broader mix of learners at an early stage of academic progression. Consequently, the performance advantage observed among senior students may partly reflect survivor effects that is, the attrition of lower-performing students across earlier semesters rather than solely

representing the benefits of prior pharmacological knowledge. Future longitudinal designs that track the same cohort across semesters would be better positioned to isolate the effect of curriculum exposure on performance growth.

Fifth, the regression model explained approximately 52% of the variance in final examination scores, leaving a substantial proportion unexplained. Non-cognitive variables such as grit, resilience, motivation, and study habits were not measured and could not be entered as covariates. Their absence limits the model's explanatory completeness and warrants measurement in future studies. Finally, qualitative insights from students and lecturers were not captured, which could have enriched the interpretation of the results. Therefore, future studies should adopt multi-institutional, longitudinal, and mixed-method designs to validate and extend these findings.

Implications for Practice

The findings of this study provide several implications for pharmacy education. First, the stronger performance of Semester 4 students highlights the importance of curriculum sequencing, suggesting that pharmacotherapy courses should ideally be offered after students acquire sufficient foundational pharmacology knowledge. Educators may consider adjusting course placement or providing bridging modules for junior students who lack prior exposure.

Second, the predictive value of midterm scores underscores the role of early assessments as diagnostic tools. Consistent with recent evidence, ongoing formative assessments and midterm tests can act as reliable early-warning indicators to identify students needing additional support (Veerasamy et al. 2022; Yağcı 2022). Instructors can use midterm results to identify at-risk students and implement timely interventions such as remedial classes, mentoring, or targeted academic support before the final examination. Implementing structured early-warning systems and remediation has been shown to reduce underperformance and inform policy in pharmacy education (Stratton 2022; Campbell et al. 2024).

Third, while group assignments are valuable for developing teamwork and communication skills, they demonstrated weak predictive validity for individual final examination performance ($\beta = 0.047$). This finding warrants a reconsideration of how group work is structured and weighted within the course. Several evidence-based modifications are worth exploring: (a) reducing the summative weighting of group assignments in favour of individually accountable tasks; (b) redesigning group assignments to include individual accountability components, such as individual reflection reports, peer evaluation scores, or individual oral defences of group outputs; or (c) repositioning group assignments as formative rather than summative tasks for junior cohorts, allowing peer learning benefits to be retained without disproportionately influencing the final grade. These modifications would align assessment design more closely with learning objectives that prioritise demonstrable individual mastery of therapeutic concepts.

Finally, given that non-cognitive skills such as grit, resilience, and time management are known to influence academic success, pharmacy programs should embed skill-building workshops and reflective learning activities into the curriculum to better prepare students for the demands of pharmacotherapy courses (Halimi et al. 2024; Masnan et al. 2025). Together, these implications support the need for a more structured and student-centred approach to pharmacotherapy education, tailored to the readiness level of students across different stages of their program. Curriculum sequencing should therefore not only consider the order of course delivery but also the workload balance across semesters, to ensure that junior students are not disadvantaged by insufficient prior knowledge while senior students are not overwhelmed by concurrent pharmacotherapy modules. Integrating foundational content earlier in the program, as demonstrated in pharmacogenomics education (Marcinak et al. 2018), may help strengthen competencies and better prepare students for subsequent pharmacotherapy modules.

CONCLUSION

This study compared the academic performance of junior (Semester 2) and senior (Semester 4) Diploma in Pharmacy students in a pharmacotherapy course. Semester 4 students achieved significantly higher scores in midterm, final examination, and overall performance, while Semester 2 students had a higher rate of failures.

The midterm assessment emerged as the strongest predictor of final examination outcomes, reinforcing the value of early assessments as diagnostic tools.

These findings highlight the importance of curriculum sequencing, prior pharmacology exposure, and early intervention strategies in shaping student success. Strengthening bridging support for junior students, incorporating structured early-warning systems, and embedding non-cognitive skills training may enhance readiness and performance in pharmacotherapy courses. Future research should extend this work through multi-institutional, longitudinal, and mixed-method studies to confirm these findings and explore the influence of non-academic factors on student achievement.

