Research Article

A Pre-Post Survey Analysis on Pharmacy Students' Perceptions of Pharmacist Roles in the Pharmaceutical Industry

Anugerah Budipratama Adina [1*] [iD] [SC] [O]

Alhara Yuwanda [1] [iD] [SC] [O]

Rizky Farmasita Budiastuti [1] [iD]

Nopratilova [1]

Eddy Yusuf [1] [iD] [SC]

Suk Fei Tan [2] [iD] [SC] [O]

Saeid Mezail Mawazi [2] [iD] [SC] [O]

Amelia Herli [1]

[1] Department of Pharmacy, Universitas Global Jakarta, Depok, West Java, Indonesia
[2] School of Pharmacy, Management and Science University, Shah Alam, Selangor, Malaysia

*email: anugerah@jgu.ac.id; phone: +6289630411147

Abstract

The pharmaceutical industry is undergoing rapid evolution, characterized by a complex regulatory landscape and the need for diverse skill sets. This study aimed to assess pharmacy students' perceptions of the pharmaceutical industry and the impact of a dedicated seminar on their career aspirations and knowledge. A pre-post online survey was administered to 55 undergraduate pharmacy students at the National Pharmacy Seminar 2024, hosted by Jakarta Global University. Data were analyzed using descriptive statistics and the Wilcoxon signed-rank test ($p \leq 0.05$). Results indicate a strong preference for careers in state-owned pharmaceutical companies (63.6%) and research and development departments (34%). The seminar significantly enhanced participants' understanding of pharmacists' roles, industry complexities, drug development challenges, and regulatory requirements. Notably, 93% of participants reported that the seminar met their expectations and provided valuable insights for future career exploration. These findings underscore the importance of educational interventions in shaping pharmacy students' career trajectories and aligning their knowledge with the dynamic pharmaceutical industry.

INTRODUCTION

The pharmaceutical industry, characterized by advancements in personalized medicine and gene therapies, operates within a complex regulatory landscape that demands stringent quality standards, extensive clinical trials, and careful navigation of drug pricing and vaccine development debates[1]. Success in this field requires a multifaceted skill set, encompassing pharmaceutical sciences, regulatory knowledge, effective communication, and practical experience[2]. Assessing the readiness of aspiring professionals in this area is crucial to addressing the evolving challenges and ensuring a successful career in the pharmaceutical industry.

The transition from academia to the pharmaceutical industry presents significant challenges for pharmacy graduates. Previous studies have highlighted knowledge gaps in regulatory compliance and industry intricacies, underscoring the need for targeted educational interventions[3,4]. Research on the evolving pharmaceutical landscape further emphasizes the importance of equipping students with industry-specific skills[5]. To address these challenges, educational initiatives such as guest lectures, industry talks, and national seminars are crucial. These interventions can bridge the gap between theoretical knowledge and practical industry requirements, fostering a smoother transition for pharmacy graduates[6].

National pharmacy seminars serve as valuable educational platforms for pharmacy students, offering insights into the multifaceted roles and challenges of the pharmaceutical profession[7]. Despite the growing importance of professional

development seminars, research exploring pharmacy students' perceptions and expectations of these programs remains limited. This study aimed to delve into the perceptions and expectations of pharmacy students who participated in such a seminar, shedding light on their understanding of the industry and their aspirations for future careers. By understanding their perspectives, we can identify areas for improvement in pharmacy education to ensure that students are well-prepared to navigate the complexities of the pharmaceutical field.

MATERIALS AND METHODS

Materials

This study involved 63 undergraduate pharmacy students from Jakarta Global University, Depok, Indonesia, who participated in the "National Pharmacy Seminar 2024: Shaping the Future in Industry, Hospital, and Entrepreneurship," held on January 20, 2024. A purposive sampling method was employed to recruit students who attended the seminar. Of the initial 63 participants, 55 completed both the pre- and post-seminar surveys. The seminar focused on exploring the professional roles of pharmacists in three distinct domains: the pharmaceutical industry, hospital settings, and herbal entrepreneurship. The primary data collection tools for this study were online surveys administered through Google Forms. The pre-seminar survey link is available at: https://s.jgu.ac.id/pre-seminar and the post-seminar survey link is available at: https://s.jgu.ac.id/post-seminar.

Methods

To assess the impact of the seminar on students' knowledge and career interest, an online survey was administered before and after the event. The survey instrument was developed through a review of existing literature and consultations with practicing pharmacists[8]. A pilot test with a small group of pharmacy students was conducted to refine the survey questions for clarity and reliability. The survey consisted of questions related to participants' knowledge of the pharmacist's role in the pharmaceutical industry, career interest in the industry, and demographic information such as gender, class category, and academic year[9]. All survey responses were collected using a four-point Likert scale.

