

RESEARCH ARTICLE

Pharmacy students' confidence, perceived importance, and skills application in Management, Innovation, Leadership, and Entrepreneurship (MILE): A single-institution study

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Abstract

Background: As pharmacists assume increasingly complex roles within healthcare systems, competencies in management, innovation, leadership, and entrepreneurship (MILE) have become increasingly important. However, evidence informing the effective integration of these domains into pharmacy education remains limited. This study evaluated the impact of a MILE capstone course on pharmacy students' confidence, perceived importance, and anticipated application of MILE-related skills. **Methods:** A one-group pretest-posttest educational evaluation was conducted among fourth-year pharmacy students enrolled in a required MILE capstone course. Anonymous pre-course and post-course surveys assessed confidence in MILE knowledge, perceived importance of MILE competencies, anticipated future skill use, and course expectations. Descriptive statistics, thematic analysis, and Mann-Whitney U tests were used to analyse the data. **Results:** Of 70 eligible students, 54 completed the pre-course survey, and 50 completed the post-course survey. Post-course respondents reported significantly greater confidence in management, innovation, leadership, and entrepreneurship knowledge and a higher likelihood of applying these skills in future practice. The largest improvements were observed in innovation and entrepreneurship. Perceived importance remained high and unchanged. Most respondents (78%) reported that the course met their expectations. **Conclusion:** The MILE course was associated with increased confidence and perceived applicability of key professional competencies, supporting the integration of MILE-focused learning experiences within pharmacy curricula.

Introduction

The role of pharmacists has expanded considerably beyond dispensing medications to encompass a broader set of administrative and organisational responsibilities. While clinical care remains their central focus, pharmacists are increasingly expected to contribute to the operational and strategic functioning of pharmacy practice settings. The Center for the Advancement of Pharmacy Education (CAPE) Educational Outcomes reflect this shift, calling for

pharmacy graduates to develop competencies in management (Domain 2.2: Medication Use Systems Management), leadership (Domain 4.2: Leadership), and innovation and entrepreneurship (Domain 4.3: Innovation and Entrepreneurship) alongside clinical expertise (Medina et al., 2013). These competencies represent educational priorities that were not previously emphasised in pharmacy curricula, marking a deliberate expansion beyond traditional clinical training (Medina et al., 2013).

Building on this foundation, pharmacy education organisations have introduced further guiding standards to help curriculum committees translate these priorities into practice. The Accreditation Council for Pharmacy Education (ACPE) Standards 2025 emphasise preparing graduates to serve as effective leaders, managers, and innovators within evolving healthcare systems, with particular attention to organisational structure, strategic planning, project and personnel management, and decision-making. ACPE encourages schools to cultivate leadership through both didactic and experiential learning, giving students opportunities for self-assessment, initiative-taking, and interprofessional collaboration (Accreditation Council for Pharmacy Education, 2024). The standards similarly call for graduates to develop an entrepreneurial mindset capable of designing and implementing innovative care models and optimising medication use systems, with curricula expected to foster creative problem-solving and adaptability in identifying and addressing gaps in healthcare delivery (Accreditation Council for Pharmacy Education, 2024).

In response to these evolving expectations, pharmacy curricula have increasingly incorporated content on management, leadership, innovation, and entrepreneurship (Davey et al., 2022; Khanfar et al., 2022; Mattingly et al., 2019a; Mattingly et al., 2019b). This shift is reflected in the growing number of dual-degree programmes, such as PharmD/MBA and PharmD/MHA, which pair clinical training with formal business and healthcare administration education (Gortney et al., 2013; Islam et al., 2016a; Salmon & Fan, 2019). Many schools have also developed dedicated training programmes, specialty tracks, or certifications in these areas (Afeli & Adunlin, 2022; Bechtol, 2022; Islam et al., 2016b; Wilson et al., 2021). Furthermore, organisations such as the American Society of Health-System Pharmacists, Academy of Managed Care Pharmacy, and American College of Clinical Pharmacy offer Advanced Pharmacy Practice Experiences (APPEs) rotations focused on leadership, management, and administration (Academy of Managed Care Pharmacy, 2024; American College of Clinical Pharmacy, 2025; ASHP, n.d.).

Despite this growth, the literature offers limited evidence on best practices for teaching and developing competencies in management, innovation, leadership, and entrepreneurship (MILE), underscoring the need for scholarly exchange and evidence-based strategies to strengthen their integration into pharmacy curricula. This study addresses that gap by assessing the confidence,

perceived importance, and practical application of management, innovation, leadership, and entrepreneurship skills among fourth-year pharmacy students. In doing so, it aims to deepen understanding of pharmacy students' awareness and competency in these areas across the United States and to identify where educational or training interventions may be needed.

Methods

Curricular framework for pharmacy administration education

The School of Pharmacy at which this study was conducted implemented its "Practice and Team Ready Curriculum" in the fall of 2021. A distinctive component of the curriculum is its focus on practice and team readiness. One of the key innovations of the curriculum is the early start of APPEs, which begin in late February of the third professional year rather than in the fourth year, as was the case in the previous curriculum.

