




RESEARCH ARTICLE

Impact of curricular and institutional factors on Pharm.D. students' NAPLEX success: A comprehensive analysis of US pharmacy programmes

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Abstract

Background: Curricula and institutional factors in pharmacy schools play a pivotal role in shaping students' readiness for the North American Pharmacist Licensure Examination (NAPLEX). The factors that influence student success remain uncertain. This research explores the association between various aspects of pharmacy school curricula and NAPLEX pass rates. **Methods:** Data on various aspects of pharmacy programs across the United States were collected, including curricular structure and content. Multiple linear regression analysis was conducted to investigate the correlation of factors with NAPLEX pass rates. **Results:** The four-year programmes and research-focused institutions, with a curricular emphasis on practice management, pharmacology, pharmacotherapy, and APPE, had a positive relationship with NAPLEX pass rates. Focus on Pharmaceutical Calculations had a negative relationship with NAPLEX performance. All other factors were non-significant. **Conclusion:** This study provides valuable insights into the determinants of NAPLEX pass rates. It underscores the importance of a well-rounded curriculum and a balanced course selection to enhance student performance.

Introduction

The field of pharmacy education is dynamic and constantly evolving to adapt to the changing demands of the healthcare environment. The curriculum and course content offered by pharmacy schools in the United States (US) and worldwide play a crucial role in shaping the competence and preparedness of aspiring future pharmacists. The variations in curricula can significantly influence how pharmacy students perform on licensure exams like the North American Pharmacist Licensure Examination (NAPLEX). While pharmacy schools aim to improve their graduates' NAPLEX pass rates, it is indeed a challenging task. Despite these efforts, reliable indicators of NAPLEX success have not

been definitively identified at this point (Park *et al.*, 2021).

First-attempt NAPLEX pass rates have recently become a primary source of concern for colleges and schools of pharmacy, with national pass rates beginning to drop in 2014, with the most substantial drop occurring between 2015 and 2016 (Williams, 2017; Williams *et al.*, 2019). Following the decline in national pass rates, there has been much interest in identifying student exam achievement characteristics (Fiano *et al.*, 2022). Educators and institutions need to understand and comprehend the relationship between curriculum types, course contents, and the number of credit hours in each discipline and how they impact NAPLEX first-time pass rates.

Many schools consider the NAPLEX preparation programme essential to preparing students for success. However, little or no association exists between first-time NAPLEX pass rates and NAPLEX preparation programme characteristics (Fiano *et al.*, 2022; Sobieraj *et al.*, 2023). Researchers showed some correlation of NAPLEX pass rates with specific programme characteristics, such as the presence of academic health centres, multiple campuses, accreditation time of schools, programme structure and type, and student-to-faculty ratio. It has been recommended that individual programmes proactively and critically evaluate their educational programmes and the readiness of their students for the NAPLEX (Williams *et al.*, 2019; Ried *et al.*, 2022). The programmes' class size and public/private status have also been shown to influence student success (Jimenez *et al.*, 2019). Multiple course remediations have been found to negatively impact NAPLEX pass rates (Kane *et al.*, 2023), underscoring the significance of curriculum, content, and educational resources in addressing overall student success, including NAPLEX competencies.

Pharmacy schools may adopt varying curriculum models, including traditional didactic coursework emphasising fundamental science and pharmaceutical knowledge, team-based learning, and an integrated approach incorporating more hands-on or clinical experiences early in the programme. Pharmacy education differs significantly between institutions and geographical areas. These differences are reflected in course content, curriculum types, and credit hour distribution among different subject areas (Gleason *et al.*, 2013; Talasaz *et al.*, 2023). Understanding the strengths and weaknesses of varying curriculum types and contents is essential to assessing their impact on students' NAPLEX performance. It is also vital to ensure that the curriculum includes the necessary knowledge and skills required for pharmacy practice, aligning with the evolving healthcare landscape. The allocation of credit hours to different subjects or courses can influence the depth of knowledge. A balanced distribution of credit hours is essential to ensuring that students are adequately prepared for all aspects of the profession.

The assessment methods used within the curriculum can also affect how well students retain and apply their knowledge (Mort & Messerschmidt, 2001; Peterson *et al.*, 2011; Hein *et al.*, 2019). Frequent assessments, including practical exams and clinical rotations, can contribute to better preparation for licensure examinations, including the NAPLEX. Pharmacy schools should provide dedicated resources and support, including review courses, practice exams, and guidance on effective study strategies, to help students prepare for licensure exams. Collecting and analysing data on

NAPLEX scores and the performance of students from different programmes can help identify strengths and weaknesses in specific curricular elements and make data-driven improvements.