Data analysis

Data analysis was conducted using IBM SPSS version 26. Quantitative data collected from the survey were entered into Excel and subsequently uploaded to SPSS 26 for statistical analysis. Descriptive statistics were calculated to summarize the relevant variables. To assess changes in mean scores between the pre- and post-seminar surveys, the non-parametric Wilcoxon signed-rank test was employed. A p-value of ≤0.05 was considered statistically significant.

RESULTS AND DISCUSSION

The examination of survey demographic data, involving a participant cohort of 55 individuals, revealed distributions across key variables as illustrated in **Table I**. In evaluating the student's interest in the pharmaceutical industry, participants were queried about their future career preferences within pharmaceutical companies. Four students (7.3%) expressed interest in local companies, 16 (29.1%) in multinational enterprises, and 35 (63.6%) in state-owned companies. Additionally, their departmental preferences were assessed, with 34% favoring research and development, followed by 16% and 15% for production and quality control, respectively, among the 67 selections made by the 55 participants. The distribution of interest in other departments is visually represented in **Figure 1**.

The analysis extended to examine students' understanding of the role of pharmacists in the pharmaceutical industry, as detailed in **Table II**. Overall, after the seminar, there was a significant increase in their comprehension with all p-values indicating significance levels below 0.05. Specifically, the post-survey revealed that the three questions of the survey (Q_{1-3}) highlighted a notable enhancement in students' overall understanding of the complexities and highly regulated nature of the pharmaceutical industry (p-value <0.05). In terms of percentages, a total of 42 students (76.4%) demonstrated a heightened familiarity with the intricacies of the pharmaceutical industry (Q_1), while 46 students (83.6%) acquired a better understanding of the challenges and considerations involved in drug development and manufacturing (Q_2). Additionally, 44 students (80.0%) became familiar with the regulatory requirements and compliance standards associated with drug

manufacturing (Q_3) after attending the seminar. This highlights a substantial advancement in students' awareness of the crucial aspects related to drug quality assurance and regulatory adherence, reinforcing the positive impact of the seminar on their knowledge acquisition[10].

The consistent pre- and post-seminar interest levels among participants in pharmaceutical industry employment, as evidenced by the non-significant mean difference, underscore the seminar's effectiveness (Q_{12}). Post-seminar, 54 students demonstrated increased or sustained interest in pursuing a career in the pharmaceutical industry. Notably, only one student reported persistently low interest (pre=4), while none indicated no interest (pre=1) in pursuing a career in the pharmaceutical industry after attending the seminar. These nuanced insights into the participants' interests provide valuable context to the broader assessment of their preferences within the pharmaceutical sector.

Table I. Demographic distribution of survey participants.