In addition to enabling earlier placement in practice settings, the curriculum allocates time for fourth-year students to return to campus and complete the Management, Innovation, Leadership, and Entrepreneurship (MILE) capstone course, designed to support their transition to professional practice. Overall, the curriculum is structured to develop exemplary pharmacists who are ready to lead, innovate, and collaborate within the healthcare system.

Pharmacy administration is a significant part of the PharmD Practice and Team Ready Curriculum, covering various aspects of managing and leading pharmacy operations. Required courses in pharmacy administration include Pharmacy Financial Management and Pharmacoeconomics, offered in the spring semester of Year 2; Human Resource Management, offered in the spring semester of Year 3; and a Capstone course on Management, Innovation, Leadership, and Entrepreneurship, provided in the spring semester of Year 4. A Pharmacy Business and Innovation Laboratory is offered during the spring semester of the second professional year. The laboratory provides a dedicated environment for students to develop innovative ideas, technologies, and solutions that address challenges and opportunities in pharmacy practice. Pharmacy administration electives include courses such as Leadership in Pharmacy Practice, Managed Care Pharmacy, Advanced Pharmacoeconomics, and

Independent Pharmacy Business Plan Development. The curriculum employs progressively sequenced integration in pharmacy administration education, ensuring that content and skills become more advanced and complex as students progress through each stage. Repeated learning experiences and spaced repetition in the curriculum are essential for student pharmacists to develop and strengthen their management, innovation, leadership, and entrepreneurial skills.

MILE capstone course description

This section does not examine the course content or instructional methods; rather, it offers a brief overview of the course. The Capstone 'Management, Innovation, Leadership, and Entrepreneurship (MILE)' course aims to equip students to engage in pharmacy and healthcare business ventures, contribute to innovative care delivery models, and manage clinical pharmacy practice. The MILE is a one-credit-hour, five-week course conducted during the spring semester of the fourth year, typically between March and April. The course builds foundational knowledge from the pharmacy curriculum, including financial management, pharmacoeconomics, human resource management, communications, and experiential learning. Thus, the MILE course was designed to build on the previous three years of didactic coursework by engaging students in activities and experiences that allow them to practice, refine, and further develop their management, innovation, leadership, and entrepreneurial skills.

This course is taught collaboratively by two faculty members with complementary expertise in pharmacy education and practice, sharing teaching and instructional responsibilities. One instructor holds a PhD in Pharmacy Administration with expertise in management, leadership, innovation, entrepreneurship, and health services research, while the other is a clinical pharmacist with experience in pharmacy practice, patient care, professional education, and leadership, providing complementary administrative and practice-based perspectives that informed the design and delivery of the educational intervention.

The course uses a blended pedagogical approach to enhance student learning and engagement, combining didactic instruction with active learning. Students attend two weekly sessions of 1 hour and 15 minutes each, consisting of a lecture on Mondays and an active learning session on Wednesdays. In the Monday lecture, foundational concepts and theoretical frameworks are introduced through direct instruction and guided discussions that

promote critical thinking. Wednesday sessions are interactive and application-focused, featuring group work, case studies, problem-solving exercises, and hands-on projects. The course utilises vodcasts presented by local pharmacy experts to provide in-depth insights into each area of specialty. This combination supports diverse learning styles and encourages deeper understanding through active participation and practical application.

Study design

This one-group pretest-posttest educational evaluation study used a structured online pre- and post-course questionnaire as the primary tool for data collection. The survey was carried out during the spring 2025 semester. The pre-survey was administered one week prior to the start of the course and remained open for seven days. The post-survey was launched on the final day of the course and was also available for seven days. Two reminder emails were sent at regular intervals to encourage students to complete the surveys before the closing dates. The pre- and post-surveys consisted of seven questions: six closed-ended Likert scales and one open-ended question. The Likert scale questions used a five-point scale, from "not at all confident" to "extremely confident," to assess student confidence in the topics covered in the MILE course and their perceptions of the importance of these topics. The open-ended question asked students to share their expectations for the course. The two course instructors reviewed the instrument for functionality, phrasing, and content validity. A faculty member not involved in teaching the course then conducted an independent review of item clarity, relevance, and appropriateness, and their feedback was incorporated before the survey was administered.

Data collection

All eligible fourth-year students enrolled in the MILE course were invited to participate in the study. The School of Pharmacy offers a variety of PharmD dual-degree options designed to enhance students' expertise and expand their career opportunities. Through credit-sharing structures, students pursuing the PharmD/MBA (Master of Business Administration) and PharmD/MHA (Master of Healthcare Administration) programmes are exempt from completing the MILE course, resulting in a total of 70 students eligible to participate in the survey. Participation was entirely voluntary, the survey was anonymous, and no personal identifiers were collected. To preserve participant anonymity, pre- and post-survey responses were not matched at the

individual level. An ideal sample size of 62 participants was calculated a priori, based on a 95% confidence level and a 5% margin of error (QualtricsXM, 2025). Consent information, documenting the risks and benefits of participation in the research, was distributed with the survey, and completion implied voluntary, informed consent. The survey was distributed to participants by email using the Qualtrics Survey Tool (Qualtrics, Provo, UT, USA). This study was reviewed and approved by the University's Institutional Review Board (Reference number: EXMT-P-25-SUM-9).