This study aims to investigate the relationships between curriculum types, course content, credit hour allocation, and first-time NAPLEX pass rates. It also aims to provide data-driven insights that can guide curricular decisions and improve the educational experiences of pharmacy students by carefully examining these variables. The overarching goal is to encourage further advancements in pharmacy education and the training of knowledgeable, competent pharmacists who meet the needs of future healthcare practice.

Methods

Design

As of July 2023, the information on the accredited US pharmacy programmes was collected from online public sources. NAPLEX pass rates were obtained from the National Board of Pharmacy (NABP) and ClinCalc websites (ClinCalc, 2023; NABP, 2023). During the summer of 2023, the above sources were searched to collect the following publicly available data for each US school or college of pharmacy: curricular structure; content and credit hours; programme structure (traditional four-year curriculum vs accelerated three-year curriculum); programme type (public vs private); research status (research-intensive vs teaching-focused); student diversity index for Autumn 2014-2018 enrolment classes; State and region of the school; and NAPLEX first-time pass rates for 2018-2022. The number of credits for all courses was obtained from each school's website, and each school's total number of credits was computed. The diversity index (DI) was calculated from the Student Enrolments data with ethnic breakdowns publicly available for AACP members on their institutional research site. The calculation was conducted by using the following formula [Simpson, 1949]:

$$DI = 1 - D; \quad D = \frac{\sum_1^7 n(n-1)}{N(N-1)}$$

In this equation, D = Simpson's Diversity Index; N = number of individuals in the total student population in all racial/ethnic groups; n = number of individuals in each racial group.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics 2023. Categorical variables were summarised

using frequencies and percentages, while continuous variables were summarised using means and standard deviations.

All categorical variables (region, state, programme duration, integrated curriculum, research or teaching, and public or private) and all continuous variables, including the number of credit hours in each area and each course, the total number of credit hours in each programme, and the diversity index, were included in the multiple linear regression analysis. Schools with research-based Ph.D. and/or MS programmes were research-focused, while schools with professional Pharm.D. degrees without research-based graduate programmes were teaching-focused. Only relevant or significant variables were reported in the result tables.

Results

The Accreditation Council for Pharmacy Education (ACPE) Standards 2016 Appendix 1 included a total of 37 subject areas in four core areas (not shown in the table): biomedical sciences, pharmaceutical sciences, social, administrative, and behavioural sciences, and clinical sciences (Accreditation Council for Pharmacy Education, 2015). Among all 135 schools evaluated, over 90% dedicated one or more credits to nine out of 37 content areas, i.e. medicinal chemistry, pharmaceuticals, pharmacology, biopharmaceuticals,

pharmacy law, professional communication, health information retrieval and evaluation, patient assessment, pharmacotherapy, and electives.

The content area with the highest average term credit hours (SCHs) allocated was pharmacotherapy, with an average of 27.7 SCHs, followed by pharmacology, with an average of 8.9 SCHs. All these subject areas and their credit hours were analysed to determine any correlation with the NAPLEX pass rate.

Table I contains a detailed breakdown of categorical variables relevant to pharmacy programmes, such as programme duration, integrated curriculum, regional location, research or teaching focus, and public or private status. It also displays the average NAPLEX first-time pass rates for these categories, giving a comprehensive picture of the characteristics and outcomes of the programmes under consideration. Integrated curricula were available in a slightly higher percentage of programmes, with 63% adopting this approach. The region with the highest NAPLEX average (91.29%) was the "Great Plains," while the lowest NAPLEX average was found in "New England" (81.10%). The distribution between programmes focusing on research (50.4%) and those emphasising teaching (49.6%) was relatively balanced. Additionally, there were slightly more private (51.9%) than public (48.1%) programmes. The majority of schools (57.8%) performed better than the national average on NAPLEX.

Table I: Frequencies and percentages of the important categorical variables

Variable	Category	Frequency	Percentage	NAPLEX average
Programme duration	3 Years	17	12.6	79.39
	4 Years	118	87.4	85.57
Integrated curriculum	No	49	36.3	85.30
	Yes	85	63.0	84.49
Region	New England	16	11.9	81.10
	Mid-Atlantic	19	14.1	83.62
	South	27	20.0	84.92
	Midwest	22	16.3	85.50
	Great Plains	8	5.9	91.29
	Rocky Mountains	17	12.6	85.75
	Southwest	7	5.2	86.35
	West Coast	19	14.1	83.94
Research or teaching	Teaching	67	49.6	81.30
	Research	68	50.4	88.26
Public or private	Private	70	51.9	82.00
	Public	65	48.1	87.82
NAPLEX first-time pass rate (%)	<National average	57	42.2	77.46
	> National average	78	57.8	90.20

Table II summarises the average credit hours for each core subject area. It includes multiple linear regression analysis results for selected subject areas, other significant variables, and the corresponding *p*-values at 95% confidence intervals (CI). The average NAPLEX first-time pass rates for 2018–2022 ranged from 59.1 to 97.3, with a mean of 84.81±7.90. Schools with a strong emphasis on courses such as pharmacology, pharmacotherapy, practice management, and APPE had a positive effect.