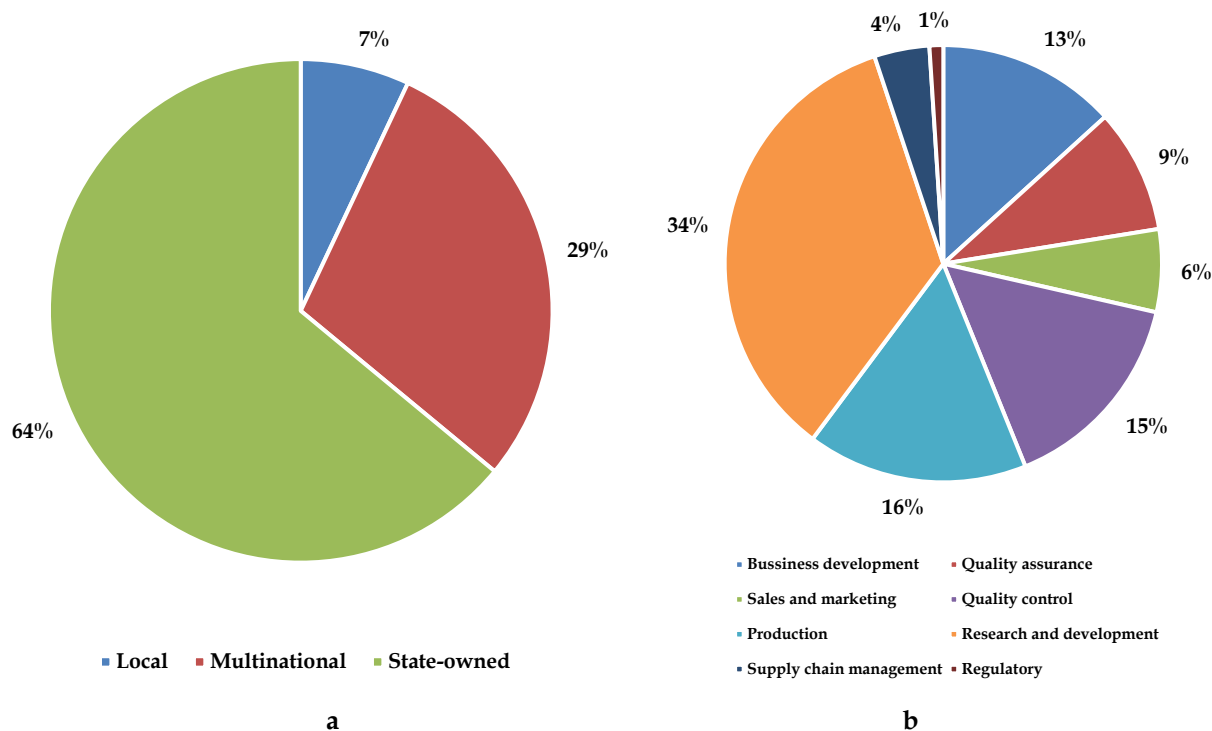| Demographic Variable	Options	Number of Participants	%
Gender	Male	7	12.7
	Female	48	87.3
Class category	Evening classes	17	30.9
	Regular classes	38	69.1
Age (years)	18-22	47	85.5
	>22	8	14.5
Study year	1st	29	52.7
	2nd	12	21.8
	3rd	7	12.7
	4th	5	9.1
	5th	2	3.6

Figure 1. Distribution of participants' preferences for company types (**a**) and various departments in future pharmacy careers (**b**).

The subsequent dataset (**Table II**) comprised seven questions aimed at gauging students' comprehension of the pharmacist's role and responsibility in ensuring drug quality during manufacturing (Q_{4-10}). Post-seminar, there was a notable and statistically significant increase in students' understanding, with p-values consistently below 0.05. Importantly, the majority of students demonstrated a very well understanding, and no students exhibited poor knowledge of the subject. Notably, there was a significant improvement in students' comprehension of the pharmacist's role in ensuring regulatory compliance within the pharmaceutical industry. These findings underscore the positive impact of the seminar on advancing students' comprehension of their prospective roles within the pharmaceutical sector[11,12].

Table II. Pre-post survey analysis of student understanding of seminar topics on the role of pharmacists in the pharmaceutical industry.

No.	Question statement	4 (Pre/Post)	3 (Pre/Post)	2 (Pre/Post)	1 (Pre/Post)	Pre-mean (SD) N=55	Post-mean (SD) N=55	Z-value	p-value
Q_1	How well were you acquainted with the intricacies of drug manufacturing processes within a pharmaceutical plant?	Very familiar (1/8)	Moderately familiar (23/34)	Slightly familiar (23/13)	Not familiar at all (8/0)	2.31 (0.74)	2.91 (0.62)	4.262	0.000
Q_2	How familiar were you with the challenges and considerations related to drug formulation and production in a pharmaceutical plant?	Very familiar (2/8)	Moderately familiar (25/38)	Slightly familiar (23/9)	Not familiar at all (5/0)	2.44 (0.71)	2.98 (0.56)	4.316	0.000
Q_3	How familiar were you with the regulatory requirements and compliance standards specific to drug manufacturing in the pharmaceutical industry?	Very familiar (0/8)	Moderately familiar (16/36)	Slightly familiar (27/11)	Not familiar at all (12/0)	2.07 (0.72)	2.95 (0.59)	5.197	0.000
Q_4	How well did you understand the pharmacist responsibilities in ensuring the efficiency and effectiveness of drug manufacturing operations?	Well (8/21)	Moderately (32/34)	Poorly (13/0)	Very poorly (2/0)	2.84 (0.71)	3.38 (0.49)	4.499	0.000
Q_5	How confident were you in understanding the role of a pharmacist in ensuring the quality and consistency of pharmaceutical drug manufacturing processes?	Very confident (6/22)	Moderately confident (27/31)	Slightly confident (16/2)	Not confident at all (6/0)	2.60 (0.83)	3.36 (0.56)	4.945	0.000
Q_6	How well did you understand the pharmacist involvement in overseeing the manufacturing of different drug forms, such as tablets, capsules, and injectables?	Well (10/21)	Moderately (37/32)	Poorly (8/2)	Very poorly (0/0)	3.04 (0.58)	3.35 (0.55)	2.959	0.003
Q_7	To what extent is your understanding of the challenges faced by pharmacists in drug manufacturing in the pharmaceutical industry?	Well (2/12)	Moderately (28/43)	Poorly (23/0)	Very poorly (2/0)	2.55 (0.63)	3.22 (0.42)	5.049	0.000
Q_8	How well did you understand the pharmacist role in	Well (4/30)	Moderately (21/23)	Poorly (25/2)	Very poorly (5/0)	2.44 (0.76)	3.51 (0.57)	6.050	0.000