Data analysis

Descriptive statistics were used to summarise participant responses to all survey items. For Likert-scale questions, frequencies, percentages, means, and standard deviations were calculated to describe students' confidence, perceived importance, and anticipated application of MILE concepts.

Because survey responses were collected anonymously and pre- and post-course responses were not linked at the individual level, the pre-course and post-course datasets were treated as independent samples. Accordingly, inferential comparisons between pre-course and post-course responses were conducted using the Mann–Whitney U test, a nonparametric test appropriate for comparing ordinal outcomes between two independent groups. Statistical significance was established a priori at $p < 0.05$.

Effect sizes were calculated using the standardised effect size statistic (r), derived from the Mann–Whitney U test, to evaluate the magnitude of observed differences. Effect sizes were interpreted using conventional benchmarks, with r values less than 0.10 considered negligible, 0.10 to <0.30 considered small, 0.30 to <0.50 considered medium, and ≥ 0.50 considered large. All quantitative analyses were conducted using IBM SPSS Statistics (Version 30; IBM Corp., Armonk, NY, USA). Responses to the open-ended survey questions were analysed using qualitative content analysis. Written responses were reviewed iteratively to identify recurring concepts and patterns. Initial codes were developed from the data and subsequently grouped into broader categories and themes. The final themes identified through qualitative content analysis were

synthesised into thematic network maps. Microsoft Copilot was used to generate the visual representation, which illustrated the relationships among the themes.

Ethics approval and informed consent

This study was conducted in accordance with the ethical standards set forth by the Samford University Institutional Review Board and received an exemption under exemption number (EXMT-P-25-SUM-9). Participation was entirely voluntary, and participants were provided with detailed information regarding the study's purpose, procedures, potential risks, and benefits.

Results

Descriptive statistics

For the calculation of descriptive statistics, missing values for any given question were handled by excluding them from the specific calculation for that variable. This ensures that the summary statistics reflect only valid responses. As shown in Table 1, the descriptive statistics show a consistent upward pattern from pre-course to post-course responses across most domains. For the confidence-related items, pre-course means were generally in the low-to-moderate range, whereas post-course means shifted toward the higher end of the scale. This suggests that students completed the course with greater confidence in their knowledge of management, innovation, leadership, and entrepreneurship. In contrast, ratings for the perceived importance of these topics were already high before the course began and remained high afterwards, indicating that students entered the course with an established belief that these skills are important for pharmacy practice. For anticipated practical application, the post-course distribution also moved upward, implying that students not only felt more knowledgeable but also more likely to use these competencies in their future professional roles. The standalone post-course item assessing whether the module met expectations produced a high mean and a median in the top category, indicating strong overall satisfaction with the educational experience.

Table I: Descriptive statistics of self-reported confidence, perceived importance, skill application, and expectations related to MILE (n=54 pre-course, n=50 post-course)

Question	N ^e	Mean	Median	SD ^f	Min	Max
Q1_Pre.How confident are you in your knowledge of management aspects of pharmacy? ^a	54	2.8	3.0	0.76	1	4
Q1_Post.How confident are you in your knowledge of management aspects of pharmacy? ^a	50	3.96	4.0	0.92	2	5
Q2_Pre.How confident are you in your knowledge of innovation aspects of pharmacy? ^a	54	2.41	2.0	0.92	1	5
Q2_Post.How confident are you in your knowledge of innovation aspects of pharmacy? ^a	50	3.96	4.0	0.9	2	5
Q3_Pre.How confident are you in your knowledge of leadership aspects of pharmacy? ^a	54	3.37	3.0	0.9	1	5
Q3_Post.How confident are you in your knowledge of leadership aspects of pharmacy? ^a	50	3.96	4.0	0.83	2	5
Q4_Pre.How confident are you in your knowledge of entrepreneurship aspects of pharmacy? ^a	54	2.46	3.0	1.08	1	4
Q4_Post.How confident are you in your knowledge of entrepreneurship aspects of pharmacy? ^a	50	3.94	4.0	0.91	2	5
Q5_Pre.How important do you think it is for new pharmacy practitioners to understand pharmacy management, innovation, leadership, and entrepreneurship? ^b	54	3.85	4.0	1.02	2	5
Q5_Post.How important do you think it is for new pharmacy practitioners to understand pharmacy management, innovation, leadership, and entrepreneurship? ^b	50	4.1	4.0	0.86	2	5
Q6_Pre.Based on your anticipated employment, how likely are you to use skills in management, innovation, leadership, and entrepreneurship? ^{ch}	54	3.94	4.0	0.96	1	5
Q6_Post.Based on your anticipated employment, how likely are you to use skills in management, innovation, leadership, and entrepreneurship? ^{ch}	49	4.43	5.0	0.68	3	5
Q7_Post.Did the capstone module on pharmacy management, innovation, leadership, and entrepreneurship meet your expectations? ^{d*}	50	4.56	5.0	0.84	3	5

^a Confidence level items were measured with a 5-point Likert type scale (1=not at all confident to 5=extremely confident).

^b Importance level items were measured with a 5-point Likert type scale (1 = not at all important to 5=extremely important).

^c Skill application level items were measured with a 5-point Likert type scale (1= not at all likely to 5 = extremely likely).

^d Expectation level items were measured with a 5-point Likert type scale (1= Did not meet expectations to 5 = completely met expectations).