In contrast, schools with a strong emphasis on pharmaceutical calculations appeared to have a negative impact on NAPLEX performance. No

significant correlation was observed with other specific or core subject areas. Moreover, the total SCHs required to complete the degree programme, spanning from 124 to 169, did not significantly influence NAPLEX scores.

As per Table II, pharmacy programme duration was a significant predictor of NAPLEX scores. Students in 4-year programmes tended to perform better on the NAPLEX than those in 3-year programmes. Also, research-focused institutions substantially influence NAPLEX scores with better performance. Integrated vs non-integrated curriculum was not significantly associated with NAPLEX score outcomes.

Table II: Average credit hours for core subject areas of Appendix 1 of ACPE Standards 2016, multiple linear regression analysis of selected variables in Doctor of Pharmacy curricula (N=135)

Core subject area	Min credit	Max credit	Mean ± (SD)	B	P-value (95% CI)
Pharmaceutical calculations	0.00	8.00	1.66 (1.35)	-1.483	.026 (-2.785&-.181)
Practice management	0.00	12	2.72(1.78)	1.397	.004(.469&2.325)
Pharmacology	0.00	20.0	8.86(3.35)	.714	.005(.219&1.208)
Pharmacotherapy	13	55.00	27.73(7.62)	.396	.003(.138&.655)
APPE	24	66.00	38.38(4.96)	.411	.005(.129&.693)
Electives	0.00	17.3	6.85 (3.15)	.460	.098 (-.087& 1.006)
Grand total credits	123.7	169.0	145.9 (8.62)	.058	.689(-227&348)
Diversity index	10.26	76.75	53.96 (13.87)	-.074	.205 (-.190&.041)
NAPLEX first-time pass rate	59.1	97.3	84.81 (7.90)	NA	NA
4-year programme	NA	NA	NA	8.022	.002(3.057&12.987)
Fully integrated	NA	NA	NA	-1.703	.342(-5.250&1.843)
Public or private	NA	NA	NA	-.306	.893(4.830&4.218)
Research or teaching	NA	NA	NA	6.910	.003(2.487&11.333)

ACPE=Accreditation Council for Pharmacy Education; No credit may mean the courses are integrated within other areas or are taught as part of pre-pharmacy course requirements.

Discussion

This study investigated the relationship between curricular variables, institutional characteristics, and first-time NAPLEX pass rates in pharmacy schools and colleges nationwide.

Maintaining a current curriculum that equips students for entry into pharmacy practice is an ongoing issue for all Pharm.D. programmes recognised by ACPE (Lloyd, 2020). Programmes need to re-evaluate how much time should be spent on a given subject in light of changing practice roles every time curricula are updated (Talasaz *et al.*, 2023). They must decide which material to cut each time new information is added to the curriculum to keep students from becoming overwhelmed and avoid curricular hoarding (Romanelli, 2020). Several schools have taken

measures to incorporate competency-based education and integrated courses as the field has developed toward a more complicated practice role for pharmacists (Talasaz *et al.*, 2023).

The findings of this study show the average credit hours allotted to core subject areas, elective courses, and experiential education in Doctor of Pharmacy programmes and the related average first-time NAPLEX pass rates. While biomedical, pharmaceutical, social and administrative, and clinical sciences, which require various credit hours, reflect the range of educational designs, the allocation of a significant number of credit hours for experiential education emphasises the critical importance of the latter in pharmacy education.

The average NAPLEX pass rate across all universities was a solid 84.81%. It is essential to highlight the differences between institutions in programme

duration, integrated curriculum, geographic region, concentration on research or teaching, and public or private status. One notable finding is the disparity in NAPLEX pass rates across colleges offering 3-year and 4-year programmes. Students enrolled in 4-year programmes had a higher average NAPLEX pass rate (85.57%) than those in 3-year programmes (79.39%). The multiple linear regression analysis of programme duration and NAPLEX scores showed statistically significant results ($p < 0.05$), indicating an association between the two variables, consistent with previous findings (Williams *et al.*, 2019). However, the analysis of fully integrated curricula and public vs private schools did not yield statistically significant results, in contrast with the conclusions of other studies (Jimenez *et al.*, 2019; Williams *et al.*, 2019).