	optimizing manufacturing processes to meet production targets while ensuring product quality?								
Q_9	How confident were you in your understanding of the plant manager's role in managing resources and personnel to ensure efficient drug manufacturing?	Very confident (3/13)	Moderately confident (18/39)	Slightly confident (28/3)	Not confident at all (6/0)	2.33 (0.75)	3.18 (0.51)	5.201	0.000
Q_{10}	To what extent is your understanding of the pharmacist's contribution to ensuring compliance with regulations and regulatory standards in the drug manufacturing process in the pharmaceutical industry?	Well (5/24)	Moderately (23/28)	Poorly (23/3)	Very poorly (4/0)	2.53 (0.77)	3.38 (0.59)	5.425	0.000
Q_{11}	To what extent is your interest in the expected insights about the responsibilities and challenges faced by pharmacists in drug manufacturing in the pharmaceutical industry?	High interest (24/29)	Moderate interest (26/26)	Low interest (3/0)	No interest (2/0)	3.31 (0.74)	3.53 (0.50)	2.355	0.019
Q_{12}	To what extent is your interest in working in drug manufacturing in the pharmaceutical industry?	High interest (28/24)	Moderate interest (21/30)	Low interest (4/1)	No interest (2/0)	3.36 (0.78)	3.42 (0.53)	0.529	0.597

The seminar evaluation focused on students' expectations (Q_{11}). A significant majority (90.9%, N=55) attended the seminar to gain insights into the challenges and responsibilities of pharmacists in drug manufacturing. Post-seminar evaluations confirmed that all students remained interested in exploring these aspects further. Moreover, **Table III** highlights suggested topics for future seminars, reflecting students' preferences for upcoming events. This culmination of results underscores the overall positive impact of the seminar, as evidenced by the participants' heightened understanding, sustained interest, and favorable reception of the event[13]. This comprehensive analysis of the survey data provides valuable insights into students' perceptions and knowledge development in the pharmaceutical industry.

Table III. Requested seminar topics related to career opportunities in the pharmaceutical industry as suggested by students.

No.	Topic statement
1	Strategies for attaining desired positions
2	Becoming a pharmacist and successful entrepreneur in the pharmaceutical field
3	Detailed explanation of necessary skills, preparations, tips, and tricks for entering the pharmaceutical industry
4	Improving access and drug distribution
5	Enhancing personal quality as a pharmacist within the industrial environment with a focus on the latest insights emphasizing creativity and innovation
6	Business understanding in the pharmaceutical industry, including explanations of marketing strategies, and sales.
7	Knowledge related to jobs in each department associated with pharmacy

The analysis of students' post-seminar interest in the pharmaceutical industry not only revealed a positive impact but also provided insights into the theoretical underpinnings guiding this transformation. The heightened and sustained interest among pharmacy students in pursuing careers in the pharmaceutical industry post-seminar can be dissected through the lens of the "Expectancy-Value Theory," shedding light on the perceived value and anticipated success associated with working in the pharmaceutical sector[14]. For pharmacy students, the pharmaceutical industry offers a plethora of valuable opportunities. Firstly, it provides a dynamic and evolving professional landscape, where individuals can actively contribute to advancements in healthcare, drug development, and patient outcomes. The industry fosters an environment conducive to continuous learning and innovation, offering pharmacists the chance to stay at the forefront of scientific and technological advancements[1,15]. Additionally, a career in the pharmaceutical industry often involves collaboration with multidisciplinary teams, providing pharmacists with the chance to apply their clinical knowledge in a collaborative and impactful manner[16]. Moreover, the industry presents opportunities for career growth, leadership development, and the potential to make a tangible difference in public health. Overall, the pharmaceutical sector, with its emphasis on research, innovation, and patient-centered care, emerges as a valuable and rewarding avenue for pharmacist students keen on contributing to the advancement of healthcare[17,18].