^e N = the number of valid (non-missing) responses; Mean = arithmetic average of responses; Median = middle score.

^f SD= sample standard deviation; Min / Max = observed range.

^h n = 49

* Q7_Post, did not have a corresponding pre-course survey item.

Inferential analysis of pre- and post-course changes

As shown in Table II, statistically significant differences were observed for self-reported confidence in MILE knowledge items (Q1-Q4) and perceived likelihood of

using MILE skills (Q6), indicating that post-course responses were meaningfully higher than pre-course responses on these items.

Table II: Pre- and post-course changes in confidence, perceived importance, and skill application related to MILE (N=54 pre-course, N=50 post-course)

Question	Pre mean	Post mean	Mean difference	U	p-value	Effect size r
Q1. Confidence in Management	2.8	3.96	1.16	500.5	< .001	0.542
Q2. Confidence in Innovation	2.41	3.96	1.55	348.5	< .001	0.639
Q3. Confidence in Leadership	3.37	3.96	0.59	882.0	0.001	0.299
Q4. Confidence in Entrepreneurship	2.46	3.94	1.48	447.0	< .001	0.576
Q5. Importance of MILE for Practitioners	3.85	4.1	0.25	1182.0	0.247	0.107
Q6. Likelihood of Using MILE Skills ^h	3.94	4.43	0.48	947.5	0.008	0.244

^a Confidence level items were measured with a 5-point Likert type scale (1=not at all confident to 5=extremely confident).

^b Importance level items were measured with a 5-point Likert type scale (1 = not at all important to 5=extremely important).

^c Skill application level items were measured with a 5-point Likert type scale (1= not at all likely to 5 = extremely likely).

^h n=49

Students who completed the post-course survey reported significantly higher confidence in their knowledge of pharmacy management than students who completed the pre-course survey (mean difference = 1.16; $U = 500.5$, $p < 0.001$). The large effect size ($r = 0.542$) suggests that the difference was not only statistically significant but also educationally meaningful. These findings indicate that the course was strongly associated with improved confidence in management-related concepts and skills. Confidence in innovation demonstrated the largest observed increase across all study variables. Post-course respondents reported substantially higher confidence than pre-course respondents (mean difference = 1.55; $U = 348.5$, $p < 0.001$), with a large effect size ($r = 0.639$). This finding suggests that innovation may represent an area in which students initially feel less prepared but experience substantial gains following targeted instruction and exposure. Leadership confidence was significantly higher among post-course respondents compared with pre-course respondents (mean difference = 0.59; $U = 882.0$, $p = 0.001$). However, the effect size was moderate ($r = 0.299$), indicating a somewhat smaller magnitude of improvement relative to the other confidence domains. This pattern may reflect higher baseline familiarity with leadership concepts compared with innovation or entrepreneurship. Entrepreneurship confidence increased significantly following course completion (mean difference = 1.48; $U = 447.0$, $p < 0.001$), with a large effect size ($r = 0.576$). These results suggest that students perceived notable gains in their understanding of entrepreneurial concepts and their ability to engage with business-related opportunities in

pharmacy practice. Although post-course respondents reported slightly higher ratings of perceived importance than pre-course respondents, the difference was not statistically significant (mean difference = 0.25; $U = 1182.0$, $p = 0.247$). The small effect size ($r = 0.107$) indicates minimal practical change. This finding likely reflects a ceiling effect, as students entered the course with already high perceptions regarding the importance of management, innovation, leadership, and entrepreneurship in pharmacy practice. Students completing the post-course survey reported a significantly greater likelihood of applying MILE-related skills in their future professional roles compared with pre-course respondents (mean difference = 0.48; $U = 947.5$, $p = 0.008$). Although the effect size was small to moderate ($r = 0.244$), the finding suggests that the course strengthened students' perceptions of the practical relevance and future utility of these competencies.

Figure 1 visually reinforces the inferential results. For most items, the post-course distributions are shifted upward relative to the pre-course distributions, indicating that higher response categories were selected more often after the course. The separation appears especially pronounced for innovation, management, and entrepreneurship confidence, which is consistent with the larger effect sizes observed for those domains. The more modest shift for leadership and future application corresponds to their smaller effect sizes, while the relative overlap for perceived importance is consistent with the absence of a statistically significant difference.