The analysis of research vs teaching-focused institutions yielded highly significant results, with students in research-focused institutions performing significantly better in NAPLEX. Although research activities may not directly educate Pharm.D. students or align with the NAPLEX blueprint, the positive correlation may highlight enhanced institutional resources, faculty expertise, and elective opportunities. These factors can collectively contribute to improved educational experiences across various areas, potentially leading to better overall performance.

Only pharmaceutical calculations, pharmacology, pharmacotherapy, practice management, and APPE were significant in the regression analysis that examined the means of NAPLEX scores and all pharmacy courses and domains. For instance, schools that allocated more credits to pharmaceutical calculations tended to perform lower on NAPLEX, suggesting their oversight of the importance of other topics. The emphasis on calculations without in-depth study of other areas may contribute to students' lower performance at NAPLEX. Electives offer students flexibility to tailor their education according to their interests, career goals, and specialisations, which might help students choose the courses they need to fill the gap in knowledge in these areas; however, it was not significant.

Multiple subject areas substantially influence NAPLEX performance, suggesting that it is not a single subject that is crucial for student success but a balanced course offering. Overall, this study could provide valuable insights into the factors influencing NAPLEX pass rates in pharmacy schools and colleges across the US.

Some of the main findings and implications from the study are:

1. Curriculum design and credit hours. This study highlighted the variability in the number of credit hours allocated to core subject areas such as biomedical,

pharmaceutical, social administrative, clinical sciences, and experiential education. It also underscored the importance of experiential education in pharmacy programmes.

2. Programme duration. This study revealed a significant difference in NAPLEX pass rates between 3-year and 4-year pharmacy programmes, with the latter having higher pass rates, suggesting that more extended, comprehensive programmes may better prepare students for the NAPLEX.

3. Integrated curriculum. This study indicates that the level of integration within the curriculum does not significantly affect NAPLEX scores, suggesting that the curriculum format (integrated or not) does not necessarily correlate with student performance.

4. Public vs private institutions. This study could not find differences in NAPLEX pass rates between public and private institutions.

5. Research focus. This study found a positive association between institutions prioritising research activities and higher NAPLEX pass rates, suggesting the potential benefit of improved institutional resources, faculty expertise, elective opportunities, and educational experiences in multiple areas in contributing to better performance.

6. Course specifics. Some courses like pharmaceutical calculations, pharmacology, pharmacotherapy, practice management, and APPE were significantly associated with variations in NAPLEX scores. While other subject areas were positively correlated with NAPLEX performance, pharmaceutical calculations content was negatively associated with NAPLEX performance, indicating that a more balanced curriculum might be beneficial.

Future directions

While these findings provide valuable insights, they represent correlations rather than causations. Further research would be necessary to establish causal relationships and better understand the underlying factors influencing NAPLEX pass rates.

However, these findings can serve as a starting point for institutions to consider improving NAPLEX pass rates, potentially by adjusting their curriculum, programme duration, or other factors to better prepare students for this critical examination. They also offer a roadmap for enhancing the quality of pharmacy education and ensuring that future pharmacists are well-prepared for their roles in the healthcare industry. Collaborative efforts between schools and colleges of pharmacy may help refine these findings and continue improving the quality of pharmacy education.

Limitations

This research has a few limitations. First, it did not include all schools, as not all provide their complete curriculum on their website. Nonetheless, the participating schools were evenly split between private (51.9%) and public (48.1%) schools, mirroring the national distribution (52% private, 48% public) (AACP, 2023). Second, the data collection relied on publicly accessible websites, assuming that each school's webpage is regularly updated, which may not be the case for all schools. Third, publicly available data and course descriptions were used to determine credit allocations for each content area. Integrated courses covering various subject areas were assessed by the authors and were not validated by contacting school-specific personnel.

Conclusion

This comprehensive study offers a valuable understanding of the multiple factors associated with NAPLEX pass rates in Pharm.D. programmes, including programme duration, research or teaching focus, and specific courses. These findings are valuable for pharmacy schools and institutions as they consider curriculum design, programme duration, research integration, and the importance of particular courses to improve student preparedness for the NAPLEX. However, it is imperative to reiterate that these findings represent correlations, and further research is needed to determine causal relationships and explore other potential factors that can influence NAPLEX performance.

Ethics approval and informed consent

Exempt #23-033 University of Charleston IRB.

Conflict of interest

The authors declare no conflict of interest.

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