The substantial increase in students' comprehension of the complexities, regulations, and challenges within the pharmaceutical industry post-seminar aligns seamlessly with the principles of the "Constructivist Learning Theory." This theory posits that individuals actively construct knowledge based on their experiences[19]. The seminar, functioning as an experiential learning opportunity, acted as a catalyst for students to engage actively with the intricacies of the pharmaceutical industry, facilitating the internalization of crucial information about their future roles[20]. This active engagement enabled students to not only grasp theoretical concepts but also to contextualize and apply their knowledge within the dynamic and multifaceted landscape of the pharmaceutical sector.

This heightened understanding corresponds directly with the competencies essential for pharmacists operating in this complex industry. It underscores the importance of regulatory acumen, a nuanced understanding of industry complexities, and the ability to navigate challenges inherent to drug development and manufacturing[21]. In alignment with Kolb's Experiential Learning Theory[22], which posits that learning is most effective when it involves a cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation, the seminar offered a platform for students to engage in this iterative learning process[23]. The increased understanding resonates with the competencies pharmacists need, emphasizing their ability to navigate the intricate regulatory landscape, contribute to quality assurance processes, and effectively address challenges within the pharmaceutical manufacturing domain.

Building upon the students' enhanced understanding of the pharmaceutical industry, their seminar topic suggestions create a strategic roadmap that seamlessly aligns with their aspirations. The emphasis on business understanding, regulatory compliance, and department-specific roles not only mirrors their deepening comprehension of the pharmaceutical landscape but also strategically aligns with competencies crucial for industry success[24]. This proactive approach reflects an intention to equip themselves with the essential knowledge and skills for seamless integration into the multifaceted pharmaceutical sector. Furthermore, this alignment between their expectations and the intricate demands of the pharmaceutical field highlights their awareness of the competencies required for success in this dynamic sector showcasing a commitment to acquiring the necessary skills for a meaningful contribution to the pharmaceutical industry.

Finally, while this study has provided valuable insights into the perceptions and aspirations of pharmacy students regarding the pharmaceutical industry, it is crucial to acknowledge its limitations. The small sample size may restrict the generalizability of the findings, and the use of survey instruments, although informative, may have inherent limitations in capturing the nuanced intricacies of student perspectives[25]. Additionally, the potential influence of social desirability response bias, pre-existing interest in evidence-based learning strategies, and the utilization of a four-point Likert scale could have impacted the students' survey responses and subsequent outcomes. Recognizing these limitations, future research endeavors could employ more extensive sampling methodologies and diversified assessment tools to enhance the robustness and applicability of findings in understanding the complex dynamics of pharmacy students' perceptions in the ever-evolving landscape of the pharmaceutical industry.

CONCLUSION

As we navigate the 21st century, the education of pharmacy students is pivotal in ensuring the continued advancement of the pharmaceutical industry. This survey analysis offers valuable insights into the interests and perceptions of pharmacy students, shedding light on the potential impact of educational interventions. By understanding the evolving needs and expectations of students, educators, policymakers, and industry stakeholders can refine educational strategies, curricula, and industry engagement initiatives. This analysis contributes to the ongoing dialogue on aligning pharmacy education with the dynamic pharmaceutical landscape, fostering a cadre of well-prepared professionals equipped to address the challenges and opportunities of the evolving industry.

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AUTHORS' CONTRIBUTION

Conceptualization: Anugerah Budipratama Adina

Data curation: Anugerah Budipratama Adina, Alhara Yuwanda, Rizky Farmasita Budiastuti, Nopratilova

Formal analysis: Anugerah Budipratama Adina, Eddy Yusuf, Suk Fei Tan, Saeid Mezail Mawazi, Amelia Herli

Funding acquisition: -

Investigation: Anugerah Budipratama Adina, Alhara Yuwanda, Rizky Farmasita Budiastuti, Nopratilova,

Methodology: Anugerah Budipratama Adina

Project administration: Anugerah Budipratama Adina

Resources: Anugerah Budipratama Adina

Software: Anugerah Budipratama Adina

Supervision: Eddy Yusuf, Suk Fei Tan, Saeid Mezail Mawazi

Validation: Eddy Yusuf, Suk Fei Tan, Saeid Mezail Mawazi

Visualization: -

Writing - original draft: Anugerah Budipratama Adina, Alhara Yuwanda, Rizky Farmasita Budiastuti, Nopratilova, Amelia Herli

Writing - review & editing: Anugerah Budipratama Adina, Eddy Yusuf, Suk Fei Tan, Saeid Mezail Mawazi

DATA AVAILABILITY

None.

CONFLICT OF INTEREST

The authors declare no conflicts of interest related to this study.

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