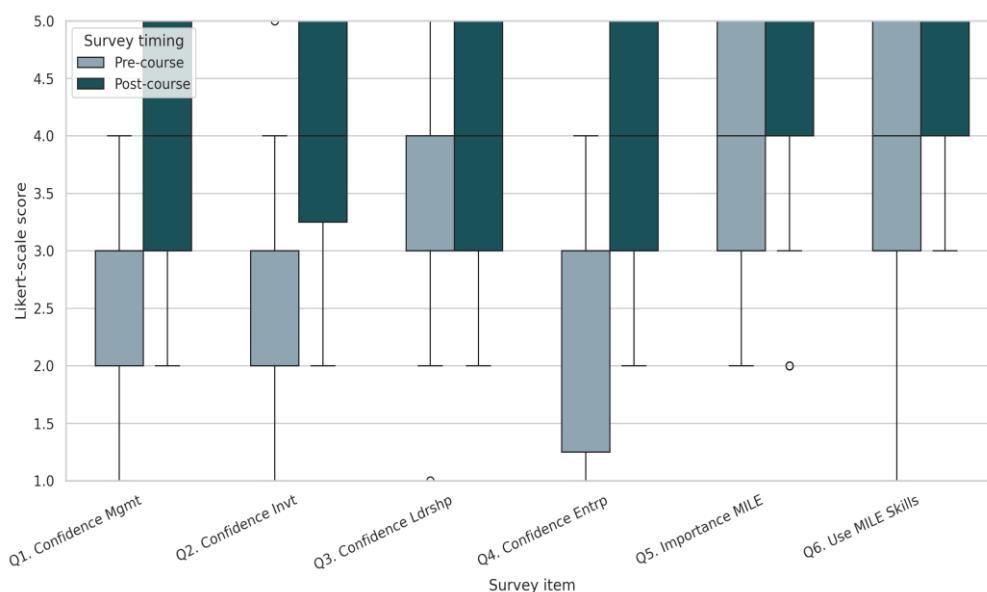


Figure 1: Distribution of pre- and post-course scores changes in confidence, perceived importance, and skill application related to MILE (N=54 pre-course, N=50 post-course)

Thematic analysis

The thematic map (Figure 2) illustrates the interconnected expectations students had before the commencement of the MILE course. Five central themes emerged: practical application, innovation, leadership, entrepreneurship, and career preparation. Each theme is linked to specific subthemes that provide further insight into students' aspirations. For example, students expressed a desire to gain hands-on skills for managing a pharmacy, learn innovative strategies to

improve access to care, develop leadership abilities to drive change, cultivate an entrepreneurial mindset to create new services or products, and acquire tools to advance their careers. The map highlights how these themes are not isolated but are perceived by students as complementary and mutually reinforcing. This underscores the importance of an integrated curricular approach that equips future pharmacists with the practical, strategic, and leadership competencies needed to thrive in a dynamic healthcare environment.

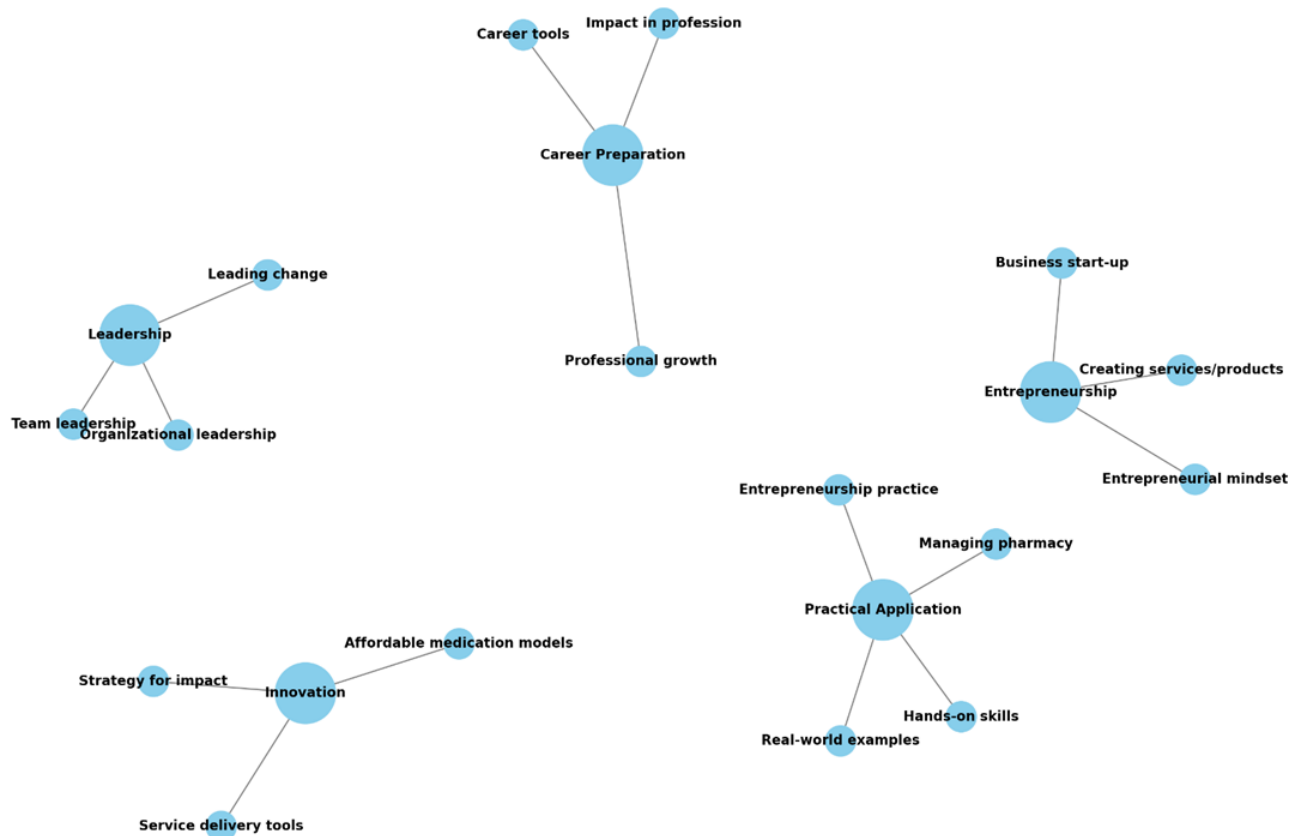


Figure 2: Thematic map of student expectations for the MILE course (pre-course)