ACKNOWLEDGEMENT

The authors appreciate the support of UiTM Cawangan Pulau Pinang for facilitating the execution of this study. The authors used AI-assisted language editing tools to improve clarity and grammar during manuscript preparation. All intellectual content, interpretation of data and final decisions remain the responsibility of the authors. All authors reviewed and approved the final manuscript.

Conflict Of Interest

The authors declare that they have no conflicts of interest.

REFERENCES

1. Abubakar, U., Azli, N. A. S. M., Hashim, I. A., Kamarudin, N. F. A., Latiff, N. A. I. A., Badaruddin, A. R. M., Razak, M. Z. & Zaidan, N. A. (2021), Association between grit and academic achievement among pharmacy undergraduate students in Malaysia. Currents in Pharmacy Teaching and Learning, 13(5), 550–555. https://doi.org/10.1016/j.cptl.2021.01.013.
2. Abubakar, U., Salehudin, A. H. M., Asri, N. A. A. N. M., Rohi, N. A. M., Ramli, N. H., Khairuddin, N. I. M., Izham, N. F. S., Nasrullah, S. H. & Sa'ad, A. A. (2022). Perceptions of undergraduate pharmacy students towards online assessments used during the COVID-19 pandemic in a public university in Malaysia. Pharmacy Education, 22(1), 191-198. https://doi.org/10.46542/pe.2022.221.191198.
3. Campbell, A., Hinton, T., da Costa, N. C., O'Brian, S. E., Liang, D. R. & Wheate, N. J. (2024). Causes and outcomes of at-risk underperforming pharmacy students: implications for policy and practice. BMC Medical Education, 24, 421. https://doi.org/10.1186/s12909-024-05327-z
4. Etukakpan, A., Uzman, N., Ozer, O., Tofade, T., Leite, S. N., Joda, A., Choonara, Y., Mwila, C., Azzopardi, L. M., Mantel-Teeuwisse, A. K., Rahal, M., Darwish, R., Lee, B. J., Shakya, R., Gallagher, P. J., Moreau, P., Lourenço, L., McKinnon, R. A. & Altiere, R. J. (2023). Transforming pharmaceutical education: A needs-based global analysis for policy development. Exploratory Research in Clinical and Social Pharmacy, 9, 100234. https://doi.org/10.1016/j.rcsop.2023.100234
5. Halimi, S. N., Mirzaei, A., Rowett, D. & Luetsch, K. (2024). An investigation of academic resilience, resilience, and empathy in pharmacy students: Implications for pharmacy education. Pharmacy Education, 24(1), 226–237. https://doi.org/10.46542/pe.2024.241.226237.
6. Jegede, A. O., Olabanji, K. T. & Arolagbade, T. (2024). Exploring student perceptions: Factors influencing academic performance in a school of pharmacy in Nigeria. Pharmacy Education, 24(1), 238-247. https://doi.org/10.46542/pe.2024.241.238247.
7. Khurshid, F., O'Connor, E., Thompson, R., & Hegazi, I. (2023). Pedagogical interventions and their influences on university-level students learning pharmacology-a realist review. Frontiers in Education. https://doi.org/10.3389/feduc.2023.1190672
8. Lyons, K. M., Newman, M. C., Carlson, E. E. & Schneider, J. J. (2020). Predictors of pharmacy student performance on written examinations. American Journal of Pharmaceutical Education, 84(12), 777–784.
9. Maerten-Rivera, J. L., Medina, M. S., Joseph, J., Barnett, C. & Ballentine, J. E. (2022). Multi-institutional analysis of student and program factors as predictors of examination performance. American Journal of Pharmaceutical Education, 86(10), 1254–1261.