The thematic map (Figure 3) visually represents key themes and their connections derived from participant feedback after course completion. The thematic analysis of open-ended responses revealed five major themes: expectation versus reality, workload and time management, learning resources and delivery, leadership content, and value and preparedness. The analysis highlights a desire for a better balance between in-class activities and heavy out-of-class assignments, emphasising the importance of a manageable workload and structured delivery. Participants valued the practical skills gained, particularly in management, leadership, and entrepreneurship. There was a strong preference for

content that is relevant and innovative, especially focused on real-world leadership, while general content was viewed less favourably. Responses were mixed regarding instructional delivery, with some appreciating the inclusion of guest speakers and learning materials, while others desired more structured lectures. Additionally, the usefulness of practical resources, tools, and readings was positively noted. Overall, the feedback suggests maintaining strengths in skills development and resource provision while addressing workload balance and increasing interactive engagement to improve the learning experience.

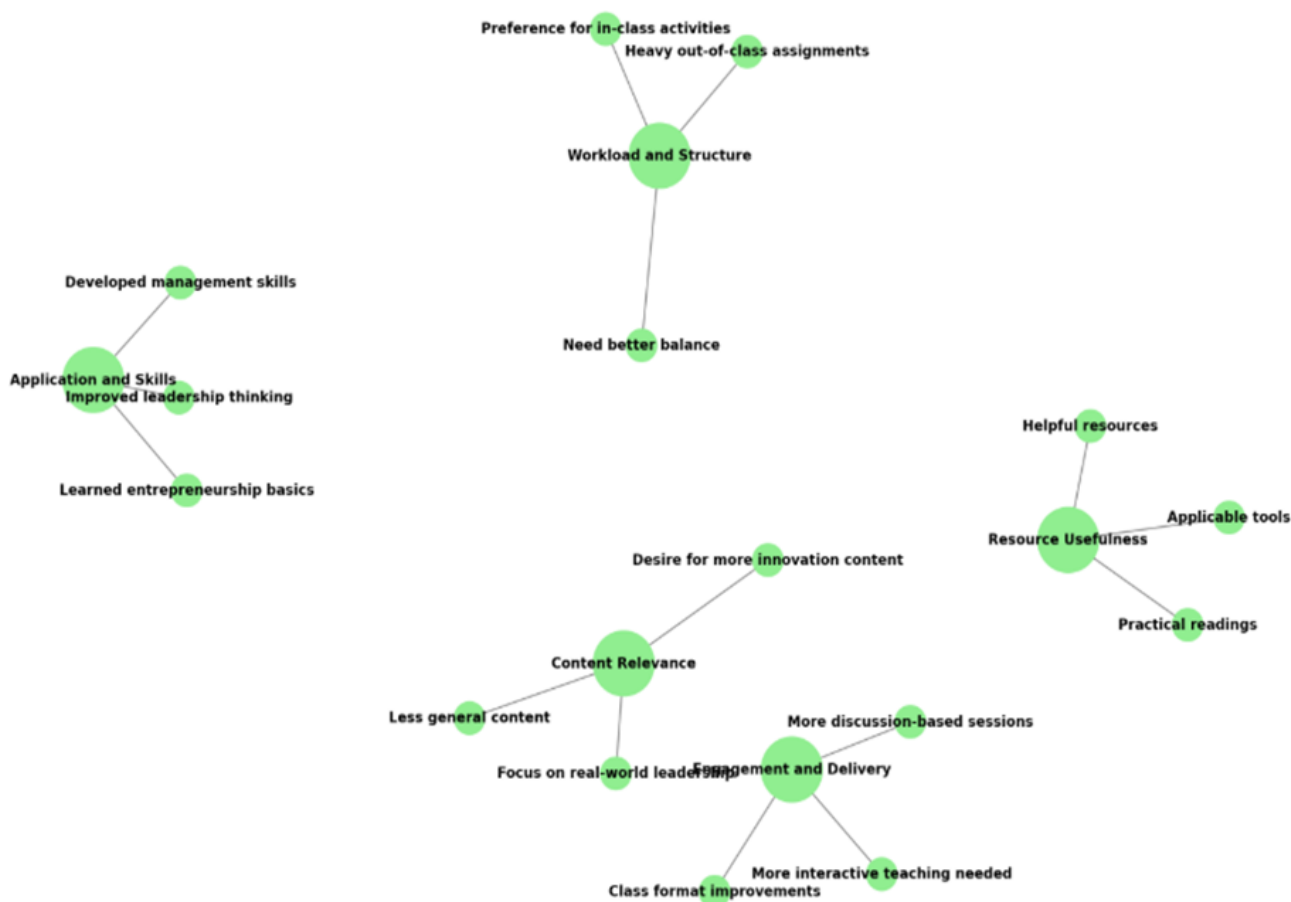


Figure 3: Thematic map of student expectations for the MILE course (post-course)

Discussion

This evaluation provides evidence that a required capstone course on Management, Innovation, Leadership, and Entrepreneurship was associated with meaningful improvements in students' self-reported confidence across several nonclinical professional domains. The clearest gains were observed in innovation and entrepreneurship, followed closely by management. These findings are important because they suggest that structured curricular exposure can strengthen areas that are often underemphasised in traditional pharmacy training, yet are increasingly relevant to modern practice environments that demand adaptability, systems thinking, leadership, and value creation (Mattingly, 2019b).

The substantial increase in management confidence suggests that exposure to the administrative, operational, and business aspects of healthcare delivery can enhance pharmacy students' perceived readiness for managerial responsibilities (Davey, 2023a; Collier, 2023). This finding supports previous calls for greater emphasis on management competencies within pharmacy

education as practice environments become increasingly complex. Although leadership confidence also improved significantly, the smaller effect size may reflect students' prior exposure to leadership concepts through coursework, co-curricular activities, or experiential learning, leaving less room for measurable growth (Feller *et al.*, 2016; Aly, 2025). Consistent with experiential learning and self-efficacy theories, these results suggest that targeted exposure to less familiar management-related content can strengthen confidence in professional skills. Collectively, the findings support integrating management and business-focused training into pharmacy curricula to better prepare future pharmacists for leadership and practice management roles.

The absence of significant changes in the perceived importance of management, innovation, leadership, and entrepreneurship should not be interpreted as a lack of educational impact but rather as evidence that students entered the course with an established appreciation of these competencies. The consistently high ratings observed at baseline suggest that student pharmacists already recognised the relevance of these domains to

contemporary pharmacy practice, creating a ceiling effect that limited the potential for further increases. This finding is encouraging because it indicates alignment between student perspectives and the growing emphasis in the literature on leadership, innovation, entrepreneurship, and management as essential competencies for pharmacists practising in increasingly complex healthcare environments (Mattingly *et al.*, 2019b; Davey *et al.*, 2023b; Davey *et al.*, 2022). While the course may not have altered perceptions of importance, the concurrent gains in confidence suggest that it strengthened students' perceived ability to apply these competencies in practice. From an educational standpoint, these results highlight the value of curricular interventions that build skills and self-efficacy among learners who already acknowledge the importance of these areas.

A notable feature of the results is the contrast between knowledge-related confidence and perceived importance. Students already rated the importance of these competencies highly before taking the course, and this perception remained stable afterwards. This pattern suggests that the educational intervention did not need to convince students that management, innovation, leadership, and entrepreneurship matter; instead, its value appears to lie in helping students feel more capable of engaging with these areas. From an educational standpoint, that distinction is meaningful. Changes in perceived importance may be difficult to achieve when baseline endorsement is already strong, but gains in confidence and anticipated application may reflect deeper learning and greater readiness to transfer course concepts into future practice settings.

The significant increase in students' anticipated future use of management, innovation, leadership, and entrepreneurship skills suggests that the course not only enhanced confidence but also strengthened students' recognition of the practical relevance of these competencies in contemporary pharmacy practice. This finding is particularly important because intentions to apply newly acquired skills may serve as a precursor to future professional behaviours and engagement, indicating that students were not merely reporting abstract knowledge gains but were beginning to view these competencies as actionable tools for practice. As pharmacists assume increasingly diverse roles in healthcare delivery (Felemban, 2024), including practice management, service development, team leadership, and business innovation, the ability to apply MILE-related skills effectively has become essential to addressing evolving healthcare needs and advancing patient care. The observed increase may reflect the use of real-world examples and experiential learning opportunities that helped bridge the gap between theoretical instruction and practice-oriented

competence. Consistent with prior literature emphasising the importance of preparing pharmacists for leadership and practice transformation, these findings support the integration of business-focused content into pharmacy curricula to promote workforce readiness and professional adaptability (DeVold *et al.*, 2022; Davey *et al.*, 2022; Scahill & Pirouzi, 2025). Moreover, improvements in both confidence and anticipated application suggest the potential for meaningful downstream effects on workplace performance and long-term professional development, reinforcing the practical value of such educational interventions.

The strong ratings for the post-course expectations item further strengthen the interpretation of the findings. Students generally felt that the module met or exceeded expectations, which provides supportive evidence that the educational experience was well received. This is important because favourable learner perceptions can influence engagement, motivation, and openness to future curricular innovations (Jones, 2019). The convergence between positive satisfaction ratings and improved confidence across multiple domains adds credibility to the interpretation that the course was both acceptable and educationally beneficial.