10. Marcinak, R., Paris, M. & Kinney, S. R. M. (2018). Pharmacogenomics education improves pharmacy student perceptions of their abilities and roles in its use. American Journal of Pharmaceutical Education, 82(9), 6424. https://doi.org/10.5688/ajpe6424.
11. Masnan, F., Rani, M. J. A., Alias, N. S., Esquivias, M. A., Shaari, M. S. & Kustiningsih, N. (2025). The role of sense of purpose, time management, attendance, sleep and self-esteem in academic performance among university students in Malaysia. Social Science & Humanities Open, 11, 101258. https://doi.org/10.1016/j.ssaho.2024.101258.
12. Mosleh, R., Ghanim, M., Khatib, A. O. A., Jarrar, Y., Hamdan, A., Balasmeh, R. & Shilbayeh, S. A. R. (2025). Assessment of knowledge and perceptions of pharmacy students toward pharmacovigilance activities, and their predictors: A cross-sectional study in Palestine. BMC Medical Education, 25, 1067. https://doi.org/10.1186/s12909-025-07575-z.
13. Nezhad, M. T., Shayanfar, A., Yaqoubi, S., Hamedeyazdan, S., Kazemi, M., Garjani, A. & Dizaji N. M. (2024). Implementation of an integrated pharmacy education system for pharmacy students: a controlled educational trial. BMC Medical Education, 24, 1272. https://doi.org/10.1186/s12909-024-06277-2.
14. Othman, M. I., Sulaiman, S. & Ismail, W. N. H. W. (2022). Forced online and distance learning during COVID-19 pandemic: Students' perceptions and experiences. Asian Journal of University Education, 18(4), 894-905.
15. Othman, M. I., Najib, M. N. M. & Sulaiman, S. (2024). Through the pharmacy lens: Unveiling students' insights into the curriculum. Asian People Journal, 7(2), 86–99.
16. Othman M. I., Najib, M. N. M. & Sulaiman, S. (2023). Forced transition into online assessments: Exploring perceptions and challenges amongst pharmacy students. International Journal of Modern Education, 5(17), 228-243.
17. Paraidathathu, T., Ploylearmsang, C. & Olson, P. S. (2022). The development and trends in pharmacy education across ASEAN countries. Isan Journal of Pharmaceutical Sciences, 18(1), 1–20.
18. Stratton, T. P., Janetski, B. K., Ray, M. E., Higginbotham, M. C., Lebovitz, L. & Martin, B. A. (2022). Detection of academic early warning signs and effective intervention "takes a village"'. American Journal of Pharmaceutical Education, 86(7), 8743. https://doi.org/10.5688/ajpe8743
19. Thanh-Thao, P. T., Song Ha, N. T., Thu Trang, T. T. & Vu Ha, D. (2024). Factors influencing pharmacy students' satisfaction with pharmacy education quality: A cross-sectional study at a private university in Vietnam. Pharmacy Education, 24(1), 818–828. doi: 10.46542/pe.2024.241.818828.
20. Thiagarajan, H., Jamshed, S., Suhaimi, A. M., Lua, P. L., & Ibrahim, U. I. (2023). A quantitative exploration of the knowledge of pharmacy and medical students about Pharmacogenetics: Findings from a public university in Malaysia. Pharmacy Education, 23(1), 723-731.
21. Veerasamy, A. K., Laakso, M-J. & D'Souza, D. (2022). Formative assessment tasks as indicators of student engagement for predicting at-risk students in programming courses. Informatics in Education, 21(2), 375–393. https://doi.org/10.15388/infedu.2022.15
22. Werners, A. & Fajt, V. R. (2021). What a veterinary graduate should know about basic and clinical pharmacology: A Delphi study to finalize day-1 competencies. Journal of Veterinary Pharmacology and Therapeutics, 44(4), 568–574. https://doi.org/10.1111/JVP.12920
23. Yağcı, M. (2022). Educational data mining: prediction of students' academic performance using machine learning algorithms. Smart Learning Environments, 9(11), 4. https://doi.org/10.1186/s40561-022-00192-z
24. Zainal, Z. A., Awang N. A. I. A., Redzuan, A. M., Huri, H. Z., Hashim, R. & Jamil, N. (2023). Health sciences students' readiness for interprofessional education (IPE) in Malaysia. Journal of Asian Association of Schools of Pharmacy, 12, 12–19.