An important consideration is that, while management and leadership competencies have long been incorporated into pharmacy curricula across the United States, it remains unclear whether existing educational programmes adequately equip students with the innovation and entrepreneurship skills necessary to address the growing complexity of contemporary healthcare systems and drive practice transformation. In response, some pharmacy schools have begun incorporating innovation and entrepreneurship coursework that leverages business and design methodologies to develop creative solutions for complex healthcare issues (Afeli & Adunlin, 2022; Mattingly *et al.*, 2019a; Mattingly *et al.*, 2019b). In this context, entrepreneurship refers to pharmacists applying both their clinical knowledge and business acumen to identify unmet market needs and develop new healthcare products, services, or ventures, ranging from launching community pharmacies to creating novel pharmaceutical innovations. Innovation plays a crucial role in both the pharmaceutical industry and biomedical research (Petrova, 2013). The development and commercialisation of every new drug or therapeutic product originates from intellectual curiosity and often involves years of proof-of-concept work. Pharmacists significantly contribute to the development of social capital in communities by fostering trust, promoting health equity, and providing readily accessible healthcare services (Bissell, 2006). Consequently, pharmacists may be regarded as "social entrepreneurs,"

prioritising societal well-being over the financial objectives typically associated with traditional “business entrepreneurs.” It is recommended that pharmacy schools further enrich their curricula by incorporating increased exposure to innovation and entrepreneurship (Afeli & Adunlin, 2022). Such integration may encourage pharmacy trainees to consider these areas as viable pathways for developing novel healthcare solutions.

Educational approaches used to develop competencies in management, innovation, leadership, and entrepreneurship (MILE) vary considerably across pharmacy programmes with respect to course design, instructional methods, and curricular integration (Afeli & Adunlin, 2022). Common approaches include combining didactic instruction with active learning strategies such as team-based learning, project-based assignments, technology-enhanced instruction, and experiential activities (Afeli & Adunlin, 2022). Additional pedagogical frameworks reported in the literature include design thinking, service-learning, problem-based learning, and collaborative learning models (Afeli & Adunlin, 2022; Mattingly *et al.*, 2019a). Exposure to real-world examples of pharmacists who have successfully assumed managerial, leadership, innovative, or entrepreneurial roles may further enhance student engagement by illustrating the practical application of these competencies in professional practice. Given students' preference for experiential and application-based learning, continued research is needed to identify and evaluate evidence-based educational strategies that most effectively develop MILE-related competencies among pharmacy learners.

The MILE capstone course represents a novel curricular approach to developing pharmacy students' competencies in management, innovation, leadership, and entrepreneurship. To our knowledge, it is the first course in the United States to integrate these four domains into a five-week modular curriculum delivered after students have completed their experiential rotations. Although Mager *et al.* (2021) previously described a required pharmacy course focused on leadership, entrepreneurship, and administration, the present course expands upon this model by incorporating innovation as a distinct domain within an integrated educational framework. A key strength of the present study is its comprehensive approach, evaluating students' perceptions of management, innovation, leadership, and entrepreneurship collectively rather than examining these domains individually, as has been done in most prior studies. Another notable strength is the timing of data collection, which captured students' perspectives after completion of their introductory and advanced pharmacy practice experiences and during their transition to professional practice. At this stage of training, students are well positioned to provide

informed and reflective feedback based on both their didactic preparation and cumulative experiential learning, thereby enhancing the relevance and depth of the findings.

Limitations

Some limitations should be considered when interpreting the findings of this study. The survey was administered to student pharmacists from a single academic institution, which may restrict the generalisability of the findings and introduce potential institutional bias. The study did not reach its target sample size, which could further impact the representativeness and robustness of the results. The survey did not collect demographic information or academic performance data (such as grades or other assessments), which limits the ability to conduct additional analyses that could have provided valuable insights into how these factors may relate to student responses. The survey validation process relied primarily on internal review and did not include formal psychometric testing or evaluation by an independent panel of experts. Consequently, the reliability and validity of the instrument were not formally established, which may limit the interpretation and generalisability of the findings.

Several survey items assessed management, innovation, leadership, and entrepreneurship as a combined construct rather than as distinct domains. Consequently, it was not possible to determine the extent to which individual domains contributed to participant responses, limiting the interpretation of findings related to specific areas of competency.

The absence of a control group limits the ability to determine whether the observed differences between pre-course and post-course responses were attributable solely to participation in the MILE course. Furthermore, because the study was conducted over a defined period, the potential influence of external factors or concurrent experiences could not be excluded. Furthermore, the findings were based on self-reported perceptions and attitudes, which may be subject to response bias and may not accurately reflect actual knowledge, skill acquisition, or future professional behaviours.

The study did not provide a comprehensive description of the MILE course design, instructional strategies, and learning activities, limiting readers' ability to determine which specific course components may have influenced the observed outcomes and reducing the reproducibility and transferability of the findings to other educational settings. Be that as it may, future

work will involve providing a comprehensive description of the course and a detailed outline of the course evaluation methods.

Conclusion

The Management, Innovation, Leadership, and Entrepreneurship (MILE) capstone course was associated with meaningful improvements in student pharmacists' self-reported confidence in their knowledge of management, innovation, leadership, and entrepreneurship, as well as their anticipated application of these skills in future practice. Although students recognised the importance of these competencies at baseline, participation in the MILE course was associated with greater confidence and a stronger appreciation of the practical relevance of management, innovation, leadership, and entrepreneurship in professional pharmacy practice. As healthcare systems continue to evolve, pharmacists must be prepared not only as clinicians but also as leaders, innovators, managers, and entrepreneurs capable of advancing patient care and shaping the future of the profession. The findings of this study support the continued integration of management, innovation, leadership, and entrepreneurship into pharmacy curricula and highlight the importance of purposeful educational experiences that equip future pharmacists to lead, innovate, and adapt in an increasingly complex healthcare environment.

Conflict of interest

The authors declare no conflict of interest.

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